

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
115275	0	0	0	0	The chapter has overall a very good structure. However, as always with the first chapters, it is quite a challenge to make clear to the reader upfront what is really assessed by this chapter or what is summarized as assessed by other chapters or what is left to other chapters. General efforts to clarify this more whenever there may doubt come up would strengthen the chapter. I try to give at specific locations hints where I would see opportunities, yet have also not been able to point out all. Therefore this more generic comment to keep this in mind at all times when revising. [Andreas Fischlin, Switzerland]	Accepted. Thanks, we have attempted to clarify where possible.
85905	0	0	0	0	In general, Section 1 of Chapter 1 of WG1 is where all the most important, urgent, powerful concepts need to land, clearly and unequivocally. Nobody should be left in any doubt whatsoever, about where we are, where we are going, how urgent the situation is. That is the responsibility of this first (and then again the last) chapter more than any others. These high level messages then need to be elevated to TS and SPM where they can be picked up easily – including by other WGs. For this reason it would also be good to read the chapter once through with ‘public’ eyes, and aim to improve the readability and reduce jargon and technical language to a minimum. [Debra Roberts and the Durban WGII TSU, South Africa]	Taken into account. Thanks. The chapter has been worked through for broader readability.
64677	0	0	300	70	i like the overall framing in this chapter, and i think it will play its role in the AR6 outline. Some part might appear a little bit too definitive, at least in the Executive summary statements. The definitive conclusion should emerge from the overall report, and not from the first chapter. These are writing (point of views), and not necessarily content issues. [Pascale Braconnot, France]	Taken into account, the Executive Summary has been revised. (Clear statements in Ch1 generally build on earlier Assessment Reports, or refer explicitly to later chapters.)
28637	0	0			Congratulations on an excellent chapter! There may be overlap between the Chapter 1 ES and SPM (also 1.2.1.1) so any further effort to make this distinct (e.g. evidence from past reports, what is already known and where AR6 advances) will be beneficial. I guess the unique aspects are documenting the historical advances/assessments, where AR6 picks up in terms of new scenarios and their details plus new definitions e.g. pre-industrial/GSAT)? Section 1.3 seems strong, useful and distinct. Box 1.2 could be more powerful as a table. Box 1.3 is excellent. [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Noted - with thanks!
823		11			"will help" or "have helped"? [Bart van den Hurk, Netherlands]	Accepted, text revised.
827		11			wouldn't it be better to state that colours indicate their rank instead of their value? [Bart van den Hurk, Netherlands]	Accepted, text revised.
847		12			"would have" or "have"? [Bart van den Hurk, Netherlands]	Accepted, text revised.
849		22		23	"so influencing" is pretty unclear [Bart van den Hurk, Netherlands]	Accepted, text revised.
851		30			some scholars regard "climate change storylines" to be incapable for formal risk assessment, since the probability of this storyline is normally not explicitly quantified. For a formal risk assessment a probability of occurrence is required [Bart van den Hurk, Netherlands]	Accepted, text revised.
855		36			is not the third bar in fig 1.2 [Bart van den Hurk, Netherlands]	Accepted, text revised.
829		38			I don't see this SH declining trend in the figure [Bart van den Hurk, Netherlands]	Accepted, text revised.
843		56			Could use a reference to De Bruijn et al (2016, Nat. Hazards 81, 99–121. doi:10.1007/s11069-015-2074-2.) and to Atlas.6.1.5 [Bart van den Hurk, Netherlands]	Rejected, unclear where this comment belongs.
16319	0		200		West Asia and Central Asia are important locations as global view on climate change issue as well as desertification and dust storm phenomena, it could be helpful in sense of framing, but there is no any citation in the general view of the report. [Mostafa Jafari, Iran]	Rejected. These are clearly important topics, but such regional changes are not in the scope of Chapter 1. Chapters 10-12 and the Atlas cover these and other topics.

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114179	0				There is a coordination of the definitions of net zero CO ₂ , net zero GHG, carbon neutrality, GHG neutrality across chapters and WGI - WGIII. As discussed in mail, ch1 could be a good place to introduce these concepts. This would also need to include an explanation of the different temperature developments of net zero CO ₂ and net zero GHG - and how this depends on method. [Jan Fuglestad, Norway]	Accepted. This is now done in Box 1.4.
114181	0				The role of SLCF in the context of "balance of GHG" as stipulated in the Paris Agreement would be useful to address briefly in Ch1 - which needs coordination with Ch7 [Jan Fuglestad, Norway]	Accepted. This is now briefly introduced in several places.
107015	0				"Modes of variability and associated teleconnections" is a cross-cutting theme in AR6. MOVs are assessed throughout the report as an expression of internal variability at large-scale and as drivers of observed changes and future climate outcomes at regional scale. Those can be treated as a transmission belt from large scale to regional scale and they are helpful better understand the origins of the uncertainties associated with internal variability. The concept of modes of variability should be introduced in Chapter 1. The added text and phrasing can be inspired by the foreword in the Technical Annex (TA VI.1) which should be also introduced in Chapter 1. [Christophe CASSOU, France]	Accepted. This is done in 1.4, and MOVs are listed in the cross-cutting table.
114195	0				Ch1 addresses several issues close to policymaking and is therefore a chapter with high relevance for the users that IPCC is meant to provide input to. In my view this is done in a policy neutral way. The authors need to be very conscious about this and carefully consider their perspective and formulations in the further revisions. [Jan Fuglestad, Norway]	Taken into account. Thanks. These considerations have been carefully made throughout the chapter.
107797	0				This is an overview comment on the whole chapter. I am so pleased to see this chapter in WG1. I have literally hoped for this for decades. The integration across the working groups reflected in this chapter is most desired. Kudos to all for making such amazing progress! [Linda Mearns, United States of America]	Noted - with thanks!
21271	0				The chapter tends to make too few cross-references to other chapters at appropriate junctures in several places with significant heterogeneity in the approach between (sub-)sections. Clearly there is a sweet point to be found here but right now it feels like perhaps there are not quite enough signposts given to the reader at the chapter level to where to go to find the comprehensive assessment of given topics within much of the main body text (1.2 -1.7). Conversely, in several places the opposite is the case. It may be worthwhile deciding a more consistent approach and e.g. only citing chapters down to X.Y granularity but doing so much more consistently. [Peter Thorne, Ireland]	Taken into account. The links to other chapters have been strengthened, and attempted to be made more consistent.
96055	0				Please include a FAQ in Chapter 1 on "GSAT vs. GMST" explaining the rationale behind changing temperature metrics between reports. [Nicole Wilke, Germany]	Rejected. This is done in Cross-Chapter Box 2.3, Chapter 2.
114759	0				Section 1.4 could very briefly mention the difference between GMST and GSAT with reference to the box in Ch2 [Jan Fuglestad, Norway]	Noted. This is mentioned in 1.4.1.
35421	0				Chapter 1 fulfills the purposes set out, highlighting among them, the needs of formulating regional policies on climate change. This chapter plays an essential role within the AR6, as it introduces highly complex topics that are later developed in the other chapters. [Gladys Linares-Fleites, Mexico]	Noted - with thanks!
114787	0				The box on reference periods fits well in ch1, and the point about PI can be linked between this box and CCB 2.3 [Jan Fuglestad, Norway]	Accepted.
21369	0				A good example of how I would suggest chapter 1 more explicitly links to and supports remaining aspects of the assessment is given in pg. 77 paragraph starting on line 17 where why the discussion of EMICs that precedes it matters for the present report is outlined via explicit linkage that enables the reader to find explicitly relevant information within the remainder of the report. [Peter Thorne, Ireland]	Accepted. This and other sections have been revised to add links to later chapters.

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114309	0				The chapter discusses model evaluation and fit for purpose. I think you can make it more clear that the models are (or will be) assessed where they are use - in light of what they are needed for; and to a lesser extend a general model evaluation. [Jan Fuglested, Norway]	Noted. Text clarifies that the main purpose is fit for purpose evaluation, and that this is done in corresponding chapters.
41355	0				A big thanks to the authors for their efforts to set the scene for AR6 WGI and congratulations on pulling together such a large compilation of useful information. However, for an introductory chapter, Chapter 1 is extremely long, considerably too long actually. It provides much more information than defined by the scoping document. The chapter should be lightened by sacrificing information that is not asked for/ crucial for setting the stage for the following chapters. [Alexander Nauels, Germany]	Noted. Thanks. The chapter deliberately goes beyond introducing material for later assessments, including framing and context, as set out in our title.
70039	0				Would be useful if chapter 1 could address the question of "How is global average temperature defined?". This question is currently treated in chapter 2 (in a cc box), but Tglob being such a critical integration variable across the chapters and also across working groups, it seems that it should also be assessed at a general level in chapter 1. Maybe there is scope for two different types of assessments, a more technical one in chapter 2 and a more conceptual one in chapter 1 (focused on the definitions). [Sonia Seneviratne, Switzerland]	Rejected. This was at one point the topic of a Chapter 1 FAQ, but it was in the end deleted as it was considered not central enough for this assessment.
71839	0				The chapter is overall well written but I think way too long - maybe a factor of three or four! There is a lot of material that is barely relevant to the target audience and other material that would be better placed in the more detailed chapters. Even after reviewing the prescribed outline I think my view is valid. At the same time the chapter is unbalanced. For example, there is a lot of discussion of GCMs, but essentially nothing on ice sheet models (the area of most significant progress) or glacier models. And the reader is not left with a good idea of how the previous projections are holding up, and there are not a series of simple figures of emissions, concentrations and radiative forcing of the various scenarios from SRES (or before?) to SSPs. [John Church, Australia]	Noted. We have aimed for a different type of Chapter 1 to previous report, and note that reception is broadly good. Some more information on ice sheet modelling is added, although this is predominantly done in a later chapter (as for other process level progress). We focus on the global developments. On previous projections, this is extensively discussed in section 1.4.
70051	0				Since there is no chapter dedicated to paleo-climate information, this topic needs in part to be covered in chapters 1 and 2. I find Fig. 1 of Burke et al. (2018, PNAS) very effective at communicating which type of climates we would be facing under much warmer scenarios (i.e conditions only existing prior to human species' existence). This would also bring down a point from contrarians who like to point to the fact that warmer temperatures existed in the past (but this would show that this was only the case in time periods in which humans did not exist). Would it be possible to include a figure going further back in time than 800'000 before present (time frame covered by Fig. 1.3)? [Sonia Seneviratne, Switzerland]	Rejected. This was indeed considered (and desired), but the relevant material was not available from other chapters. It is not in the scope of Chapter 1 to undertake assessment of paleo datasets and reconstructions.
70057	0				It seems that the concept of "anthropocene" is a notion that could be elevated to the ES, in particular the fact that we are in the middle of the sixth mass species extinction since the existence of the Earth. [Sonia Seneviratne, Switzerland]	Rejected. We note that there is still debate surrounding the term Anthropocene, and a sixth mass extinction, and hence have only referred to them as ongoing debates that contextualize AR6.
21423	0				In many of the figures the inline text is so small as to be utterly illegible. I have commented individually on a few of the worst offenders but this is a generic issue across many figures. The text must be resized such that it can be read when presented in final layout that may be even smaller than is the case in the review version provided. This includes the legends to all colour bars and in-line keys [Peter Thorne, Ireland]	Accepted, figures revised.

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45743	0				It is not clear how radiative forcing is defined in this chapter. This may be fine when the term is used in a general sense and only approximate values are given. However, when quantitative estimates are compared (as e.g. on page 41, lines 42 to 43) it should be clear which definition is used. In other chapter the effective radiative forcing is used as the key measure of forcing, and it would be logical to do the same in this chapter. [Twan van Noije, Netherlands]	Accepted. Text revised where applicable. Effective Radiative Forcing is indeed the main quantity.
36529	0				This report frequently refers to "global mean surface temperature" or "global average surface temperature" when neither is true because no such data can be calculated. Typically you mean "global average surface temperature anomaly" (i.e. the global average of the calculated temperature anomalies). [John McLean, Australia]	Accepted. Text revised where applicable.
21427	0				Overall I found this chapter considerably improved and much more readable than the FOD. [Peter Thorne, Ireland]	Noted - with thanks!
19131	0				I wish to congratulate the authors on writing an interesting overview of the report and its framing. I particularly enjoyed the scientific historical context, which adds particular weight to many of our current findings. In fact, I do not understand why the AR6 leadership insists for chapter authors to stick to post-AR5 literature. [Thorsten Mauritsen, Sweden]	Noted - with thanks!
32199	0				Chapter 1 clearly highlights the new political context and the need for AR6 to be relevant for the global stocktake, as well as for risk assessment. [Eric Brun, France]	Noted - with thanks!
83913	0				There are 2 IPCC (2019) references listed (IPCC, 2019a and IPCC, 2109b) but throughout Chapter 1 sometimes it only appears as IPCC, 2019. [Marco Tulio Cabral, Brazil]	Noted. IPCC 2019a and 2019b refer to the two IPCC special reports and are cited throughout the chapter.
114125	0				Ch1 does a very good job in setting the stage for the report. It introduces perspectives and concepts in a new and refreshing manner. The holistic perspective is important for the report as a whole, especially given the new structure compared to previous WGI reports. It also nicely places the WGI report in the context of other reports in the sixth cycle [Jan Fuglestedt, Norway]	Noted - with thanks!
114127	0				Although this chapter serves a different purpose than the following chapters - i.e. setting the scene and introducing concepts - I think it can in some places add more assessment - given that this is coordinated and consistent with the following chapters [Jan Fuglestedt, Norway]	Taken into account. We have added rigorous assessment in several places.
36567	0				It seems that the IPCC has not again - 6 times in 30 years - failed to audit the temperature data that it uses but also ignored the only audit that has ever been undertaken. This data is crucial to the IPCC's claims that warming has occurred, is of concern and that some of that warming might be man-made. It is also crucial to climate models because they are calibrated against past temperatures. That the audit found multiple significant problems with both SST and land-based near surface temperatures should be of great concern. If you claim it was past some cut-off date then I point out that the report cites many references that are flagged as submitted and have no publication date (Still unpublished? Published too recently for comments from the wider community?). Don't bother trying to claim that trends in the BEST data agree with those in CRUTEM4 because if WMO recommended procedures for data adjustment are followed, non-meteorological distortions, and the trends they create, are not removed from the CRUTEM4 data, just as they are not removed from BEST data. Even in January 2020, which I believe was after the drafting of this chapter, the CRUTEM4 station data for Golden Rock Airport, St Kitts and Nevis, continued to show 0.0C for the monthly mean temperatures in December 1981 and 1984. [John McLean, Australia]	Noted. Please see the discussion in Chapter 2 of which temperature data series were included and not, and why these choices were made. It is in any case not in the scope of Chapter 1.

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19161	0				In general, I did not feel the chapter highlighted the advances made in assessing ECS and TCR, it is basically limited to a reference in Table 1.1 [Thorsten Mauritsen, Sweden]	Noted. This could certainly have been better discussed, but was in the end left for Chapter 7 and the TS/SPM. Note, however, the historical discussion of ECS estimates in 1.3.
67817	0				There is a need for consistency in the writing of the term "sea level" rise throughout the chapters. In some parts it was written "sea-level", but in others sea level. [Ruandha Agung Sugardiman, Indonesia]	Taken into account. This common error has been mostly corrected throughout the report during copy-editing.
19177	0				The chapter has a lot of focus on how ESM models have been improved, in particular section 1.5, much in the vain of previous reports. However, something which is new in AR6 is the use of emulators to transfer assessed ECS, TCR, forcing, etc. to projections. This is an entire new development which deserves much better explaining and highlighting [Thorsten Mauritsen, Sweden]	Accepted. The emulator discussion has been revised and made consistent with usage later in the report.
114409	0				This interesting and important chapter deserves a better title, but I realise the challenges related to chnaning this at such a late stage. [Jan Fuglestedt, Norway]	Noted. We have tried raising this, but it was not possible to change the title.
114411	0				On the use of emulators; ch1 could make it clear to what extent the same emulators are used across chapter and if not, how consistency is secured. This topic is also covered in ch7, and close coordination and clarifications of repsonsibilities are needed on this issue [Jan Fuglestedt, Norway]	Accepted. The emulator discussion has been revised and made consistent with usage later in the report.
36861	0				<p>After 87 pages I've lost interest in commenting on this. Apart from about 10 pages of the 87 it seems that IPCC authors don't know how to write objectively, comprehensively and using correct grammar. They don't even seem to know the difference between "global mean temperature" and "global mean temperature anomaly". Far too much of it was like a marketing brochure; it failed to be comprehensive, open and transparent. Sceptics of significant manmade warming are sometimes maliciously called deniers but the IPCC authors of this chapter were:</p> <ul style="list-style-type: none"> (a) IN DENIAL about each IPCC climate assessment report since and including 2AR in 1995 presented new so-called "evidence" because each report changes the "evidence" of previous reports because that "evidence" has been shown to be false (sometimes even by the IPCC), (b) IN DENIAL that AR5's claims were based on output from climate models that text Box 9.2 (and elsewhere) of that report showed to be flawed and other parts of that report admitted that they "overestimated" the warming, (c) IN DENIAL that despite the CO2 increase over the 15 years prior to its drafting, AR5 wasn't certain that any warming had occurred in that time, (d) IN DENIAL that the near-surface temperature record has many uncertainties, especially that the coverage of that data has varied so greatly and inhomogenously that global average temperature anomalies prior to 1900 are meaningless (and that's not to say that their quality improved greatly since then), (e) IN DENIAL that multiple independent studies using different methods have determined that the ECS is 1.5 to 2.0, which is at the lowest end of the range claimed by IPCC reports, (f) IN DENIAL that "expert opinion" is not evidence, (g) IN DENIAL that warming is not evidence per se of man-made warming but is only a precondition of it, (h) IN DENIAL that correlation does not prove cause, (i) IN DENIAL that appending data obtained using different methods in different locations is unethical and unprofessional, and 	Noted. No response requested or required. Comment is opinion that cites no peer reviewed literature.

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124953	1	1	1	1	label on bottom portion for global-mean temperatures: "Paris Agreement Targets". These are Paris Agreement temperature goals, not targets. [Trigg Talley, United States of America]	Accepted, text revised.
101493	1	1	1	1	This is such a great chapter. I enjoyed reading and cannot wait to use it for teaching my students and using figures for talks. Congratulations to all! In the sections that I reviewed, I gave lots of fine detail comments, but that is more a reflection of (a) how important this chapter is (b) how good shape it is in, i.e. the edits are mostly small tweaks to clarify and avoid ambiguity. Unfortunately I only had time to review 1.1-1.3 thoroughly, then skip to the ice sheet parts later, but I would be happy (and keen) to contribute further through discussions or as a CA if that would be helpful. [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Noted - with thanks!
14477	1	1	1	1	Thank you for the opportunity to review three chapters of the IPCC's WGI Sixth Assessment Report. The material is fascinating and as always the authors should be commended for having distilled an enormous amount of information into these summaries. My comments below are a mix of true 'review' comments and recommended edits for clarity, grammar, etc. The review comments pertain to subject areas in which I have expertise (earth-surface processes, sediments, geomorphology) and many include pointing the authors to additional relevant literature not yet cited in the Assessment Report. I realize that it is not possible to cite every relevant paper in a report of this nature, given the volume and rapid growth rate of climate-related science. However, in certain places the addition of new references would add substantively to the content, as the suggested papers can directly inform the report's findings. [Amy East, United States of America]	Noted (no action required).
12401	1	1	1	51	It was a very nice reading of chapter-1 (best compared with other chapters), The history view of climate science and the high-level conceptual context are highly valuable, the figures are illustrative and simple which are great. Please keep them. The overall comments are (1) the chapter need many thorough proo-reading and remove overlapping discussions. (2) the CA list is heavily developed country weighted (>90%), especially UK weighted (11 from UK). This is not good for IPCC [Lijing Cheng, China]	Noted - with thanks! We are aware of the western/developed nation bias of the CA list, and have tried to expand it for the final version.
3993	1	1	50	6	It should be good to give a definition of a few key terms used in the report, including climate change, climate variability and so on...It should be also necessary to indicate that term climate change used here is different from that used in UNFCCC and understood by public and policy-makers. Guoyu Ren (CUG, China) [Guoyu Ren, China]	Noted. Key concept mentioned by reviewer have glossary definitions, and reader is referred to glossary
77173	1	1	193	29	This is an important chapter. It could be clearer and shorter and some material could best be used in other IPCC reports. [Emer Griffin, Ireland]	Noted. In our view, the broader context is important also for the assessment of physical science literature.
77175	1	1	193	29	A lot of the detail included here may best be address in subsequent chapters with simple and clear framing for this material being provided here [Emer Griffin, Ireland]	Noted. The structure of AR6 is different to previous WG1 reports, and this includes Chapter 1. We have provided more material and a broader context and framing than before, in line with the broader scoping and also the intents of the IPCC Bureau.
77177	1	1	193	29	There have been significant advances since the AR5 e.g. on climate sensitivity, these advances can be previewed here in a manner that enables the reader to look for new and additional information in the later chapters. [Emer Griffin, Ireland]	Rejected. Climate sensitivity is thoroughly treated in Chapter 7. The historical evolution of estimates is covered in section 1.3, though, as a starting point, and we link forward to Ch7. We hope this is sufficient to prepare the reader.

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42051	1	1	200	1	What are the differences of hadcrut4 (and t4.6) and t5 (these different observation datasets are also used in chapter 2 and it might be valuable to have a comparison of the most important variables, e.g. temperature and precipitation) [Julia Nabel, Germany]	Taken into account; please see Chapter 2.
105071	1	1	200	9	Overall, I found this chapter very clear, well written and illustrated. [Masa KAGEYAMA, France]	Noted - with thanks!
69787	1	1	200	9	SLCF is a new chapter in AR6 and would like to point out that in Chapter 1 the following usage is encountered. Word (usage) - SLCF (1); Short lived climate forcings (8) aerosols (92). Please also see the comment for page 74 line 40 for example. [Bhupesh Adhikary, Nepal]	Taken into account. We agree that we had some references to aerosols that should have been broader (SLCF or similar), and have revised accordingly. We have also included more introduction to Chapter 6 material, in collaboration with Ch6 authors.
839	1	1	200	50	Many sections in this chapter are based on literature references prior to 2015 and it is unclear to what extent these texts are new compared to AR5 and other assessments [Bart van den Hurk, Netherlands]	Noted. We have indeed included earlier literature as part of the context of the report, but still focus on post-AR5 developments for most of the text.
77117	1	5	198	10	Chapter 1 sets the scene for the WGI report as well as the full AR6 report. It should be clear provide a narrative for a report which addresses existing understanding and new material to be provided. This should be apparent from the summary and content. As currently written this is hard to determine [Emer Griffin, Ireland]	Noted. The current Chapter 1 however goes beyond simply introducing the materials, but also presents our own, dedicated content. This is by design, and consistent with the indicative bullet points in our scoping.
77119	1	5	198	10	The direct relevance of some material included here to the scientific understanding of climate change is not readily apparent but may be more important for WGII and III reports. [Emer Griffin, Ireland]	Noted. In our view, the broader context is important also for the assessment of physical science literature.
77121	1	5	198	10	The links to policy are important but these should be quoted carefully here and serve as bases for further use to through the report e.g. on the objective of the UNFCCC and the Paris Agreement goals and pathways. These should be correct and consistent throughout the report. [Emer Griffin, Ireland]	Taken into account. We have revised the statements related to the UNFCCC and the Paris Agreement.
77123	1	5	198	10	The links to policy are important but these should be quoted carefully here and serve as bases for further use to through the report e.g. on the objective of the UNFCCC and the Paris Agreement goals and pathways. These should be correct and consistent throughout the report. [Emer Griffin, Ireland]	Taken into account. We have revised the statements related to the UNFCCC and the Paris Agreement.
82851	1	9	11	15	Ed Hawkins has done some great works in climate stripes but we should also consider monthly variability and trends [Archibong Akpan, Nigeria]	Rejected. Section 1.2.1.1 describes changes at the annual mean scale so that more variables can be included.
4249	1	14	1	31	It looks like the list of contributing authors was compiled in a hurry. It has extra commas at different places, as well as some missing commas (e.g. in front of Michael Grose). In addition, names of some authors are misspelled (e.g. Gillett with one "t" instead of two). We suggest a careful revision of the list. [Claude-Michel Nzotungicimpaye, Canada]	Accepted.
90435	1	16	1	25	irregular spacing, missing comma, double commas between authors' names. [Holly Kyeore Han, Canada]	Accepted.
70807	1	18			Please correct the spelling of 'Gillett'. There are two t's in Gillett. [Gillett Nathan, Canada]	Accepted. (With apologies; this change seems to have reverted to an error for the final version. We will fix this - again - via the errata process.)

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68021	1	19	1	27	This summary point should include reference to results from paleoclimate reconstructions and realistically forced simulations of regional to global mean surface conditions, primarily surface temperature, for the past millennium (section 1.2.1.2), that allow study of recent rates of decadal to multidecadal change, their attribution, and estimation of the unforced variability (e.g. Neukom et al 2019a, also 2019b and references in section 1.2.1.2). In particular recent 50-year rates of warming are unusually relative to those estimated from the prior 1-2 millennia. [Michael Evans, United States of America]	Rejected. This is treated in Chapter 2; we cannot go into this level of detail at this stage of the report. References to Chapter 2 are made, though.
82853	1	19	25	33	Early warning systems that are context-specific and contingency plans should be designed at local, national and regional scales [Archibong Akpan, Nigeria]	Sorry, but we are not sure to which part of the chapter this comment corresponds to.
71403	1	22			Please change my country to Austria/Germany [Douglas Maraun, Austria]	Accepted.
82843	1	25	6	27	There would be long term trend in the tropics if temperature values are collected on decadal scales [Archibong Akpan, Nigeria]	Noted.
82849	1	25	10	26	Most Countries only ratified the Paris agreement yet they are not complying, and this action is attenuating collaborative efforts to take climate action globally [Archibong Akpan, Nigeria]	Noted
82847	1	27	7	39	Using CMIP6 to ensemble regional climate variability becomes less significant and generalize conditions in micro-scale and local scales. There are many communities that do not have weather stations to measure and account for climate variability and ground truthing from regional models and GCMs [Archibong Akpan, Nigeria]	Noted.
82845	1	32	6	35	Values should also be flexible to capture and re-classify moderately-impacted zones [Archibong Akpan, Nigeria]	Noted.
4463	1	37	1	39	Statement "In 2018, the IPCC Special Report on Global Warming of 1.5°C (SR1.5) assessed that the warming caused by human activities matches the level of observed warming since the year 2000 to within ±20% (likely range)." This sentence does not make any sense and can be easily misunderstood. I guess you want to say that all of the observed warming of the past 150 is anthropogenic, plusminus 20%. Why do you introduce "since 2000"? What time frame does "warming caused by human activities" refer to? Furthermore the 100% anthropogenic attribution of SR15 does not reflect current scientific understanding. Significant natural warming rebound after the Little Ice Age is to be expected. Warming through CO2 during the early 20th century is limited. A significant part of the warming 1980-2000 is attributable to multidecadal natural variability (PDO, AMO) which is neglected here. Climate models consistently overestimate warming. Where does the overconfidence of IPCC authors come from? Considering that the CMIP-6 models have mostly failed, it would now be the right moment to backtrack from the 100% anthropogenic claim and return to a more realistic mix of anthropogenic vs. natural climate drivers. Credibility of the IPCC is seriously at risk if these issues are not addressed in a more balanced way. [Sebastian Luening, Switzerland]	Not applicable (text removed/revised).
86179	1				Need to make it extremely clear in the Executive Summary that the improvements in analysis, data, methodology etc.can have an impact on previously reported facts and conclusions - including increasing our uncertainty. Otherwise some policy makers will think that the science is unreliable. [Debra Roberts and the Durban WGII TSU, South Africa]	Taken into account. We did not find a good place for this in the Executive Summary, but the introduction to our Chapter (1.1) states that "Each report builds on the earlier comprehensive assessments by incorporating new research and updating previous findings." Uncertainties are discussed explicitly later in the chapter.
3219	2	15	2	15	Risk and solution framing to assist with decision making [Sergio Aquino, Canada]	Taken into account; header revised, although slightly differently.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
3221	2	17	2	17	Climate change communication under uncertainty [Sergio Aquino, Canada]	Taken into account; header revised, although slightly differently.
3225	2	19	2	19	Treatment of uncertainty and calibrated uncertainty language (no need to say IPCC) [Sergio Aquino, Canada]	Taken into account; header revised, although slightly differently.
3227	2	21	2	21	Scientific values and their impact on climate change communication [Sergio Aquino, Canada]	Taken into account; header revised, although slightly differently.
3229	2	22	2	22	Climate change and the media [Sergio Aquino, Canada]	Taken into account; header revised, although slightly differently.
90437	2		4		There seems to be an inconsistency in the capitalization of the first letters of words. For example on Line 13, the word "Relvance" starts with a capital letter but "reference" on Line 37 is not. [Holly Kyeore Han, Canada]	Accepted, text revised.
102449	4	3	34	3	A "the" seems to be missing in front of "physical" [Philippe Tulkens, Belgium]	Rejected. Not sure what page/line this comments is mentioning
111897	4	6			I would expect more frequently asked question on comparing against IPCC AR5, with continuation or other one what are the main areas of the progress since then. [Tomas Halenka, Czech Republic]	Rejected. This is a good suggestion, but it was not possible to implement it for practical reasons. (The FAQs have been in development for a long time.)
26517	4	20	4	25	The Paris Agreement Paris also fixed objectives in terms of resilience and the alignment of financial flows which could also be recalled given the broader nature of the goals of the Agreement [Eric Brun, France]	Accepted, this is now explicitly mentioned under 1.2.2.
64679	4	27	4	35	This is an example of statement that should be slightly revised to open the door to the AR6 focus and conclusions [Pascale Braconnot, France]	Not applicable. It's not clear what this comment refers to.
64681	4	37	3	41	The end of the paragraph should open on what AR6 will bring on these questions [Pascale Braconnot, France]	Not applicable. It's not clear what this comment refers to.
34803	4	43	4	49	Detailed Comments by SOD Chapter – Chapter 1: The SOD states that reaching net-zero emissions is a prerequisite to halting warming at 1.5°C or well below 2°C. Two comments: (a) such a statement implies that the models are reliable, which they are not, and (b) net zero emissions is technically impossible, economically unaffordable and socially undesirable. Please see general comment #14 above. [Jim O'Brien, Ireland]	Rejected. Neither comment is supported by peer-reviewed scientific literature.
107101	4	44		48	pt 3 of 3] As I pointed out in my comments on p. 1-40 of the FOD, the "carbon budget" concept is nonsense. The unscientific "carbon budget" nonsense needs to be purged entirely from this Report, and replaced with a mea culpa. Here're some references for one of the two major negative feedback mechanisms which remove CO2 (greening, a/k/a transfer of carbon from atmosphere to terrestrial biosphere): https://www.nature.com/articles/ncomms13428 https://www.nasa.gov/feature/goddard/2016/carbon-dioxide-fertilization-greening-earth https://www.nature.com/articles/nclimate3004 [David Burton, United States of America]	Rejected. The carbon budget is thoroughly discussed in Chapter 5, and builds on solid scientific literature. It has pros and cons, and limitations, but these are well discussed in the subsequent assessment.
102451	4	51	4	51	The leading sentence reads badly, it seems like the word "Scientific", i.e. "Scientific understanding of key features ...", is missing [Philippe Tulkens, Belgium]	Accepted, text revised.
19605	5	1	5	1	This title calls for 2 remarks, which are not specific of this particular chapter. First there is no good reason to use the word "executive". The expression "executive summary" is used to summarize a business plan to be presented to decision-makers. This is not the present case at all. On the other hand, a summary is generally defined with reference to a main text, and is meant to present briefly the main elements included in the main text. I expect this rule applies to IPCC reports.As for chapter 1, I believe it complies. [philippe waldteufel, France]	Noted. These are relevant points, but not something we can change at the present time. It's worth keeping in mind for AR7 though.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
98895	5	1	5	3	This sentence I think is well stated and I think it would help to think of the types of information listed as the basis for how the various points made in this Executive Summary might be organized. For me, the three sub-section titles now used to break up the set of points are really not very useful descriptions of the points included below them. I'd urge a reworking of the subheadings so that they cover and convey the progress made for each of the approaches listed in the first sentence, so, for example, saying "Paleoclimatic reconstructions are now providing greater insight into" and then below this have the paleo-related paragraphs. Right now, the findings listed seem to jump around and I found it hard to figure out the few key thematic messages of all of these points--it all just seemed a list but without overall meaning. [Michael MacCracken, United States of America]	Taken into account. The flow of the Executive Summary has been revised.
111781	5	1	5	13	I think this executive summary should also mention the main finding of WG1 [Alessandra Conversi, Italy]	Rejected. This is done in the SPM and the TS. It has been discussed, but the division between the chapters is such that we cannot list the main findings here.
85907	5	1	200	6	This is a well-written introductory chapter to WGI contribution to AR. It provides a clear roadmap for the rest of the chapters. [Debra Roberts and the Durban WGII TSU, South Africa]	Noted - with thanks.
111783	5	1			At the moment the points are not linked to one another and it is not obvious why they are important. I think every sentence should be completed with an answer to this question: "And so?" There is also the need of a paragraph summarising the main take home message from the various points. The main take home message is not evident (If on purpose, disregard) [Alessandra Conversi, Italy]	Noted. This is a consequence of how the Executive Summaries of the IPCC reports are constructed. However, we have attempted to strengthen the narrative flow of the ES.
3233	5	3	5	3	The IPCC Working Group [Sergio Aquino, Canada]	Not applicable. Text removed.
79803	5	3	5	3	"most current" -> "current" [Dáithí Stone, New Zealand]	Not applicable. Text removed.
19607	5	3	5	13	This paragraph sounds rather solemn. Is this deliberate? This chapter is just the first chapter of one of the 3 parts constituting IPCC's AR6. If I am not mistaken, it is part of the AR6. [philippe waldteufel, France]	Accepted, text revised.
9071	5	4	5	4	Cut out "evaluating knowledge". Too much "knowledge" in this sentence. [Olaf Morgenstern, New Zealand]	Accepted, text revised.
1691	5	4	5	4	"reanalyses" I suggest adding reanalyses process or reanalysis datasets [Ruba Ajjour, Jordan]	Rejected. The word is used as defined in the IPCC Glossary.
1693	5	4	5	4	evaluating- should be evaluates [Ruba Ajjour, Jordan]	Rejected. The meaning is ", by evaluating..." but the "by" was removed for brevity.
79805	5	4	5	5	Terms like "reanalyses" are rather technical and quite possibly not understood by your clients. Is that appropriate in the very first sentence of your ES? [Dáithí Stone, New Zealand]	Taken into account. The word is now defined later in the ES, but retained here for completeness.
3235	5	5	5	5	climate model simulations [Sergio Aquino, Canada]	Accepted, text revised.
77125	5	5	29	12	It is odd that no statement is made about the Earth's climate sensitivity here as it provides the key response to the additional energy being trapped by GHGs and also the topic of the full chapter. Simple text on this e.g. from page 35 lines 34-43 and from page 38 last para lines 39-51 can be used. [Emer Griffin, Ireland]	Rejected. The climate sensitivity is a key quantity, but discussed in great detail later in the report - and in section 1.3. We do not provide new insights in chapter 1, however.
77127	5	5	29	12	It is odd that no statement is made about the Earth's climate sensitivity here as it provides a key response to the additional energy being trapped by GHGs and therefore for climate policy. Simple text on this could be used e.g. from page 38 lines 38-51 can be used which frames the update in the AR6. [Emer Griffin, Ireland]	Rejected. The climate sensitivity is a key quantity, but discussed in great detail later in the report - and in section 1.3. We do not provide new insights in chapter 1, however.
3237	5	6	5	7	and its methodology. [Sergio Aquino, Canada]	Rejected, text revised following other comments.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
124955	5	7	5	10	Sentence beginning with "It sets the scene..." can be cut. Similarly, the phrase at the end of the paragraph "... with a focus... policymaking." should be cut. [Trigg Talley, United States of America]	Accepted, partially. Scene-setting is retained, the WGII/WGIII link has been removed.
114129	5	8	5	8	I think "responses" could be changed to "processes" here. [Jan Fuglestedt, Norway]	Rejected. After discussion, the term has been retained (processes was considered too general; our context is the response to climate change specifically).
102453	5	11	5	12	"pre-industrial" needs to be followed by a word e.g. "times" or "period". [Philippe Tulkens, Belgium]	Rejected. 'Levels' is specified, meaning temperature (as in the first part of the sentence.)
31307	5	11	5	13	It is not clear why the intention to complement WGII and WGIII is mentioned here. It is given from the overall AR6 structure. There is no particular information content here, and the sentence could be omitted. Or, if there is a need, developed into a more substantial statement. [Markku Rummukainen, Sweden]	Accepted, sentence removed.
50553	5	11	5	13	"Chapter 1 also aims to support WGII and WGIII contributions to the AR6, with a focus on international climate governance, risk framing and on the needs of global and regional climate change policy making." Are WGII and WGIII TSUs and author teams aware, reviewing this material and factoring it into their own drafting? [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account, sentence removed.
114131	5	11	5	13	I suggest deleting the last sentence here since this is incomplete and is not needed here anyway. [Jan Fuglestedt, Norway]	Accepted, sentence removed.
100567	5	13	5	13	Note: Hasn't this been demonstrated for the Pliocene also? [Matthew Kohn, United States of America]	Not applicable; unclear what this comment refers to.
33267	5	13	5	25	I would include this paragraph in the Executive Summary (meaning in the first paragraph in italics): The Paris Agreement (2015) set the goals of "holding the increase in global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels." As part of these efforts, each country submitted a Nationally Determined Contribution (NDC) indicating its planned emission reductions. The NDCs submitted so far are insufficient to achieve the Paris goals (high confidence). [Guiomar Rotllant, Spain]	Rejected. This comes as the second main point of our Executive Summary.
64867	5	15	5	15	"Framing and context of the WGI report" should be emphasised differently than title "Executive summary" [Kreso Pandzic, Croatia]	Accepted; editorial.
90029	5	15	5	25	Follow structure outlined in page 8: the three pillars - large-scale information, process understanding and regional information with cross-WG issues at the end. Section 1.2.1 "The Changing state of the Physical climate system" needs to be highlighted as fundamental aspect and inception point to the "Framing". [Govindarajulu Srinivasan, Thailand]	Accepted, this is highlighted in the first point of the ES.
104713	5	17	5	18	"The WGI contribution to the AR6 assesses scientific information on climate change relevant for a world whose climate system is rapidly changing". This statement is misleading. AR6 assess all scientific information relevant for climate change. Not only information for a "rapidly changing world". There are several areas on the planet not currently experiencing a "rapid change". It is still a matter of concern for the future! The word "rapid" should be omitted. AR6 is looking at all aspects, rapid or not. [Jan Lindstrom, Sweden]	Rejected. The introductory statement gives the full scope, as asked for here. This particular ES statement points out that - further to the framing - what we assess has close connections to the situation the world is currently in.
124957	5	17	5	18	The word "whose" should be replaced with a term that does not confer human qualities on "world". Same problem on line 19. [Trigg Talley, United States of America]	Accepted. Revised as suggested

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15883	5	17	5	25	<p>It is vitally important at the outset to have a clear and full statement of the targets set within a wider context. The initial 2°C and subsequent 1.5°C targets were set in accordance with objective 2 of the UNFCCC for the, "Stabilization of the greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time-frame sufficient to..... enable economic development to proceed in a sustainable manner." Thus the targets had to reconcile economic development with climate impact at the outset. A scientifically assessed safe target would be less than 0.5°C above baseline which is commensurate with the temperature in 1980 when multiple interacting feedback mechanisms were first observed.</p> <p>The proposed wording of the text should therefore be:</p> <p>International efforts to address the risks posed by these changes, began with the UN Framework Convention on Climate Change (UNFCCC, 1992), whose objective is to prevent "dangerous anthropogenic interference with the climate system. while enabling sustainable economic development" In response to this objective, the Paris Agreement (2015) set the goals of "holding the increase in global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C pre-industrial levels," while scientifically set safe targets are established.' [Kevin Lister, United Kingdom (of Great Britain and Northern Ireland)]</p>	Taken into account. Text revised, although not precisely as suggested.
77129	5	17	5	25	A fuller text of Art 2 could be used including GHG stabilisation and text on food production ecosystems and sustainable development [Emer Griffin, Ireland]	Taken into account. GHG stabilisation included. The other aspects could be found in the section 1.2 and in the Cross-Chapter Box on Global Stocktake.
77131	5	17	5	25	The Paris Agreement and COP21 also looked for long term low emissions strategies. Mention of these here would complete the statement on NDCS [Emer Griffin, Ireland]	Taken into account. GHG stabilisation included.
69985	5	17	5	25	Excellent text, very informative. [Sonia Seneviratne, Switzerland]	Noted with thanks.
114133	5	17	5	25	I suggest also mentioning Art 4 of the PA [Jan Fuglestedt, Norway]	Rejected. We did not find room for this.
115199	5	17	5	25	While there is nothing wrong with this para, I expect it will provoke a lot of criticism, since it is focusing only on one part of Art. 2 of the PA, i.e. Art. 2.1a. This is missing out on parts 2.1b and c, aspects that are of key importance to the Global South. The way out may be to frame this para more by stating that this para addresses primarily the aspect of temperature limits (Art. 2.1a) only to simply avoid misunderstandings about the scope, in particular of the last sentence, and preempt such criticism. [Andreas Fischlin, Switzerland]	Taken into account- Art 2.1 indicated.
36451	5	18	5	19	International efforts did not start with UNFCCC in 1992; they began prior to that, as the documentation of the UNEP/ICSU/WMO Villach meeting of 1985, the Villach-Bellagio workshops of 1987 and the Toronto conference of 1988 show. [John McLean, Australia]	Taken into account, reformulated to "became formally organized" instead
64683	5	18	5	27	such statement would be expected from chapter 2, even though we need something here [Pascale Braconnot, France]	Rejected- probably x-wrong page or line references
124959	5	19	5	19	Strike "began" and replace with "became formally organized" as the international efforts to address these risks did exist before the formation of the UNFCCC, just not in as organized a way. [Trigg Talley, United States of America]	Accepted-Changed
87471	5	19	5	19	remove first comma [Stephen Humphreys, United Kingdom (of Great Britain and Northern Ireland)]	Editorial
79807	5	19	5	20	"changes, began" -> "changes began" [Dáithí Stone, New Zealand]	Editorial

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83915	5	20	5	21	proposal: In response to this objective, UNFCCC established several instruments and means of implementations, being the most recent one the Paris Agreement (2015), that set the goals... Just: as it is stated, the message is that since the establishment of its objectives, in 1992, nothing was accomplished, being the only valid instrument the PA. It is also relevant to mention the efforts of the Kyoto Protocol. [Marco Tulio Cabral, Brazil]	Taken into account- changes to say In response to this objective, UNFCCC established several instruments and means of implementations, being the most recent one the Paris Agreement (2015)
69983	5	21	5	21	It is excellent that chapter 1 mentions the explicit text of the Paris Agreement here. Note that the cited text mentions "global average temperature" regarding the definition of global warming. Given the existence of different definitions of Tglob (e.g. GMST vs GSAT in cc box in chapter 2) and their impacts on the assessment, as well as the fact that the text of the Paris Agreement is not explicitly referring either to GMST or GSAT (see wording), it seems that it would be useful for chapter 1 to possibly address the question of "What is global average temperature and how is it defined ?" (either in a box or an FAQ). At the moment this is done in chapter 2 (cc box), but this gives an observational focus to this question, which is actually broader and relevant across the AR6 report. [Sonia Seneviratne, Switzerland]	Noted
111803	5	21	5	21	the PA sets only 1 long-term temperature goal (LTTG), see WG3 ch14 [Oliver Geden, Germany]	Accepted, changed accordingly
40389	5	21	5	21	I think there's only one temperature 'goal' of the Paris Agreement (the long-term temperature goal) - not multiple temperature 'goals'. This applies elsewhere in the chapter where you talk about temperature goals. Note though that I think the Paris Agreement has several goals (the long-term temperature goal plus other, non-temperature, goals, e.g. net-zero). [TSU WGI, France]	Accepted, changed accordingly
102455	5	21	5	23	This line is complex to read and understand especially for non-experts. [Philippe Tulkens, Belgium]	Noted but It quotes the Paris Agreement text.
18561	5	22	5	37	"pre-industrial" This word is used numerous times from page 5-37 and it is only on page 37 that the reader surmises that "pre-industrial" refers to atmospheric CO2 concentrations ~275 ppm (and then a discussion in Box 1.2 on page 46-47). Is it defined elsewhere by a time period or a CO2 level? Clearly for climate, the CO2 concentration, not the time period matters. If the latter, when was CO2 at that level? "Industrialization" was a human action that ramped up at a historical moment... so clearly it's tied to both human events that had consequences on atmospheric CO2 concentrations. In reading this report and the literature, I feel like that term gets thrown around a lot and is fluid in meaning, so it would be nice to address that sooner in the main text. Perhaps at its first mention, a sentence can be added defining the preindustrial and then pointint to Box 1.2 on some of the nuances. [Miriam Jones, United States of America]	Rejected. It is used two times in our Executive Summary, both times clearly in the context of temperatures. The term is further discussed (in depth) later in the Chapter (CC-box 1.2).
19481	5	23	5	24	"The tropical regions have experienced less warming than most other regions " what is your evedence for this subject? I mean it is better to bring some example, [Hamideh Dalaei, Iran]	Rejected. The evidence is shown in the sections referenced (1.4, FAQ1.2), and in Chapter 2.
79809	5	23	5	25	This sentence is highly specific and so does not connect with the broad introductory heading in lines 17-18. [Dáithí Stone, New Zealand]	Taken into account. An entry only for international policy
114135	5	23	5	25	You may reconsider if the two sentences on NDCs are needed here. [Jan Fuglestedt, Norway]	Rejected. Sentences retained, to present our assessment on their current inadequacy for reaching the aims of the Paris Agreement.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
124961	5	24	5	24	This line about NDCs suggests that they are a one time, one shot commitment, which is not the case. This first key message poorly represents the purpose and process of NDCs from the Paris conference. A much more accurate description is provided on page 15, lines 24-25. [Trigg Talley, United States of America]	Taken into account- ES wording change
124963	5	24	5	25	The characterization of NDCs is inaccurate and misleading. Sentences should be revised to read: "... indicating its planned emission reductions BY 2025 OR 2030. WHILE NEVER INTENDED TO DO SO, THIS FIRST ROUND OF THE NDCs IN AND OF THEMSELVES are insufficient to achieve the Paris goals, THOUGH THEY COULD BE CONSISTENT WITH SCENARIOS THAT DO SO." [Trigg Talley, United States of America]	Taken into account- ES wording change
26213	5	24	5	25	Additionally to mention that NDCs are insufficient to achieve the PA, the projected increases of T ⁹ under current NDCs should also be added (2.6-3-5°C mentioned in page 15 - section 1.2.2). This information, here at the beginning, can help to increase awareness of policymakers. [Tania Guillén Bolaños, Germany]	Noted- That is mentioned in the text in 1.2
111991	5	24	5	25	Suggest inserting "aforementioned" before "Paris goals" to make clear that you are asserting the goals of reaching 2 degrees or below 1.5 is not achievable with current NDCs, rather than other goals of the Paris agreement [Cynthia Randles, United States of America]	Not applicable (text revised).
110735	5	24	5	25	it can be noted that due to frequent policy changes and the positive development of technology and the renewable energy market many countries have undertaken the revision of their CDN which has proved to be below their current ambitions [Bruno Korgo, Burkina Faso]	Noted. This is to be assessed in WG 3 report
19133	5	24	5	25	I found surprisingly little assessment of the inadequacy of NDCs in addressing Paris goals in the chapter, though perhaps I was not paying enough attention. [Thorsten Mauritsen, Sweden]	Accepted, text revised and assessment strengthened.
64711	5	24	5	25	You mean the quantifiable mitigation commitments in the NDCs submitted? [Sanz Sanchez Maria Jose, Spain]	Taken into account. Explicitly mention "to keep global surface temperature increase within the limits sought by the Agreement"
106237	5	24	5	25	NDCs cover more than only mitigation (they also include planned action on adaptation or means of implementation/finance). Only highlighting one aspect might not be considered balanced, in particular, because the Paris Agreement "goals" include a goal on mitigation (Article 2.1.a), adaptation (Article 2.1.b), and means of implementation (Article 2.1.c). [Rogel] Joeri, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Explicitly mention that we consider Art 2.1.A and also highlight adaptation and mitigation in NDCs
111805	5	25	5	25	the PA sets only 1 long-term temperature goal (LTTG), see WG3 ch14 [Oliver Geden, Germany]	Accepted with thanks.
124965	5	27	5	29	Move "rising atmospheric greenhouse gas concentrations" to the middle of line 27 as they are the cause of everything that follows. Also, authors should consider adding something about the biosphere (e.g., forests, reefs, etc.). [Trigg Talley, United States of America]	Not applicable- ES wording has changed
34573	5	27	5	30	It seems more logical to list rising greenhouse gas concentrations at the beginning of this sentence because they are the driver behind the other observed changes. [Russell Vose, United States of America]	Not applicable- ES wording has changed
11325	5	27	5	30	The order is not logic. Rising atmospheric greenhouse gas concentrations should be first, followed by the others. [Michael Schmitt, Germany]	Not applicable- ES wording has changed
77133	5	27	5	30	Is pH change part of the climate system? [Emer Griffin, Ireland]	Not applicable- ES wording has changed

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21249	5	27	5	35	The portion of the assessment statement here from lines 33-35 is overtly over-reaching into the charge of chapter 2. Furthermore the assessment finding is at odds with the more nuanced findings arising from chapter 2. To avoid this it would be better if the finding were to be restricted to end with the point that prior assessments concluded unequivocal evidence existed. This then would nicely tee up the substantive assessment undertaken in chapter 2. [Peter Thorne, Ireland]	Accepted, text revised accordingly.
15885	5	27	5	35	A clarifying statement should be made at the end of the end of this section to the effect of: 'There are no internationally agreed targets for any of these variables.' [Kevin Lister, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable, relevant text removed.
112271	5	27	5	35	Ongoing observed changes to the climate system include increasing atmospheric greenhouse gas concentrations, extreme weather events, change in precipitation patterns, increasing ocean heat content (OHC) and global surface air temperatures both over land and oceans, to increased rates of ice melt of glaciers and ice sheets in Greenland and Antarctica, sea level rise and oceans acidification. Since 1990, the IPCC Assessment Reports have comprehensively and consistently laid out the vast evidence of a changing climate system. Both the Fourth and Fifth Assessment Reports (AR4, 2007; AR5, 2013) concluded that climate system global warming is unequivocal. Multiple independent lines of evidence indicate the unusual nature of the present rate and scale of global changes, as well as already committed future changes, even when seen in the context of a multi-million-year period. {1.2.1, Figure 1.2, Figure 1.3} instead of Ongoing observed changes to the climate system include increasing global surface air and sea temperatures, loss of ice and glacier mass, sea level rise, increasing ocean heat content, changes to precipitation patterns and extreme weather, declining ocean pH, and rising atmospheric greenhouse gas concentrations. The series of five IPCC Assessment Reports since 1990 have comprehensively and consistently laid out the vast evidence of a changing climate system, with the Fourth and Fifth Assessment Reports (AR4, 2007; AR5, 2013) both concluding that warming of the climate system is unequivocal. Multiple independent lines of evidence indicate the unusual nature of the present rate and scale of global changes, as well as already committed future changes, even when seen in the context of a multi-million-year period. {1.2.1, Figure 1.2, Figure 1.3} [Kamal Mohammedi, Algeria]	Not applicable- ES wording has changed
107087	5	27		35	[pt 1 of 5] It says, "Ongoing observed changes to the climate system include increasing global surface air and sea temperatures, loss of ice and glacier mass, sea level rise, increasing ocean heat content, changes to precipitation patterns and extreme weather, declining ocean pH, and rising atmospheric greenhouse gas concentrations. ... Multiple independent lines of evidence indicate the unusual nature of the present rate and scale of global changes, as well as already committed future changes, even when seen in the context of a multi-million-year period." That is extravagantly misleading... [cont'd] [David Burton, United States of America]	Not applicable- ES wording has changed

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107089	5	27		35	[pt 2 of 5] ...because it falsely suggests that many or all of those climate metrics have changed with an unusual "rate" and "scale" way within the last million years. In fact, only one of those eight metrics has changed in an unusually rapid or unique way in the last million years: greenhouse gas concentrations. Recent changes in the other metrics have all been modest and benign, in the context of the last million years; in fact, for most, even within the context of the last 20,000 years. E.g., it is known that sea-level rise, loss of glacial mass, and temperatures have all exhibited changes at rates at least an order of magnitude greater than the rates seen over the last century. [cont'd] [David Burton, United States of America]	Not applicable- ES wording has changed
107091	5	27		35	[pt 3 of 5] ...E.g., Buizert et al 2014 [Science, Vol. 345, Issue 6201, pp. 1177-1180, DOI: 10.1126/science.1254961] reported Greenland ice core evidence of persistent temperature changes as rapid as several degrees per decade. http://archive.is/aUi9R#selection-415.0-419.271 summarized the conclusions: "...a jump in Greenland's air temperatures of 10-15 degrees (C) in just a few decades beginning about 14,700 years ago." [and] "... about 12,800 years ago ... abrupt cooling of some 5-9 degrees (C), also over a matter of decades." [cont'd] [David Burton, United States of America]	Not applicable- ES wording has changed
107093	5	27		35	[pt 4 of 5] Even after accounting for Arctic amplification, that's at least ten times as rapid as the (presumably anthropogenic) "warming spurt" which we experienced in the 1980s to 1990s, and the similar (presumably mostly non-anthropogenic) warming spurt which we experienced in the 1920s to 1940s. The paragraph needs to be rewritten to say that, "The rise in GHG levels is believed to have been uniquely rapid, even in the context of a million year period, but the other measured climate changes (to temperatures, sea-level, cryosphere, etc.) have not, thus far, been out of the ordinary, in the context of the last 15,000 years." [cont'd] [David Burton, United States of America]	Not applicable- ES wording has changed
107095	5	27		35	[pt 5 of 5] I pointed this out in my FOD comments, yet the authors apparently ignored it. That is disappointing. ### [David Burton, United States of America]	Not applicable- ES wording has changed
34571	5	28	5	28	Looks like a word is missing from this sentence; presumably it should read "loss of ice SHEET and glacier mass." [Russell Vose, United States of America]	Not applicable- ES wording has changed
124967	5	28	5	28	Consider inserting "that have led to" after the words "surface air and and sea temperatures". Insert the word "accelerated, before the words "sea level rise". [Trigg Talley, United States of America]	Not applicable- ES wording has changed
26011	5	28	5	28	Consider to add also "reduction of snow cover" [Don Alfonso Pino Maeso, Spain]	Not applicable- ES wording has changed
623	5	29	5	29	"increasing" rather than "rising" for greenhouse gas concentrations, because (a) consistency with "increasing" earlier in the sentence, and (b) "rising" implies vertical movement. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable- ES wording has changed
36453	5	31	5	31	Are you serious? Each IPCC report has shown different evidence to the previous report, which means that each previous was incorrect. (I wonder, is this report going to show that AR5 was also incorrect?) [John McLean, Australia]	Not applicable- ES wording has changed
38647	5	32	5	32	The reference (AR5, 2013) must be complete with a and b (AR5, 2013 a; b), as reported in the final bibliography [Luisa Sturiale, Italy]	Not applicable. Relevant text removed.
124969	5	33	5	33	Can or should "unusual" be replaced with "unprecedented"? [Trigg Talley, United States of America]	Accepted. Revised as suggested.
20969	5	33	5	34	We suggest to replace "Global Changes" with "Global climate change" or with Global Environmental change" to be more consistent and factual. [Ladislav Chang'a, United Republic of Tanzania]	Rejected. We want to place climate change in a bigger context and "global changes" is a well accepted term for changes that are more than "global climate change".

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
104715	5	33	5	35	"Multiple independent lines of evidence indicate the unusual nature of the present rate and scale of global changes, as well as already committed future changes, even when seen in the context of a multi-million-year period. {1.2.1, Figure 1.2, Figure 1.3}" No, this is not correct. The proxy methods currently at hand do not have the ability to resolve historical data for ALL of the listed climate change indicators to state that they are of "unusual nature". Certainly not on a multi-million-year scale. The conclusion is by far overstretched. The word "unusual" should be omitted. As recent as the Holocene period contains rapid sea level changes and temperature swings on par with todays as just one pair of examples. "Comitted future changes" means model outcomes? That should never pose as a THE truth of the future. Rather as a risk indicator. That is also what the introductory text says about the AR6. Risk does not mean unavoidable fact. I propose "comitted future risks" instead. [Jan Lindstrom, Sweden]	Taken into account. Thanks. The related text has been reformulated.
70425	5	33	5	35	It was not clear to me where the 'multi-million-year context' was assessed. Figures 1.2 and 1.3 do not show changes on these timescales, and I couldn't find the assessment in Section 1.2.1. [Gillett Nathan, Canada]	Not applicable. The expression "the context of a multi-million-year period." has been removed.
28639	5	33		35	Not clear what second part of sentence was meaning, consider removing "as well as already committed future changes, even". [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. The related sentence has been removed.
1695	5	34	5	34	committed- I guess should be "expected" or "projected [Ruba Ajjour, Jordan]	Not applicable. Relevant text removed.
79811	5	34	5	34	Can you clarify "already committed future changes".in this section about observed changes? I can see many ways to interpret this, some that are justified (such as in lines 39-41, but then this is redundant), others not. [Dáithí Stone, New Zealand]	Not applicable. Relevant text removed.
29667	5	34	5	35	Strictly speaking, Section 1.2.1, Figure 1.2 and Figure 1.3 do not span "multi-million-year period"; please, consider replacing it by "centennial- to millennial-scale variations". [Hernan Edgardo Sala, Argentina]	Not applicable. The expression "the context of a multi-million-year period." has been removed.
115201	5	37	5	37	Any IPCC report has to build on all previous IPCC assessments and provide merely updates. For me this sentence seems somehow to disregard this principle, while wanting actually probably to only address the fact that AR5 WGI stated that the human influence on the climate system is clear. Please reformulate this sentence a bit to avoid this confusing meaning in this first sentence and avoids to give any impression that this report builds only on the AR5 WGI report. E.g. write "This report builds largely on the AR5 assessment that human influence on the climate system is clear" or "To an essential extent this report builds on the AR5 assessment that human influence on the climate system is clear" or similar formulations. [Andreas Fischlin, Switzerland]	Not applicable. Relevant text removed.
124971	5	37	5	37	Re-phrase sentence so the intent is more clear: "This report builds on A PRIMARY CONCLUSION OF the AR5 assessment that human influence on that climate system is clear AND INCREASING(?)." [Trigg Talley, United States of America]	Not applicable. Relevant text removed.
124975	5	37	5	37	This headline statement is essentially the same as the previous headline statement. [Trigg Talley, United States of America]	Not applicable. Relevant text removed.
69987	5	37	5	37	"builds on the assessment that human influence on the climate system is clear". This wording sounds a bit strange to my ear. It could possibly be wrongly interpreted as the AR6 taking blindly the assessment of the AR5. Maybe use "confirms and strengthens" instead of "builds". [Sonia Seneviratne, Switzerland]	Not applicable. Relevant text removed.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
36455	5	37	5	37	It is subjective nonsense to say that AR5 showed a clear human influence on climate. AR5 claims were based largely on models, which text box 9.2 of that report showed to exaggerate - sorry "over-estimate" - the influence of greenhouse gases. [John McLean, Australia]	Not applicable. Relevant text removed.
32471	5	37	5	37	Builds on? This is way too weak a statement. How about reconfirms beyond any reasonable doubt? There are so many lines of evidence for this now. [Robert Colman, Australia]	Not applicable. Relevant text removed.
114137	5	37	5	37	This formulation could be reconsidered. It sounds as if you take the AR5 conclusion for granted without adding our own and new assessment of this. I dont think the sentence is needed [Jan Fuglestedt, Norway]	Not applicable. Relevant text removed.
124973	5	37	5	39	Sentence is unclear. What are the authors trying to saying about the observed warming since 2000? That it was all man-made? Re-phrase to clarify. [Trigg Talley, United States of America]	Not applicable. Relevant text removed.
69989	5	37	5	39	Would be useful to update this statement with a reference to the AR6 assessment, e.g. "the AR6 assessment confirms this conclusion". [Sonia Seneviratne, Switzerland]	Not applicable. Relevant text removed.
115203	5	37	5	41	It might be appropriate to mention here, i.e. towards the end of the par, also the other recent IPCC reports, such as SROCC and SRCCL, not only SR1.5. They have also updated AR5, e.g. SROCC and SLR etc. [Andreas Fischlin, Switzerland]	Not applicable. Relevant text removed. Section 1.1 now introduces SROCC and SRCCL, in addition to SR1.5.
104717	5	37	5	41	This paragraph is strange. It starts with the AR5 (which is ok) but then focus on a non-climate part in SR1.5? Unless IPCC has abandoned the definition on climate which states among other things 30 year periods, this quotation from SR1.5 adds no information on the climate at all. (18 years is a far too short period). The whole paragraph should be omitted. It has no scientific value. [Jan Lindstrom, Sweden]	Not applicable. Relevant text removed.
77135	5	37	5	41	Some reference to the other two special reports is warranted. [Emer Griffin, Ireland]	Not applicable. Relevant text removed. However, Section 1.1 now introduces SROCC and SRCCL, in addition to SR1.5.
19353	5	37	5	41	I don't understand what the authors are trying to communicate by saying that observed warming "represents a multi-century commitment to worldwide loss of ice, sea level rise, and many other impacts...". Are they trying to say that the level of observed warming to date guarantees/locks-in centuries of worldwide loss of ice, etc? If so, I'd recommend reframing language to clarify the intent. [Lia Cairone, United States of America]	Not applicable. Relevant text removed.
64713	5	37	5	41	Revise the sentence, for example: The report builds on the finding of the 5AR that stated that the human influence in the climate system is scientifically supported and clear. Some how needs ot be leased with the sentnece on the 1.5 report... "As a follow up" [Sanz Sanchez Maria Jose, Spain]	Not applicable. Relevant text removed.
54867	5	37	5	42	This text describing potentially relevant information from the WGI report for the global stocktake doesn't mention the relevance of information on the current state and recent trends in large scale indicators of climate change (i.e. all of Chapter 2). This seems like an important gap. Consideration of adaptation needs and potential loss and damage (elements of the global stocktake) related to adverse effects will also need to consider the current state of the climate as well as future projections (consistent with para 36 (e) in FCCC/CP/2018/L.16. And consistent with identified relevant inputs in Ch. 1 Cross-chapter Box 1.1.) [Nancy Hamzawi, Canada]	Not applicable. Relevant text removed. Potentially relevant information for the global stocktake can be found in Cross-chapter Box 1.1.
36457	5	38	5	38	SR1.5 did not assess but assert; its evidence was weak. (See comments on evidence above in ref to line 31.) An analysis over a mere 18 years, as was the period for SR1.5, is insufficient (and unscientific) when it comes to climate, which is defined as the average of various weather factors over 30 years. [John McLean, Australia]	Noted.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
124977	5	38	5	39	This sentence needs clarity. Do you mean the warming cause by human activities "since the industrial revolution" matches the level of observed warming..."? [Trigg Talley, United States of America]	Not applicable. Relevant text removed.
26519	5	39	5	39	This might add "in the light of equity and the best-available science" given the importance both of equity (addressed in several paragraphs of the report) and the nature of the IPCC input as "best-available science" [Eric Brun, France]	Not applicable. Relevant text removed.
131349	5	39	5	41	The meaning of this sentence and the meaning of the term "commitment" in this context are not clear; I suggest revising/rephrasing to improve clarity [Hans Poertner and WGII TSU, Germany]	Not applicable. Relevant text removed.
42825	5	40	5	41	"worldwide loss of ice, sea level rise, and many other components" - doesn't make sense (loss of components?), you need to specify eg "changes to many other components" [Eric Wolff, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. Relevant text removed.
77137	5	42	5	43	Points on changes to earth's energy balance which have been relatively stable for millenia, forcing and climate sensitivities can be included here. This would frame the next material on GHGs [Emer Griffin, Ireland]	Not applicable. Relevant text removed.
124979	5	43	5	44	As written, the statement is simply not true. Authors need to revise statement to include something like, "Limiting further climate change will require substantial and sustained reductions of GHG emissions AND/OR EXTRAORDINARY AND UNPRECEDENTED LEVELS OF CARDON DIOXIDE REMOVAL." [Trigg Talley, United States of America]	Not applicable. Relevant text removed.
69991	5	43	5	45	Excellent text, very clear. [Sonia Seneviratne, Switzerland]	Noted. Thanks!
5027	5	43	5	45	No doubt, but how? If measures are proposed that will negatively impact other areas of sustainability, this will righteously cause a social system-resistance that will negatively influence our chances of success. An example is the goal-conflict between biofuels for replacement of petroleum on the one hand, and areal needed for preserving biodiversity, unhampered bio-geochemical cycles, and affordable food production on the other. Or in other words, a narrow focus on climate change will negatively influence our chances to arrive at not only cross-sector sustainability in general, but even climate sustainability. Clever cooperation towards attractive futures will not happen unless negotiations between, e.g., sectors and nations are informed by boundary conditions for ecological and social sustainability. A strategic approach to sustainable transport system development - Part 1: attempting a generic community planning process model. K-H Robèrt et. al 2017. J. Clean. Prod. Volume 140, Part 1, Pages 53-61 [Karl-Henrik Robèrt, Sweden]	Noted.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
15887	5	43	5	48	<p>"Without net-zero or net-negative CO2 emissions, and a stabilization or decrease in the non-CO2 net forcing, the climate system will continue to warm" should be replaced with:</p> <p>"Without long term net-negative CO2 emissions, and a decrease in the non CO2 net forcing, the climate system will continue to warm"</p> <p>-----</p> <p>"While quantifying the remaining carbon budgets precisely is sensitive to various assumptions, reaching net-zero carbon emissions remains a prerequisite for halting warming at 1.5°C, well below 2°C, or higher levels"</p> <p>The word 'precisely' gives the wrong connotation and should be removed. Also, there is no time dimension to this, so the proposed rewording of the sentence is:</p> <p>"While quantifying the remaining carbon budgets is sensitive to various assumptions, achieving net-negative CO2 emissions and the introduction of measures to reduce radiative forcing remain prerequisites for stabilizing the temperature at 1.5°C, or well below 2°C." [Kevin Lister, United Kingdom (of Great Britain and Northern Ireland)]</p>	Not applicable. Relevant text removed.
15889	5	43	5	48	<p>The temperature targets of 1.5°C and 2°C should be put into context, so a further qualifying statement is needed to the effect of:</p> <p>"At the current temperature rise of ~1.2°C above baseline significant and deleterious change are being observed in ecosystems, such as the death of coral reefs, heat waves in central continental regions threatening grain production, the collapse of entire marine ecosystems and the melting of the Himalayan glaciers. Allowing further temperature rises will aggravate these problems and their cumulative effect over time will most likely make the challenge of feeding a global population that is set to rise to 10 billion by mid century impossible." [Kevin Lister, United Kingdom (of Great Britain and Northern Ireland)]</p>	Not applicable. Relevant text removed.
106265	5	43	5	49	<p>This is a very important ES message but the line of sight to the chapter sections and the assessment of evidence is weak. The indicated sections mainly speak to CO2, which is covered appropriately, but the assessment of the contribution and the implications for non-CO2 I was not able to find in the referenced sections. Maybe include further references or expand the respective sections to also include additional specific detail. [Rogel] Joeri, United Kingdom (of Great Britain and Northern Ireland)]</p>	Not applicable. Relevant text removed.
66599	5	43	5	49	<p>I think this is a really good point to make, but also think it's a great spot to point out that the idea of a cumulative budget is scientifically compelling in the case of CO2 and N2O, but it does not apply for short-lived climate pollutants like Black Carbon or biogenic methane. How about the following: "The concept of a cumulative carbon emission budget associated with stabilising global temperatures at particular levels was established in the AR5. Cumulative budgets work for long-lived stock pollutants such as CO2 and N2O. The same logic does not apply for short-lived forcings such as black carbon, short-lived industrial gases, or biogenic methane. While quantifying the remaining carbon budgets precisely is sensitive to various assumptions, reaching net-zero carbon emissions remains a prerequisite for halting warming at 1.5°C, well below 2°C, or higher levels." [Dave Frame, New Zealand]</p>	Not applicable (text removed).

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
18739	5	43	5	49	What is the role of SRM in limiting climate change? A statement can be made here - Large scale deliberate climate interventions that reduce the amount of sunlight absorbed by the planet have been proposed but [Govindasamy Bala, India]	Not applicable. Relevant text removed.
106239	5	43	5	49	This is an essential message for the ES. Please keep it through to the final draft. [Rogelj Joeri, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Thanks! The message is presented elsewhere.
124981	5	44	5	45	This overgeneralization is technically flawed. Consider deleting the first phrase beginning with the words "net-zero" and ending with the word "emissions". [Trigg Talley, United States of America]	Not applicable. Relevant text removed.
98883	5	44	5	45	I would suggest adding a phrase at the end of the sentence to the effect: "in the absence of a prolonged commitment to unprecedented and as yet untested climate intervention." This issue is coming up in many for and ignoring it I do not think is appropriate to ignore it as it really is the only approach, bar a miraculous and early increase in national commitments, capable of shaving off warming that goes above the Paris targets and that has the potential to pull the increase in global average back below 0.5 C, which is likely what is needed to avoid many meters to sea level rise over the next few centuries. [Michael MacCracken, United States of America]	Not applicable. Relevant text removed.
107097	5	44		48	[pt 1 of 3] It says, "Without net-zero or net-negative CO2 emissions, and a stabilization or decrease in the non-CO2 net forcing, the climate system will continue to warm. The concept of a cumulative carbon emission budget associated with stabilising global temperatures at particular levels was established in the AR5. While quantifying the remaining carbon budgets precisely is sensitive to various assumptions, reaching net-zero carbon emissions remains a prerequisite for halting warming at 1.5°C, well below 2°C, or higher levels." That is 100% crackpot nonsense. [cont'd] [David Burton, United States of America]	Not applicable. Relevant text removed.
107099	5	44		48	[pt 2 of 3] Current anthropogenic CO2 emissions are around 11 pgC/year. Natural stabilizing negative feedbacks (terrestrial greening & oceans) are simultaneously removing around 5.5 PgC/year. The difference between those two fluxes is the current rate of increase in atmospheric CO2 concentration, i.e., about 5.5 PgC = 2.6 ppmv per year. If anthropogenic CO2 emissions went to zero, the natural removal mechanisms would continue to remove CO2 from the atmosphere, so that the CO2 level would be falling by more than 2.5 ppmv per year. "Net-zero or net-negative CO2 emissions" would cause falling CO2 levels, and thereby cause global COOLING, at a rate comparable to the current warming trend. Sharply falling CO2 levels OBVIOUSLY would NOT cause "stabilizing global temperatures." [cont'd] [David Burton, United States of America]	Not applicable. Relevant text removed.
131351	5	45	5	45	Consider explaining or rephrasing the term "non-CO2 net forcing". Not clear for a non-expert. [Hans Poertner and WGII TSU, Germany]	Not applicable. Relevant text removed.
819	5	46	5	47	the phrase "While quantifying the remaining carbon budgets precisely is sensitive to various assumptions" is pretty generic; this is always true. Better to refer to inherent uncertainty on the exact budget [Bart van den Hurk, Netherlands]	Not applicable. Relevant text removed.
79813	5	46	5	48	I get what you mean here, but it took a little while for me to figure out the missing sentence about how timing of the halt matters. [Dáithí Stone, New Zealand]	Not applicable. Relevant text removed.
124983	5	47	5	47	"budgets" should be singular. [Trigg Talley, United States of America]	Not applicable. Relevant text removed.
131353	5	47	5	48	It is not clear what "higher levels" mean in this sentence. Please revise, specify or explain. [Hans Poertner and WGII TSU, Germany]	Not applicable. Relevant text removed.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
31309	5	47	5	48	While it is true that halting warming at any level requires reaching net-zero carbon emissions, the sentence is misleading in the sense that it does not express the urgency of the challenge of 1.5 degrees, compared to "higher levels". It would be reasonable to also provide this information. It could also be useful to provide a better sense on the significance of "sensitive to various assumptions", as it does not shed any light on whether there is specific actionable knowledge. [Markku Rummukainen, Sweden]	Not applicable. Relevant text removed.
115205	5	48	5	48	I would prefer to write "limiting" instead of "halting". Halting might be misunderstood as reaching that warming level and then staying there, which may be one of the policy options, but only one among many. A lot of governments however think differently and consider those warming levels only as limits, not as targets! [Andreas Fischlin, Switzerland]	Not applicable. Relevant text removed.
115207	5	48	5	48	I suggest you write: "2°C, or any higher temperature limits" [Andreas Fischlin, Switzerland]	Not applicable. Relevant text removed.
124985	5	48	5	48	Delete the phrase "or higher levels" as it's unhelpful. [Trigg Talley, United States of America]	Not applicable. Relevant text removed.
26215	5	48	5	48	Could "higher levels" be better specified? (net-zero might not be needed for all higher than 2°C levels of warming) [Tania Guillén Bolaños, Germany]	Not applicable. Relevant text removed.
36459	5	48	5	48	Unsustainable claim. The warming is relative to pre-industrial levels (presumably pre-1750 but no statement of exactly when) but the average global temperature back at that time is both unknown and unknowable. If you have no credible pre-industrial temperature then you cannot say how much the temperature has changed since that time. (see also my comment below re page 10 line 31) [John McLean, Australia]	Noted. Please provide peer-reviewed scientific literature for claims such as "unknown and unknowable," since there is a great deal of peer-reviewed literature establishing the magnitude (and knowability) of pre-industrial temperatures.
32473	5	48	5	48	I know what you are saying about 1.5, well below 2 etc, but it is confused. You're essentially saying we need to get to net zero to stabilise anywhere -- which is true. But we need to get to zero sooner to stabilise lower, such as 1.5 or 2. So why not just say that (also saying well below 2 also sounds clumsy -- just say 2). [Robert Colman, Australia]	Not applicable. Relevant text removed.
19483	5	50	5	51	with emphasise of different culture to make common frame between societies [Hamideh Dalaei, Iran]	Noted. The "understanding" here refers to understanding of physical, chemical, and biological processes.
115211	5	51	5	51	Suggest to change the begin of the sentence "19th century..." to "Already 19th century..." [Andreas Fischlin, Switzerland]	Noted. Now the sentence starts with "Scientists in the ...".
124987	5	51	5	51	The key message could have been stated in AR3 or AR5 -- not very strong as a standalone finding in AR6 unless the words "key features" are replaced by a more specific term relating to the influence of human activity and natural drivers of climate variability. [Trigg Talley, United States of America]	Taken into account. Thanks. We have replaced "key" with "fundamental".

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
4465	5	51	5	51	Authors claim that "Understanding of key features of the climate system is robust and well established." This is an exaggeration. There are still huge uncertainties of many components of the climate system. We are just beginning to understand natural variability. Climate models consistently overestimate warming. SO2 aerosols cool much less than previously thought, implying that some of the excess warming that had been interpreted cannot be cooled down by aerosols. CO2 climate sensitivity is only poorly known and the wide range has not changed for the past 30 years. How can one then say the understanding of the climate system is robust and well established? There are quite a few papers involving prominent IPCC authors who warn against overstating the case. They recommend to openly communicating the remaining uncertainties. Authors of AR6 SOD Chapter 1 are apparently ignoring these recommendations. It is true that the main drivers of climate are now known qualitatively quite well. However, in a quantitative sense, we are still far away from putting this puzzle together. I strongly suggest avoiding misrepresenting the current scientific understanding in the executive summary of Chapter 1. This harms the credibility and may ultimately undermine climate protection initiatives once the exaggeration is published and subsequently identified and criticized in public. [Sebastian Luening, Switzerland]	Rejected. Here we focus on "the fundamental features of the climate system" with a focus on the influence of human activity on the climate system, and we don't claim that our understanding of all processes and drivers in the climate system is robust and without uncertainties.
112529	5	51	5	51	The word 'global' must be added to 'climate system' because understanding of regional and local climate systems are not robust and well established [Suraje Dessai, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. The climate system by definition is global.
32475	5	51	5	51	This dot point is okay, but the title is not. When I read the title I thought you were going to talk about major circulation such as monsoons, jets, ENSO et cetera. In fact you're talking only about the greenhouse effect and radiative forcing. Ok, but make that clear in the title [Robert Colman, Australia]	Noted. We have replaced key features" with "fundamental feature" which refers to the influence of human activity on the climate system.
77139	5	51	6	3	Not clear on the usefulness of this point. The IPCC has language that is calibrated to provide insights on the robustness of understanding. [Emer Griffin, Ireland]	Noted. This paragraph briefly presents the history of climate change science, which is a useful information. As such, there is no need to use the IPCC calibrated language.
104719	5	51	6	5	A highly misleading text. There are several unknown, critical factors in the climate: cloud feedback, ocean oscillations etc etc. The knowledge is robust on some of them, but far from all. Also, the text gives the impression that the early models got everything basically right. Then why all the research after that? "Early climate change projections published since the 1980s are in close agreement with the rate and pattern of subsequent observed temperature change, especially when accounting for differences between the emission scenarios they used, and what actually occurred. {1.3.1 - 1.3.6}" This paragraph should be reworded: "especially" should be replaced with "but only". [Jan Lindstrom, Sweden]	Rejected. Here we focus on "the fundamental features of the climate system" with a focus on the influence of human activity on the climate system, and we don't claim that our understanding of all feedbacks in the climate system is robust and without uncertainties.
124989	5	51	6	5	[PROGRESS] This isn't new from the AR5. [Trigg Talley, United States of America]	Noted. We agree that the evolution of climate change science is something new. But AR did not describe it in such a detail as this report.
115521	5	52	5	53	The CFCs are important heat absorbing gases but this was not known in the 19th century; the monteval protocol had a large impact on climate [Rolf Müller, Germany]	Noted. This detail is presented in 1.3.1.
124991	5	53	5	53	Change "radiation" to "light". [Trigg Talley, United States of America]	Noted. But we could not find the word "radiation" in line 53 on page 5.
79815	5	53	5	55	Are technical terms like "drivers" and "irradiance" ones that your clients will be familiar with? [Dáithí Stone, New Zealand]	Noted. We think these are understandable in the context.

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86661	5	54	5	55	Human-induced changes in biogeophysical factors is also worth mentioning, and it could be summarized that human influence include changes in the earths surface, as well as changes in the composition of the atmosphere. [Oyvind Christophersen, Norway]	Noted. We used "global biogeochemical cycles" to indicate the factors and components you mentioned. Due to the limitation of words, we can't have more detailed description of these.
67539	5	54	5	55	The natural climate variability, like ENSO and decadal variability, should be mentioned here. [Baijun Tian, United States of America]	Rejected. We wan to focus on the influence of human influence on the climate system here.
124993	5	55	5	55	Change volcanoes to "volcanic activity" for clarity. Inactive volcanoes are not a factor. [Trigg Talley, United States of America]	Taken into account. Thanks. Changed as suggested.
124995	5	55	5	55	Change "irradiance" to "output". [Trigg Talley, United States of America]	Taken into account. "irradiance" has been replaced with "solar radiation".
70429	5	55			I would not characterise 'global biogeochemical cycles' as a natural driver of climate change, but as part of the mechanism of response to climate change. [Gillett Nathan, Canada]	Noted. This is what we meant.
26013	5		5		Explicitly write "Weather and climate extremes". They may not be coincident. [Don Alfonso Pino Maeso, Spain]	Accepted, text revised.
87215	5		6		The executive summary might be improved if the specific human activities causing climate change were mentioned (industrial production based on fossil fuels, consumerism, agriculture practice, and so on). Otherwise it seems too technical and disconnected from social, economic and political issues. [Rodolfo Sapiains, Chile]	Rejected. This is presented in the SPM, TS and in later chapters. We do not provide attribution statements at top level of Chapter 1.
31311	6	1	6	1	This refers to pre-IPCC, but it is not clear what "systematic scientific assessments" refers to. "Systematic" may sound as there being a continuous coordinated process on global scale. Assumedly this is more about various systematic scientific assessments of climate (change), or which continuous assessments does this refer to? [Markku Rummukainen, Sweden]	Noted. This refers to NAS 1970 report, now presented in Table 1.2. We have no space in the Executive Summary to provide this and other details.
21251	6	1	6	2	I'm not sure that this sentence is required. It seems to risk being seen as an inflamatory statement to some for little potential value and risks being seen as running spoilers on findings in several later chapters that may provide the assessment basis that can in more detail back such an assertion. I would therefore suggest deleting the sentence over these two lines. [Peter Thorne, Ireland]	Rejected. After many deliberations, we decided to keep the original wording.
90927	6	1	6	2	The hypothesis to fact language is open to multiple interpretations. A proposal for clarifying and softening is: "the influence of human activity on the climate system has evolved from plausible hypothesis to established scientific fact". [Wendy Parker, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. After many deliberations, we decided to keep the original wording.
111993	6	1	6	2	This sentence is overly broad. There are many hypothesized ways in which human activities can influence climate that are indeed NOT facts, and others that are closer to be considered fact. For example, while the impact of human emitted GHGs on global mean surface temperature is quite indisputable, the impact of human activities on cloud changes is certainly uncertain. This sentence should be qualified so as not to imply that everything presented in this report represents a fact rather than a hypothesis or even a theory. [Cynthia Randles, United States of America]	Accepted. The sentence now specifies "warming", which is what the conclusions refer to.
124997	6	1	6	5	Be more clear: state explicitly that it's NOT natural variability. [Trigg Talley, United States of America]	Noted. It is clearly about "the influence of human activity on the climate system".

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
821	6	2	#REF!	3	This is statement is valid for global mean climate projections, surely not for regional projections [Bart van den Hurk, Netherlands]	Taken into account. The revised text reads "Past projections of global surface temperature and the pattern of warming are broadly consistent with subsequent observations (limited evidence, high agreement), especially when accounting for the difference in radiative forcing scenarios used for making projections and the radiative forcings that actually occurred. {1.3.1 - 1.3.6}"
36461	6	2	6	2	After the word "fact" insert "although the magnitude of that influence is widely debated". (This might seem extraneous to you but the wording is honest and you do want to be honest, open and transparent, don't you?) [John McLean, Australia]	Rejected. The statement has been revised to clarify that it refers to surface warming.
79819	6	2	6	2	Interesting, but technically quite apt, choice of word "evolved" in the context of this paragraph! [Dáithí Stone, New Zealand]	Noted.
4731	6	2	6	3	This is statement is valid for global mean climate projections, surely not for regional projections [Bart van den Hurk, Netherlands]	Taken into account. The revised text reads "Past projections of global surface temperature and the pattern of warming are broadly consistent with subsequent observations (limited evidence, high agreement), especially when accounting for the difference in radiative forcing scenarios used for making projections and the radiative forcings that actually occurred. {1.3.1 - 1.3.6}"
34575	6	2	6	5	Would it make more sense to say, "Early climate change projections published IN the 1980s"? [Russell Vose, United States of America]	Taken into account. The revised text reads "Past projections of global surface temperature and the pattern of warming are broadly consistent with subsequent observations (limited evidence, high agreement), especially when accounting for the difference in radiative forcing scenarios used for making projections and the radiative forcings that actually occurred. {1.3.1 - 1.3.6}"
107103	6	2		5	[pt 1 of 6] It says, "Early climate change projections published since the 1980s are in close agreement with the rate and pattern of subsequent observed temperature change, especially when accounting for differences between the emission scenarios they used, and what actually occurred." That's nonsense. [cont'd] [David Burton, United States of America]	Rejected. The revised text reads "Past projections of global surface temperature and the pattern of warming are broadly consistent with subsequent observations (limited evidence, high agreement), especially when accounting for the difference in radiative forcing scenarios used for making projections and the radiative forcings that actually occurred. {1.3.1 - 1.3.6}" The substance behind this statement is well documented in the report - including how well the projections did if we take into account the subsequently realized emissions.
107105	6	2		5	[pt 2 of 6] It is a revision of the FOD version, which said, "Climate change projections made since the 1980s are generally in good agreement with the amplitude and pattern of subsequent observed temperature change." The addition of the caveat, "especially when accounting for differences between the emission scenarios they used, and what actually occurred," does not make the statement accurate, because it was NOT emissions they overestimated, it was the response of the Earth's climate system to those emissions. [cont'd] [David Burton, United States of America]	Rejected. See answer to #107103. (Multi-part comment.)

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
107107	6	2		5	[pt 3 of 6] E.g., Hansen et al 1988 http://onlinelibrary.wiley.com/doi/10.1029/JD093iD08p09341/abstract and associated Congressional testimony http://sealevel.info/1988_Hansen_Senate_Testimony.html discussed projections from NASA GISS's GCM Model II (a predecessor of the current Model E2) under several scenarios. They reported what the model projected if emission growth was not curbed, which Dr. Hansen called "business as usual" in his Congressional testimony, and which the paper described as "assumed annual growth [which] averages about 1.5% of current emissions." For that scenario, the projection in their accompanying graph showed a temperature increase of 0.37°C per decade, and the text of the paper discussed a "warming of 0.5°C per decade." [cont'd] [David Burton, United States of America]	Rejected. See answer to #107103. (Multi-part comment.)
107109	6	2		5	[pt 4 of 6] Now, compare that projection with what really happened. Of course, CFC emissions declined sharply, but that was just "business as usual," because of the existing Montreal Protocol of 1987 and the Vienna Convention For The Protection Of The Ozone Layer of 1985. CO2 emissions actually INCREASED EVEN FASTER than their 1.5% per year assumption, averaging +1.97% per year, and totaling 66% in 26 years. https://cdiac.ess-dive.lbl.gov/ftp/ndp030/global.1751_2014.ems [cont'd] [David Burton, United States of America]	Rejected. See answer to #107103. (Multi-part comment.)
107111	6	2		5	[pt 5 of 6] Yet, temperatures rose nowhere near as fast as the GCM Model II projections. From 1960 to 2014 (i.e., with starting and ending dates chosen to avoid ENSO spikes), global temperatures rose only between 0.4°C and 0.8°C (depending on which temperature indices you use), https://sealevel.info/GISS_vs_UAH_and_HadCRUT_1960-2014_woodfortrees_annot2.png and from 1988 to 2014 by between about 0.2°C and about 0.4°C. That's the total, not the per-decade figure. So the rate of warming was at most 0.16°C per decade, which is less than half of the 0.37°C/decade shown in Hansen et al's graph, and just 1/3 of the 0.5 °C they discussed in the paper. [cont'd] [David Burton, United States of America]	Rejected. See answer to #107103. (Multi-part comment.)
107113	6	2		5	[pt 6 of 6] Their biggest mistake (though by no means their only one) was in not anticipating that negative feedbacks would remove so much CO2 from the atmosphere. In fact, in their paper, model and analysis, they conflated GHG emissions with GHG level increases, assuming that atmospheric CO2 levels would increase as much as atmospheric CO2 emissions did. That turned out to be wildly mistaken. So I suggest that the sentence be rewritten as follows: "Climate change projections made in the 20th century were generally in poor agreement with subsequent observed temperature change, but there is hope that newer models will prove more accurate." ### [David Burton, United States of America]	Rejected. See answer to #107103. (Multi-part comment.)
19485	6	4	6	4	although upper air information [Hamideh Dalaei, Iran]	Not applicable. Relevant text removed.
32641	6	4	6	4	add "upper air information" after " satellite-based retrievals" [sadegh zeyaeyan, Iran]	Not applicable. Relevant text removed.
32971	6	4	6	4	add "upper air information" after " satellite-based retrievals" [Sahar Tajbakhsh Mosalman, Iran]	Not applicable. Relevant text removed.
79817	6	5	6	5	"used, and" -> "used and" [Dáithí Stone, New Zealand]	Not applicable. Relevant text removed.
114139	6	5	6	5	"what actually occurred" could be changed to "which emisditions occurred" [Jan Fuglestedt, Norway]	Rejected; this was re-phrased in terms of radiative forcing rather than emissions.
36463	6	7	6	7	The words 'has often' are false. Only the IPCC and (I think) the UNFCCC have used 1850-1900 data to supposedly indicate pre-industrial global average temperature. [John McLean, Australia]	Rejected. 1850-1900 is a broadly accepted baseline period, which is how it is used here.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
112273	6	7	6	8	<p>Mean global temperature during the 1850-1900 time period has often been used as an approximation for pre-industrial era, but it is more likely than not that this choice results in a slight underestimation of the total anthropogenic change in global mean surface temperature (GMST) (medium confidence) instead of</p> <p>Mean global temperature during the 1850-1900 period has often been used as an approximation for pre-industrial global temperature, but it is more likely than not that this choice results in a slight underestimation of the total anthropogenic change in global mean surface temperature (GMST) (medium confidence) [Kamal Mohammedi, Algeria]</p>	<p>Taken into account, although the final text is somewhat different to the SOD version.</p>
115213	6	7	6	9	<p>This mixing of the choice of the proxy for pre-industrial as 1850-1900 with the consequences for global warming metrics such as GMST is not a good one and I fear is likely to create political havoc if this is promoted to the TS or SPM. Why not first simply assessing what the difference is between true pre-industrial (building on traditional IPCC definitions of pre-industrial) and the proxy used in AR5 and all previous AR6 cycle SRs? Whether that is of any consequence for whatever metric we are using for assessing global warming can then be treated as a separate question. [Andreas Fischlin, Switzerland]</p>	<p>Taken into account. This point has been discussed extensively, also in cross-WG settings, to arrive at a solution that is as precisely worded as we can make it. What we assess here is the temperature change (total and anthropogenic) over the period from around 1750 and up to 1850-1900. We do not discuss the choice of proxy for preindustrial here.</p>
77141	6	7	6	10	<p>This is a major statement. It is not clear why it is included here, perhaps included in a later chapter? [Emer Griffin, Ireland]</p>	<p>Rejected. The topic is put here because it is covered in a cross-chapter box placed in Chapter 1, and the assessment was led by Chapter 1 authors.</p>
36465	6	7	6	10	<p>Dishonest statement. During 1850 to 1900, in particular through the 1860s and 1870s, the northern hemisphere average temperature anomalies were heavily biased by the amount of temperature data from Europe, recovering from the Little Ice Age, and the Southern Hemisphere data heavily biased by the amount of data for the shipping routes through the South Atlantic to south east Asia. I refer you to section 4.5 of "An Audit of the Creation and Content of the HadCRUT4 Temperature Dataset" (2018) which discusses this. The facts are easily established by examining the number of months in which the HadCRUT4 grid cells reported data. (And don't try to tell me that my audit is ignored because it is not peer reviewed. From just the authors whose names start with 'A', 'B' or 'C' in your list of references you include 19 references that have not undergone journal-style review.) [John McLean, Australia]</p>	<p>Rejected. The various influences on late 1800s temperatures are discussed in Chapter 2.</p>
124999	6	7	6	17	<p>This conclusion about the fallacy of using a 1850-1900 as a baseline for "preindustrial temperature" is not consistent with the statement made on page 11 (line 19): "Taking a baseline of 1850-1900, which approximates pre-industrial conditions (see Cross-Chapter Box 1.3), GMST change for the modern reference period (1995-2014) is 0.87°C (0.77-0.97°C) (see Section 2.3.1.1)." [Trigg Talley, United States of America]</p>	<p>Taken into account. This point has been discussed extensively, also in cross-WG settings, to arrive at a solution that is as precisely worded as we can make it. What we assess here is the temperature change (total and anthropogenic) over the period from around 1750 and up to 1850-1900. We do not discuss the choice of proxy for preindustrial here.</p>
125001	6	7	6	17	<p>Delete this entire para. It's a weedy detail that does not warrant rising to the Executive Summary. [Trigg Talley, United States of America]</p>	<p>Rejected. There has been new research into this topic, and marked scientific progress. It is also of broad interest to quantify the total anthropogenic warming as far back as scientifically defensible, even if 1850-1900 is the common baseline period used in policy discussions.</p>

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
4467	6	7	6	17	The conclusions of this paragraph are wrong and the opposite is true. Using the 1850-1900 period as an approximation for pre-industrial global temperature, this choice results in a significant OVERESTIMATION of the total anthropogenic change in global mean surface temperature. In most case studies and many regional and global temperature reconstructions, the year 1750 marks the coldest phase of the Little Ice Age (LIA). The period 1850-1900 lies at the end of the LIA and is already slightly warmer. A meaningful approximation for „pre-industrial global temperatures“ has to represent an average temperature over a longer (late) Holocene time span, e.g. the last 2000 or 10,000 years (until 1850). The choice 1850-1900 does clearly not fulfil this criterion. See Lüning & Vahrenholt 2017 (doi: 10.3389/feart.2017.00104) for details. Furthermore it is dangerous to claim that even the pe-industrial warming 1750-1900 is associated with greenhouse gases. This is the idea of a minority of scientists, some of who happen to be part of the author group of this chapter. It is not ok to present personal beliefs as “consensus view” in an IPCC report. The majority of scientists view pre-industrial climate change to be fully driven by natural climate factors. A significant part of climate scientists also see “up to half” of the observed warming of the industrial era caused by natural climate drivers. [Sebastian Luening, Switzerland]	Rejected. The comment is based on a misrepresentation of the SOD content. The current report includes consideration of both the total surface temperature change since 1750, and the anthropogenic component. These are not the same, as pointed out in the comment.
107115	6	7		17	It says, "Mean global temperature during the 1850-1900 period has often been used as an approximation for pre-industrial global temperature, but it is more likely than not that this choice results in a slight underestimation of the total anthropogenic change in global mean surface temperature (GMST) (medium confidence)... The net increase of GMST caused by anthropogenic factors between 1750 and 1850-1900 is likely -0.1 to 0.2°C (medium confidence), with potential implications for remaining cumulative carbon emission budgets for given temperature levels." There are two big problems with that statement. The first problem is that you fail to mention that that warming was unambiguously BENEFICIAL. The second problem is the reference to the crackpot "cumulative carbon emission budget" concept, which is based on the authors' astonishing failure to recognize that natural negative feedbacks which remove CO2 from the atmosphere (currently at a rate of about 2.5 ppmv/year) ensure that atmospheric CO2 levels -- and presumably temperatures -- will be falling long before anthropogenic emissions go to zero. [David Burton, United States of America]	Rejected. These views do not reflect the scientific assessments made by the IPCC and other bodies, or the literature upon which the assessments are based. Please see the rest of the present report, and the upcoming reports from WG2 and WG3.
72139	6	9			This is the first occurrence of GMST, where it is properly defined. It is redefined several times elsewhere in the chapter, seeminly arbitrarily. [Alexander Wall, Australia]	Accepted, text revised.
4733	6	11	6	11	"will help" or "have helped"? [Bart van den Hurk, Netherlands]	Not applicable, relevant text removed.
34805	6	11	6	16	Reanalysis of temperature databases does not provide reliable evidence on global warming trends and attribution results may not be objective. Please see general comment #1 above. [Jim O'Brien, Ireland]	Rejected. Comment is not supported by scientific literature.
4735	6	12	6	12	"would have" or "have"? [Bart van den Hurk, Netherlands]	Taken into account, though the text is substantially revised.
31313	6	12	6	13	The cause-and-effect are reversed here, it would be more logical to first affiliate radiative forcing to increased GHG concentrations, and then the resulting warming. [Markku Rummukainen, Sweden]	Rejected. We begin with observations, leaving attribution to later chapters.
36467	6	12	6	14	False claim. A more honest statement would be that "Climate models indicate that ... (etc)" [John McLean, Australia]	Rejected. The underlying assessment is documented in the chapter.
109725	6	12	6	14	The italicized 'very likely' and the units for '+0.3 Wm ⁻² ' may instantly scramble or lose policy-minded folks as we need a reference early on to make sense of what the overarching message is. [Eric Nolan, United States of America]	Taken into account, though the text is substantially revised.

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115673	6	14	6	14	Consider reporting the full anthropogenic forcing for the period from 1750 to 1850, not just the one from GHG emissions. I suggest to shorten the corresponding paragraph (for instance, removing "with potential implications...". [Valerie Masson-Delmotte, France]	Taken into account, text revised.
115215	6	14	6	15	<p>An what about the LIA? I think you need to clarify this here as well, in particular given the fact that AFAIK climate sceptics continue to argue that all warming is only due to the LIA ending. I understand that orbital forcings alone would actually have caused a small cooling trend in addition to the LIA, another factor that may be relevant in this context for a comprehensive picture of what happened since ~1750 (e.g. Wanner et al., 2008, 2011; Jones et al., 2009).</p> <p>Cited References: -----</p> <p>Jones, P.D., Briffa, K.R., Osborn, T.J., Lough, J.M., van Ommen, T.D., Vinther, B.M., Lutherbacher, J., Wahl, E.R., Zwiars, F.W., Mann, M.E., Schmidt, G.A., Ammann, C.M., Buckley, B.M., Cobb, K.M., Esper, J., Goosse, H., Graham, N., Jansen, E., Kiefer, T., Kull, C., Kuettel, M., Mosley-Thompson, E., Overpeck, J.T., Riedwyl, N., Schulz, M., Tudhope, A.W., Villalba, R., Wanner, H., Wolff, E. & Xoplaki, E., 2009. High-resolution palaeoclimatology of the last millennium: a review of current status and future prospects. <i>Holocene</i>, 19(1): 3-49. doi: 10.1177/0959683608098952 Jo115</p> <p>Wanner, H., Beer, J., Bütikofer, J., Crowley, T.J., Cubasch, U., Flückiger, J., Goosse, H., Grosjean, M., Joos, F., Kaplan, J.O., Küttel, M., Müller, S.A., Prentice, I.C., Solomina, O., Stocker, T.F., Tarasov, P., Wagner, M. & Widmann, M., 2008. Mid- to Late Holocene climate change: an overview. <i>Quaternary Sci. Rev.</i>, 27(19-20): 1791-1828 . doi: 10.1016/j.quascirev.2008.06.013 Wa166</p> <p>Wanner, H., Solomina, O., Grosjean, M., Ritz, S.P. & Jetel, M., 2011. Structure and origin of Holocene cold events. <i>Quaternary Sci. Rev.</i>, 30(21-22): 3109-3123. doi: 10.1016/j.quascirev.2011.07.010 Wa214 [Andreas Fischlin, Switzerland]</p>	Taken into account. This is treated elsewhere in the report, and in the literature underlying the assessment. (In fact we do not explicitly refer to the LIA in AR6 WG1.) However we do not wish to address it in the ES, other than specifying that there is a clear distinction between total temperature change and its anthropogenic component.
70431	6	14	6	15	There is no confidence assessment associated with the attribution of cooling to anthropogenic aerosol emissions between 1750 and 1850-1900 i.e. it is an unequivocal attribution. Are we really this confident in this result? By contrast the assessed likely range of warming attributable to anthropogenic aerosols and other anthropogenic forcings for the period 1850-1900 to 2010-2019 spans zero (Chapter 3). [Gillett Nathan, Canada]	Taken into account. The assessment builds on forcing estimates from Chapter 7, and their assessment of early anthropogenic aerosol emissions. Hence we have left that particular assessment to them. The language is somewhat changed to reflect this.
29571	6	14	6	15	This "This warming influence was at least partially offset by a cooling influence from anthropogenic aerosol emissions." needs to be qualified. We cannot say with much certainty that this is true. For example, as demonstrated in Smith and Bond 2014, Figure 4. doi:10.5194/acp-14-537-2014), net warming from aerosols is possible in this time period. After about 1920 it is very likely that there was aerosol cooling, but this is not the case before 1900. Note that the uncertainty in this era is even larger than illustrated in Smith and Bond 2014 since uncertainty in emissions levels was not considered. This is very high for BC/OC emissions, which could be a dominant factor in this time period. [Steven Smith, United States of America]	Taken into account. The assessment builds on forcing estimates from Chapter 7, and their assessment of early anthropogenic aerosol emissions. Hence we have left that particular assessments to them. The language is somewhat changed to reflect this.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
79821	6	14	6	15	I think it would be useful to point out that this aerosol forcing was highly regional in nature, so that it probably had a strong cooling effect on Europe, but very little effect on other parts of the world. [Dáithí Stone, New Zealand]	Taken into account. The assessment builds on forcing estimates from Chapter 7, and their assessment of early anthropogenic aerosol emissions. Hence we have left that particular assessment to them. The language is somewhat changed to reflect this.
77143	6	14	6	17	This is obscure, maybe put in some framing text on calculation of global temperature. [Emer Griffin, Ireland]	Accepted, text revised.
125003	6	15	6	15	Indicate period during which the cooling influence of aerosols is seen in the climate record. [Trigg Talley, United States of America]	Taken into account. The assessment builds on forcing estimates from Chapter 7, and their assessment of early anthropogenic aerosol emissions. Hence we have left that particular assessment to them. The language is somewhat changed to reflect this, and there is a Figure in the underlying chapter that clarifies.
26521	6	15	6	15	We suggest to mention instruments recalibration, too [Eric Brun, France]	Rejected. While this is important, it is part of the dataset assessment performed in Chapter 2.
19135	6	15	6	17	It appears somewhat "academic" to discuss a 0.1 K offset due to pre-1850 forcing [Thorsten Mauritsen, Sweden]	Noted, though we do not quite agree. Recent literature provides a new and improved window on another 100 years of global temperature evolution. This is what we discuss. The number happens to come out as 0.1K, though with a wider range.
34577	6	16	6	16	Is the range really -0.1 to + 0.2? If so, the former is not an "increase," and so the beginning of the sentence should probably read, "The net "CHANGE" of GMST..." [Russell Vose, United States of America]	Taken into account. The text has been revised.
74279	6	16	6	16	is likely to have been [Christopher Hollis, New Zealand]	Not applicable, relevant text removed.
31315	6	16	6	16	"with potential implications" is very vague - could this be stated more explicitly (including if the implications are in some way decisive for estimating carbon emission budgets", or of lesser influence). [Markku Rummukainen, Sweden]	Not applicable, relevant text removed.
115217	6	16	6	17	I suggest to split the last sentence in two at the comma for the same reasons I commented on the bold statement at the begin of this para. The last sentence beginning with something like "The latter may have implications for remaining cumulative carbon ..."	Not applicable, relevant text removed.
42827	6	16	6	17	"with potential implications for remaining cumulative carbon emission budgets" - this is only the case if you have not defined the start point for the 1.5 or 2 degree targets. You are highlighting the need to define the baseline period for the Paris Agreement (discussed also at end of page 46, where you infer that the negotiators may have assumed that it is 1880-2012). It would be more reasonable to make this point than to imply that it reduces the emission budget. [Eric Wolff, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable, relevant text removed.
69993	6	16	6	17	"... with potential implications for the remaining cumulative carbon emissions budgets for given temperature levels"- This statement is tricky and actually incorrect in the context of the Paris Agreement. This all depends on the definition of "global warming". The Paris Agreement (PA) assumes that the climate conditions of the pre-industrial period can be approximated with the time frame 1850-1900. Since the temperature targets within the PA are defined with respect to this baseline, warming that occurred prior to this is irrelevant in this context. Would remove this sentence. But the rest of the paragraph is useful. [Sonia Seneviratne, Switzerland]	Not applicable, relevant text removed.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
114141	6	16	6	17	Important point, but this is also related to definition of RCB - so please coordinate with Ch5 [Jan Fuglestedt, Norway]	Not applicable, relevant text removed.
79823	6	17	6	17	Unclear. Allowable if we are to limit warming to a specific temperature level? [Dáithí Stone, New Zealand]	Not applicable, relevant text removed.
38649	6	17	6	17	Cross recalled refers to climatic impact drivers, but in the text it talks about temperature change over time (1750-1900) [Luisa Sturiale, Italy]	Taken into account, text revised.
131355	6	19	6	19	It might be good to specify "interannual variability" here, e.g. by saying "natural interannual temperature variability" or something like that [Hans Poertner and WGII TSU, Germany]	Accepted, text revised.
125005	6	19	6	19	[PRECISION] Is it "interannual variability" or "natural variability" or "internal variability"? Use these terms consistently throughout. [Trigg Talley, United States of America]	Accepted. The final usage is consistent with the glossary definitions. (Note that they are distinct terms with separate meaning.)
9073	6	19	6	19	Is the word "virtually" necessary here? Either it's "all regions" or else I suggest to be a little more specific here. Which regions have not experienced significant warming? (For example the signal might not be significant in some oceanic regions because the data basis is too patchy?) [Olaf Morgenstern, New Zealand]	Taken into account. We have retained the wording after some discussion, as it conveys the meaning without becoming too lengthy.
79825	6	19	6	19	This says that the long-term warming is larger than the largest year-to-year variation in temperature to have occurred during that long-term period. Is this what you mean? Interannual variability has not been defined in a way that makes this statement falsifiable. [Dáithí Stone, New Zealand]	Rejected. It is defined in the underlying chapter text; this is only the Executive Summary.
81485	6	19	6	20	Recommend to change the word 'virtually' in the sentence, "Changes in surface temperature exceeding levels of interannual variability have emerged in virtually...", as it create confusion. [Ee Ling Lee, Malaysia]	Rejected. After discussions, it was concluded that the term is precise enough for this usage.
77147	6	19	6	21	Time period being considered should be clear. When did this emerge? [Emer Griffin, Ireland]	Rejected. Timing of emergence is a separate topic, well treated later in the report. Here, the point is that the context of the present report is a world where temperature change has emerged from interannual variability.
67541	6	19	6	21	How about the decadal variability in addition to the interannual variability? [Baijun Tian, United States of America]	Taken into account. The definition is given in the underlying text. Emergence as a concept does not differentiate between interannual and decadal variability, but rather a running mean over some period relative to the standard deviation of a defined reference period.
21253	6	19	6	27	While this statement is undoubtedly true this level of granularity I would have expected as a reader to see arising in chapter 3 and not chapter 1. Are you sure that this material really should reside in chapter 1 and not in chapter 3? [Peter Thorne, Ireland]	Noted. Yes, we regard it as part of the context and framing of the report. The text has been revised, though, and links to Chapter 3 strengthened.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
98885	6	19	6	27	While the warming in low latitudes may be most convincing on a signal to noise basis in the tropics, making this point about regional changes without mention of the greatly amplified changes in the Arctic where there are also key signals in sea ice and snow cover retreat, permafrost thawing, loss of mountain glaciers, etc. just seems inappropriate. Temperature change is not the only issue that matters and the general environmental change in the Arctic (and even Antarctic) is simply too large to be brushed aside in the Executive Summary of the chapter. While saying this, I would also note that it would be worth saying that the warming in the tropics is more moderate than the global average warming due to evaporative cooling, which, while a benefit in some sense, also leads to more and more intense precipitation events that can do very significant damage--and this aspect of global climate change merits mention as well. [Michael MacCracken, United States of America]	Noted. The text has been revised, but we retain the discussion of emergence here. All other aspects mentioned in this comment are thoroughly presented in other Executive Summaries (and in the TS and SPM).
77145	6	19	6	27	Why is this in the framing section? Perhaps include some text that frames this material rather than detail from later chapters [Emer Griffin, Ireland]	Taken into account. The text has been revised. The material is here because the relevant literature is discussed and assessed in Chapter 1, as part of the advances in methodology and concepts since AR5.
89951	6	19	6	27	Cross-reference to Ch03 should be included [Jochem Marotzke, Germany]	Accepted, cross-reference added in the underlying text.
4469	6	19	6	27	This part is misleading. You are referring to warming beyond "interannual" variability. Regional developments are indeed regionally very different. In many parts of the world, temperatures have still not left the longterm temperature variability within the context of the past millennia. In many parts of the world the Holocene Thermal Maximum was significantly warmer than modern temperatures. The same applies to the Medieval Climate Anomaly. I strongly advise against using global reconstruction which are still not stabilized and still change dramatically from one edition to the next. When using regional and local palaeotemperature proxy series, it becomes very clear that modern temperatures in many parts of the world are still well within the range of natural variability. This needs to be stated here. [Sebastian Luening, Switzerland]	Taken into account, wording revised and made more precise.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
112275	6	19	6	27	<p>Changes in surface temperature exceeding levels of interannual variability have nearly emerged in all regions, particularly the tropical regions exhibiting the most clearly distinguishable anthropogenic warming signals (high confidence). Both the rate of long-term change and the amplitude of interannual variability differ between regions and across climate variables, and from global to regional to local scales, thus influencing long-term change signal emergence. The tropical regions have experienced less warming than most other regions, but have smaller interannual variations, meaning the signal of change is more apparent than in regions with larger warming but larger interannual variations. Regional changes in climate states that are amplified or opposite in sign compared to the long-term trend are expected to occur on decadal timescales, especially in regions with large interannual climate variability. {1.4.2; 1.4.3; FAQ1.2}</p> <p>Instead of</p> <p>Changes in surface temperature exceeding levels of interannual variability have emerged in virtually all regions, with tropical regions exhibiting the most clearly distinguishable anthropogenic warming signals (high confidence). Both the rate of long-term change and the amplitude of interannual variability differ between regions and across climate variables, and from global to regional to local scales, so influencing when a signal of long-term change emerges. The tropical regions have experienced less warming than most other regions, but have smaller interannual variations, meaning the signal of change is more apparent than in regions with larger warming but larger interannual variations. Regional changes in climate states that are amplified or opposite in sign compared to the long-term trend are expected to occur on decadal timescales, especially in regions with large interannual climate variability. {1.4.2; 1.4.3; FAQ1.2} [Kamal Mohammedi, Algeria]</p>	Not applicable, relevant text removed.
69995	6	20	6	20	"anthropogenic": Here and elsewhere: Consider replacing with "human-induced" to have text more easily understandable by the general public. [Sonia Seneviratne, Switzerland]	Rejected. While technical, we regard 'anthropogenic' as standard IPCC terminology.
115219	6	21	6	21	Append to the sentence "despite having experienced the least warming". [Andreas Fischlin, Switzerland]	Accepted, albeit with a slightly different wording.
79827	6	21	6	21	This needs to be phrased more straightforwardly. [Dáithí Stone, New Zealand]	Accepted, text revised for clarity (and merged with another Executive Summary point).
39139	6	21	6	23	Unclear, something must be missing in this sentence. [Lourdes Tibig, Philippines]	Accepted, text revised.
125007	6	21	6	27	Explicitly call out the Arctic for warming the fastest, but also having the highest variability. [Trigg Talley, United States of America]	Accepted, albeit with a slightly different wording.
114143	6	22	6	22	change "so" to "thereby" ? [Jan Fuglestedt, Norway]	Accepted, text revised.
4737	6	22	6	23	"so influencing" is pretty unclear [Bart van den Hurk, Netherlands]	Accepted, text revised.
7675	6	23	6	23	It is suggested to insert "significant" before "signal". [Klaus Radunsky, Austria]	Rejected. 'Significant' carries special meaning, and is not necessarily implied by emergence. Emergence quantifies signal-to-noise, and a threshold level can be set, but it is not a formal significance test. (This is detection, a stronger criterium.)
90929	6	23	6	25	It seems to me that a small change in the context of small variability doesn't necessarily mean greater signal to noise than a large change in the context of large variability; it depends on the quantitative details. Use of the phrase "meaning that" is thus not quite right. [Wendy Parker, United Kingdom (of Great Britain and Northern Ireland)]	Accepted, text revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
28641	6	23		25	Suggest: "Tropical regions have experienced less warming than most other regions but the signal of change is more apparent relative to the smaller natural year to year variability." [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted, albeit with a slightly different wording.
125009	6	24	6	25	Shouldn't Central Africa, Northern South America, and Australasia be mentioned as examples of tropical regions in this key message about the climate signal? The signal to noise ratio is striking in these regions in Figure 1.9. [Trigg Talley, United States of America]	Rejected. We do not wish to highlight regions here; this is done in the later chapters of the report. Broader regions such as the tropics is however within scope, and mentioned.
69997	6	24	6	25	"is more apparent". One could argue that once the signal emerges, it does not matter how "apparent" it is. Maybe state instead "emerges earlier". [Sonia Seneviratne, Switzerland]	Rejected. We have not considered time of emergence (here; it is done later in the report), and thus we cannot make this change.
79829	6	24	6	25	"apparent" to whom? Monitoring is so poor in many tropical regions that long-term warming is not monitored accurately enough in observational products to be "apparent" (Stone and Hansen, 2016, 10.1007/s00382-015-2909-2). If we are talking about apparent to people or ecosystems, then there are all sorts of exposure and perception complications. [Dáithí Stone, New Zealand]	Noted. "Apparent" is used in the context of signal-to-noise, i.e. simple quantification, without any assumption implied on experienced impacts or similar (this is considered by WG2).
79831	6	25	6	27	This needs to be phrased more straightforwardly. [Dáithí Stone, New Zealand]	Accepted, text revised.
69999	6	26	6	26	"are expected to occur": Maybe note that this would not be expected everywhere at the same time. [Sonia Seneviratne, Switzerland]	Not applicable, relevant text removed.
64685	6	27	6	27	it should be increased physical and biogeochemical processes. [Pascale Braconnot, France]	Not applicable, unclear what the comment refers to. (Wrong page/line number?)
64687	6	28	6	28	May be add somewhere here still with different level of complexity [Pascale Braconnot, France]	Not applicable, unclear what the comment refers to. (Wrong page/line number?)
34579	6	29	6	29	It would be helpful to include a very brief definition of "consistent risk framework" in this sentence. The key message on the global stocktake (which comes right after this one) is a good example in that regard. [Russell Vose, United States of America]	Accepted, changed to 'unified' and also further explained.
125011	6	29	6	29	[SCOPE] This first AR6 introduction to a "risk framework" is not very well written. Need to delete the two words and insert a more descriptive phrase that can be interpreted by most policymakers. Or delete the whole paragraph as it adds nothing to the executive summary. This should be taken up by WGII and WGIII. [Trigg Talley, United States of America]	Taken into account. The risk framework is cross-WG, and therefore needs to be introduced (and indeed is used) already in WG1, and thus in Chapter 1. The text has been rewritten for clarity, though.
98887	6	29	6	35	I've more reading to do, but I simply do not think this is done in Chapter 9 dealing with the cryosphere and potential sea level rise. A reading of the Executive Summary will make clear that the growing risk of collapse of some ice stream during this century is not even mentioned, and the amount of sea level rise estimated essentially ignores what could happen from both ice sheet movement and thinning of the ice shelves in Antarctica due to ocean warming. And I would note that I don't really see this risk treated in this summary either. There are all sorts of scientific articles reporting on the increasing risk of collapse of major ice streams, from study of both tendencies now and the paleoclimatic record. [Michael MacCracken, United States of America]	Noted. The chapters must rely on their underlying literature, which may or may not be well suited for risk assessments, but the framework adopted in AR6 is still common where risk can rigorously be discussed.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
98889	6	29	6	35	It would be worth mentioning that there is a serious mismatch between how the issue of risk is handled in the scientific approach used by IPCC versus out in the banking, industrial, investment, national security and infrastructure planning communities (hereafter banking et al.)) have traditionally approached dealing with risk. The scientific community has generally focused on the central likelihood and then tried to give a sense of how wide the uncertainty range is as an indication of the possible risk. The banking et. all communities do what is variously called due-diligence analysis, contingency planning, etc. where what they are supposed to consider is the worst-plausible case that could be faced, so for banks the worst plausible draw on their assets, for the US national security community ensuring the capability to fight both an Atlantic and a Pacific theater war, for the infrastructure planning community to be resilient to a 1 in a 100 year flood (or in the Netherlands, a 1 in 10,000 year storm surge), for the investment community a threat to business operation over some extended period, and so on. IPCC and the scientific approach it carries out does not provide such estimates as they are said to be too uncertain (and they are quite uncertain), and so the banking et al. community has ended up generally using the IPCC's central estimates, and as a result society is not ending up protected against the increasing intensity and likelihood of extremes. So, Houston is said to have experienced three 1 in 500 year events over a decade--well, yes, three such events using the statistics of the mid-20th century, but were the likelihoods updated, and IPCC needs to be point out that they are changing by large amounts, then the events in houston that were called 1 in 500 year events might be, were updated likelihoods being used, 1 in 10 year events or so. The shifting bell curves in the Hansen et al. analysis indicate the likelihood of what was a three-sigma summertime warm event for NH land areas in the mid-20th century is now occurring with over a 10% likelihood, so a factor of roughly 100 times as often!!! What would really be helpful would be for IPCC to be presenting the changing and projected likelihoods of extreme events. It seems to me the text here is simply inadequate about the challenges of offering insight into these shifts while also making clear that they are happening, and what is presented in these lines needs to be clarified about what is and is not being presented.	Taken into account. Some of what is requested here is indeed now presented in the SPM, building on the TS and material from a number of chapters. It is not done in Chapter 1, however.
70001	6	29	6	35	The risk framework is not only relevant for the "low-probability high-impact" storylines. It is relevant for any consideration of risk, also high-probability risk. It seems a bit reductive only to mention LPHI cases here. More relevant would be to ensure that changes in climate are expressed as probabilities in the assessment for this information to be integrated in the risk framework. I am not sure this was done throughout the report. [Sonia Seneviratne, Switzerland]	Noted. LLHI is mentioned in the context of storylines, which are related to but separate from the risk framework. The underlying chapter text makes this clearer.
70003	6	29	6	35	This text gives the impression that low-probability high impact storylines (LPHI) received a lot of attention in the AR6. I do not believe this was the case. There is often a focus on the "likely range", which is the opposite. LPHI storylines could (and probably should) be expanded for the FGD. [Sonia Seneviratne, Switzerland]	Noted. LLHI storylines are somewhat more prominent in the final report, but we agree it could have been done even better.
36469	6	29	6	35	This is a weak excuse for increasing the use of storylines that use "low-likelihood" events. Your position should be the opposite, viz, mention low-likelihood events but concentrate on the most likely. [John McLean, Australia]	Rejected. The majority of the report does indeed concentrate on the most likely, i.e. the central values and their uncertainties. LLHI storylines are designed to go beyond this, and help communicate the parts of the assessment that are not easily covered by the most likely outcomes.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
112531	6	29	6	35	The concept of climate change storylines is relatively new in the literature (sometimes called tales and narratives). It is predominately used when estimating likelihoods (of particular variables or outcomes) is difficult and/or not robust. I recommend separating the risk framework from storylines in this paragraph. Storylines are one way to characterise and communicate uncertainty within a risk framework. There are many different ways. Also, storylines do not predominately focus on low-likelihood, high-impact events; they predominately focus on unknown likelihood events. [Suraje Dessai, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. This was considered, but for practical purposes the text was retained (albeit with a number of changes for clarity and precision).
125013	6	29	6	42	[SCOPE] Cut these two paragraphs. They are not physical science and, therefore, do not belong in the WGI report. [Trigg Talley, United States of America]	Rejected. Chapter 1's mandate is to describe the framing and context of the WGI report. These aspects of its context are important for understanding the WGI report's goals and purpose.
125015	6	29	6	51	[SCOPE] This information is better suited to the SYR for entire AR6 rather than for WGI alone. [Trigg Talley, United States of America]	Rejected. Chapter 1's mandate is to describe the framing and context of the WGI report. These aspects of its context are important for understanding the WGI report's goals and purpose.
28643	6	29		51	The topic of these final 3 bullets of framing seems distinct from previous bullets and could form an additional titled section. [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. We considered this, but in the end considered them all part of the 'context and framing' header.
4739	6	30	6	30	some scholars regard "climate change storylines" to be incapable for formal risk assessment, since the probability of this storyline is normally not explicitly quantified. For a formal risk assessment a probability of occurrence is required [Bart van den Hurk, Netherlands]	Noted, and agreed. This is why they are presented as separate concepts, useful for different purposes. We have attempted to clarify this in the text.
79833	6	30	6	30	What are "high-impact events"? Landfall of a tropical cyclone on a vulnerable population? Collapse of the Greenland Ice Sheet? Decision by the world bodies to reach net-zero carbon emissions within the decade? [Dáithí Stone, New Zealand]	Taken into account. We do not (and cannot) rigorously define the term, but find the meaning to be clear enough. See also the Glossary: "Events whose probability of occurrence is low or not well known (as in the context of deep uncertainty) but whose potential impacts on society and ecosystems could be high."
5029	6	31	6	32	This is right, but the term "risk", when it comes to violating boundary conditions for sustainability, is dependent on time. Or in other words, the very violation of robust boundary conditions for sustainability should be perceived as fatal impacts for the long run, already before the specifics of such impacts are identified and validated. "Risk" is, in this perspective, a term related to how long time the boundary conditions can be violated until fatal consequences will be unavoidable. Jumping out the Eiffel tower is in this context "a fatal impact", already before the specifics of the fatal injury have been explored. Approaching this distinction of "risk" is scientifically two different things. To manage risks of specific damage inherently relies on time-consuming follow up and statistics. To consciously avoid damage already before it has happened, and even before we know of its specifics, relies on deductive reasoning. Both approaches are obviously needed, though the latter is dangerously underrepresented in the public and scientific discourses on climate change. We simply need to systematically move towards compliance with boundary conditions for sustainability as fast as we can. This is to reduce the inevitably increasing risks of known and un-known damages before it is too late. [Karl-Henrik Robèrt, Sweden]	Noted. This is a broader context than what we can cover in the ES of Chapter 1, but it is treated in the discussion of the Risk Framework - and also in the cross-WG guidance document produced by IPCC authors and other experts.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
26523	6	31	6	35	There will be considerable interest in the use of CMIP6 results, but the use also of results from CMIP5 is not well-explained here. It might usefully use language from the first sentence of 1.5.4.2 that more clearly explains the overlap between the two [Eric Brun, France]	Rejected. We considered this, but the paragraph is already quite long so we decided to leave the explanation for the underlying text.
9075	6	32	6	32	I suggest to make "climatic change" singular much like "climate change" is typically used as a singular phrase. Also elsewhere in this chapter. [Olaf Morgenstern, New Zealand]	Rejected. The term is now used consistently in the plural form. (There are differing views, we had to choose one.)
13193	6	32	6	33	The decision-making should be added, through of public policies. [Maria Amparo Martinez Arroyo, Mexico]	Rejected. It is clearly a key concept, but more of relevance for WG2 and WG3.
114147	6	32	6	35	I think you could mention say more explicitly that storylines can also be a communication tool. [Jan Fuglestedt, Norway]	Accepted.
115221	6	37	6	37	Not only the Global Stock Take (GST), but also the Structured Expert Dialogue as part of the 2nd periodic review of the long-term global goal may be of value, if not even a greater one in the latter case. Therefore this is too specific. I suggest to mention "vaguely" UNFCCC processes in general such as the GST and to correct for the bad formulation mixing a long-term process, i.e. the GST, with its first employment in 2023. E.g. write similar to this: "The AR6 provides information of potential relevance to various UNFCCC processes such as the global stock take, a 5-yearly..." [Andreas Fischlin, Switzerland]	Rejected. The approved outline for this chapter expressly states: "framing of the physical science information relevant for mitigation, adaptation, and risk assessment in the context of the Global Stocktake."
41357	6	37	6	37	Please remove "potential", here and in the following instances (p17 l13, p17 l17, p17 l34). WGI AR6 will be very much relevant for the global stocktake as IPCC was explicitly tasked by the UNFCCC to provide input. Hence, the relevance is given and there is no policy prescriptiveness to fear here. [Alexander Nauels, Germany]	Rejected. The actual relevance is not for us to consider, but we do list topics that we consider of potential relevance. This is, as mentioned in the comment, to avoid prescriptiveness.
64717	6	37	6	37	It is more appropriated for the Framing Chapter to say "aims to provide" [Sanz Sanchez Maria Jose, Spain]	Rejected. The whole report is published together.
65647	6	37	6	39	Suggest using language consistent with the Paris Agreement when referring to the goals and purpose of the Global Stocktake. Description as drafted is not accurate. Suggest changing to: "The AR6 provides information of potential relevance to the 2023 global stocktake, the first of the five-yearly stocktakes under the Paris Agreement that assesses the collective progress in achieving the purpose of the Agreement and its long term goals. The global stocktake will consider mitigation, adaptation and the means of implementation and support, in the light of equity and the best available science. This report assesses, among other topics, remaining cumulative carbon emission budgets for a range of temperature levels, effects of long-lived and short-lived climate forcers, projected changes in sea level rise and extreme events, and attribution to anthropogenic climate change. (Cross-Chapter Box 1.1)" [Kushla Munro, Australia]	Taken into account, albeit with slightly different wording.
66601	6	37	6	42	I don't see the relevance of this point to a WGI report. This is pure WGIII stuff. [Dave Frame, New Zealand]	Rejected. The approved outline for this chapter expressly states: "framing of the physical science information relevant for mitigation, adaptation, and risk assessment in the context of the Global Stocktake."
125017	6	37	6	42	This paragraph should be deleted entirely. It talks about the report, not a key finding of the authors or the climate literature. [Trigg Talley, United States of America]	Rejected. The approved outline for this chapter expressly states: "framing of the physical science information relevant for mitigation, adaptation, and risk assessment in the context of the Global Stocktake."

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
125019	6	37	6	42	[SCOPE] Isn't the relevance for governments to decide? Also, the audience for the AR6 is government IPCC focal points, who are often also UNFCCC focal points. They will not need descriptions of the Paris Agreement or of the global stocktake. [Trigg Talley, United States of America]	Rejected. The approved outline for this chapter expressly states: "framing of the physical science information relevant for mitigation, adaptation, and risk assessment in the context of the Global Stocktake."
77149	6	37	6	42	The AR6 should inform implementation of the UNFCCC, its Paris Agreement including the GST, not just the GST. [Emer Griffin, Ireland]	Rejected. The approved outline for this chapter expressly states: "framing of the physical science information relevant for mitigation, adaptation, and risk assessment in the context of the Global Stocktake."
36471	6	37	6	42	This paragraph conflicts with the IPCC's role as stated in the "Principles governing IPCC work", which I'll repeat here - "The role of the IPCC is to assess on a comprehensive, objective, open and transparent basis the scientific, technical and socio-economic information relevant to understanding the scientific basis of risk of human-induced climate change, its potential impacts and options for adaptation and mitigation. IPCC reports should be neutral with respect to policy, although they may need to deal objectively with scientific, technical and socio-economic factors relevant to the application of particular policies." [John McLean, Australia]	Rejected. Relevance to an international process does not break neutrality. Also, the global stocktake is explicitly mentioned in the approved outline of Chapter 1.
74281	6	39	6	39	its means [Christopher Hollis, New Zealand]	Accepted.
90931	6	39	6	39	I think "it's" should be "its" [Wendy Parker, United Kingdom (of Great Britain and Northern Ireland)]	Accepted.
89953	6	39	6	39	it's --> ist [Jochem Marotzke, Germany]	Accepted.
625	6	39	6	39	it's should be its. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Accepted.
14479	6	39	6	39	"it's" should be "its" [Amy East, United States of America]	Accepted.
110749	6	39	6	39	its [Bruno Korgo, Burkina Faso]	Accepted.
114145	6	39	6	39	"it's" --> "its" [Jan Fuglestedt, Norway]	Accepted.
71333	6	39			Change "...it's means of implementation ..." to "its means of implementation". (Remove apostrophe) [David Wratt, New Zealand]	Accepted.
28645	6	39			I think "it's" should be "its" (sorry, pedantic but couldn't stop!) [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted.
79835	6	40	6	40	Unclear. Allowable if we are to limit warming to a specific temperature level? [Dáithí Stone, New Zealand]	Noted. Yes. Section 1.6.3 describes cumulative CO2 emission and warming levels in more detail.
31317	6	41	6	41	It is not clear what "attribution" refers to here. What is being attributed, projections? [Markku Rummukainen, Sweden]	Accepted. It is revised to "observed climate changes and their attribution to human forcing".
70005	6	41	6	42	Order is not logical and observed changes are not mentioned. Would change the end of the sentence as follows: "... short-lived climate forcers, observed climate changes and their attribution to human forcing, and projected changes in sea level rise and climate extremes". [Sonia Seneviratne, Switzerland]	Accepted. Revised as suggested.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
115223	6	44	6	51	<p>I feel considerable unease reading this para. This is outside my core expertise and I hope human scientists will review this more specifically. Regardless of my limitations, I nevertheless object to the mixing of communication with epistemological issues and with valuation. For my understanding these are not properly separated in their respective role and the implications this has on AR6 in this para. Moreover, I see risks with this para being unfairly exploited by ill-meaning critics.</p> <p>Finally some specific aspects I dare to ask for sure to be improved on: Science is foremost guided by ethics, which is in my understanding not identical with values (albeit there is of course the term 'ethical values'). Values arise from valuation, but scientific standards result not directly from valuation, most of all not from subjective valuation. Valuations typically matter the most where subjective viewpoints, circumstances etc. play an important role for particular individuals, groups or societies. Of course these scientific standards are embedded and produced by cultural and societal circumstances and processes, which depend in the end of values. But I do not think we need to go so deep into these philosophical questions in the context of an IPCC report. In particular not since this opens up a can of worms that can be very badly exploited. I am fully aware that the current practice of climate policy making as done e.g. within UNFCCC and the reality of a mode 2 science in today's modern societies (e.g. Nowotny et al., 2001) contrast quite a bit. Therefore even more, let sleeping dogs lie and find a more precise and robust formulation for this para that better teases out the role of communication, epistemology, and valuation.</p> <p>Cited References: ----- Nowotny, H., Scott, P. & Gibbons, M., 2001. Re-thinking science - knowledge and the public in an age of uncertainty. Polity Press, Cambridge, UK, 278 . http://opac.nebis.ch/cgi-bin/showAbstract.pl?u20=0745626084_No024 [Andreas Fischlin, Switzerland]</p>	<p>Noted. It is incumbent upon the IPCC to explicitly acknowledge the role of both ethics and values in its work. Further, a great deal of scholarship in history, philosophy, and sociology of science has demonstrated that values and epistemology are not so cleanly separable as suggested here. Further, we have gone to some lengths to emphasize the socio-cultural character of the values relevant to communication. While some social scientists and psychologists do understand values as subjective, in general values are considered (and expressed here) not as individual-psychological but as a socio-cultural in origin. We have revised the section as well as this paragraph to try to render this more clearly. Revised version: "Construction of climate change information and communication of scientific understanding occurs in the context of, and is informed by, the values of producers, users, and their broader audiences. Scientific knowledge interacts with pre-existing conceptions of weather and climate, including values and beliefs stemming from ethnic or national identity, traditions, religion, or lived relationships to land and sea (high confidence). Science has values of its own, including objectivity, openness, and evidence-based thinking. Social values may guide certain choices made during the construction, assessment, and communication of information (high confidence)."</p>
66603	6	44	6	51	<p>I don't like how this point is written, and I think it should be cut. It is true that values underpin the scientific method, but it's hardly something that warrants an Exec Summary point, given the number of things which won't make the cut. More significantly, I don't think this reflects how the WGI / physical climate science community perceives either how we do science, or who we are as a community. To most of us, values like truth, objectivity and disinterested enquiry are so obvious that they don't need to be stated. Especially in the SPM. [Dave Frame, New Zealand]</p>	<p>Noted. It is incumbent upon the IPCC to explicitly acknowledge the role of values in both science and science communication, in particular because this organization's outputs are developed precisely in order to be widely communicated throughout human societies. We have revised the section as well as this paragraph to try to render this more clearly. Revised version: "Construction of climate change information and communication of scientific understanding occurs in the context of, and is informed by, the values of producers, users, and their broader audiences. Scientific knowledge interacts with pre-existing conceptions of weather and climate, including values and beliefs stemming from ethnic or national identity, traditions, religion, or lived relationships to land and sea (high confidence). Science has values of its own, including objectivity, openness, and evidence-based thinking. Social values may guide certain choices made during the construction, assessment, and communication of information (high confidence)."</p>

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
42829	6	44	6	51	As written this paragraph is meaningless, and doesn't warrant inclusion in the summary [Eric Wolff, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. It is incumbent upon the IPCC to explicitly acknowledge the role of values in both science and science communication, in particular because this organization's outputs are developed precisely in order to be widely communicated throughout human societies. We have revised the section as well as this paragraph to try to render this more clearly. Revised version: "Construction of climate change information and communication of scientific understanding occurs in the context of, and is informed by, the values of producers, users, and their broader audiences. Scientific knowledge interacts with pre-existing conceptions of weather and climate, including values and beliefs stemming from ethnic or national identity, traditions, religion, or lived relationships to land and sea (high confidence). Science has values of its own, including objectivity, openness, and evidence-based thinking. Social values may guide certain choices made during the construction, assessment, and communication of information (high confidence)."
31319	6	44	6	51	This is a rather unclear paragraph and it risks misunderstanding. The meaning of "value" is here something more quite more specific than the everyday meaning/understanding of the term. At the very least, a definition (footnote? In the text?) should be provided. Also, the text could be made more substantive in the sense of "what does this mean/imply", which at present is not clear. [Markku Rummukainen, Sweden]	Noted. It is incumbent upon the IPCC to explicitly acknowledge the role of values in both science and science communication, in particular because this organization's outputs are developed precisely in order to be widely communicated throughout human societies. We have gone to some lengths to emphasize the socio-cultural character of the values relevant to communication. We have revised the section as well as this paragraph to try to render this more clearly. Revised version: "Construction of climate change information and communication of scientific understanding occurs in the context of, and is informed by, the values of producers, users, and their broader audiences. Scientific knowledge interacts with pre-existing conceptions of weather and climate, including values and beliefs stemming from ethnic or national identity, traditions, religion, or lived relationships to land and sea (high confidence). Science has values of its own, including objectivity, openness, and evidence-based thinking. Social values may guide certain choices made during the construction, assessment, and communication of information (high confidence)."

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
31321	6	44	6	51	The "fundamental trade-off between the values of reliability and informativeness [in the usage of the IPCC's calibrated language...]" is rather unclear. Different mixes of e.g. likelihood ranges and confidence level statements would not seem to be balancing "reliability" and "informativeness". What is meant by these two expressions? Please clarify the idea expressed in this paragraph, as the matter is rather important. [Markku Rummukainen, Sweden]	Taken into account. The relevant sentence has been removed from this paragraph. To the commenter's point: Large likelihood ranges ("very likely") are generally more reliable because they refer to a broader range that is more certain, while smaller ranges ("likely") are more informative because they zero in on a smaller range (albeit one that is more uncertain). This is explained in the section summarized by this paragraph.
125021	6	44	6	51	[SCOPE] This paragraph about communicating climate science and societal values should be deleted entirely. The key messages should be reserved for conclusions about physical climate science. [Trigg Talley, United States of America]	Rejected. It is incumbent upon the IPCC to explicitly acknowledge the role of values in both science and science communication, in particular because IPCC outputs are developed precisely in order to be widely communicated throughout human societies.
77151	6	44	6	51	Not clear on the added value of this text. Perhaps this is best for WGIII. [Emer Griffin, Ireland]	Rejected. It is incumbent upon the IPCC to explicitly acknowledge the role of values in both science and science communication, in particular because IPCC outputs are developed precisely in order to be widely communicated throughout human societies.
125023	6	44	6	51	Cut this paragraph as it does not need to be in the Executive Summary. It's debateable whether this content should be retained at all as it is not directly germane to an assessment of the physical science of climate change; if it is, move to an appendix. [Trigg Talley, United States of America]	Rejected. It is incumbent upon the IPCC to explicitly acknowledge the role of values in both science and science communication, in particular because IPCC outputs are developed precisely in order to be widely communicated throughout human societies.
77153	6	44	6	51	Added value would be provided by indicating where further research is needed. [Emer Griffin, Ireland]	Noted. These issues are also treated by WGIII, which discusses further research needs.
125025	6	44	6	51	This is academic and the relevance is unclear to this assessment. [Trigg Talley, United States of America]	Noted. It is incumbent upon the IPCC to explicitly acknowledge the role of values in both science and science communication, in particular because IPCC outputs are developed precisely in order to be widely communicated throughout human societies.
19355	6	44	6	51	This is an important point, and I wonder if the authors can make even clearer the point that levels of confidence expressed in the scientific literature (i.e. IPCC reports) use language that is appropriate in its objectivity and specificity, but which can lead the public to believe that scientists are less confident in the science/projections than they actually are. Perhaps a comparison to confidence levels around other well-accepted phenomena would be helpful to drive this point. Clearly explaining the meaning (in simple terms) of phrases like "high confidence" and "medium confidence" would also be helpful throughout the report. [Lia Cairone, United States of America]	Taken into account. These issues are discussed at some length in Section 1.2.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
87475	6	44	6	51	This is an important paragraph and it should stay. However, at present it does not read very clearly or well. 'Science has values of its own', for example, is both very broad and very narrow. The relevance of 'diverse cultural' views on weather is unclear. The point is surely that, while some values are relative or discipline-specific, others are common and general. The Paris Agreement is a locus of common values (which is why it is generally agreed), and some of these values are explicitly named, such as equity, burden-sharing, addressing poverty, sustainable development. [Stephen Humphreys, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Common values explicitly expressed by the Paris Agreement are mentioned and discussed in section 1.2.3.2. This summary point focuses on the role of values in communicating scientific results to non-scientist audiences and stakeholders. We have gone to some lengths to emphasize the socio-cultural character of the values relevant to communication. We have revised the section as well as this paragraph to try to render this more clearly. Revised version: "Construction of climate change information and communication of scientific understanding occurs in the context of, and is informed by, the values of producers, users, and their broader audiences. Scientific knowledge interacts with pre-existing conceptions of weather and climate, including values and beliefs stemming from ethnic or national identity, traditions, religion, or lived relationships to land and sea (high confidence). Science has values of its own, including objectivity, openness, and evidence-based thinking. Social values may guide certain choices made during the construction, assessment, and communication of information (high confidence)."
39141	6	44	6	54	If I were a policy maker, his paragraph would be difficult to understand and make use of. This is very important, especially because it pertains to the communication of scientific understanding. How are implicit and explicit values defined and differentiated. Perhaps adding some examples will help. [Lourdes Tibig, Philippines]	Noted. Common values explicitly expressed by the Paris Agreement are discussed in section 1.2.3.2. This particular paragraph is about the role of values in communicating scientific results to non-scientist audiences and stakeholders. We have gone to some lengths to emphasize the socio-cultural character of the values relevant to communication. We have revised the section as well as this paragraph to try to render this more clearly. Revised version: "Construction of climate change information and communication of scientific understanding occurs in the context of, and is informed by, the values of producers, users, and their broader audiences. Scientific knowledge interacts with pre-existing conceptions of weather and climate, including values and beliefs stemming from ethnic or national identity, traditions, religion, or lived relationships to land and sea (high confidence). Science has values of its own, including objectivity, openness, and evidence-based thinking. Social values may guide certain choices made during the construction, assessment, and communication of information (high confidence)."

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
87217	6	44		51	<p>Although values do play a fundamental role in climate change communication, I would recommend to talk about psychological, social and cultural factors (which include values and belief systems, social norms, attitudes toward the environment and so on). Some refs: Gifford, R. (2011). The dragons of inaction psychological barriers that limit climate change mitigation and adaptation. <i>American Psychologist</i>, 66(4), 290-302; Howell, R.A. (2013). "It's not (just) 'the environment, stupid!'" Values, motivations, and routes to engagement of people adopting lower-carbon lifestyles. <i>Global Environmental Change</i>, 23, 281-290; Hart, P.S. & Nisbet, E.C. (2012). Boomerang effects in science communication: How motivated motivated reasoning and identity clues amplify opinion polarization about climate mitigation policies. <i>Communication Research</i>, 39, 701-723. [Rodolfo Sapiains, Chile]</p>	<p>Taken into account. We have gone to some lengths to emphasize the socio-cultural character of the values relevant to communication. While some social scientists and psychologists do understand values as subjective, in general values are considered (and expressed here) not as individual-psychological but as a socio-cultural in origin. We have revised the section as well as this paragraph to try to render this more clearly. Revised version: "Construction of climate change information and communication of scientific understanding occurs in the context of, and is informed by, the values of producers, users, and their broader audiences. Scientific knowledge interacts with pre-existing conceptions of weather and climate, including values and beliefs stemming from ethnic or national identity, traditions, religion, or lived relationships to land and sea (high confidence). Science has values of its own, including objectivity, openness, and evidence-based thinking. Social values may guide certain choices made during the construction, assessment, and communication of information (high confidence)."</p>

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
5031	6	45	6	46	<p>This is true but could be misunderstood and may benefit from being nuanced. First, we must distinguish between the value statement of “wanting sustainability” which, in line with the naturalistic fallacy, cannot be scientifically validated. However, once we have agreed that we want civilisation to survive, we can ask science to explore the conditions for this scenario to be possible. We need this to distinguish between robust boundary conditions for sustainability on the one hand (that go beyond cultural and other value-based differences), and different preferences of scenarios within such boundary conditions on the other. Climate scientists, as well as policy scientists, are generally not aware of the existence of such boundary conditions for sustainable redesign. These boundary conditions are defined at the first approximation level, and thereby serve as a unifying metaphase for cross-sector and cross-culture sustainable development. Only science can explore and validate such boundary conditions, the qualities of which have to meet five criteria. Boundary conditions, robust for a certain purpose, need to be: (i) necessary (but not more to leave innovative room for group-dynamics based on debatable differences in preferences and values), (ii) sufficient (to not forget essential aspects), (iii) general (to allow for co-creation), (iv) concrete-operational (to guide real-life transitions) and (v) non-overlapping (to create comprehension and make transitions possible to indicate and monitor). This science for sustainable re-design is currently not part of this document, nor is its existence even mentioned. It cannot be replaced by "negotiations" derived directly from climate data and risk-panoramas built on such, and/or methods for dialogue and policy. For as long as this missing meta-level is allowed to be the norm in the societal discourse on climate change, it is like proposing various measures against cancer, without informing them with the boundary conditions for the cure of cancer - (i) kill the last cancer stem-cell, but (ii) don't kill the patient. This was not known until science had cracked the cause of the disease upstream in cause-effect chains - it is a monoclonal disease. Before this scientific breakthrough, medical doctors chased symptoms - anaemia, fatigue, bumps, dysfunctional organ systems, weight-loss, pains... But with the boundary conditions, not before, it became possible to effectively cooperate between pathologists, radiologists,</p>	<p>Noted. This is an interesting comment, but it is unclear how it applies to this short Executive Summary paragraph, which does not even mention "sustainability." Common values explicitly expressed by the Paris Agreement are discussed in section 1.2.3.2. This particular paragraph is about the role of values in communicating scientific results to non-scientist audiences and stakeholders. We have gone to some lengths to emphasize the socio-cultural character of the values relevant to communication. We have revised the section as well as this paragraph to try to render this more clearly. Revised version: "Construction of climate change information and communication of scientific understanding occurs in the context of, and is informed by, the values of producers, users, and their broader audiences. Scientific knowledge interacts with pre-existing conceptions of weather and climate, including values and beliefs stemming from ethnic or national identity, traditions, religion, or lived relationships to land and sea (high confidence). Science has values of its own, including objectivity, openness, and evidence-based thinking. Social values may guide certain choices made during the construction, assessment, and communication of information (high confidence)."</p>
28647	6	45			<p>"across diverse cultures". Is this bullet really WG1 or can it be removed? [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]</p>	<p>Noted. It is incumbent upon the IPCC to explicitly acknowledge the role of values in both science and science communication, in particular because IPCC outputs are developed precisely in order to be widely communicated throughout human societies.</p>

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
115675	6	46	6	46	Please check the description of the scientific method and related values. Aspects related to verification / confirmation (of falsification), peer review, documentation and replication are also important. This paragraph could be revisited to highlight choices in this report which differ from those in earlier reports. [Valerie Masson-Delmotte, France]	Taken into account. The subsection summarized by this paragraph discusses all of these points. Revised version of this summary paragraph focuses on communication: "Construction of climate change information and communication of scientific understanding occurs in the context of, and is informed by, the values of producers, users, and their broader audiences. Scientific knowledge interacts with pre-existing conceptions of weather and climate, including values and beliefs stemming from ethnic or national identity, traditions, religion, or lived relationships to land and sea (high confidence). Science has values of its own, including objectivity, openness, and evidence-based thinking. Social values may guide certain choices made during the construction, assessment, and communication of information (high confidence)."
87473	6	48	6	48	trade-off between reliability and informativeness'... one knows what is intended but it's a bit hard to follow (might this be a trade-off between precision and clarity?). [Stephen Humphreys, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. The relevant sentence has been removed from this summary paragraph. Revised version: "Construction of climate change information and communication of scientific understanding occurs in the context of, and is informed by, the values of producers, users, and their broader audiences. Scientific knowledge interacts with pre-existing conceptions of weather and climate, including values and beliefs stemming from ethnic or national identity, traditions, religion, or lived relationships to land and sea (high confidence). Science has values of its own, including objectivity, openness, and evidence-based thinking. Social values may guide certain choices made during the construction, assessment, and communication of information (high confidence)."
107799	6	48	6	49	Meaning here should be made clearer - reliability vs. informativeness [Linda Mearns, United States of America]	Taken into account. The relevant sentence has been removed from this summary paragraph. Revised version: "Construction of climate change information and communication of scientific understanding occurs in the context of, and is informed by, the values of producers, users, and their broader audiences. Scientific knowledge interacts with pre-existing conceptions of weather and climate, including values and beliefs stemming from ethnic or national identity, traditions, religion, or lived relationships to land and sea (high confidence). Science has values of its own, including objectivity, openness, and evidence-based thinking. Social values may guide certain choices made during the construction, assessment, and communication of information (high confidence)."
70007	6	48	6	49	Good point. [Sonia Seneviratne, Switzerland]	Noted. Thanks!

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
98891	6	49	6	49	There are not degrees of certainty—one is certain or not. There are degrees of confidence that one might have, but not degrees of certainty (e.g., less certain and more certain). The word "certainty" needs to be changed to "confidence". [Michael MacCracken, United States of America]	Noted. The relevant sentence has been removed from this summary paragraph. Revised version: "Construction of climate change information and communication of scientific understanding occurs in the context of, and is informed by, the values of producers, users, and their broader audiences. Scientific knowledge interacts with pre-existing conceptions of weather and climate, including values and beliefs stemming from ethnic or national identity, traditions, religion, or lived relationships to land and sea (high confidence). Science has values of its own, including objectivity, openness, and evidence-based thinking. Social values may guide certain choices made during the construction, assessment, and communication of information (high confidence)."
74283	6	50	6	50	"how they (values?) are framed in traditional media reporting and social media". Not sure what is meant by this. Whose values? The scientists' values or the reporters' values? [Christopher Hollis, New Zealand]	Noted. Revised version: "Construction of climate change information and communication of scientific understanding occurs in the context of, and is informed by, the values of producers, users, and their broader audiences. Scientific knowledge interacts with pre-existing conceptions of weather and climate, including values and beliefs stemming from ethnic or national identity, traditions, religion, or lived relationships to land and sea (high confidence). Science has values of its own, including objectivity, openness, and evidence-based thinking. Social values may guide certain choices made during the construction, assessment, and communication of information (high confidence)."
90933	6	50	6	50	Referent of "they" is unclear and appears to be "values". I would think the referent is "climate knowledge", in which case "they" should be "it". [Wendy Parker, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Revised version: "Construction of climate change information and communication of scientific understanding occurs in the context of, and is informed by, the values of producers, users, and their broader audiences. Scientific knowledge interacts with pre-existing conceptions of weather and climate, including values and beliefs stemming from ethnic or national identity, traditions, religion, or lived relationships to land and sea (high confidence). Science has values of its own, including objectivity, openness, and evidence-based thinking. Social values may guide certain choices made during the construction, assessment, and communication of information (high confidence)."
64869	6	53	6	53	"Data, tools and methods used across the WGI report" as subtitle should be emphasised differently than title "Executive summary" [Kreso Pandzic, Croatia]	Accepted. This and other subtitles within the Executive Summary are formatted as cursive.
3239	6	53	6	53	move line 53 to next page [Sergio Aquino, Canada]	Taken into account. Thanks.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
125027	6	53	7	53	Much of this section is descriptive and doesn't rise to the level of key findings. It is unclear why these are included in what should be a short description of new insights into climate science. [Trigg Talley, United States of America]	Noted. No action. These paragraphs summarize key developments in how climate science has evolved since the last IPCC report.
78289	6	70	6	70	It was noted that GSAT is used as the principal surface temperature metric throughout the SPM report (indicated under SPM, Page 2, Line 31 to Page 3 Line 1) while this report is using GMST. An explanation on the rationale for the selection of GMST could be incorporated given that this is a distinct departure/deviation from AR5 and the Special Reports. [Leonie Lee, Singapore]	Taken into account. The distinction between uses of GMST and GSAT have been made clearer throughout the report.
54869	7	1	7	4	It would be more informative here to highlight how the SSPs have advanced capacity to simulate future climate change, by introducing a new very low emission/high mitigation scenario, a broader range of intermediate scenarios and 2 no climate policy scenarios (not just the highest emission one). [Nancy Hamzawi, Canada]	Rejected. This is covered under a different ES statement, so in a sense it is taken into account, but we retain the main point of this statement.
98761	7	1	7	6	The reduction of sampling over the ocean of several surface ECVs, including temperature and humidity, is already occurring due to a reduction in the ship-based observing system and should be mentioned here. This is affecting our ability to generate observational datasets of temperature and humidity change over the ocean. A suitable reference documenting this decline would be: Elizabeth C Kent, Nick A Rayner, David I Berry, Ryan Eastman, Victoria Grigorieva, Boyin Huang, John J Kennedy, Shawn R Smith and Kate M Willett, Observing requirements for long-term climate records at the ocean surface, Front. Mar. Sci. 6:441. doi: 10.3389/fmars.2019.00441. [Elizabeth Kent, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. A new sentence has been added to the relevant Chapter section.
86663	7	1	7	7	Please consider noting that some determinants of climate change are rather easy to monitor, as they are largely homogeneous, unidirectional and measurement/use of indices is relatively trivial. Other factors have high variation and measurement is highly demanding, such as for instance soil carbon [Oyvind Christophersen, Norway]	Noted. The executive summary point is around improvements or losses of observing systems. The point suggested in your comment is taken as understood.
125029	7	1	7	9	Reviewers commend WGI for stating the importance and the overall value of data collected from a large range of platforms, including satellite data, surface based observation measurements, in situ data, and paleoclimate data. Please refer to "Earth observations" collectively somewhere in this paragraph and in Section 1.5.1. [Trigg Talley, United States of America]	Taken into account.
70009	7	1	7	9	Excellent point, very important to state. Could be maybe better elevated to the SPM. [Sonia Seneviratne, Switzerland]	Noted. Thanks.
19609	7	1	7	9	You might mention also (provided the chapter mentions it) damages due to the greediness of human activity; for example, the frequency requirements for the 5G communication system threaten to damage the spectroscopic observations which allow to retrieve the concentration of tropospheric water vapour. [philippe waldteufel, France]	Noted. This is a future threat, rather than a limit to this assessment.
18085	7	1			A recent concern in maintaining observational networks is the inability to service and repair the instruments caused by events such as the recent pandemic limiting travel possibilities. [Vlad Macovei, Germany]	Noted. An extra section has been added to the Chapter text, but it is still only a minor threat, so has not been elevated to the ES.
79837	7	4	7	4	Is the technical "in situ measurements" not covered by the first two items in the list? I guess the ocean sub-surface is not covered. [Dáithí Stone, New Zealand]	Noted. The first two items have been removed.
41769	7	4	7	5	Not sure what is meant with this sentence, particularly in a context of continuously increase satellite observations. Suggest rephrasing by "Emerging risks of coverage or continuity include discontinuation of certain satellite missions, surface station networks (...)" [Isabel Trigo, Portugal]	Accepted.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
36473	7	4	7	6	Wrong. Reductions in "surface station networks" might not mean any loss of coverage for HadCRUT4 data because the specific grid cell might still contain reporting stations after the loss of some, and HadCRUT4 coverage is based on simply the presence of reporting stations. The paragraph also says nothing about increasing amounts of data. It would be better to express the concept that the availability of climate data is always changing, sometimes decreasing and sometimes increasing, in amount, precision and detail. [John McLean, Australia]	Noted. A point has been added about the increases in data - particularly for ocean and remote sensing products. Your point about the changing networks and instrumentation is also well taken and added. As to surface station networks, the loss in variables other than near-surface temperature is more acute.
70433	7	4	7	9	By discussing risks of future reductions in observing systems, and the remaining undigitised observations, this may be implicitly making a research recommendation (continue observing systems, digitise more records). Since the focus here is on future changes to observing systems, this can't be justified in terms of explaining limits to the assessment. Research recommendations are off-limits in IPCC assessments. [Gillett Nathan, Canada]	Noted. The last sentence on digitising records has been removed.
98893	7	5	7	5	I'd suggest changing "certain" to "particular" so as not to confuse readers who might think this adjective has to do with the quality of the measurement; that is, we might be losing high-quality observations. [Michael MacCracken, United States of America]	Accepted.
89957	7	5	7	51	"latter two" [numbers]: one number, two digits [Jochem Marotzke, Germany]	Noted and corrected.
14889	7	6	7	7	corals, tropical glaciers, and trees are rapidly disappearing'. I am not sure to understand the point. I agree that living corals may be dying. But I thought that most of the corals used as paleo archives are fossil corals or death corals. Or am I wrong? The same hold for the tree. The most remote records are coming from fossil tree. Although I agree that some long-life tree do record long climate change. [Marie-France Loutre, Switzerland]	Noted. Recent high resolution natural archives are necessary for adequate and accurate calibration of paleoclimate archives. Added: "and modern natural archives used for calibration e.g. corals and trees"
107117	7	6		8	It says, "paleoclimate archives such as corals, tropical glaciers, and trees are rapidly disappearing owing to a host of pressures, including high temperatures caused by anthropogenic climate change..." That is misleading. Trees and corals are not disappearing, let alone rapidly, and the worst damage to paleoclimate archives from "high temperatures" was from the high temperatures in the University of Alberta's freezer, because they put irreplaceable ice cores in a in it, and didn't invest in a \$200 temperature alarm. Here's an article about it: https://www.theguardian.com/environment/2017/apr/16/arctic-ice-cores-melt-university-alberta-canada [David Burton, United States of America]	Noted. Thank you for the information about the loss of these ice cores. Glaciers and modern corals and trees are under pressure from a range of factors. New words have been added to distinguish that the trees and corals are modern, and needed for calibration of older natural archives.
26217	7	7	7	8	Should environmental degradation be added? In the case of loss of corals and trees this is also an important driver. [Tania Guillén Bolaños, Germany]	Noted. This is an important factor, and falls under 'a host of pressures'.
3347	7	7	10	7	I would appreciate it if you could expand on the terminology and make the text understandable to those who do not have technical expertise in your valuable research [Eduardo Erazo Acosta, Colombia]	Taken into account. The executive summary text has been polished and section 1.1 has been significantly expanded, which should have made the content more understandable.
125031	7	8	7	8	Please avoid subjective terms like "substantial quantities". [Trigg Talley, United States of America]	Noted. This sentence has been removed.
39143	7	8	7	9	This is correct, in particular, in developing countries where the capacity to digitize and do data rescue is severely limited. The danger of losing these datasets is increased by the fact that paper records may be poorly archived. [Lourdes Tibig, Philippines]	Noted.
125033	7	9	7	9	Consider explaining why this is such a problem: "... remain undigitized, PARTICULARLY IN DEVELOPING COUNTRIES, AMPLIFYING UNCERTAINTY IN CLIMATE PROJECTIONS IN THESE REGIONS." [Trigg Talley, United States of America]	Noted. This has not been included due to space constraints.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
125035	7	11	7	11	[PRECISION] The abrupt introduction of the term "reanalysis" in the text here is jargonistic. The reader wants to know what type of reanalysis "is used". Please rephrase and define a "reanalysis dataset", which is not necessarily intuitive. Distinguish "reanalysis" from the continued analyses of all long-term datasets that one would expect from IPCC WGI. Or refer reader to the definition provided on page 69, lines 51-53 and Annex 1. [Trigg Talley, United States of America]	Taken into account. Thanks. An explanation of the word is added.
10335	7	11	7	12	Reanalyses are not a "separate line of evidence". As described in 1.5.2 they use observations as boundary conditions, so are not "separate" from observations. [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account.
125037	7	11	7	12	[PRECISION] It is very important that a phrase or sentence be inserted in this summary point that explains what is meant by the term "reanalysis", which is not intuitive to those outside of the WGI community. Most non-WGI scientists would assume that climate experts are continually reanalyzing climate data as a normal part of their work. But that is not the context for the term "reanalysis" in this report. Perhaps insert a short line summarizing and simplifying Lines 51-55 on page 69, or draw from the better written summary on the NCAR website at: https://climatedataguide.ucar.edu/climate-data/atmospheric-reanalysis-overview-comparison-tables [Trigg Talley, United States of America]	Taken into account. Thanks. An explanation of the word is added.
36475	7	11	7	12	This is nonsense. A reanalysis of climate data does not mean a new line of evidence. Data per se is not evidence. Data needs a context before it can be called evidence that supports a claim. [John McLean, Australia]	Rejected. It is a simple fact that the reanalyses are counted as a 'line of evidence' in this report, without going into its dependence or independence of other lines.
21255	7	11	7	16	This finding could be redrafted to make more clear that many of the obvious data issues in prior generations of reanalysis have largely been addressed and furthermore perhaps note that wherever possible the present report makes use of the most recent generation of reanalysis products. The sparse-input (surface only) reanalysis products and teh potential insights they can afford us are also a novelty since AR5 and could / should be better drawn out in modifications to this ES statement in th next draft. [Peter Thorne, Ireland]	Taken into account. The statement has been revised for clarity and precision.
34581	7	11	7	16	I'm a big fan of the reanalyses, and they have gotten much better over time, and so they do have their place in helping to document observed changes in some variables such as temperature. However, reanalyses are not up to this task for many other variables, and some mention of this should be made in this key message. [Russell Vose, United States of America]	Noted. This is treated in the chapter, but is difficult to do justice in the ES point.
66605	7	11	7	16	I like the reanalysis point. Doesn't get enough love. [Dave Frame, New Zealand]	Noted. Thanks.
109671	7	11	7	16	In the interest of the scientific values of objectivity and openness extolled earlier in the executive summary, mention here that their benefits notwithstanding, reanalysis datasets retain significant limitations in terms of spatiotemporal resolution and provable accuracy particularly in mountainous and remote regions. This emphasizes the continuing requirement for improving and expanding both ground observation networks and remote sensing datasets to validate and ground-truth remote sensing and modeling products and hybrids like reanalysis products. [Sean Fleming, United States of America]	Taken into account.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
125039	7	11	7	16	[PRECISION] This section should include that reanalyses are built on three key components: Observations, Data Assimilation, and Earth System Models. The *models* are guided by the observational data assimilation, which is the way they provide the variables and locations not directly observed. This needs to be called out as there are still too many reanalysis users who consider that reanalyses are observations, which they are not. This is slightly mentioned in Section 1.5.2, but it should be brought out foremost and in these specific terms. [Trigg Talley, United States of America]	Taken into account. Thanks. "Reanalysis" is now briefly described.
32477	7	11	7	16	Since this is an assessment, it would be worth assessing the increasing use of reanalyses, not just saying that it is occurring and provides consistency. It would be useful here to briefly state the pros and cons of using reanalyses [Robert Colman, Australia]	Taken into account. The statement has been revised for clarity and precision.
79839	7	11	7	16	Will your clients know what "reanalyses" means? Likewise other terms here. [Dáithí Stone, New Zealand]	Taken into account. Some definitions have been inserted.
28649	7	11		16	Reanalyses are unable to represent global-scale changes in the water cycle since their energy and water budgets are not balanced so this limitation should be stated. [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account.
70435	7	11			I would characterise reanalyses as an 'additional line of evidence' rather than as a 'separate line of evidence'. The reanalyses are not independent of the instrumental observations which are assimilated into them, which might provide the primary line of evidence. [Gillett Nathan, Canada]	Taken into account.
26015	7	15	7	15	Add "estimation of uncertainty arising from the range of initial conditions".more consistent data assimilation, estimation of uncertainty arising from the range of initial conditions and an improved representation.... [Don Alfonso Pino Maeso, Spain]	Taken into account.
70011	7	18	7	18	"attribution techniques" sounds strange. Would replace with "attribution science". [Sonia Seneviratne, Switzerland]	Not applicable (text revised)
98763	7	18	7	25	As reported in Chapter 2 reanalysis products are not reliable enough to document trends in surface variables - observations of ECVs are required for assimilation and evaluation of reanalysis output. [Elizabeth Kent, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Thanks. We are now talking about "...are increasingly used ...".
79843	7	19	7	19	"links between human influence on the climate system and climate and weather events" -> "human influence on climate and weather events" or something else. The "and"s are difficult in the current text. [Dáithí Stone, New Zealand]	Not applicable (text revised).
79841	7	20	7	20	What is a "climatic impact driver"? [Dáithí Stone, New Zealand]	Not applicable (text revised).
114149	7	20	7	20	But the application in WGIII is somewhat different. So you may soften this statement or introduce some more nuances. [Jan Fuglestedt, Norway]	Accepted. This part is revised in consultation with WGIII.
105055	7	21	7	22	This sentence would not be clear for a non expert - please reformulate [Masa KAGEYAMA, France]	Not applicable (text revised).
21257	7	22	7	23	This sentence was unclear to me and the finding may well be clearer were it to be omitted. [Peter Thorne, Ireland]	Not applicable (text revised).
79845	7	22	7	23	What is "such an observed change" referring to here? The text appears to be about attribution analyses covering topics across all three working groups, but I get the impression that this statement is about attribution of changes in climate measures only. [Dáithí Stone, New Zealand]	Accepted. This part is revised in consultation with WGIII.
79847	7	22	7	23	Why is attribution required "to illustrate a narrative"? A spurious decadal warming can be very illustrative for narratives, irrespective of its cause. Would "to calibrate narratives" be more accurate? [Dáithí Stone, New Zealand]	Not applicable (text revised).

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
32479	7	23	7	23	What is meant by "can be used to illustrate a narrative of the near future"? Would be good to more clearly articulate the importance of attribution. And why "near" future in any case? [Robert Colman, Australia]	Not applicable (text revised).
32481	7	24	7	24	What you mean by "drivers"? Modes of variability? [Robert Colman, Australia]	Not applicable (text removed).
70437	7	24	7	25	The meaning is unclear. Is this referring to the attribution of changes in emissions to climate policies as in WGIII? Or is this referring to the attribution of the climate response to changes in policies? This has been proposed, but has hardly been done in practise, with the exception of studies examining affects of the Montreal Protocol, as far as I'm aware. I suggest adding a few more words to clarify the intended meaning. [Gillett Nathan, Canada]	Not applicable (text revised).
36477	7	27	7	27	If you are admitting that previous IPCC reports were nonsense because the climate models were rubbish then please be more explicit. [John McLean, Australia]	Rejected. That is not what the statement says, or implies.
4471	7	27	7	28	Statement „The latest generation of climate models has an improved representation of physical processes relative to previous generations“. This is clearly wrong and misleading. It is well known that most CMIP-6 models have produced too much warming that cannot be aligned with observed warming, which is much lower. The modelling crisis is openly being debated and key modelers strongly advise against using the CMIP-6 results. And here you are suggesting that the latest models are better than the ones before? This is clearly wrong, judging from the problematic results of the CMIP-6 models. It would be important to openly admit this issue and develop strategies to improve this in the future. It is not ok to “sweep this under the carpet” by staying silent on this. This is very much about transparency and credibility. [Sebastian Luening, Switzerland]	Rejected. No evidence or reference for the "modelling crisis" mentioned has been provided.
19137	7	27	7	39	Given how the AR6 report takes a fundamentally different approach to projections from AR5, based on assessed estimates of forcing, ECS, TCR, etc., translated to temperature with emulators, I feel this paragraph focuses far too much on traditional ESMs. I suggest making a new paragraph that explains this new development in AR6. [Thorsten Mauritsen, Sweden]	Noted. This paragraph was not designed to present how future scenarios are done in AR6. The text was revised to better explain the new development in AR.
32483	7	27	7	39	There is a mismatch here between the title, on lines 27-28, and the rest of the dot point. The first couple of sentences do suggest there might be better representation of processes (although it would be nice to talk about improved parameterisations as well), but thereafter the dot point lists more model Intercomparison projects, and greater ensembles, which is not to do with improved models, but rather improved, more targeted and better coordinated experimentation. I suggest the whole thing be split in 2, with separate dot points describing model improvements and experimentation improvements. Incidentally it would be good to actually say how models have improved, in that they agree better with observations. [Robert Colman, Australia]	Taken into account. Th revised title now has more info about how the models have been improved.
28651	7	27			has --> have. This is rather a long bullet. Also I consider that CMIP5 plays a stronger role than implied e.g. "provide a substantial contribution to the assessment" [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Thanks. The sentence about CMIP5 is slightly changed.
34583	7	28	7	29	This sentence documents improved model capabilities, such as increased resolution, but it does not indicate whether these capabilities equate to improved model performance. The key message would be stronger if something could be said in that regard. Perhaps some reference could be made to the last key message of Chapter 3, which states that the latest generation of models do a better job for most large-scale indicators of climate change relative than did the models used in AR5. [Russell Vose, United States of America]	Rejected. Model evaluation and performance improvement are presented in Chapter 3, not in this chapter.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
14481	7	28	7	29	in addition to biogeochemical cycling, it is also important to mention that modeling of physical landscape response to the forcing of modern climate change has advanced greatly in recent years. See Pelletier et al., 2015, for synthesis/summary: Earth's Future, 3, 220–251. Doi:10.1002/2014EF000290 [Amy East, United States of America]	Rejected. There are many improvements in the models. We could only mention the most important ones here.
115225	7	29	7	29	Replace 'available' with 'better represented'. [Andreas Fischlin, Switzerland]	Taken into account. Thanks.
70013	7	29	7	29	"that capture smaller-scale processes and extremes". This is not correct as stated. Some high-resolution models may not capture some extremes correctly. Also some extreme events are not of small scale (e.g. continental droughts and heatwaves). Higher resolution alone is not a guarantee for capturing the right processes (in this case you could just run some bogus code at very high resolution...). Better performance at smaller-scale is a potential improvement associated with higher-resolution models, but not a guaranteed improvement. Would replace with "that CAN better capture smaller-scale processes and SOME extreme events (E.G. HEAVY PRECIPITATION EVENTS)". [The improved skilled is mostly true for heavy precipitation events, but not necessarily for other types of extremes, i.e. would specify this as example] [Sonia Seneviratne, Switzerland]	Accepted. The sentence is revised.
26017	7	29	7	29	However, it is important to note that new components and new processes may add new feedbacks and widen uncertainty [Don Alfonso Pino Maeso, Spain]	Rejected. Model evaluation and other details about feedbacks are presented in other chapters, not in here.
70439	7	29	7	31	I would not characterise the participation of more modelling centres in CMIP6 as 'a challenge' for WGI. Having literature based on more models to assess can only be a good thing from the perspective of the robustness of the assessment. If it means we have to include more models in our figures this could be a personal challenge for the authors, but it is not a challenge from the perspective of the WGI assessment. This could also be read as saying that the models from the new modelling centres present a challenge or are of lower quality, but I don't think we have evidence for this. [Gillett Nathan, Canada]	Accepted. The sentence deleted.
125041	7	30	7	30	State specifically how many more modelling centers are contributing now compared to any prior IPCC report. Is it still 23? If you don't know, then delete this sentence. [Trigg Talley, United States of America]	Not applicable (text removed).
31323	7	31	7	31	It is not necessarily readily obvious what the meaning of "and a challenge" is, and - what is more important - whether it is a challenge that the authors have not been able to tackle, thus compromising the assessment. Please clarify. [Markku Rummukainen, Sweden]	Not applicable (text removed/revised).
79849	7	31	7	35	Is this list appropriate for the ES? [Dáithí Stone, New Zealand]	Not applicable partly (text removed/revised). But we still kept mentioning of CMIP6 and cMIP5 due their importance to AR6.
70441	7	34			Replace 'used' with 'assessed'. [Gillett Nathan, Canada]	Accepted. Revised as suggested.
36479	7	35	7	37	Surely only one model at most can be correct so why create an ensemble (ie. average of model output) using the data from one correct model (at most) merged with the data from other models that were not correct? [John McLean, Australia]	Rejected. It is not true that only one model is correct.
125043	7	37	7	37	[PRECISION] Again, unclear how "internal variability" vs "natural variability" vs "interannual variability" are used. [Trigg Talley, United States of America]	Noted. This is not the place to explain all these terminologies. Interested readers can consult the Glossary for the definitions and explanations.
36481	7	37	7	37	What is the difference between a "broad set" and a "set". If there is none then delete "broad". [John McLean, Australia]	Rejected. "broad" was necessary to indicated the varying focuses/purposes of these models.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
125045	7	37	7	39	Cut the last sentence of this paragraph as it's not necessary. [Trigg Talley, United States of America]	Rejected. As these simplified climate models were used in AR6, it is necessary that they are introduced, which is the mandate of this chapter.
89955	7	38	7	39	Not only for transfer, also within our own community. Reference to Cross-Chapter Box 7.1 needed. [Jochem Marotzke, Germany]	Accepted. Thanks! Revised as suggested.
31325	7	41	7	41	Suggest "future levels of warming". [Markku Rummukainen, Sweden]	Accepted. Revised as suggested
70015	7	41	7	41	To be consistent with the wording of the Paris Agreement and not necessarily imply that GMST is the definition of "global average temperature", replace "global mean surface temperature" with "global average temperature" (see text of Paris agreement cited on page 5 of same chapter). [Sonia Seneviratne, Switzerland]	Not applicable (revised).
79851	7	41	7	41	How are "future levels of global mean surface temperature" not "scenarios" [of global mean surface temperature]? [Dáithí Stone, New Zealand]	Not applicable (revised).
115229	7	41	7	53	Very useful para [Andreas Fischlin, Switzerland]	Noted. Thanks!
112173	7	41	7	53	One of the very likely criticisms to expect in any application of scenarios in the AR6 will be their relevance in the light of the COVID-19 pandemic. Something really has to be said about this, probably in Chapter 1, but obviously also in the SPM. In terms of long-term trends, COVID-19 most likely will appear as a short-term blip in terms of emissions, concentrations, and effects on the climate system. In terms of its effects on socioeconomic drivers, there are short-term economic effects, of course, but there may also be some structural shifts and there are clear effects (at least in the near-term) on societal vulnerability and exposure to certain types of climate change events. I only flag this as an important issue to raise somewhere (perhaps in a short box) [Timothy Carter, Finland]	Accepted. A Cross-CHAPTER BOX (6.1) is added to deal the COVID-19.
125047	7	41	7	53	The concept of "dimensions of integration" unnecessarily introduces a layer of complexity to describe otherwise straightforward ideas. Just talk about: (1) scenarios, (2) global temperature, and (c) cumulative carbon. Spend time describing scenarios carefully and explicitly. [Trigg Talley, United States of America]	Taken into account. Thanks.
111785	7	41	8	6	If I understood correctly in AR6 SSP substitute RCP (except than in the cases in lines 5-6 of pag 8). I consider making this clearer [Alessandra Conversi, Italy]	Taken into account. Thanks.
32485	7	42	7	42	The phrase "dimensions of integration" is very unclear. What does "dimensions" mean here? Do you mean unifying concepts? Suggest reword this. [Robert Colman, Australia]	Taken into account. Thanks.
112175	7	43	7	44	Either they are emissions or they are concentration scenarios, though in fact they are used as both and neither of these. Somehow there needs to be some common language to distinguish SSPs being applied in IAV and mitigation assessment with SSPs used here as markers. I think the terminology used here is potentially confusing when compared to the AR5 useage with RCPs, but I suppose it's too late to change this now. However, the precise description of the SSPs needs to be carefully checked across the WGs. SSPs are actually narratives, which were subsequently quantified into a range of socioeconomic drivers, then converted to emissions, concentrations and radiative forcing. So how should that information most effectively be conveyed? [Timothy Carter, Finland]	Taken into account. Thanks.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
50617	7	43	7	44	It is confusing to treat emission and concentration scenarios as if they are the same thing when they are different. There has been widespread surprise, even among scientists, that the reduction in emissions due to the Covid-19-related global lockdown did not result in a reduction in CO2 concentrations, and in fact concentrations continued to rise. This suggests that many people expected that dealing with climate change would be easier than it is, and are not aware of the long-term commitment to climate change that comes from the long lifetime of CO2 in the atmosphere. Promoting the idea that emissions and concentrations are interchangeable risks continuing this confusion. Also, it overlooks the uncertainties in climate-carbon cycle feedbacks that mean that there is no single concentration pathway that would arise from any one emissions scenario or socioeconomic pathway. [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Thanks.
79853	7	43	7	44	"emission or" -> "emission and" [Dáithí Stone, New Zealand]	Not applicable (text revised).
29669	7	44	7	44	Add "(SSP)" after "Shared Socioeconomic Pathways". [Hernan Edgardo Sala, Argentina]	Accepted. Added as suggested
125049	7	44	7	45	[PRECISION] This definition of "Shared Socioeconomic Pathways" is not meaningful: "is used to synthesize knowledge across the physical sciences, impact, and adaptation and mitigation research". This first reference to SSPs needs a good summary sentence explaining exactly what SSPs represent and how they were derived. This is all provided in the next key message, so maybe change the order of their presentation (move paragraph starting with line 55 to line 40). [Trigg Talley, United States of America]	Taken into account. Thanks.
70017	7	45	7	45	"SSP" acronym was not introduced, write in parenthesis next to "Shared Socio-economic Pathways". [Sonia Seneviratne, Switzerland]	Accepted. Introduced as suggested
50619	7	45	7	46	This statement refers to the SSP-RCPs as "emission scenarios" but in the report they appear to be mainly used as concentration pathways, eg. when the CMIP6 projections are presented. This promotes confusion between emissions and concentrations. [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Thanks.
70443	7	46			Replace 'cover lower emissions pathways' with 'includes a lower emissions pathway'. I think it is only SSP1-1.9, which has substantially lower emissions than the RCPs. [Gillett Nathan, Canada]	Taken into account. Thanks.
71335	7	46			Change "...cover lower emission pathways ..." to " ... include lower emission pathways ...". Reason: "Cover " could be taken to imply all of the emissions pathways are lower than in previous assessment reports, whereas "include" implies some (but not all) emissions pathways are lower than used previously. [David Wratt, New Zealand]	Taken into account. Thanks.
853	7	47	#REF!	#REF!	why "potentially" consistent? This addition hides a large interpretation debate on ensembles of projections for a given SSP scenario. Probably also SSP3 is "potentially" consistent with 1.5 degree warming [Bart van den Hurk, Netherlands]	Not applicable (text removed).
115227	7	47	7	47	Append at the end of the sence 'limit' so tha the sentence reads "...consistent with a 1.5°C warming limit". 1.5°C global warming relative to pre-industrial levels as enshrined in the Paris Agreement is a limit, not a target in the sense, we reach 1.5°C and then stay there for good. [Andreas Fischlin, Switzerland]	Not applicable (text removed).
36483	7	47	7	47	No-one knows what 1.5C warming means because there is no credible pre-industrial global average temperature to use as a baseline. (Also see above coments re page 6 lines 7 to 10) [John McLean, Australia]	Not applicable (text removed).
4741	7	47	7	47	why "potentially" consistent? This addition hides a large interpretation debate on ensembles of projections for a given SSP scenario. Probably also SSP3 is "potentially" consistent with 1.5 degree warming [Bart van den Hurk, Netherlands]	Not applicable (text removed).
79855	7	47	8	6	This is heavy technical reading. Is it appropriate for the ES? [Dáithí Stone, New Zealand]	Taken into account. Thanks. It is simplified and shorted.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
28653	7	47		49	Suggest: "Cumulative carbon emissions are linearly related to global-mean surface air temperature increase, the levels of which are closely related to a number of regional climate impacts and serve as additional common reference points within and across IPCC Working Groups." (or break into 2 sentences) [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Thanks.
31327	7	50	7	50	The "4.5" is one number, not [latter] two. [Markku Rummukainen, Sweden]	Not applicable (text removed).
50621	7	50	7	52	It is a very substantial approximation to claim that any particular socioeconomic pathway will lead to a specific radiative forcing by 2100. There are large uncertainties involved in the steps from socioeconomic scenario to emissions to concentrations to radiative forcing, which are downplayed here. [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable (text removed/revised).
34585	7	50	7	53	This sentence would logically fit better in the next key message (which starts on line 55) because it provides details about the SSPs. [Russell Vose, United States of America]	Not applicable (text revised/removed).
66541	7	50	7	53	It is correct that the SSPs with the extension of a nominal radiative forcing is providing a link to the RCPs used in AR5. However, it is important to note that the forcing scenarios behind the "nominal forcing levels" such as SSP2-4.5 and RCP4.5 are sometimes very different (different evolution of GHG levels) and that resulting climate projections based on these different scenarios can lead to large differences in results even if the nominal radiative forcing is the same. For instance, Wyser et al (2020) shows that the EC-Earth model commonly used in CMIP5 and CMIP6 get a much stronger climate change signal when forced by the new CMIP6 SSP-forcing compared to the corresponding RCPs. This difference in forcing has a strong impact in addition to changes in climate sensitivity in this model. Wyser, K., Kjellström, E., König, T., Martins, H. and Doescher, R., 2020. Warmer climate projections in CMIP6: the role of changes in the greenhouse gas concentrations from CMIP5 to CMIP6. Environ. Res. Lett., 15, 054020, DOI: 10.1088/1748-9326/ab81c2. [Kjellström Erik, Sweden]	Not applicable (text removed/revised).
125051	7	51	7	51	Important to correct an error here - it should be "latter of the two" not "latter two". And please insert that an RCP is a measure of "radiative forcing in watts/m2". [Trigg Talley, United States of America]	Not applicable (text removed/revised).
74285	7	52	7	52	Delete "heavily"? [Christopher Hollis, New Zealand]	Not applicable (text removed).
19139	7	52	7	52	Delete 'heavily' [Thorsten Mauritsen, Sweden]	Not applicable (text removed).
70445	7	52			Replace 'also providing a link to the RCPs' with 'corresponding to the naming convention of the RCPs'. If I understand correctly, the link is simply that the RCPs were labelled based on their radiative forcing in 2100, just like the SSP scenario labels used here. This was also unclear to me in the underlying chapter material. [Gillett Nathan, Canada]	Not applicable (text removed).
89959	7	55	7	55	very high only in greenhouse gases; air pollutants much more heterogeneous across scenarios (SPM-19, 33-40) [Jochem Marotzke, Germany]	Noted. Thanks!
3241	7	55	7	55	move line 55 to next page [Sergio Aquino, Canada]	Noted. Thanks!
50623	7	55	8	4	The pairing of socioeconomic scenarios and concentration pathways implies that the resulting evolution of the climate system could only occur from those socioeconomic pathways, which is not the case. Alternative socioeconomic futures could result in similar emissions scenario, and alternative emissions scenarios could result in similar concentration pathways and radiative forcing levels. [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Thanks.
115231	7	55	8	6	Even more useful para [Andreas Fischlin, Switzerland]	Noted. Thanks!

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
106241	8	1	8	1	For internal consistency keep the label for SSP1-1.9 in the key message and the following text the same ("very low", or whichever is decided upon). [Rogelj Joeri, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable (text removed).
109475	8	1	8	1	Both climate change mitigation and air pollution mitigation exist, the term "mitigation" should be replaced by "climate change mitigation" [Sophie Szopa, France]	Not applicable (text removed).
21259	8	2	8	2	GMST should be GSAT for consistency with x-chapter box 2.3 and subsequent chapters [Peter Thorne, Ireland]	Not applicable (text removed).
125053	8	2	8	2	"GMST" needs to be defined. [Trigg Talley, United States of America]	Not applicable (text removed).
70019	8	2	8	2	"GMST": Suggest to use another acronym for the "global average temperature" defined in the Paris Agreement, since GMST has an existing IPCC definition which might not be suitable as reference. E.g. use "Tglob" instead as acronym. [Sonia Seneviratne, Switzerland]	Not applicable (text removed).
36485	8	2	8	2	No-one knows what 1.5C warming means because there is no credible pre-industrial global average temperature to use as a baseline. (Also see above coments re page 6 lines 7 to 10) [John McLean, Australia]	Not applicable (text removed).
114151	8	2	8	2	I think you mean GSAT here and not GMST [Jan Fuglestedt, Norway]	Not applicable (text removed).
125055	8	2	8	6	[PRECISION] State explicitly that neither scenario is "business as usual" nor are they "best" or "worst" case scenarios. They are simply "plausible future conditions." It is very important to characterize scenarios carefully and thoughtfully. [Trigg Talley, United States of America]	Not applicable (text revised).
102457	8	5	8	5	The text uses the phrase "human-induced climate change", which seems to imply that anthropogenic forcing is the only factor driving the currently observed climate change. While this is almost perfectly so, attribution studies in principle show that a small part of the observed climate change signal (hidden in the uncertainty) could be attributed to natural variations of time scales similar to that driven by greenhouse gas emissions. Perhaps this warrants an extra line or two here in the beginning? [Philippe Tulkens, Belgium]	Noted. But we could not find the phrase "human-induced climate change" on page 8, line 5.
3243	8	5	8	6	where no SSP-based results are available or where the AR6 results are compared to (omit results from6) earlier IPCC reports. [Sergio Aquino, Canada]	Not applicable (text removed).
64871	8	8	8	8	"WGI report structure and overall limitations" as subtitle should be emphasised differntly than title "Executive summary" [Kreso Pandzic, Croatia]	Not applicable (text removed).
66607	8	8	8	28	I don't think the last two Exec Summary points are Exec Summary points. They're editorial comments and grumbles about how hard it is to put all this together. They don't belong here, but perhaps could be written into either the introduction of the Introduction, or into the SPM as caveats/points to note. [Dave Frame, New Zealand]	Accepted. Removed as suggested.
79857	8	11	8	11	Aren't your clients the Parties to the UNFCCC? [Dáithí Stone, New Zealand]	Not applicable (text removed).
70023	8	11	8	12	This official structure may give the impression that the global and regional chapters are not doing any process understanding, which is not correct (e.g. for chapter 11). In addition, Chapter 11 is also assessing continental-scale and global changes in extremes. [Sonia Seneviratne, Switzerland]	Not applicable (text removed).
70447	8	11			I suggest replacing 'based on three pillars' with 'structured around three themes' or similar. Although 'pillars' has been used in describing the strucutre of this report, it is a metaphor, and is usually used in the sense of 'pillars of our understanding'. Usually it has the sense that all the pillars are required to support the whole, like a building which might collapse if you take one pillar away. I don't think this is the intended meaning here - the three areas are all important, but not in the sense that the overall report depends on them all for the validity of its conclusions. [Gillett Nathan, Canada]	Not applicable (text removed).

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
70027	8	14	8	15	Replace "regional climate information and changes in climate hazards relevant for risk assessments" with "regional climate information, climate extremes and changes in further climate-impact drivers relevant for risk assessments". It would seem useful and interesting for the reader to explicitly state "climate extremes" in this text. [Sonia Seneviratne, Switzerland]	Not applicable (text removed).
18599	8	14	8	15	The organized structure of chapters is helpful here, but is a bit inconsistent with some other frames used in the report. For example, Chapters 10,11,12+Atlas are often grouped as the regional chapters, but CH8 and CH9 are included here. These two chapters have an important role focusing on the physical mechanisms and projections of changes to the global water cycle and oceans/cryosphere, respectively, with only a limited regional focus given that regional features of drought and ocean climatic impact drivers are discussed in subsequent chapters. CH12 also utilizes the Climatic Impact Drivers framework to avoid an impression that WGI only focuses on 'hazards', also including a discussion of changes to the climate system that may be beneficial to some. Note that the organization in section 1.8 has the structure that I had anticipated. [Alexander Ruane, United States of America]	Not applicable (text removed).
70025	8	15	8	16	This list of integrative quantities seems a bit random (see further comments). If it is intended to be broad (but I think it would be fine to restrict the scope the "three main dimensions of integrations", see further comment), it would seem that we have further "integrative quantities" such as extremes which are mostly addressed in chapter 11, but also relate to the chapter 8 assessment for water cycle extremes, to the chapter 9 assessment for marine extremes, and to the chapter 12 assessment for extremes that are climate-impact drivers. [Sonia Seneviratne, Switzerland]	Not applicable (text removed).
70029	8	15	8	16	It seems strange to mention "equilibrium climate sensitivity" as an "integrating quantity" for the report. It is of little relevance for the regional chapters. Maybe mention instead "Global average temperature"? Tglob is the truly integrative quantity throughout the report (also related to ECS, but rather focused on 21st century perspective). Tglob is for instance also used in Chapter 11 as a dimension of integration since projections of extremes are shown for different global warming levels; similarly assessments relevant to reasons for concerns in chapter 12 are using Tglob, but not ECS. Finally Tglob is now the main variable of integration given the framing of the Paris Agreement. [Sonia Seneviratne, Switzerland]	Not applicable (text removed).
70031	8	15	8	16	On "integrating quantities" from the report, the following sentence from chapter 1 (on page 10) seems more to the point: "The three main 'dimensions of integration' across Working Groups in the AR6, i.e. emission scenarios, global temperature levels and cumulative carbon emissions, are described in Section 1.6". These are relevant both across WGs and within the WG1 assessment. [Sonia Seneviratne, Switzerland]	Not applicable (text removed).
87515	8	15	8	16	This is the first introduction to ECS but it is not actually understandable. Either explain it or let it go? [Stephen Humphreys, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable (text removed).
130463	8	16	8	16	Temperature levels should be "warming levels". Also, please note that in line 48, p12, using "global mean warming". I suggest this chapter to take a lead to standardize using key terms in this report. [Panmao Zhai, China]	Not applicable (text removed).

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
31329	8	23	8	23	There have always been, and always will be, constraints and less data that one might have wished to have, scenarios have been less than an infinite number, etc. What is at heart is how the available information and resources have been made use of. The purpose of the paragraph is not evident as it is now laid out. The key here should be whether the authors are reasonably confident that they have been able to do a representative assessment of scientific knowledge, or not. The paragraph as it now reads is confusing. [Markku Rummukainen, Sweden]	Not applicable (text removed).
70449	8	23	8	24	I wouldn't characterise 'the challenging task of assessing the ever-expanding, multi-lingual body of literature' as a limit to our assessment. This is our job as IPCC authors. This is an opportunity, not a limit. [Gillett Nathan, Canada]	Not applicable (text removed).
5023	8	23	8	26	Among this list I think that geological limitations of fossil energy must be mentioned. High emissions scenarios are, as far as we know, really unlikely ((https://pubs.rsc.org/en/content/articlelanding/2016/EE/C6EE01008C#divAbstract, Capellan-Perez and al., 2016) [Olivier RAGUENES, France]	Not applicable (text removed).
125057	8	23	8	28	[PROGRESS] This is not a key finding unique to the AR6. [Trigg Talley, United States of America]	Not applicable (text removed).
39145	8	23	8	28	The limitation in terms of assessing changes in the national scale due to sparse published studies in scientific peer-reviewed journals has long been one of the challenges in developing countries-can you include his in the list of factors that limit the assessment even if the structure is from global to regional? [Lourdes Tibig, Philippines]	Not applicable (text removed).
115683	8	24	8	24	Please refer to "scientific literature" (not literature) [Valerie Masson-Delmotte, France]	Not applicable (text removed).
21261	8	25	8	26	It isn't just the small number of scenarios but also the finite number of models available and that these constitute a scenario of opportunity. This whole ES bullet could end up becoming a hostage to fortune though because everyone could complain about their pet issue not being included within it. Careful thought is likely required around retention and if so in what form to minimise the risks. [Peter Thorne, Ireland]	Not applicable (text removed).
114153	8	27	8	27	I think it is broader than "climate risk". Mitigation is also part of this. [Jan Fuglestedt, Norway]	Not applicable (text removed).
115233	8	27	8	28	Very good point worth making [Andreas Fischlin, Switzerland]	Noted. Thanks!
125059	8	27	8	29	Cut the phrase "... but a more complete... science communities." Isn't this a role for the SYR? [Trigg Talley, United States of America]	Not applicable (text removed).
102459	8	35	8	35	A "-" is missing: "human-induced" climate change to be consistent with previous sections. [Philippe Tulkens, Belgium]	Noted. We believe the reviewer refers to page 9, not page 8. Anyway, we made sure that a "-" is used between the two words in this chapter. So thanks!
101377	9	1	9	1	Can you define anthropogenic here as human-made? [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Accepted
85909	9	1	9	1	A clear statement about the catastrophic effect that climate change has already had on human populations and life in general, with a handful of brief illustrative examples, should come up in the first few opening paragraphs, ideally the first. It had not come up by page 14. [Debra Roberts and the Durban WGII TSU, South Africa]	Rejected. Such statements are important and do appear in the most suitable sections in this chapter and elsewhere in the report. Repeating them in the introductory section about the Report and Chapter Overview would be excessive.
115523	9	1	9	55	I note that the term geo-engineering shows up in the tables (GEO-Mip) but it is not discussed in the text of the chapter at all. I suggest that Chapter one should provide some background on geo-engineering concepts [Rolf Müller, Germany]	Taken into account. Geoengineering is assessed in the Summary for Policy Makers (SPM).
125061	9	3	10	8	This could be shortened by removing the explanation of the IPCC and its role, and the history of the IPCC, including what is included in the AR6 assessment cycle. [Trigg Talley, United States of America]	Rejected. With the new formulation of this section, the explanation about the IPCC and its role become relevant.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
85911	9	5	9	5	"human-induced climate change" – it may well be better here (in relation to climate denialism) and in following text, to say that the IPCC assess all climate change (human induced and natural) but to follow it immediately, in this first paragraph, with statements about how the evidence for human induced climate change has increased from possible to virtually certain, or undeniable. The way it is worded here implies that the IPCC made an a-priory decision that climate change is human induced. Indeed, the human contribution can only be assessed by analysing natural climate change, and all this is included in IPCC reports, including paleo climate. Also see second paragraph. [Debra Roberts and the Durban WGII TSU, South Africa]	Taken into account. The paragraph has been rewritten.
70451	9	8	9	11	I would word more strongly here. Perhaps replace 'climate model capabilities have been enhanced' with 'climate models have become much more comprehensive and realistic' and insert 'vastly' before 'increased computational capacities'. [Gillett Nathan, Canada]	Rejected. The proposed wording would be too strong.
32487	9	10	9	10	and through improved representation of those processes (i.e. not just of interaction between them). [Robert Colman, Australia]	Accepted.
89961	9	11	9	11	"have been" [Jochem Marotzke, Germany]	Accepted.
125063	9	11	9	11	The word "have" needs to be inserted before the word "been". [Trigg Talley, United States of America]	Accepted.
125065	9	11	9	12	Rephrase statement to read: "... previous IPCC reports HAVE been confirm or strengthened IN THIS REPORT, indicating..." [Trigg Talley, United States of America]	Accepted.
36487	9	11	9	13	Nonsense. The evidence in each report differs from the evidence presented in the report prior to it, which implies that the previous report was incorrect. It's also not uncommon for the degree of likelihood of a certain situation to have increased (e.g. "likely" to "very likely") despite the absence of any new credible information to justify that increase. [John McLean, Australia]	Rejected. The comment is unfounded. The robustness of IPCC assessments stems from the systematic consideration and combination of multiple lines of independent evidence.
90935	9	12	9	13	It speaks here of the "veracity" and "causes" of "anthropogenic climate change". I think it would be clearer to change "veracity" to "reality" or "occurrence". I would also think to remove "anthropogenic", unless "causes" is just meant to refer to different types of human activities. [Wendy Parker, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. The paragraph has been rewritten.
89963	9	16	9	16	not only the impacts, also the change itself [Jochem Marotzke, Germany]	Accepted.
125067	9	16	9	16	Rephrase statement to read: "...to understanding the PHYSICAL SCIENCE and impacts of..." [Trigg Talley, United States of America]	Accepted.
36489	9	17	9	18	Incorrect. Reports are not "comprehensive" when they don't present the wide range of views that are known to exist. Further, the failure to fully disclose details where "expert opinion" was utilised, specifically what questions were asked of experts, who those experts were and the replies of each of then is NOT "open and transparent." The wording of this sentence needs to include these important caveats. [John McLean, Australia]	Rejected. The IPCC process of documentation details the review process to ensure that it is open, comprehensive and transparent.
40629	9	17			Phrasing should say "Comprehensive, OBJECTIVE, open, and transparent" [TSU WGI, France]	Accepted.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
36491	9	18	9	19	Wrong again. Evidence of variation in weather patterns is not automatically evidence that such variations are human induced. In fact IPCC reports have never presented credible and consistent evidence that they are human induced. Despite what previous IPCC reports have implied, the output of models is not evidence unless you can show that models are consistently correct, which was disproven by AR5 text box 9.2 which showed that 97% (111 of 114) of model runs predicted a greater warming trend for the previous 15 years than temperature observations indicated. What's more AR5 was not confident that any warming had occurred, this despite the inarguable increase in atmospheric carbon dioxide. [John McLean, Australia]	Rejected - not supported by the peer-reviewed published literature
13195	9	32	9	32	Consider that it should further explain paleoclimatology. [Maria Amparo Martinez Arroyo, Mexico]	Not applicable. The comment has not relation to the referenced page and lines.
125069	9	33	9	36	Need to eliminate the unnecessary words "for the first time" in this line: "The SR1.5 and SRCLL are, for the first time, joint products of all three Working Groups". The IPCC never produced these two reports before. The next sentence is meaningless and could be deleted. [Trigg Talley, United States of America]	Taken into account. The paragraph has been rewritten.
19611	9	34	9	35	It seems to me that there are also objective reasons for this work in common, as suggested by the fact that this joint setup was not adopted for SROCC. At any rate, do you believe that IPCC has something to gain when it compliments itself in its own reports? [philippe waldeufel, France]	Noted. Most of the authors of this text were not authors of the mentioned reports, and therefore they are not "complimenting their own reports". Rather, they are highlighting the aspects of previous reports that they consider most influential for their current work.
32853	9	37	9	40	Recast to "Overall, this chapter provides an introduction, context and methodological contribution of the WG1 to the AR6. WG1 assesses the latest physical science basis for climate change by evaluating knowledge gained from; examining observations, reanalyses, paleoclimate archives and simulations from climate models along with studies of physical climate processes". [Aaron Werikhe, Uganda]	Not applicable. This paragraph is no longer included in the chapter.
67543	9	39	9	39	paleoclimate [Baijun Tian, United States of America]	Taken into account.
21263	9	41	9	43	While this is true it is only part of the story of this assessment report and it would seem to be worth noting through one or more additional sentences to complete the paragraph how in this cycle it is different and goes beyond this traditional approach even if it is by forward throw to a later section. Presently the reader would leave this paragraph under the mis-impression that AR6 in terms of structure was BAU for IPCC which is heavily not the case. My feeling is that you need to give a flavour of this at this juncture? [Peter Thorne, Ireland]	Not applicable. This paragraph is no longer included in the chapter.
79859	9	43	9	43	May I suggest "projections of future climate change". Technically "future projections" are projections you anticipate being made in the future, which I do not think is what is meant here. [Dáithí Stone, New Zealand]	Taken into account. The text has been reformulated.
89965	9	45	9	45	WGI assessment? [Jochem Marotzke, Germany]	Accepted.
32855	9	45	9	51	Rephrase Chapter's Three Objectives to make them shorter, smarter and in bullet form as: Specifically, this chapter seeks to: (1). Set the scene for the assessment and contextualize it in ongoing global changes and policy responses in light of climate science history, while building on previous IPCC assessments including auxiliary Special Reports of this Assessment Cycle; (2): Describe key concepts and methods, relevant emerging issues and modelling framework used in this assessment; and (3). Provide valid and coherent technical support to the WGI and WGII contributions to AR6 with focus on international climate governance, risk framing and regional specific climate change policy making needs. [Aaron Werikhe, Uganda]	Taken into account. This paragraph has been rephrased and made shorter, in bullet form, as proposed.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
36493	9	46	9	46	The inclusion of "international policy responses" at this point lacks integrity as well as sense. It should only appear after you mention attribution of changes in climate. [John McLean, Australia]	Taken into account. The sentence has been modified according to Comment 114155.
114155	9	46	9	46	I think "reponses" could be changed to "processes" here. [Jan Fuglestedt, Norway]	Accepted.
114157	9	49	9	51	I find this last part incomplete. I think mitigation could be mentioned explicitly (and not only implicitly as a part of climate change policy making) [Jan Fuglestedt, Norway]	Accepted.
111899	9	49			in the current, both global and regional context (in [Tomas Halenka, Czech Republic]	Taken into account. This paragraph has been rewritten.
125071	9	51	9	51	Why focus on "regional" policymaking? Why is that more effective than national and global? Climate policy is not made by regional governmental entities. [Trigg Talley, United States of America]	Rejected. First, "regional" does not necessarily mean "on a smaller scale than national", on the contrary: it may mean a policy agreed upon by several countries in a common region (e.g. EU, Mercosur, etc.). Second, in many countries climate policy is developed on the subnational "small regional" scale.
125073	9	53	9	54	Please delete "reconstructed" in this jargonistic phrase. Long-term changes in the Earth's climate change are not literally "reconstructed"; they are "observed" one way or another. [Trigg Talley, United States of America]	Rejected -- The term "reconstructed" is the correct expression in this case. It refers to paleoclimate records, so that such climate changes are not "observed", but rather "reconstructed" from the records.
40681	9	53	10	1	Run-on sentence: "The present state of Earth's climate, in the context of reconstructed and observed long-term changes and variations caused by natural and anthropogenic drivers, as well as the international climate change governance structures, which serve as a context to the present assessment, are described in section 1.2." -> Proposition: The present state of Earth's climate, in the context of reconstructed and observed long-term changes and variations caused by natural and anthropogenic drivers. In addition, the international climate change governance structures, which serve as a context to the present assessment, are described in section 1.2. [TSU WGI, France]	Taken into account. The proposition could not be applied, because it had no verb, but the indicated sentence has been rewritten for increasing clarity, as requested.
106243	9		9		It would be useful to also include references to the various reports cited here. The readership is not necessarily familiar with where to find or unambiguously identify them. [Rogel Joeri, United Kingdom (of Great Britain and Northern Ireland)]	Accepted.
26525	10	1	10	1	Should be ocean (the plural "oceans" refers to geographical features, not climatic) [Eric Brun, France]	Accepted. Changed throughout the report.
39783	10	5	10	6	"Many governments and societies are responding to these changes" Do the (emission) data reflect this statement? If not, could it be amended to be more accurate? [TSU WGI, France]	Rejected. A response begins with an intent, as is shown by many governments through their planning towards net zero.
12403	10	9	10	55	This short section can be better organized by flowing from drivers(observed GHGs changes) to directly resultant energy imbalance, and then to various symptoms of global warming: rise in temperature, altering water cycle etc. [Lijing Cheng, China]	Rejected. We focus on a range of observed changes here, without implying attribution.
101379	10	13	10	13	Is it possible to define CMIP in Figure 1.1? And it's not immediately obvious to me why calibrated uncertainty language isn't a CC box? (and the stocktake sounded less of a CC, before reading it at least). [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. This figure presents a summary with limited space and there is no room to spell out the acronym CMIP, which is spelled out and explained in the text of the referred section. The Calibrated Uncertainty Box has been authored by Ch1 authors only, therefore it cannot be called a cross-chapter box.
26527	10	17	10	17	We suggest to replace "is most commonly" with "has traditionally been presented". [Eric Brun, France]	Rejected. Both statements are true, and we wish to keep to the present tense here.
26529	10	17	10	24	This paragraph should include a reference to GSAT and Box SPM.1 [Eric Brun, France]	Accepted, text revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
125077	10	18	10	35	This repeats from the introduction; please reduce to one to two sentences. [Trigg Talley, United States of America]	Taken into account. Changes have been brought in the introduction and in this section
125075	10	18	14	36	[SCOPE] Section 1.2 has taken the authors off on a synthesis of science covered by the entire report, not the scene setting chapter that provides context for the rest of the WGI contribution. As a result, Chapter 1 goes beyond framing and repeats what is said in the other chapters of the report. Chapter 2, for example, also provides a summary of paleo ice sheet and sea level change, AMOC, and other large scale indicators of climate change. Rates of glacier mass loss are described here and in chapters 2 and 9. According to the approved outline, Chapter 1 is supposed to highlight key findings from AR5 -- and this is accomplished in Section 1.3, beginning on page 31. Many articles cited in Section 1.2, are for literature published since AR5 WGI in 2013. Part of the problem may be with the fact that "where we are now" is not the same as where we started from AR5. [Trigg Talley, United States of America]	Rejected. The desire to have the current Chapter 1 deviate from previous Assessment Reports has been expressed since the Scoping Meeting, including providing an overview that to some (minor) extent synthesizes the results of other chapters. Also, the key point made in section 1.2 is that even physical science information and assessment is made in a context, and should be mindful of its own messaging. While observations and modelling can be said to be context-free and objective, the questions asked of the IPCC are not, and fulfilling our mandate requires consideration also of the external context into which our assessments will be delivered. Hence, while the clear majority of WG1 presents and assesses pure physical science evidence, we consider it in scope (and in line with the approved outline) to discuss also the topics covered in section 1.2.
115235	10	20	10	20	Delete "renewed", this is a political judgement that is questionable and not sufficiently policy neutral. Perhaps you could add at the end of the sentence a clause similar to this "... such as the Paris Agreement." [Andreas Fischlin, Switzerland]	Accepted
26531	10	20	10	20	The modern reference period is defined subsequently and is important, but it is strange in this section not also to provide the latest increase of around 1°C [Eric Brun, France]	Noted. The choice from WG1 is to mainly refer to the modern baseline period here, and then to provide other measures of GMST change later. The key results are in any case summarized in the SPM.
107119	10	20		26	[pt 1 of 2] It says, "Numerous substantial changes have been observed across the physical climate system and across timescales; many of these changes can be attributed to anthropogenic influences, with impacts on natural and human systems. ... Many governments and societies are responding to these changes and deciding on specific courses of action to mitigate and adapt to anthropogenic climate change." That misleadingly suggests that the observed changes are all negative. In fact, the most striking changes are positive. Thus far, there have been no major negative impacts from anthropogenic climate change. I suggest rewriting the paragraph as follows: [cont'd] [David Burton, United States of America]	Rejected. This paragraph does not state about negative or positive impacts
107121	10	20		26	[pt 2 of 2] "Numerous, substantial changes have been observed across the physical climate system, many of which can be attributed to anthropogenic influences, with mostly-positive impacts on natural and human systems. The most striking changes are global "greening" and improved agricultural productivity, both due to CO2 fertilization, and reduced agricultural vulnerability to droughts, as higher CO2 levels improve water efficiency and drought resistance of crops. Those changes have contributed to a drastic decline in frequency and severity of famines. Other observed positive changes include a decline in frequency of strong tornadoes, and a slight apparent decline in frequency and severity of droughts. Major anticipated negative effects, such as accelerated sea-level rise and worsening extreme weather events, remain hypothetical, but governments and societies are responding to these possible threats and deciding on specific courses of action to mitigate and adapt to them." ### [David Burton, United States of America]	Rejected. This paragraph does not state about negative or positive impacts

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
125079	10	21	10	21	Please delete the unnecessary, normative word "substantial", which is in the eye of the beholder. [Trigg Talley, United States of America]	Accepted -"substantial" removed
70453	10	21			I would name the Paris Agreement right here in the first sentence, since it is key context to where we are in the IPCC Sixth Assessment. This is only referred to indirectly at present as 'renewed efforts in international climate governance'. The Paris Agreement is referred to in the following paragraph in passing, but it would be better to introduce it up front. [Gillett Nathan, Canada]	Accepted. Thanks
36495	10	22	10	23	The words "many of these changes can be attributed to anthropogenic influences" implies that those changes were manmade. The correct way to say this in a "comprehensive, objective, open and transparent" manner (refer the IPCC's stated role) is to say "Although not all climate scientists are in agreement, these changes are often attributed to (etc)". [John McLean, Australia]	Rejected- There are evidences that many can be attributed to anthropogenic influences
29671	10	23	10	24	Consider replacing "Special Report on Global Warming of 1.5 °C" by "SR1.5" (the acronym was already defined in the previous page). [Hernan Edgardo Sala, Argentina]	Not applicable- Text has been shorten, The long names and acronyms are applied subsequently, thanks
36497	10	23	10	25	There is no global average pre-industrial baseline temperature, nor can one be determined, so it is fantasy to talk of 1.5C warming from an unknown base. [John McLean, Australia]	Rejected. No scientific evidence/publication provided to support changes suggested by the reviewer
15891	10	23	10	26	The statement below is not an accurate summary of the details of the 1.5°C report "The IPCC Special Report on Global Warming of 1.5°C concluded that it is still possible to limit warming to this level, but that it would require rapid and fundamental societal transformations. Many governments and societies are responding to these changes and deciding on specific courses of action to mitigate and adapt to anthropogenic climate change." A more accurate statement of the report would be: "The IPCC Special Report on Global Warming of 1.5°C concluded the best probability of limiting temperatures to 1.5°C with deep cuts in emissions is 66%. The scenarios it uses are based on the untested assumption that the temperature will overshoot and then recover in response to increased mitigation efforts. At the time of its writing, no government has an emission pathway compatible with stabilizing temperatures at these limits." [Kevin Lister, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. paragraph no longer in the introduction
28655	10	24			Surely limiting to 2oC would also require "rapid and fundamental societal transformations." [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. paragraph no longer in the introduction
85913	10	25	10	25	re "many governments" - Can one make a comment along the lines of "despite overwhelming evidence some governments are still unwilling to tackle the problem"? The opening paragraphs of WG1 report are a good place to locate some early high relevance messages. [Debra Roberts and the Durban WGII TSU, South Africa]	Not applicable. paragraph no longer in the introduction
66609	10	25	10	26	Suggest deleting "Many governments and societies are responding to these changes and deciding on specific courses of action to mitigate and adapt to anthropogenic climate change." I don't think that's a WGI point to make. It also sits awkwardly with the points about the emissions gap. (And of course countries simply do not agree about which of them really are "Many governments and societies are responding to these changes and deciding on specific courses of action to mitigate" and which are just pretending to do so.) [Dave Frame, New Zealand]	Not applicable. paragraph no longer in the introduction

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
115237	10	28	10	29	This sentence makes it not really clear to me inasmuch this chapter is making the assessment of current warming itself or if that does not interfere with the assessment as done in the respective chapter (Ch2). Perhaps you move some of the text written further down, notably page 10, line 47 up to here. [Andreas Fischlin, Switzerland]	Taken into account. The section has been revised.
21265	10	28	10	35	While this paragraph is fine it also feels unnecessary. I'm not sure that much would be lost in readability through just proceeding directly to the next subsection without the inclusion of this paragraph [Peter Thorne, Ireland]	Rejected. The chapter has adopted a model for all sections. however this e paragraph has been shorten
36499	10	29	10	29	The long-term context of anthropogenic climate change How can you talk about this when you have never proven that it exists and is significant enough to be concerned about? As I said above, your evidence for man-made warming changes with every new climate assessment report. This implies that previous reports were incorrect. [John McLean, Australia]	Not applicable. paragraph no longer in the introduction
125081	10	29	10	35	[SCOPE] The content described here (beginning with "It then summarizes...") is beyond the scope of WGI and needs to be cut. [Trigg Talley, United States of America]	Not applicable. paragraph no longer in the introduction
115239	10	31	10	31	Same mistake. I suggest: "... including the first global stock take scheduled for 2023...". However, again I personally would prefer not to mention the GST explicitly. At least you write "including", which you need to retain, or I would object more strongly. ;-) [Andreas Fischlin, Switzerland]	Not applicable. paragraph no longer in the introduction
36501	10	31	10	31	If this report was "comprehensive, objective, open and transparent" it would admit that the Paris Climate Agreement provides no specific date/years for "pre-industrial" and fails to define a baseline global average temperature. IPCC SR1.5 claimed that the 1850-1900 averages were indicative but this was mendacious because from 1860 to 1880 in particular the global average temperature was biased towards European data or a specific shipping route in the southern hemisphere. (see also my comments for page 6 lines 7-10) [John McLean, Australia]	Not applicable. paragraph no longer in the introduction
125083	10	31	10	31	Authors should define "Global Stocktake" process under the UNFCCC -- e.g., via A footnote. Crib from the much better (and brief) explanation of the "global stocktaking process to assess progress towards meeting the Paris goals " provided on page 15, lines 26-28. [Trigg Talley, United States of America]	Not applicable. paragraph no longer in the introduction
36503	10	33	10	33	The media's role in how climate change is perceived falls outside the IPCC's stated role, viz "The role of the IPCC is to critically assess the scientific, technical, and socio-economic information relevant to understanding the impacts of human-induced climate change, including its risks, opportunities and options for adaptation and mitigation" and therefore all reference to what the media does should be removed from the report. [John McLean, Australia]	Not applicable. paragraph no longer in the introduction
114159	10	34	10	35	"... and the place of values...": can you be more clear here? [Jan Fuglestedt, Norway]	Taken into account, changed to "bias related to scientists values in constructing, assessing and conveying IPCC findings"
19487	10	35	10	35	surface temperature changes between where? See and land? Land and land? [Hamideh Dalaei, Iran]	Not applicable. The reviewer not indicating the right page/line
26533	10	36	10	36	Replace "third" with "second" [Eric Brun, France]	Not applicable. The reviewer not indicating the right page/line

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
70423	10	38	14	36	Section 1.2.1 contains assessment of past and future changes in large-scale climate. It cites and assesses primary research literature on past large-scale climate change, attribution and future changes, and mainly refers to Ch1 figures. This overlaps with Chapters 2, 3, and 4. Based on the principle that the same topic should not be assessed in two places in the report, I do not think it is appropriate to include this section in Chapter 1. In some cases this section refers forward to assessment conclusions from later chapters - this is better than assessing research literature in parallel - but I would suggest that the place in the report where these conclusions should be synthesized is in the TS and SPM, not in Chapter 1. [Gillett Nathan, Canada]	Rejected. This section does not contain assessment (as can be seen from the lack of calibrated language and references), but rather a set of links to where the assessment can be found. The ongoing changes are a key part of framing the report, and need to be shown here at the outset. We do appreciate comments and feedback on how to respectfully link to the locations of the full assessments, though. Also, we note that this kind of "framing via context" has been explicitly requested of CH1 from the start of this assessment cycle.
34809	10	40	10	44	The SOD claims that the Greenland ice sheet state is unprecedented over centuries. Please see rebuttal comment #8 above. [Jim O'Brien, Ireland]	Rejected. We refer to the sections of the report where the relevant assessment is made (see the links in the text). Also: In future comments, please note that authors do not receive your comments in the order you submit them, so references to your own comments by your own numbering system do not enable us to locate them.
34811	10	40	10	44	The SOD claims that the Antarctic has lost ice mass since the early 1990s, but further down correctly admits that there is no significant trend. Please see general comment #9 above. [Jim O'Brien, Ireland]	Rejected. We refer to the sections of the report where the relevant assessment is made (see the links in the text). Also: In future comments, please note that authors do not receive your comments in the order you submit them, so references to your own comments by your own numbering system do not enable us to locate them.
34807	10	40	10	45	The SOD claims an unprecedented loss in Arctic sea ice over the last 1000 years. Please see rebuttal comment #7 above [Jim O'Brien, Ireland]	Rejected. We refer to the sections of the report where the relevant assessment is made (see the links in the text). Also: In future comments, please note that authors do not receive your comments in the order you submit them, so references to your own comments by your own numbering system do not enable us to locate them.
28657	10	40		41	The opening could be removed: "The starting point for the present report is the context of ongoing changes in the physical and biogeochemical climate system, increased overall monitoring capability, and improved knowledge. In 2013,.". The next sentences then repeat p.31 L19. [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. The introduction has been revised.
21267	10	41	10	44	While this is true it is incomplete as it was in AR4 that the unequivocal finding was first made and it would seem important to acknowledge this here rather than to inadvertently imply that this finding first arose in AR5. [Peter Thorne, Ireland]	Taken into account. 'Concluded' changed to 'stated'. We need to start from the AR5 phrasing here, and the discussion of the evolution of IPCC statements comes later in the chapter.
26535	10	46	10	46	This could also signal the share of total heat absorbed by the ocean - perhaps in link with paragraph beginning line 14 on page 32 [Eric Brun, France]	Not applicable. The section has been substantially revised.
36505	10	46	10	47	False implications. The climate is always changing. And I hope that you can really support your argument that changes are accelerating bearing in mind that similar changes are quite likely to have occurred previously but either not be observed, or not worth recording. [John McLean, Australia]	Rejected. The implication is clearly not that changes to the climate is something new, but that the anthropogenic changes documented in this and previous reports are continuing.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
15893	10	46	10	49	<p>The statement:</p> <p>"Since the AR5, changes to the state of the physical and biogeochemical climate system have continued, and, in some respects, accelerated. Details of these changes are assessed in full in later chapters. In this section, the ongoing changes are illustrated through key large-scale observables, and shown in relation to the longer term evolution of the climate."</p> <p>underplays the severity by using the word "some." The proposed rewording:</p> <p>"Since the AR5, changes to the state of the physical and biogeochemical climate system have continued, and, in many respects, accelerated and this is evident on all critical measures of climate change, e.g. atmospheric CO₂, methane concentrations, ocean heat content, etc. Details of these changes are assessed in full in later chapters. In this section, the ongoing changes are illustrated through key large-scale observables, and shown in relation to the longer term evolution of the climate." [Kevin Lister, United Kingdom (of Great Britain and Northern Ireland)]</p>	Rejected. Thanks for the suggestion, but another solution was found for this intro section.
125085	10	52	11	55	[ACCESSIBILITY] Shouldn't all of the observed changes reported in Section 1.2.1.1 be presented in the chapters of the report devoted to these aspects of change in the physical climate system? This chapter is too long and deleting this section that is redundant with other parts of the report would save a lot of space. Instead, rely on Figure 1.2 and its accompanying text to provide context. [Trigg Talley, United States of America]	Rejected. Indeed Figure 1.2 represents the key message, but for it to be placed here we need some accompanying material. Also, the ongoing changes make up such a key part of the framing of the report that they should be summarized here - even if the full assessment is performed later.
107123	10	53			Thank you for removing the erroneous statement in the FOD claiming that the rate of global mean sea level rise "has itself increased." However, many people have that misconception, and you really need to debunk it. I suggest adding the following sentence: "Coastal sea levels (measured by tide gauges) are falling in some places, but rising in most. The long-term global average rate of rise is about +1.5 mm/yr. The longest, best-quality measurement records show substantial decadal fluctuations, but no significant, sustained acceleration in the rate of sea-level rise since the 1920s. Mid-ocean sea-levels (measured by satellite altimetry) are less consistent, with average trends in the neighborhood of +3 mm/year, but different satellites measuring substantially different rates, numerous large revisions from differences in data processing, and some studies reporting acceleration but others reporting deceleration." [David Burton, United States of America]	Rejected. This is not material for Ch1, but for Ch9 and their assessments of sea level rise.
67697	10	54	10	55	It is written that "Broadly speaking, the climate system is divided into five realms" in this sentence. However, the left figure in Figure 1.2 indicates the main domain of climate system consists of four domains, that is, the land and biosphere systems are combined into one system. This discrepancy should be settled. [Hiroaki Kondo, Japan]	Taken into account. The 'realms' used in the report have been harmonized as 'atmosphere, biosphere, cryosphere and oceans'.
70035	10	55	11	1	Important that all 5 realms, including land, are mentioned here. Note that this should also be reflected in the structure of Fig. 1.2. [Sonia Seneviratne, Switzerland]	Rejected. The 'realms' used in the report have been harmonized as 'atmosphere, biosphere, cryosphere and oceans', after discussions with several chapters.
19615	10	55	11	7	It would be fair and exact to include in this list remote sensing from the Earth surface. Radars explore convective storms; lidars and radiometers contribute for example to monitor the impact of the Montreal protocol on the stratospheric ozone layer. [philippe waldteufel, France]	Accepted.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
29665	10	55	11	15	Please, consider three suggestions about Figure 1.2: 1) Try to use a different color palette (instead of grayscale) because it is difficult to distinguish CO2 values from missing data (grey also indicates missing data). 2) In the main text, in the previous paragraphs where Figure 1.2 is discussed (page 10, line 55 and page 11, line 1), the climate system is divided in five "realms", but the Figure 1.2 only has four "domains". So, I suggest to explicitly state that land and biosphere has been grouped together in one "component" of the climate system. 3) Consider if the use of three different terms (realms, domains and components) in the Figure 1.2 and its corresponding text in the main text in relation to the climate system is convenient or not. [Hernan Edgardo Sala, Argentina]	Taken into account. Text revised, where applicable.
19613	10	55	12	18	So the climate system is said to be divided into five realms. According to figure 1.2 and its legend, there are however four climate system domains! You have got the reader a bit confused. [philippe waldteufel, France]	Taken into account. The 'realms' used in the report have been harmonized as 'atmosphere, biosphere, cryosphere and oceans'.
42831	10	55			Here you describe 5 realms, but in Fig 1.2 you show it as 4. This needs to be consistent. [Eric Wolff, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. The 'realms' used in the report have been harmonized as 'atmosphere, biosphere, cryosphere and oceans'.
125087	11	1	11	1	Why include the biosphere if it isn't discussed further? [Trigg Talley, United States of America]	Noted. Because it is used in later chapters. This has been clarified in the text.
101385	11	1	11	11	Can you briefly define cryosphere? [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Definition added.
125089	11	2	11	3	Cut "by scientists, institutions, and the general public" as it's unnecessary. [Trigg Talley, United States of America]	Rejected. We wish to highlight that such studies are not the domain of scientists alone, but have had valuable input from the public.
825	11	3	2	7	Maybe good to add the notion that this intensifying (non stationary) observation system introduces a challenge in detecting systematic trends, for which a stationary interpretation of observations is required [Bart van den Hurk, Netherlands]	Noted. This is taken up later in the chapter, but is too detailed at this point.
111901	11	3	11	5	The standard land surface measurements should be the first in such a list of observational resources. For climate change assessment spanning the periods discussed this is still the main source of the consistent data. [Tomas Halenka, Czech Republic]	Taken into account, text revised accordingly.
4743	11	3	11	7	Maybe good to add the notion that this intensifying (non stationary) observation system introduces a challenge in detecting systematic trends, for which a stationary interpretation of observations is required [Bart van den Hurk, Netherlands]	Noted. This is taken up later in the chapter, but is too detailed at this point.
115241	11	5	11	5	Delete ", and much more", since you already started the list with "include". [Andreas Fischlin, Switzerland]	Accepted.
16271	11	5	11	5	consider adding "historical collections" and/or "heritage materials" since the natural history and human experience evidence concentrated in the World's museums AND archives contains comparative evidence illustrating change over time. They are not represented entirely by the term 'citizen science' which would indicate collected only because of citizen recordation. As an example, Henry David Thoreau's (US) phenology records in his mid-19th century journals, as compared to present-day research by Richard B. Primack, Boston University, and Humboldt Research Award recipient, illustrate multi-week changes regionally. This type of information is an opportunity to add detail to narratives, and broaden public engagement with the narrative in ways that increase relevance and encourage attachment to the concept, perhaps even support it more strongly. (Phylogenetic patterns of species loss in Thoreau's woods are driven by climate change CG Willis, B Ruhfel, RB Primack, AJ Miller-Rushing... - Proceedings of the National Academy of Sciences, 2008) [Sarah Sutton, United States of America]	Accepted.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
11007	11	5	11	5	It appears a little strange to include paleoclimate datasets in this sentence, among other modern instrumental observations. [Mengxi Wu, United States of America]	Rejected. The paleo records are being continually improved, even though they represent conditions in the past.
21269	11	7	11	7	The brackets should be expanded to point to chapter 2 for the comprehensive assessment of these aspects rather than inferring that section 1.5 is where this occurs as is presently the case. [Peter Thorne, Ireland]	Taken into account.
89967	11	9	11	15	The long time series of ocean heat content (OHC) appears to be based on a single ocean reanalysis. In contrast to the OHC products post-1970, the reanalysis may well have a much lower credibility level than the other time series depicted here -- contrast with lines 46--50 on this very page; page 91 lines 9--10. At a minimum, some justification should be given for including the ocean reanalysis here. [Jochem Marotzke, Germany]	Accepted. Text revised.
125091	11	9	11	15	Figure 1.2 is an excellent graphical presentation of what is said in this paragraph. [Trigg Talley, United States of America]	Noted. Thanks.
4745	11	11	11	11	wouldn't it be better to state that colours indicate their rank instead of their value? [Bart van den Hurk, Netherlands]	Rejected. That could be done, but as it is, the colours are linked to specific values rather than rank (see the colour bars).
113017	11	13	11	14	This statement ('For these...globally') is not directly supported by the figure. [Diego Miralles, Belgium]	Noted. The results are however documented in the sections referred to when discussing the figure.
67545	11	13	11	14	add decade-to-decade variability [Baijun Tian, United States of America]	Accepted.
105057	11	15	11	15	"albeit not for all indicators" => please indicate which ones or give examples. [Masa KAGEYAMA, France]	Not applicable. (Text deleted.)
85915	11	15	11	15	Figure 1.2 should be positioned here for ease of reference. [Debra Roberts and the Durban WGII TSU, South Africa]	Noted.
70037	11	17	11	24	This text will need to be carefully reworded based on the work of the CC box on the definition of global average temperature in Chapter 2. Note that the question of the definition of Tglob is possibly a topic that could be addressed in chapter 1. I believe there would be a lot less confusion if a neutral term were used to refer to "global average temperature" as a concept, e.g. Tglob. "global average temperature is the term used is the central statement of the Paris Agreement, neither GMST, nor GSAT. How Tglob can be best estimates seems a very relevant topic for chapter 1. [Sonia Seneviratne, Switzerland]	Rejected. The concept is relevant, but hasn't been put to sufficient use throughout the report to be introduced here. We adhere to what is decided in CC-box 2.3 and the box on warming levels, though.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
68249	11	17	11	24	<p>Include that the rate of warming has increased in recent decades. The rate of global annual temperature increase has more than doubled in recent decades to 0.17 °C per decade. The rate of CO2 concentration in the atmosphere also is accelerating, growing to a rate of 2.48 ppm/year in 2018; for comparison, the average increase of CO2 in the 1980s was about 1.6 ppm/year and 2.2 ppm/year during the last decade (2008–2017). The accelerating warming is being driven not only by continuing emissions, but also by self-reinforcing feedbacks. Xu Y., et al. (2018) Global warming will happen faster than we think, NATURE, Comment 564:30–32; National Oceanic and Atmospheric Administration (NOAA), Global Climate Report - Annual 2018 (last accessed 15 June 2019) (“During the 21st century, the global land and ocean temperature departure from average has reached new record highs five times (2005, 2010, 2014, 2015, and 2016), with three of those being set back-to-back. From 1880 to 1980, a new temperature record was set on average every 13 years; however, for the period 1981–2018, the frequency of a new record has increased on average to once every three years. Nine of the 10 warmest years (listed below) have occurred since 2005, with the last five years (2014–2018) ranking as the five warmest years on record. The year 1998 is the only year from the 20th century among the ten warmest years on record, currently tying with 2009 as the ninth warmest year on record. The yearly global land and ocean temperature has increased at an average rate of 0.07°C (0.13°F) per decade since 1880; however, the average rate of increase since 1981 (0.17°C / 0.31°F) is more than twice as great.”); National Oceanic and Atmospheric Administration (NOAA), Earth System Research Laboratory Global Monitoring Division, “The NOAA Annual Greenhouse gas index (AGGI)”;</p> <p>Xu and Ramanathan (2017) Well below 2 °C: Mitigation strategies for avoiding dangerous to catastrophic climate changes, Proc. Natl. Acad. Sci., doi: 10.1073/pnas.1618481114; Report of the Committee to Prevent Extreme Climate Change (Co-Chairs: Ramanathan V., Molina M. L., and Zaelke D.; Authors: Alex K., Auffhammer M., Bledsoe P., Borgford-Parnell N., Collins W., Croes B., Forman F., Gustafsson Ö., Haines A., Harnish R. Jacobson M. Z., King S., Lawrence M., Leloup D., Lenton T., Morehouse T., Munk W., Picolotti R., Prather K. Raga G. B., Rignot E., Shindell D., Singh A. K., Steiner A.,</p>	<p>Rejected. Thanks for the comment. This material is however to be assessed in later chapters, rather than in Ch1 where we only introduce the overall context.</p>

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
66741	11	17	11	24	<p>Include that the rate of warming has increased in recent decades. The rate of global annual temperature increase has more than doubled in recent decades to 0.17 °C per decade. The rate of CO2 concentration in the atmosphere also is accelerating, growing to a rate of 2.48 ppm/year in 2018; for comparison, the average increase of CO2 in the 1980s was about 1.6 ppm/year and 2.2 ppm/year during the last decade (2008–2017). The accelerating warming is being driven not only by continuing emissions, but also by self-reinforcing feedbacks. Xu Y., et al. (2018) Global warming will happen faster than we think, NATURE, Comment 564:30–32; National Oceanic and Atmospheric Administration (NOAA), Global Climate Report - Annual 2018 (last accessed 15 June 2019) (“During the 21st century, the global land and ocean temperature departure from average has reached new record highs five times (2005, 2010, 2014, 2015, and 2016), with three of those being set back-to-back. From 1880 to 1980, a new temperature record was set on average every 13 years; however, for the period 1981–2018, the frequency of a new record has increased on average to once every three years. Nine of the 10 warmest years (listed below) have occurred since 2005, with the last five years (2014–2018) ranking as the five warmest years on record. The year 1998 is the only year from the 20th century among the ten warmest years on record, currently tying with 2009 as the ninth warmest year on record. The yearly global land and ocean temperature has increased at an average rate of 0.07°C (0.13°F) per decade since 1880; however, the average rate of increase since 1981 (0.17°C / 0.31°F) is more than twice as great.”); National Oceanic and Atmospheric Administration (NOAA), Earth System Research Laboratory Global Monitoring Division, “The NOAA Annual Greenhouse gas index (AGGI)”;</p> <p>Xu and Ramanathan (2017) Well below 2 °C: Mitigation strategies for avoiding dangerous to catastrophic climate changes, Proc. Natl. Acad. Sci., doi: 10.1073/pnas.1618481114; Report of the Committee to Prevent Extreme Climate Change (Chairs: V. Ramanathan, M. L. Molina, and D. Zaelke) (2017) Well Under 2 Degrees Celsius: Fast Action Policies to Protect People and the Planet from Extreme Climate Change; Steffen W., et al. (2018) Trajectories of the Earth System in the Anthropocene, PROC. NAT'L. ACAD. SCI. 115(33):8252–8259. [Kristin Campbell, United States of America]</p>	<p>Rejected. Thanks for the comment. This material is however to be assessed in later chapters, rather than in Ch1 where we only introduce the overall context.</p>

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
69861	11	17	11	24	<p>Include also rate of warming. The accelerating warming is being driven not only by continuing emissions, but also by self-reinforcing feedbacks. Xu Y., et al. (2018) Global warming will happen faster than we think, NATURE, Comment 564:30–32; National Oceanic and Atmospheric Administration (NOAA), Global Climate Report - Annual 2018 (last accessed 15 June 2019) (“During the 21st century, the global land and ocean temperature departure from average has reached new record highs five times (2005, 2010, 2014, 2015, and 2016), with three of those being set back-to-back. From 1880 to 1980, a new temperature record was set on average every 13 years; however, for the period 1981–2018, the frequency of a new record has increased on average to once every three years. Nine of the 10 warmest years (listed below) have occurred since 2005, with the last five years (2014–2018) ranking as the five warmest years on record. The year 1998 is the only year from the 20th century among the ten warmest years on record, currently tying with 2009 as the ninth warmest year on record. The yearly global land and ocean temperature has increased at an average rate of 0.07°C (0.13°F) per decade since 1880; however, the average rate of increase since 1981 (0.17°C / 0.31°F) is more than twice as great.”); National Oceanic and Atmospheric Administration (NOAA), Earth System Research Laboratory Global Monitoring Division, “The NOAA Annual Greenhouse gas index (AGGI)”;</p> <p>Xu and Ramanathan (2017) Well below 2 °C: Mitigation strategies for avoiding dangerous to catastrophic climate changes, Proc. Natl. Acad. Sci., doi: 10.1073/pnas.1618481114; Report of the Committee to Prevent Extreme Climate Change (Co-Chairs: Ramanathan V., Molina M. L., and Zaelke D.; Authors: Alex K., Auffhammer M., Bledsoe P., Borgford-Parnell N., Collins W., Croes B., Forman F., Gustafsson Ö., Haines A., Harnish R. Jacobson M. Z., King S., Lawrence M., Leloup D., Lenton T., Morehouse T., Munk W., Piccolotti R., Prather K. Raga G. B., Rignot E., Shindell D., Singh A. K., Steiner A., Thiemens M., Titley D. W., Tucker M. E., Tripathi S., Victor D., & Xu Y.) (2017) Well Under 2 Degrees Celsius: Fast Action Policies to Protect People and the Planet from Extreme Climate Change; Steffen W., et al. (2018) Trajectories of the Earth System in the Anthropocene, PROC. NAT'L. ACAD. SCI. 115(33):8252–8259. [Gabrielle Dreyfus, United States of America]</p>	<p>Rejected. Thanks for the comment. This material is however to be assessed in later chapters, rather than in Ch1 where we only introduce the overall context.</p>
21273	11	17	11	32	<p>It would arguably make more sense to put the change in the drivers ahead of the response to those drivers - so flip the order of these two paragraphs. This would also be consistent with the narrative undertaken in chapter 2. [Peter Thorne, Ireland]</p>	<p>Rejected. From a physics point of view this is clearly true. However, in the current broader context, the main emphasis is placed on GMST change. Also, we do not want to imply attribution here, even when it is solidly established.</p>
70455	11	17	11	50	<p>These paragraphs assess observed changes, based on a mixture of references to analysis presented in this chapter (Figure 1.2), references to IPCC Special Reports, and references to later chapters. Quantitative results regarding observed changes are presented. No confidence or likelihood assessments are presented with these results. This assessment overlaps with the assessment of other chapters, especially Chapter 2. I recommend removing this material from Chapter 1. [Gillett Nathan, Canada]</p>	<p>Rejected. We're not making an assessment, which is why there is no calibrated language. This section introduces the ongoing changes to a small number of key indicators that have been extensively reported on in previous cycles, and links to where they are further assessed in this report. Quantitative results are only presented as provided to us by later chapters, with links to the full assessments.</p>
90031	11	18	11	18	<p>"observations in each realm of the physical climate system" - what does "realm" mean is no clear [Govindarajalu Srinivasan, Thailand]</p>	<p>Rejected. This refers to the definition of realms two paragraphs before.</p>
42053	11	19	11	19	<p>box 1.2 not 1.3 [Julia Nabel, Germany]</p>	<p>Accepted.</p>

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
36507	11	19	11	19	The statement is baseless. There is no reason to assume that the 1850-1900 period approximates the baseline for global average preindustrial temperatures. Coverage from 1850-1900 did not exceed 50% of the Earth's surface. From January 1850 to June 1853 a single weather station in Indonesia was the only source of southern hemisphere temperature data. During the 1860s more than 60% of the northern hemisphere coverage was from western Europe, the North Atlantic Ocean and the east coast of the USA, this despite the region covering only 12% of the hemisphere. The bias towards this region decreased reasonably consistently to ~22% in 1885. Europe was recovering from the Little Ice Age at the time so the bias in the Northern Hemisphere average, and therefore to the global average is to low values. I refer you to "An Audit of the Creation and Content of the HadCRUT4 Temperature Dataset" (2018) which discusses these issues in chapter 4. And don't try to tell me that my audit is ignored because it is not peer reviewed. From just the authors whose names start with 'A', 'B' or 'C' in your list of references you include 19 references that have not undergone journal-style review. By the way, before trying to making claims about warming shouldn't you first audit the data to check that it is correct? [John McLean, Australia]	Rejected. The assessment of Chapter 2 (and previous IPCC reports) confirms that 1850-1900 is the end of a period of relatively slow and weak changes to global surface temperature, just prior to the current rapid rise. The literature that this is based upon discusses all issues raised in this comment. For further information, please see Chapter 2, and CC-Box 1.2 in Chapter 1.
125093	11	19	11	19	This line contradicts the conclusion on page 6 beginning on line 7 which says the baseline should begin in 1750, not 1850. Key messages in Chapter 2 use 1700s as a starting point for comparing pre- and post-industrial. [Trigg Talley, United States of America]	Rejected. The decision of WG1 is to use 1850-1900 as the main baseline for comparison to 'pre-industrial' conditions. 1750-1800 is discussed in box 1.2, but is not a formal baseline period.
6427	11	20	11	20	As noted in comment 42 on the Technical Summary, the central estimate of the temperature increase from 1850-1900 to 1995-2014 quoted here is a shift of a little over 0.1°C in the pre-industrial level compared with SR1.5. This moves the goalposts of the Paris Agreement, even though the risks associated with climate change over the years following the Paris Agreement are unchanged by altering the pre-industrial level. Please see comments 2 and 3 on the entire report, which argue that the pre-operational level should be fixed at the level it was estimated to be at the time the Paris Agreement was made, or at least as it was estimated in SR1.5. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Please see Cross-Chapter box 2.3 for further discussion on this topic.
14891	11	20	11	20	(minor): Cross chapter Box 2.3 Table 1 read GMST Warming 1850-1900 to 1995-2014 : 0.87°C (0.76 – 0.98°C). Here it is 0.87 °C (0.77 – 0.97 °C). I agree that the difference is minor (probably not significant and related to rounding). However, it would be better to use the same value. [Marie-France Loutre, Switzerland]	Accepted.
42059	11	20	11	20	0.87 or 0.86 (Box 1.2 Fig.1)? [Julia Nabel, Germany]	Taken into account, number revised.
85917	11	20	11	20	The 0.87C is confusing for policy makers who now have a 1 degree increase locked into their memories because of SR1.5. Need to explain why there ia a difference as not everyone reads IPCC reports in enough detail to understand. [Debra Roberts and the Durban WGII TSU, South Africa]	Taken into account. We now refer to CC-box 2.3 which discusses this in detail, but cannot give the full story here. We will adhere to what is decided by other chapters and box teams when deciding the final wording here.
100515	11	20	11	20	I suggest to replace the 20-year modern reference period by the 10-year reference period given in Cross Chapter Box 2.3 Table 1 [Peter Lemke, Germany]	Rejected. We now refer to CC-box 2.3 which discusses this in detail, but cannot give the full story here. We will adhere to what is decided by other chapters and box teams when deciding the final wording here.
111903	11	20			Section 2.3.1.1 - It means the Chapter 2 I would say, should be referred with this, or at least for the first appearance of such a reference ist should be given as indication of shortened referencing of the sections of other chapters. [Tomas Halenka, Czech Republic]	Rejected. References across chapters have been harmonized throughout the report.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
90033	11	21	11	22	state what GSAT first report assessed and what AR5 assessed in the last cycle, rather than "evolving change has been documented in previous Assessment Reports" [Govindarajalu Srinivasan, Thailand]	Rejected. This is done in section 1.3.
42061	11	21	11	24	maybe explicitly state that the modern reference periods differed / i.e. that each previous AR has a corresponding earlier "modern" reference period? Or e.g. "each reporting a higher global temperature change as compared to the respective modern reference period of the previous one, documenting increases in mean surface air temperatures"? [Julia Nabel, Germany]	Accepted.
36509	11	21	11	24	You are ignoring the distortions caused by the adjustment of temperature according to WMO methods, none of which take into account gradually increasing non-meteorological distortion of measured temperatures (e.g. increasing UHI, degradation of Stevenson screens), this despite the eventual action to rectify these situations being an exceptionally common form of data adjustment. The WMO's equal adjustment of all data not only excessively adjusts data when less distortion was occurring but retains the trend caused by that distortion (just as the Berkeley BEST data analysis did). Multiple flawed adjustments often increase the excessive adjustment of earlier data. See section 9.9 of "An Audit of the Creation and Content of the HadCRUT4 Temperature Dataset" (2018) In short, the reported warming is incorrect but it is impossible to determine the sign and magnitude of that error. [John McLean, Australia]	Rejected. No peer reviewed literature cited to support claim. Please direct these comments to Chapter 2, which performs the assessment of the datasets in question.
82555	11	22	11	23	The statement that land temperatures are warming at nearly double the rate of the global mean is not consistent with the changes reported in Chapter 2 (e.g. 1.20 and 0.87 respectively from 1850-1900 to 1995-2014). The 1.53 increase quoted to 2006-2015 in SRCLL is from a single data set (Berkeley Earth), not the multiple data sets used in Chapter 2 (and the 0.87 with which it is being compared appears to be the multi-dataset mean from SR1.5, so not really like with like). Since the 1.53/0.87 are a finding of SRCLL it needs to be quoted somewhere, but that would perhaps be more appropriate in the box at P43 L13-15 (although even there my inclination would be to keep the 1.53, but not the potentially misleading "almost double" wording). [Blair Trewin, Australia]	Taken into account. This phrasing has been removed, and left for other parts of the report.
125095	11	23	11	23	Consider inserting: "... twice the global rate (i.e., OVER LAND AND THE OCEAN), and has..." [Trigg Talley, United States of America]	Not applicable. (Text deleted.)
42063	11	23	11	24	this is a rather specific impact example in a context dealing with info on general temperature change - consider deletion [Julia Nabel, Germany]	Accepted.
111905	11	24			Based on above interpretation, I would expect this is referring to Ch1, section 1.3, Ch2, Section 2.3 in AR6, and SRCLL, but it could be understood as Sec. 1.3 and 2.3 in SRCLL, actually, referred in the references as IPCC (2019a) [Tomas Halenka, Czech Republic]	Not applicable. (Text deleted.)
34813	11	25	11	43	The SOD mentions that during the Interglacial cycles, temperatures varied from -7°C to +2°C, and sea levels from -130m to +19m; these figures demonstrate that current temperature and sea level variations are quite insignificant in the broader context. [Jim O'Brien, Ireland]	Rejected. This report documents temperature (and other) changes over a long term context, and in the context of the evolution of human civilization. This later evolution is what drives the current impacts of climate change.
11327	11	26	11	28	Replace "407.4 ± 0.17 ppm in 2018" by most recent value "409.8 ± 0.17 ppm in 2019" [Michael Schmitt, Germany]	Accepted.
80979	11	26	11	29	Perhaps these 2018 figures can be updated prior to publication. [Jeffrey Philip OBBARD, Singapore]	Accepted.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
101381	11	26	11	32	A key section - some suggestions for clarity and readability to non-experts: Replace "concurrently" with "At the same time"? Define ppm. Delete 'based on the NOAA network'? Doesn't seem relevant, and confusing if acronym not explained / ref not directly given - can get info from section. "Broadly consistent" implies not completely - is that the case? Can you define radiative forcing briefly, or use e.g. 'driver of climate change', or link to 1.3.3 where it is defined? Also you have the observations being the source of forcing, not the CO2 itself. Precip is the only metric without a quantitative summary in the text - is that intentional? (could it be %?) [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Thanks Tamsin, very useful comment.
15895	11	26	11	32	The statement: "Concurrently, atmospheric concentrations of a range of greenhouse gases are increasing. Carbon dioxide (CO ₂ , shown in Figure 1.2) has increased from 286.7 ± 2.1 ppm in 1850 to 407.4 ± 0.17 ppm in 2018 (based on the NOAA network); concentrations of methane (CH ₄), and nitrous oxide (N ₂ O) have increased as well (see Sections 2.2 and 5.2, and Annex V). These observations are assessed to be broadly consistent with known anthropogenic and natural emissions, when accounting for observed and inferred uptake by land, oceans and biosphere respectively (see Section 5.2), and are a key source of current anthropogenic radiative forcing (see Sections 2.2 and 7.3)." should have equivalent numbers quantifying the increase of methane and nitrous oxide, along with their current contributions to radiative forcing, i.e. methane contributes ~22% to radiative forcing and nitrous oxide contributes approximately ~7% to radiative forcing using the equations from AR4, working group 1, chapter 2 [Kevin Lister, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. Agree in principle, but this is left for Chapter 2. A fully story should also have aerosols etc. CO ₂ us picked as the main driver, as documented in previous reports.
90035	11	26	11	32	that Carbon dioxide concentraions have increased is quite well know and appreciated, adding a line in the para on changes in magnitudes of CO ₂ sinks will be novel, if possible. [Govindarajalu Srinivasan, Thailand]	Rejected. The idea is appealing, but is left for Chapter 5 and potential elevation from there to the TS/SPM.
125097	11	27	11	27	In the parenthetical reference to Figure 1.2, include a reference to Figure 1.3(a). [Trigg Talley, United States of America]	Taken into account, reference added.
85919	11	27	11	28	Ensure that the final draft has the latest up-do-date CO ₂ levels, and give numbers for methane and N ₂ O as these gases have increased by an even greater margin, and mention other powerful GHGs. These are important messaging points and should come up early in chapter. [Debra Roberts and the Durban WGII TSU, South Africa]	Taken into account, data updated.
125099	11	28	11	28	Need to be more specific here about the type of network or delete the vague, unnecessary reference to a "NOAA network". [Trigg Talley, United States of America]	Taken into account, text revised accordingly.
28663	11	29			Figure 1.3 may be more powerful if projection bars revert back to lines/timeseries. [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Figure has been substantially revised. But the bars will be kept for projections. [Note: wrong page number, should be page 12, not 11]
24213	11	30			Is "broadly" consistent the appropriate adverb? Where is the citation? [Bryan Weare, United States of America]	Taken into account. The citation is the link to the relevant sections at the end of the sentence.
80981	11	34	11	34	To refer to the hydrological cycle as 'strengthening' is not the best choice of words, maybe amplifying, changing, altering etc? [Jeffrey Philip OBBARD, Singapore]	Taken into account. Changed to 'intensifying', per other comments.
101383	11	34	11	38	Can you replace hydrological with "water", or at least add it in brackets? Maybe this is too fussy but replace declining trend with decrease in precipitation? [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Accepted.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
125101	11	34	11	38	This paragraph on the hydrological cycle references Section 2.3, which also indicates "large interannual variability and regional heterogeneity" when examining global precipitation. The quoted phrase should be included in this paragraph to provide some nuance and indicate the complexity of analyzing trends in precipitation, especially at large spatial scales. [Trigg Talley, United States of America]	Taken into account. This is stated in the paragraph, albeit in a less technical form.
70457	11	34			What does it mean that the hydrological cycle is strengthening? This is the first place in the report where the strengthening of the hydrological cycle is described, so the meaning of this should be made clear. Which variable defines the strength of the hydrological cycle? Is it global mean precip? [Gillett Nathan, Canada]	Taken into account. Changed to 'intensifying', per other comments.
28661	11	34			What is meant by "the hydrological cycle is strengthening"? It is certainly intensifying in terms of increased magnitude of fluxes of water through the atmosphere and between the surface and the atmosphere. [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Changed to 'intensifying', per other comments.
28665	11	34			It could be communicated more effectively that CO2 acts as a feedback to orbital driven changes over these long time-scales. Also I think the forcing is quite distinct from present day understanding of forcing (e.g. regional and seasonal manifestation of forcing are crucial in initiating large ice-albedo feedbacks). [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. These are good points, but we had to condense the text quite a bit and thus the context was changed.
113023	11	35	11	35	different from surface' to 'different from those of surface'. [Diego Miralles, Belgium]	Accepted.
36511	11	35	11	35	Nonsense. Under what possible scenario would changes to the hydrological cycle be the same as changes to temperature when the two deal with different factors and are measured differently? [John McLean, Australia]	Rejected. The fact remains that we observe rapid changes in both temperature and precipitation, and that they have different geographical patterns. This is what is stated here.
89969	11	36	11	36	second bar? [Jochem Marotzke, Germany]	Accepted.
113025	11	36	11	36	the third bar"; unclear what this refers to. [Diego Miralles, Belgium]	Accepted.
4747	11	36	11	36	is not the third bar in fig 1.2 [Bart van den Hurk, Netherlands]	Accepted.
125103	11	36	11	36	Revise text to delete "third bar" and replace with "second bar". [Trigg Talley, United States of America]	Accepted.
37815	11	36	11	36	The third bar in Figure 1.2 should be "the second bar in Figure 1.2". [Junhee Lee, Republic of Korea]	Accepted.
111907	11	36			the third bar in Figure 1.2 - actually, it seems to be rather the second bar (or subbar of the second bar), as in legend of the Fig. There is 6 indicators mentioned, thus the reference to the Fig. Is not exactly clear [Tomas Halenka, Czech Republic]	Accepted.
42833	11	36			"variability is larger, as illustrated by the third bar in Figure 1.2". Precip is the second bar (not third). [Eric Wolff, United Kingdom (of Great Britain and Northern Ireland)]	Accepted.
24215	11	36			"second" not "third" [Bryan Weare, United States of America]	Accepted.
125105	11	37	11	38	The statement that sub-tropical dry regions have experienced a declining trend in recent decades is NOT supported by the second bar in Figure 1.2. Rather, the trend is simply noisy: there is no trend. Revise statement to accurately reflect the science. [Trigg Talley, United States of America]	Taken into account. The statement is supported by Section 2.3, now cited more clearly.
4749	11	38	11	38	I don't see this SH declining trend in the figure [Bart van den Hurk, Netherlands]	Taken into account. The statement is supported by Section 2.3, now cited more clearly.
85921	11	38	11	38	"declining trend" could mean anything. Say "drying" if that is the case. [Debra Roberts and the Durban WGII TSU, South Africa]	Taken into account.
85923	11	40	11	40	"generally" sounds like there could be a margin of uncertainty or variability. If ice is melting almost everywhere, with a few exceptions, then say it clearly like that. [Debra Roberts and the Durban WGII TSU, South Africa]	Taken into account.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
105059	11	40	11	42	the first two sentences of the paragraph should be switched. [Masa KAGEYAMA, France]	Rejected. We find that the logic flows better as the text stands.
101387	11	40	11	44	If defining cryosphere here instead of at first instance, can you put as the first sentence of paragraph? And "mass loss" is strange for non-experts - possible to explain? Define Gt. [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. The definition has been placed earlier in the text, but is also retained here for clarity.
88151	11	40	11	44	Reference should be made to Chapter 2 (2.3.2) which covers large scale observations of cryospheric change. It would also be good to provide the value for glacier mass loss over the last century to provide some context for the change over a very short period (2012-2016). [Sharon Smith, Canada]	Taken into account. (Partly.) Glacier mass loss over the last century is not a readily available number. The figure gives some context, though.
111359	11	40	11	44	warming of the climate system is 43 unequivocal," and that since the 1950s" - This needs more clarity as past report needs to linked or add the proper reference. [Neeshad Shafi, Qatar]	Rejected. There is a reference given to AR5.
14785	11	42	11	44	I am unable to find the 278 Gt/yr value anywhere in Chapter 9. Furthermore, it seems this value presented in this Chapter is only intended to cover glaciers. Instead, it should cover integrated mass loss from both glaciers, and ice sheets, and perhaps be quoted in units of sea level change (mm/yr or mm/decade). [Jeremy Fyke, Canada]	Taken into account. The text has been updated to reflect the revised assessments of Ch9, and the numbers exchanged for qualitative statements.
45595	11	43	11	44	Although it could be a typo, the value presented in Chapter 9 (page 9-69 line 3) for the global average mass loss of glaciers in 2006-2016 is -274± 113 Gt a-1 (Table 9.3), instead of -278±113 Gt a-1. Take into account that this value could have minor variations if new literature appears. [Lucas Ruiz, Argentina]	Taken into account. The text has been updated to reflect the revised assessments of Ch9, and the numbers exchanged for qualitative statements.
105525	11	43	11	44	"glaciers have been losing mass" - this value appears to be for ice sheets as well as glaciers? [Inga Jane Smith, New Zealand]	Taken into account. The text has been updated to reflect the revised assessments of Ch9, and the numbers exchanged for qualitative statements.
80983	11	43	11	44	Maybe give context to ice mass loss rates for glaciers i.e. refer to earlier periods than 2012-2016 to indicate trend, acceleration of ice mass loss. Similarly, perhaps do the same for Greenland and Antarctica ice mass loss in this paragraph. [Jeffrey Philip OBBARD, Singapore]	Rejected. Good thoughts, but we've landed on giving just one number as an indicator. All the numbers are in Ch9.
101393	11	44	11	44	I can't find this glacier number in 9.6.1. We'll need to cross-check that Ch 2 gives same headline too - 2.3.2.3 currently gives different numbers/time periods. [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. The text has been updated to reflect the revised assessments of Ch9, and the numbers exchanged for qualitative statements.
125107	11	44	11	44	Put 278 +/- 113 Gt/yr in context: how much water is that? Enough to cover an area the size of X in a pool of water that is Y deep. [Trigg Talley, United States of America]	Rejected. It's a good thought, but would break the style of the section.
42835	11	44			"they lost mass at a rate of 278 ± 113 Gt per year", I assume this excludes Greenland and Antarctica, this needs to be specified. [Eric Wolff, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. The text has been updated to reflect the revised assessments of Ch9, and the numbers exchanged for qualitative statements.
125109	11	46	11	46	Figure 1.2 suggests that unabated warming of the oceans has been occurring since about 1900. Why do you state only since 1971 here? [Trigg Talley, United States of America]	Noted. Direct observations go back to 1970, beyond this the results are model-observation hybrids. This is now noted in the figure caption. For further information, see Chapter 9.
70839	11	46	11	46	To say "since 1971" needs context. It could be interpreted as saying that there was no warming prior to 1971. Need to make clear why you are expressing changes since 1971 only. [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Direct observations go back to 1970, beyond this the results are model-observation hybrids. This is now noted in the figure caption. For further information, see Chapter 9.
110737	11	46	11	48	talking about the ocean, the expression " top to 2000m" seems unclear, is it 2000m from the shore or 2000m deep or 2000m high? [Bruno Korgo, Burkina Faso]	Not applicable. The text has been revised. (It meant down to 2000m depth.)
101389	11	46	11	50	Please define zettajoules...and give uncertainty (or reduce precision). Section 9.6.1 not 9.6.2. And/or Chapter 2? (will [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Text revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
36513	11	46	11	50	This is inconsistent. It talks of the average heat content increasing since 1971 but then says that this "ocean warming" plus other factors caused a sea level rise of 0.15 metres since 1900. Something since 1970 caused something that you refer to as starting in 1900? [John McLean, Australia]	Noted. No, that is not what is implied. The 1970 start year is from a particular observation, please see chapter 9. The text has been revised.
24217	11	46			Is the warming of oceans only visible after 1971? Citation? [Bryan Weare, United States of America]	Noted. Direct observations go back to 1970, beyond this the results are model-observation hybrids. This is now noted in the figure caption. For further information, see Chapter 9.
14787	11	47	11	47	zettajoules' likely not a term that many are familiar with. Suggest using scientific notation instead? [Jeremy Fyke, Canada]	Taken into account. Text revised.
83917	11	47	11	47	for clarity it would be nice to indicate to the reader that zettajoules = 1021 joules [Marco Tulio Cabral, Brazil]	Taken into account. Text revised.
101395	11	49	11	50	We'll need to cross check that Ch 2 gives the same headline too - currently 2.3.3.3 gives a 1901-2015 rate instead. [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Text revised.
45597	11	50	11	50	Please consider that section numbers have changed since FOD and could change for the Final Order Draft. For SOD the global mean sea level between 1900 and 2018 is assessed in section 9.6.1.1 "Sea-level change since 1900". [Lucas Ruiz, Argentina]	Taken into account. Text revised.
125111	11	50	11	50	It seems like this is an opportune time to link changes in ocean warming and ice melt to changes in ocean circulation and weather patterns. Consider adding text to raise this fact to the reader. [Trigg Talley, United States of America]	Rejected. This is a good suggestion, but would expand the section too much. Details are given in later chapters.
85925	11	52	11	52	"progressed beyond the range of natural variability" – can this be said in plain English so everyone understands. e.g. "climate is variable, with natural highs and lows. But climate is now changed so much that conditions are outside of this natural range of variability." Something like that. Again, important for messaging. On the other hand, this seems to contradict the statement of p 12, line 38 which says that temperatures have been +2 higher and sea level +19m, so it is important to include a time frame here. [Debra Roberts and the Durban WGII TSU, South Africa]	Taken into account. Year-to-year variability is now specified.
18601	11	52	11	53	This discussion of climate indicators may also benefit from a reference to regional changes, discussed in CH12 (12.4, in particular), which can be more variable and more substantial. Main point is not to describe the regional changes but to indicate that the global story and the local stories do not always neatly align. [Alexander Ruane, United States of America]	Taken into account. We added a sentence to this effect: "Later chapters (Chapter 10, 11 and 12) present similar assessment at the regional level, where observed changes do not always align with the global mean picture shown here. "
70459	11	52	11	54	These lines discuss the detection of change in large-scale indicators of climate change. This should include a reference to Chapter 3 if retained. [Gillett Nathan, Canada]	Taken into account. Text revised.
89971	11	53	11	53	Including Ch03 seems crucial here [Jochem Marotzke, Germany]	Taken into account. Text revised.
28659	11				Section 1.2.1.1 seems to overlap with the SPM and Chapter 2 so some clear indication of how this is distinct at the beginning and emphasising the distinct aspects or signposting may be beneficial for the report. If just signposting then the text could be condensed, concentrating on presenting current changes in the context of paleo as done later in the section. [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The text has been somewhat condensed, but we still find the signposting relevant as the first part of our presentation of where we are. Chapter 1 should be possible to read as a comprehensive whole.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
70041	12	4	12	20	Figure 1.2: The Figure is not consistent with the text on pages 10 (line 55)-11 (line 1), which correctly mentions that the Earth is constituted of 5 realms. It is also not consistent with the text on page 68 with further correctly separates the "Land" and "Biosphere" realms. It is not correct to concatenate "Land" and "Biosphere" is a single realm. Several land variables are not per se related to the biosphere (e.g. soil moisture, lakes, land surface temperature (not T2M temperature), land heat storage, evaporation from non-vegetated surfaces) and a substantial fraction of the land area is not covered by plants. In addition, there is also biosphere in the ocean (see e.g. on page 68). It would be more accurate to split the figure in 5 realms and include 1 land variable, e.g. lake heat uptake which is available since 1900. See accepted article in GRL (Vanderkelen, I., et al., in press: Global heat uptake by inland waters https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2020GL087867) [Sonia Seneviratne, Switzerland]	Taken into account. Land is now removed from the figure, but mentioned in the caption and text.
70043	12	4	12	20	Figure 1.2: See previous comment regarding the split in 5 realms which would be more accurate (i.e. splitting land and biosphere). Also a variable from the biosphere could be added, e.g. some phenological index. [Sonia Seneviratne, Switzerland]	Rejected. As discussed, we have rather retained biosphere but removed land, to conform to the presentations of Ch2-4. Land is mentioned in the caption and text.
28271	12	4			Figure 1.2: It can be misleading that the biosphere is only paired with land. The marine component of the biosphere, mainly phytoplankton is relevant for climate change. See Basu, S.; Mackey, K.R.M. Phytoplankton as Key Mediators of the Biological Carbon Pump: Their Responses to a Changing Climate. Sustainability 2018, 10, 869. [Ryan Padrón, Switzerland]	Taken into account. Land is now removed from the figure, but mentioned in the caption and text.
101391	12	6	12	18	Great figure! I'll definitely use this in talks/lectures. Some suggestions: I think the horizontal dashed lines slightly decrease clarity and appeal. White text on images is not completely clear. Caption: suggest deleting "The evolution of", replacing anomaly with change, and "missing data" with "that data are not available" or similar. Move baseline numbers for each up to initial statement "relative to a 1961-1990 baseline", because I think they all are? [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Thanks!
36515	12	6	12	18	(Caption to Fig 1.2) The CO2 concentration diagram is wrong. One of the first things that university science students are taught is NOT to join two datasets derived from different methods but that has been done here. Temperature data is also WRONG because it implies that there is no error margin and gives no indication of the large changes in global coverage over time. [John McLean, Australia]	Rejected. The underlying methods are standard, and described in the references given.
35435	12	11	12	12	Subscript CO2 [Carlos Antonio Poot Delgado, Mexico]	Taken into account. Text revised.
35437	12	16	12	16	Use published sources [Carlos Antonio Poot Delgado, Mexico]	Taken into account. Text revised.
98765	12	16	12	16	HadCRUT5.0 is surface temperature not surface air temperature [Elizabeth Kent, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Text revised.
70469	12	23	14	36	This section discusses paleoclimate changes in CO2, temperature, and implications for rapid changes and attribution. Inclusion of a section on paleo perspectives on climate change here would make sense if paleoclimate changes were not considered in subsequent chapters. But Chapter 2 considers observed paleo changes in each variable it assesses. Chapter 3 considers paleo evidence for detection and attribution of each variable considered etc. The scope of this section overlaps strongly with the scope of Chapters 2 and 3 and there are several overlapping assessments. [Gillett Nathan, Canada]	Noted. Chapter 1 has the mandate to provide the context for the assessment and this includes a paleoclimate perspective. We have revised the section to avoid overlap with the thorough assessments provided in e.g. CHs 2, 3, 5, and 9 and have strengthened the cross-referencing to those chapters where appropriate.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
125113	12	23	14	36	Section 1.2.1.2 is a great synthesis of Earth paloclimate history, but doesn't it repeat what is said in subsequent chapters? [Trigg Talley, United States of America]	Noted. Thanks. This broader paleoclimatic context for the WGI contribution to the AR6 is not given elsewhere.
90037	12	23			key points on additional new findings of Paleo analysis since AR5 need to be highlighted in the beginning of this section [Govindarajalu Srinivasan, Thailand]	Rejected. That would be beyond the scope of this introductory section. In AR6, contrary to AR5, there is no dedicated paleo chapter where this would fit best.
101397	12	25	12	25	If possible, please define speleothem, replace with stalagmites and stalagmites, or delete. [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. Speleothem is the technically correct term and we prefer to keep it here. Given the space limitations, we refrain from defining the term here. We also note that the term "speleothem" is used as part of the Glossary definition for "proxy". However, to partly accommodate the reviewer comment, the Section 1.3.2 on "Lines of evidence: paleoclimate" now also mentions "speleothems", and there in conjunction with "(stalactites and stalagmites)".
100563	12	25	12	25	Add: "plant and animal micro- and macro-fossils, soils" [Matthew Kohn, United States of America]	Rejected. Detail not needed.
37817	12	25	12	43	It is recommended that the causes (or sources) of the natural variation of CO2 level in paleo-climate are briefly described here in order to contrast with anthropogenic sources. [Junhee Lee, Republic of Korea]	Rejected. It is already stated that the variations on fig1.3 are driven by millennial scale changes in the orbital parameters
19617	12	25	12	45	paleoclimate or palaeoclimate? [philippe waldteufel, France]	Accepted. Final editorial revisions will take care of such issues
81277	12	25	51		I failed to understand why low frequency , robust long-term paleoclimatic indicators such as those retrieved from borehole temperature profile are not included in the list. This has been a consistent problem over the last decades. This is surprising as paleoclimate inferences from borehole temperatures are the only indicator that is NOT a proxy because the measurements to reconstruct past temperatures at the ground surface are actually temperature measurements. I suggest that you should, for completeness, include borehole temperatures and provide a suitable reference. This is particularly important as these records integrate changes at the ground surface for the complete year, unlike tree-rings that only represent the conditions during the spring-summer and then they are fitted mathematically to reconstruct the complete year. In addition, processing the tree-ring data and the elimination of the growth trend, [i.e. a tree grows more because is young not because is warm or wet] removes long-term paleoclimatic information. Thus complementing the failure of tree-rings to detect long-term changes in temperature with borehole data is not only important it is essential to understand long and shorter scale changes and the sensitivity to the changes in forcing mentioned in line 32-33, and the statement in line 45. [Hugo Beltrami, Canada]	Taken into account. Borehole temperatures mentioned
125115	12	29	12	29	Change "CO2" to read "atmospheric CO2 concentrations" [Trigg Talley, United States of America]	Accepted. Text revised
36517	12	29	12	40	This text endorses the unscientific practice of concatenating data obtained from different sources via different methods. [John McLean, Australia]	Rejected. No evidence provided to support the claim. Physical models are an important element in paleoclimate research

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42837	12	30			"comprising eight complete glacial-interglacial cycles". I suggest "at least eight g-ig cycles", as modern analysis suggests that more such cycles are identifiable (ref Past Interglacials Working Group of Pages (2016), Interglacials of the last 800,000 years, Rev. Geophys., 54, doi:10.1002/2015RG000482). Also EPICA 2004 did not extend 740 ka, but 740 ka, might be better to cite a later paper such as Jouzel, J., et al. (2007), Orbital and millennial Antarctic climate variability over the last 800 000 years, Science, 317, 793-796. [Eric Wolff, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Text revised. We added the Jouzel et al. reference. We maintain the reference to the EPICA 2004, though.
83919	12	31	12	31	as orbital cycles encompass tens of thousands of years, this line should read "driven by orbital cycles and millennial-scale related feedbacks" [Marco Tulio Cabral, Brazil]	Accepted. Text revised
101399	12	31	12	43	Gets a bit technical. If possible: "orbital cycles" -> cycles in Earth's orbit. Says "related" feedbacks but they are not related to the orbital cycles - perhaps "consequent"? "The dominant 100,000-year..." If possible rephrase more simply, e.g. "Over 100,000 year glacial cycles, CO2 concns vary between ..." [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Partially accepted. Text revised
42839	12	31			"millennial-scale orbital cycles" is very confusing terminology as we normally use millennial to imply time periods shorter than the orbital cycles covering many tens of thousands of years. I suggest "multimillennial" [Eric Wolff, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Text revised
74287	12	32	12	32	Consistent spelling of paleoclimate, not palaeoclimate [Christopher Hollis, New Zealand]	Accepted. Final editorial revisions will take care of such issues
125117	12	34	12	34	Revise sentence so it reads: "... characterized by natural variations in ATMOSPHERIC CO2 CONCENTRATIONS between ..." [Trigg Talley, United States of America]	Accepted. Text revised
21275	12	34	12	37	To the unwary reader as written this could imply that these cycles are driven by changes in carbon dioxide rather than the carbon dioxide changes being a feedback to processes initiated by changes in solar insolation. It would I think be worth redrafting this for clarity rather than leaving that as assumed knowledge? [Peter Thorne, Ireland]	Taken into account. Text has been revised to avoid a possible misinterpretation of CO2 driving these cycles.
42841	12	34			"The dominant 100,000-year cycles", to reflect modern knowledge I suggest "The dominant cycles, averaging about 100,000 years," [Eric Wolff, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Text revised
26537	12	36	12	37	This sentence is missing IPCC's calibrated language (to which "demonstrate" does not belong). [Eric Brun, France]	Taken into account. Text revised, we no longer use "demonstrates". However, this is not a formal uncertainty assessment and thus no calibrated language is being applied.
13131	12	37	12	37	minus sign - has to stay together with the 7 [Maria Amparo Martinez Arroyo, Mexico]	Accepted. Final editorial revisions will take care of such issues
105533	12	37	12	38	misleading line divider separates minus sign from value. Remove space between - and 7 [Kenneth Cole, United States of America]	Accepted. Final editorial revisions will take care of such issues
8597	12	37	12	43	Unless assessed rigorously as such, 19 m of GMSL during MWP 11 does not seem credible to me. This seems to be based on Spratt and Lisecki 2016, who had a 95% confidence interval of -11 to +40 m on this. [Robert Kopp, United States of America]	Taken into account. While we kept the Spratt and Lisecki, 2016 results in the figure and text, we now consistently refer to the thorough Chapter 2/9 assessments for ranges of the three key indicators shown in Figure 1.5. We note that they are similar to best estimates for specific time periods based on a variety of evidence assessed and presented in Chapter 2.
71337	12	37			Change "...reconstructed global average surface temperature ..." to "... reconstructed global surface temperature anomaly ...". (ie Add "anomaly"). [David Wratt, New Zealand]	Noted. Text revised. We prefer "change" over "anomaly"

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
35439	12	38	12	38	° C repeats [Carlos Antonio Poot Delgado, Mexico]	Accepted. Text revised
85927	12	39	12	39	" +19m" – in Figure 1.3 a 16m peak is shown. On page 13, L34 it talks about "up to over 15 m" [Debra Roberts and the Durban WGII TSU, South Africa]	Accepted. Text and figure revised for coherency. we now consistently refer to the thorough Chapter 2/9 assessments for ranges of the three key indicators shown in Figure1.5. We note that they are similar to best estimates for specific time periods based on a variety of evidence assessed and presented in Chapter 2.
15897	12	39	12	43	Clarification to the statement: "global sea level varied roughly between -130 m and +19 m (Spratt and Lisiecki, 2016; see Chapter 2.3.3 for a detailed assessment of sea level reconstructions). These ranges represent rough estimates of the amplitudes of natural variations over the last 800,000 years, prior to the influence of human activity. More precise estimates are available for shorter time periods (Chapters 2, 5, and IPCC, 2019)." is needed to the effect of: "global sea level varied roughly between -130 m and +19 m (Spratt and Lisiecki, 2016; see Chapter 2.3.3 for a detailed assessment of sea level reconstructions). These ranges represent rough estimates of the amplitudes of natural variations over the last 800,000 years, prior to the influence of human activity. More precise estimates are available for shorter time periods (Chapters 2, 5, and IPCC, 2019). Thus the long term equilibrium sea level rise when CO2 is consistently in excess of the maximums of the dominant 100,000 year cycle by approximately 50% will likely be in excess of 19m and the planet is also likely to be ice free. [Kevin Lister, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Text revised as part of the revisions, without explicitly following the advice by the reviewer. We do now consistently refer to the thorough Chapter 2/9 assessments for ranges of the three key indicators shown in Figure1.5. We note that they are similar to best estimates for specific time periods based on a variety of evidence assessed and presented in Chapter 2.
101401	12	40	12	40	Delete "detailed" I think? And cite 9.6.2 too. Both give the ~-130m, but I can't see that they give the +19m? [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Text and figure revised for coherency. we now consistently refer to the thorough Chapter 2/9 assessments for ranges of the three key indicators shown in Figure1.5. We note that they are similar to best estimates for specific time periods based on a variety of evidence assessed and presented in Chapter 2.
104721	12	40	12	42	This is an important conclusion on how the natural envelope is derived. It is equally important what is not stated here: the RATE cannot be established with any certainty. Therefore all statements about a climate indicator being "rapid" or "unusual" is supposedly compared with the natural changes. In those cases a historical record cannot support that today's changes are "rapid" or "unusual" one should avoid such overstretched conclusions. [Jan Lindstrom, Sweden]	Rejected. Rates are identified in the paleo records, see next para
105745	12	40	12	43	I was surprised that the point that these natural variations are related to CO2 was not reiterated here - preferably by specifying what the estimates are for [Chris Brierley, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. Purpose of fig to present range of natural changes and relation to projection
36519	12	41	12	42	Not "prior to the influence of human activity" but "prior to any possible influence of human activity". At this point you have not yet proven that there is any human influence. [John McLean, Australia]	Rejected. sub sentence refers to context of past 800,000 years
19489	12	41	12	44	it is better to bring some positive effects of climate change apart of negative impacts such as access to have large amount of freshwater [Hamideh Dalaei, Iran]	No action. This subsection does not focus on positive/negative aspects of climate change

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
70461	12	43			Elsewhere 'SROCC' is used instead of 'IPCC (2019)'. [Gillett Nathan, Canada]	Accepted. Text revised
112871	12	45	12	49	It is claimed that "Current global mean warming has proceeded at least 20 times faster than even the highest estimated warming rates in the palaeoclimate record (Snyder, 2016)." No such a claim can be made for many reasons. The most important is that palaeoclimate records have a temporal resolution of several centuries to thousand years and trends on such long time-scales cannot be arbitrarily compared against trends measured in a few decades. For example, Figure 5.7 of the IPCC AR5 (https://www.ipcc.ch/report/ar5/wg1/information-from-paleoclimate-archives/graphics-produced-by-idl/) shows several paleoclimate records of the last 2000 years and according to several records there have been periods with warming trends comparable to that observed in the 20th century. A similar critique can be formulated for the CO2 records because the text arbitrarily compares atmospheric CO2 values with an annual resolution with CO2 records obtained from ice-cores that have a much larger temporal resolution because ice needs at least 100 years to seal the gas. So you are comparing different things. [Nicola Scafetta, Italy]	Taken into account. Text revised; now reads: "Current multi-decadal GMST exhibit a higher rate of increase than over the past two thousand years (PAGES 2k Consortium 2019, see Section 2.3.1.1.2), and in the 20th century GMSL rise was faster than during any other century over the past three thousand years (see Section 2.3.3.3)."
15899	12	45	12	51	Balance the statement below: "Paleoclimatic information also provides a long-term perspective on rates of change. High-resolution reconstructions from polar ice cores indicate that the rate of increase in CO2 over the 20th and early 21st centuries is at least 10 times faster than during the last 800,000 years (Joos and Spahni, 2008; Nehrbass-Ahles et al., 2019). Current global mean warming has proceeded at least 20 times faster than even the highest estimated warming rates in the paleoclimate record (Snyder, 2016). The rate of projected sea level rise by year 2300 (SROCC) reaches about a quarter of the maximum rate of sea level rise during the past 20,000 years (Masson-Delmotte et al., 2013, FAQ 5.2, Fig. 1)." By commenting on the recovery times of the cycles in paleoclimate records, so "Paleoclimatic information also provides a long-term perspective on rates of increase and decrease. High-resolution reconstructions from polar ice cores indicate that the rate of increase in CO2 over the 20th and early 21st centuries is at least 10 times faster than during the last 800,000 years (Joos and Spahni, 2008; Nehrbass-Ahles et al., 2019). Current global mean warming has proceeded at least 20 times faster than even the highest estimated warming rates in the palaeoclimate record (Snyder, 2016). The rate of projected sea level rise by year 2300 (SROCC) reaches about a quarter of the maximum rate of sea level rise during the past 20,000 years (Masson-Delmotte et al., 2013, FAQ 5.2, Fig. 1). The paleoclimate records show a consistently saw tooth profile on the last 4 cycles with CO2 sequestration rates at approximately 6.7E-4 ppm/year, thus natural processes will take ~250,000 years to return to CO2 to the upper bounds of the dominant 100,000 year cycle. [Kevin Lister, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. No reason provided what this would add to this paragraph.
101403	12	45	12	51	No references to other chapters - should there be? [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. We have revised the section to avoid overlap with the thorough assessments provided in e.g. CHs 2, 3, 5, and 9 and have strengthened the cross-referencing to those chapters where appropriate.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
21277	12	45	12	51	These estimates are somewhat at odds with the assessment made in chapter 2 and chapter 5 and furthermore make no reference to them. Better coordination is required on this aspect if the paragraph is to be retained although it is questionable whether this paragraph constitutes over-reach into the domain of these latter chapters. [Peter Thorne, Ireland]	Accepted. We have revised the section to avoid overlap with the thorough assessments provided in e.g. CHs 2, 3, 5, and 9 and have strengthened the cross-referencing to those chapters where appropriate.
70471	12	45		48	This assessment overlaps with that of 2.2.3.2.1, which is not cited. [Gillett Nathan, Canada]	Accepted. We have revised the section to avoid overlap with the thorough assessments provided in e.g. CHs 2, 3, 5, and 9 and have strengthened the cross-referencing to those chapters where appropriate.
125119	12	46	12	46	Change "CO2" to read "atmospheric CO2 concentrations" [Trigg Talley, United States of America]	Accepted. Text revised
42845	12	46	12	47	The statement about the rate of CO2 increase is a very careless translation of the careful wording used in chapter 2.2.3.2.1. As implied there the ice core record from Dome C, Vostok and Dome Fuji simply doesn't have the resolution to assert that fast rates of change never occurred on decadal scales. A safe wording would be "is at least 10 times faster than that observed in the ice core records covering the last 800,000 years". This allows for the possibility that we did not yet observe at high enough resolution to rule out other fast rates over brief time periods. It would be helpful also to refer the reader to section 2.2.3.2.1. [Eric Wolff, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Wording updated to better reflect the Ch2 assessment. We have revised the section to avoid overlap with the thorough assessments provided in e.g. CHs 2, 3, 5, and 9 and have strengthened the cross-referencing to those chapters where appropriate.
34815	12	46	12	57	The SOD states that paleoclimate records demonstrate the synchronicity between changes in GHG concentrations and global mean temperatures. The actual evidence is to the contrary; GHG level changes followed temperature changes, and the same applies now. Please see general comment #13 above. [Jim O'Brien, Ireland]	Not applicable. Text deleted from Ch1. See Ch2 for an assessment
11009	12	48	12	49	I think an appropriate time scale needs to be added to this sentence, as the warming rate in the deeper past is more uncertain. [Mengxi Wu, United States of America]	Accepted. Wording updated to better reflect the Ch2 assessment. We have revised the section to avoid overlap with the thorough assessments provided in e.g. CHs 2, 3, 5, and 9 and have strengthened the cross-referencing to those chapters where appropriate.
70463	12	48	12	49	This assessment that 'Current global warming has proceeded at least 20 times faster than even the highest estimated warming rates in the paleoclimate record' is inconsistent with the Chapter 2 assessment 'Over the last 50 years, global mean surface temperature (GMST) has increased at an observed rate unprecedented in at least the last two thousand years (medium confidence)' (Chapter 2 ES). First the Ch1 assessment compares the entire paleo record, whereas the ch2 assessment compares only past 2000 years, second the ch1 assessment is that warming is at least 20 times faster, whereas the ch2 assessment is just that the observed rate is higher than the paleo rates, third the ch1 assessment is a factual statement with no confidence or likelihood qualifier, whereas the ch2 assessment is at the 'medium confidence' level. This inconsistency highlights the danger of having independent assessment of the primary literature regarding observations (including paleo observations), attribution and projected changes in Section 1.2.1, which overlaps with Chapters 2, 3 and 4. I recommend removing section 1.2.1 for this reason. If it is retained, this section should not independently assess research literature, but should only report assessment conclusions from the subsequent chapters. [Gillett Nathan, Canada]	Taken into account. Text revised; now reads: "Current multi-decadal GMST exhibit a higher rate of increase than over the past two thousand years (PAGES 2k Consortium 2019, see Section 2.3.1.1.2), and in the 20th century GMST rise was faster than during any other century over the past three thousand years (see Section 2.3.3.3)."

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
42843	12	48	12	49	Statement about warming is meaningless unless you specify a timeframe, eg "20 times faster than even the highest!" rate over what period - decades, centuries? In any case this statement is not supported by Snyder et al, nor by the analysis in chapter 2.3.1. Snyder only presents millennial values (ie one value every thousand years). The highest rate in the last 800 ka is just over 1 degree in a millennium. The recent rate of warming is not generally considered to be 1 degree in 50 years, which is what the current statement implies. Additionally because of the lack of resolution it is impossible to say whether the paleo record hides faster rates of change on shorter timescales tthat are hidden. An appropriate wording might be "Global mean warming of abot 1 degree in the last century compares with maximum rates of 1 degree per millennium observed in the glacial-interglacial transitions of the last 800 ka (Snyder et al)" [Eric Wolff, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Text revised; now reads: "Current multi-decadal GMST exhibit a higher rate of increase than over the past two thousand years (PAGES 2k Consortium 2019, see Section 2.3.1.1.2), and in the 20th century GMSL rise was faster than during any other century over the past three thousand years (see Section 2.3.3.3)."
115015	12	48		49	It says, "Current global mean warming has proceeded at least 20 times faster than even the highest estimated warming rates in the palaeoclimate record (Snyder, 2016)." That's the exact opposite of the truth. Depending on which temperature index you choose, global temperatures are believed to have been rising at an average rate of between 0.06°C and 0.16°C per decade since 1958 (the start of the Mauna Loa CO2 measurement record), as atmospheric CO2 level rose from 315 ppmv to 413 ppmv. Graph: https://sealevel.info/GISS_vs_UAH_and_HadCRUT_1958-2018_woodfortrees_annot2.png That warming was both very slight and very slow, in comparison with past natural changes in the Earth's temperatures. For instance, we know from ice core isotope analyses that over the last 100,000 years the Earth has experienced dozens of natural "Dansgaard-Oeschger events" in which temperatures changed at rates as rapid as several degrees per decade. Those much larger & more rapid natural temperature changes are known to have been globally synchronous, though less abrupt in the southern hemisphere, and they persisted for hundreds or (more typically) thousands of years. I'm very surprised the authors are apparently unaware of them. Here are some references: https://www.nature.com/scitable/knowledge/library/abrupt-climate-change-during-the-last-ice-24288097/ http://archive.is/aUi9R#selection-415.0-419.271 http://archive.is/x6EWS#selection-285.385-293.48 https://judithcurry.com/2017/02/17/nature-unbound-ii-the-dansgaard-oeschger-cycle/ [David Burton, United States of America]	Taken into account. Text revised; now reads: "Current multi-decadal GMST exhibit a higher rate of increase than over the past two thousand years (PAGES 2k Consortium 2019, see Section 2.3.1.1.2), and in the 20th century GMSL rise was faster than during any other century over the past three thousand years (see Section 2.3.3.3)."

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
107125	12	48		49	It says, "Current global mean warming has proceeded at least 20 times faster than even the highest estimated warming rates in the palaeoclimate record (Snyder, 2016)." That's the exact opposite of the truth. Depending on which temperature index you choose, global temperatures are believed to have been rising at an average rate of between 0.06°C and 0.16°C per decade since 1958 (the start of the Mauna Loa CO2 measurement record), as atmospheric CO2 level rose from 315 ppmv to 413 ppmv. Graph: https://sealevel.info/GISS_vs_UAH_and_HadCRUT_1958-2018_woodfortrees_annot2.png That warming was both very slight and and very slow, in comparison with past natural changes in the Earth's temperatures. For instance, we know from ice core isotope analyses that over the last 100,000 years the Earth has experienced dozens of natural "Dansgaard-Oeschger events" in which temperatures changed at rates as rapid as several degrees per decade. Those much larger & more rapid natural temperature changes are known to have been globally synchronous, though less abrupt in the southern hemisphere, and they persisted for hundreds or (more typically) thousands of years. I'm very surprised the authors are apparently unaware of them. Here are some references: https://www.nature.com/scitable/knowledge/library/abrupt-climate-change-during-the-last-ice-24288097/ http://archive.is/aUi9R#selection-415.0-419.271 http://archive.is/x6EWS#selection-285.385-293.48 https://judithcurry.com/2017/02/17/nature-unbound-ii-the-dansgaard-oeschger-cycle/ [David Burton, United States of America]	Text revised; now reads: "Current multi-decadal GMST trends are higher than over the past two thousand years (PAGES 2k Consortium 2019, see Section 2.3.1.1.2) and in the 20th century GMSL rise was faster than during any other century over the past three thousand years (see Section 2.3.3.3)."
74289	12	49	12	49	Consistent spelling of paleoclimate, not palaeoclimate [Christopher Hollis, New Zealand]	Accepted. Final editorial revisions will take care of such issues
74291	12	49	12	49	Sentences are contradictory [Christopher Hollis, New Zealand]	Taken into account. Text revised.
2747	12	49	12	49	Is there more recent projections to support this information; the citation is from 2013? [Carianne Johnson, Belize]	Rejected. Citation is actually from 2016
36521	12	49	12	50	A "projected" change almost 300 years into the future? That's nothing more than a fantasy. (See my comments above for line 28 on this same page) And the use of models is unimpressive unless you can demonstrate that those models accurately embody every climate forcing. [John McLean, Australia]	Rejected. Reviewer does not provide scientific evidence supporting his claim. We refer to the subsequent chapters for details on the use and evaluation of models.
8599	12	49	12	51	Perhaps mention that the rate of GMSL rise since 1900 is the fastest in > 3 kyr (see ch. 2, 9); based on Kopp et al 2016 and Kemp et al 2018. [Robert Kopp, United States of America]	Accepted. Text revised accordingly. Reference to Chapter 2 added.
85929	12	49	12	51	This last sentence is confusing. [Debra Roberts and the Durban WGII TSU, South Africa]	Taken into account. Text revised.
125121	12	50	12	50	Remove (SROCC). [Trigg Talley, United States of America]	Accepted. Sentence referring to SROCC deleted.
101405	12	51	12	51	FAQ 5.2 is wrong number - not sure which though, as I don't think this is in FAQ 9.1 or 9.2 [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Sentence referring to SROCC and AR5 FAQ deleted.
125123	12	51	12	51	Include a sentence explaining the lag in SLR vs [CO2] or GMST. [Trigg Talley, United States of America]	Rejected. Due to space constraints we prefer to not enter the explanation of basic concepts in the report.
74653	12	53	12	56	I support the statement on the synchronicity between changes in greenhouse gas concentrations and global mean temperature, It is also what we see in transient ESM simulations through the last deglaciation. Please note that the team of Chapter 5 SOD on p.15, l.9, using basically the same literature sources, comes to a different conclusion that greenhouse forcing leads global warming. We need consistency in this point. [Victor Brovkin, Germany]	Not applicable. Text has been deleted from revised draft. However, we have revised the section to avoid overlap with the thorough assessments provided in e.g. CHs 2, 3, 5, and 9 and have strengthened the cross-referencing to those chapters where appropriate.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
115243	13	1	13	1	<p>Figure 1.3: I am a bit surprised about the high temperatures in the Eemium as shown in Figure 1.3 (middle panel) based only on a single paper Snyder, 2016, while previous IPCC WGI reports have in my understanding not described such high temperatures as a given. E.g. Masson-Delmotte et al., 2013 wrote "New temperature reconstructions and simulations of the warmest millennia of the last interglacial period (129,000 to 116,000 years ago) show with medium confidence that global mean annual surface temperatures were never more than 2°C higher than pre-industrial." and in AR4 we had no estimate of global mean T with estimates only for Greenland and Antarctica (Jansen et al., 2007) while some GCMs estimated even a global mean temperature below our present.</p> <p>Cited References: ----- Jansen, E., Overpeck, J., Briffa, K. R., Duplessy, J.-C., Joos, F., Masson-Delmotte, V., Olago, D., Otto-Bliesner, B., Peltier, W. R., Rahmstorf, S., Ramesh, R., Raynaud, D., Rind, D., Solomina, O., Villalba, R., & Zhang, D., 2007. Paleoclimate. In: Solomon, S., Qin, D., Manning, M., Chen, Z., Marquis, M., Averyt, K. B., Tignor, M., & Miller, H. L. (eds.). Climate change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). Cambridge University Press: Cambridge, UK and New York, NY, USA. 433-497. (http://www.ipcc.ch/Ja071)</p> <p>Masson-Delmotte, V., Schulz, M., Abe-Ouchi, A., Beer, J., Ganopolski, A., González Rouco, J. F., Jansen, E., Lambeck, K., L. K., Naish, T., Osborn, T., Otto-Bliesner, B., Quinn, T., Ramesh, R., Rojas, M., Shao, X., & Timmermann, A., 2013. Information from paleoclimate archives. In: Stocker, T. F., Qin, D., Plattner, G.-K., Tignor, M., Allen, S. K., Boschung, J., Nauels, A., Xia, Y., Bex, V., & Midgley, P. M. (eds.). Climate change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). Cambridge University Press: Cambridge, United Kingdom</p>	<p>Taken into account. Figure has been updated and made more consistent with the thorough assessment in Chs 2, 5, 9 for the three indicators shown. We now include specific assessed markers for different time periods as summarized in Ch2, including their uncertainties.</p>
89973	13	1	13	25	<p>The figure is visually ineffective at transporting the intended message. The visual impression arises that change since 1850 is smooth and unremarkable relative to the wild swings in the paleorecord. This is the exact opposite of the intended effect, which would be stressing the remarkable speed at which anthropogenic change unfolds. To create this effect, the projections should also be shown as time series, and all contributions require the same time-axis scaling. Ch04 can provide time series of assessed GSAT and (Ch09-supplied) GMSL projection ranges until 2100. The 2300 range is less clear. [Jochem Marotzke, Germany]</p>	<p>Taken into account, partly. Figure revised and clarified. The projection to timeseries was not included for visualization purposes. Those can be seen in Ch4.</p>
70045	13	1	13	27	<p>Figure 1.3. Useful figure but it would be easier to interpret the long time scales if some human reference points could be added, maybe in an additional figure at the bottom: e.g. first fossil evidence of homo sapiens about 300'000 years ago, start of agriculture about 10'000 years ago. [Sonia Seneviratne, Switzerland]</p>	<p>Rejected. We appreciate the suggestion, however, the figure already now contains a lot of information and we are worried about adding more.</p>
70047	13	1	13	27	<p>Figure 1.3. The jump from mid-holocene to present is too strong and is difficult to grasp for the general public not familiar with long time scales. I find the figure 1 in Burke et al. 2018 (PNAS) easier to grasp for instance. Suggest to add a new scale between -100'000 and present with tics every 10'000 years. Possibly also an additional scale with tics every 1000 years since -10'000 and indicate start of writing at -3000 years. [Sonia Seneviratne, Switzerland]</p>	<p>Noted. The figure has been revised, clarified and improved to be visually more attractive.</p>

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
627	13	3	13	3	Figure 1.3. it looks odd that the error bar on the LIG sea level (centered at ~7.5 metres) does not overlap with the ~3 metres where the blue line is at its maximum. Why is this? Also, the caption says that the whiskers are "uncertainty", but is this the "likely" range, or "very likely", or....? [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. The figure has been revised substantially, now accommodating these comments. Reference to Chapter 2 is added for the details on the uncertainty assessments.
101409	13	3	13	25	Nice figure. Can you replace anomaly for (b) with change in axis? Define SSP and ECP. Can you explain or remove "inferred"? Suggest deleting PMIP and CMIP, or else give full acronym. Suggest deleting "a stack of". [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Thanks. We have updated the figure for clarity. Anomaly included. Acronyms elsewhere explained. "Stack" should be clear. Inferred replaced by projected.
36523	13	3	13	25	The appending to data derived from different sources using different methods is unethical. [John McLean, Australia]	Rejected. The reviewer fails to provide scientific support for his claim.
26539	13	6	13	6	We suggest to remove "However," [Eric Brun, France]	Accepted. Text revised.
13133	13	8	13	8	SSP must be expanded acronym has not been used [Maria Amparo Martinez Arroyo, Mexico]	Accepted. Text revised.
112277	13	8	13	8	on the right-hand side panels instead of on the right-hind side panels [Kamal Mohammadi, Algeria]	Accepted. Text revised.
29673	13	8	13	8	Typo in "right-hind side panels". [Hernan Edgardo Sala, Argentina]	Accepted. Text revised.
9077	13	9	13	9	Meinshausen et al. (2019) is not listed in the references. The absence of this paper (presently in GMDD) in the references makes me think that Mendeley may not have been used for all references (I have not checked all of them) which might present the authors with a small headache... (Using Mendeley consistently would have prevented such issues from creeping in.) [Olaf Morgenstern, New Zealand]	Accepted. References updated and cross-references added to respective further chapters
81279	13	9	13	13	The center panel, second row shows what is described in the figure as observations. However the figure caption in lines 9-13 states that it is actually a reconstruction based on a combination based on a combination of proxies, and models plus the CRU data. That is, these are NOT solely observations, thus labeling as observations in the figure is incorrect. [Hugo Beltrami, Canada]	Accepted. Figure and text revised.
13135	13	11	13	11	PIMP must be expanded acronym has not been used [Maria Amparo Martinez Arroyo, Mexico]	Not applicable. Text deleted.
36525	13	11	13	12	The use of HadCRUT4 global average temperature anomalies needs to show its quite large error margins especially given that global coverage was less than 50% prior to 1904 and southern hemisphere coverage did not consistently exceed 50% until 1949. [John McLean, Australia]	Noted. We refer to the thorough assessment in Ch2 on the observed temperature records.
9079	13	14	13	14	The CMIP5 simulations used "RCP" not "ECP" scenarios. Is that a typo? If not, what is "ECP"? [Olaf Morgenstern, New Zealand]	Taken into account. Updated scenario naming in figure and caption.
35441	13	15	13	15	Change & for "and" in bibliographic citations [Carlos Antonio Poot Delgado, Mexico]	Accepted. This will also be taken care of in the copy-editing process.
101407	13	16	13	17	Cross-check Ch2/9: SLR observations are Jevrejeva in Figure 1.3 (note ref is not in list) - but 9.6.1.1 are using Dangendorf et al. (2019), since 1900. Ch2 show many datasets in Fig 2.27, though seemingly Jevrejeva only back to 1900. [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Figure now uses Dangendorf et al. 2019, as suggested by the reviewer.
101411	13	17	13	18	Not sure why a distinction made between CMIP6 ensembles and process-based models? Think need to clarify (e.g. global vs ice source models) or delete because too complicated (e.g. use of emulators too). [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Reference to process-based models removed. We note, however, that process-based models are used to project total global sea level rise. Reference to CMIP6 and emulators is given for the temperature part of the figure.
38651	13	20	13	20	The source IPCC SROCC, 2019 is not listed in the final bibliography. [Luisa Sturiale, Italy]	Accepted. Revised as IPCC (2019b). Proper referencing will also be reviewed as part of the editorial process

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
101413	13	20	13	23	I find this sentence confusing - I think deleting "each of the three indicators and" might help - and it feels like it should be at start of caption because applies to all three panels? I like the idea of the dots themselves but they are also confusing - may need to explain why different to the curves e.g. sea level at LIG? I understand the scale challenges but didn't think it was entirely successful to have mixed scales (CO2 2300 and SLR) or values going off the top (especially SLR 16m). Having said all that, the pink era bands are really helpful and the different panels do a great job at summarising the past and future in one place - so these are minor comments, and some may be difficult to change in any case. [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Figure revised and clarified.
111909	13	20			IPCC SROCC, 2019 - actually, referred in References as IPCC (2019b). Please, check and unify these references to the special reports [Tomas Halenka, Czech Republic]	Accepted. Revised as IPCC (2019b). Proper referencing will also be reviewed as part of the editorial process
101415	13	27	13	27	Sea level rise, rather than change, would be more direct (even if more repetition). [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. Sea level change is more neutral
34817	13	27	13	36	"Anthropocene" is not an accepted term in the naming of geological epochs and so should be deleted. [Jim O'Brien, Ireland]	Rejected. We do clarify that this is not an accepted, but a suggested term: "suggested the definition of a new geological epoch, the Anthropocene (Crutzen and Stoermer, 2000; Steffen et al., 2007), i.e., an era in which human activity is altering major components of the Earth system and leaving measurable imprints that will remain in the permanent geological record."
36527	13	30	13	30	Reconstructions only modify data, they cannot identify a cause or a process. Hypotheses about a cause only come from interpretations of the data. [John McLean, Australia]	Noted. No action. Careful formulation "... shed light on ..."
70465	13	30	13	34	This assessment of paleo changes in sea level, including an assessment of changes over the past 800 kyr is separated from the rest of the assessment of paleo changes in sea level in Section 2.3.3.3 and does not include any characterisation of likelihood or confidence. However, it does not directly overlap with Chapter 2, because Chapter 2 do not discuss sea level changes over the full period of the last 800 kyr. Also the quantitative assessment of sea level changes over the past 800 kyr on lines 33-34 does not cite any references. Overall I think it would be better for Ch2 to assess sea level change over this period in 2.3.3.3 in a consistent manner to the changes assessed over the other periods considered there, and for chapter 1 to refer forwards. [Gillett Nathan, Canada]	Accepted. Text and figure revised for coherency. we now consistently refer to the thorough Chapter 2/9 assessments for ranges of the three key indicators shown in Figure1.5. We note that they are similar to best estimates for specific time periods based on a variety of evidence assessed and presented in Chapter 2.
21279	13	31	13	34	Given that the later assessment by chapters 2 and 9 solely assesses stage 5e in detail and that this assessment does not encompass 15m it seems questionable whether this sentence should remain within the chapter, particularly so as there is no supporting reference to the literature given. Even if one were this segment needs to be carefully coordinated with chapters 2 and 9 in redrafting to assure consistency in messaging. [Peter Thorne, Ireland]	Accepted. Text and figure revised for coherency. we now consistently refer to the thorough Chapter 2/9 assessments for ranges of the three key indicators shown in Figure1.5. We note that they are similar to best estimates for specific time periods based on a variety of evidence assessed and presented in Chapter 2.
8601	13	33	13	35	Barring a rigorous assessment, GMSL rise over 15 m during two last interglacials seems to get beyond the literature. [Robert Kopp, United States of America]	Accepted. Text and figure revised for coherency. we now consistently refer to the thorough Chapter 2/9 assessments for ranges of the three key indicators shown in Figure1.5. We note that they are similar to best estimates for specific time periods based on a variety of evidence assessed and presented in Chapter 2.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
52135	13	33		34	Instead of "metres", I suggest "meters" [Mohammad Rahimi, United States of America]	Rejected. IPCC uses UK spelling
36531	13	34	13	34	So Figure 1.3 shows nothing more than estimates? If any estimates are to be used then show the assumptions behind those estimates. [John McLean, Australia]	Rejected. Assumptions are in the text, captions and the references provided. Comprehensive and thorough assessment in subsequent chapters as indicated by the cross-references.
36533	13	34	13	34	"up to over" ? Surely you can find better wording than that. [John McLean, Australia]	Accepted. Text removed
8603	13	34	13	35	Barring a rigorous and up-to-date assessment, it is ambiguous when the highest late interglacial GMSL peak occurred and am not sure the statement about sustained warming in GrIS can be confidently made. [Robert Kopp, United States of America]	Accepted. Text and figure revised for coherency. we now consistently refer to the thorough Chapter 2/9 assessments for ranges of the three key indicators shown in Figure1.5. We note that they are similar to best estimates for specific time periods based on a variety of evidence assessed and presented in Chapter 2.
83395	13	35	13	35	Inconsistency in the age used for the last interglacial! On p. 36 line 29 and in chapter 2 (and the glossary) it is defined as 129-116 ka and referred to as "125 ka" if just one age is given (e.g. p. 5 line 16; p. 10 line 9/Table). [Antje H. L. Voelker, Portugal]	Accepted. Text revised, exact ages no longer mentioned.
36535	13	36	13	36	The reference to Figure 5.15 is incorrect, which also means that (a) I cannot check a source within the report for the claim and (b) that your argument rests on an unconfirmed paper. [John McLean, Australia]	Rejected. Reference is sufficiently clear. We have updated it however to refer to the exact chapter, though this is clear from the figure number.
36541	13	36	13	36	The expression "long term" is vague and non specific. The expression might mean anything from several days to several millenia (or perhaps even more). [John McLean, Australia]	Taken into account. Text revised, no longer using long term here.
11011	13	36	13	37	Instead of "long-term", I would recommend a more concrete adjective, as the time scale of an interglacial might be longer than the concept of "long-term" for some readers. [Mengxi Wu, United States of America]	Taken into account. Text revised, no longer using long term here.
36539	13	36	13	37	False claim because the graph is based on estimates. At most you can say the record suggests that long-term warming ... etc. [John McLean, Australia]	Rejected. Assumptions are in the text, captions and the references provided. Comprehensive and thorough assessment in subsequent chapters as indicated by the cross-references. Anyway, text has been revised.
113027	13	36	13	44	This this discussion feels hard to reconcile with the cooling seen in projections for the optimistic scenarios after 2100. [Diego Miralles, Belgium]	Rejected. All scenarios show warm GMST relative to 1850-1900, as shown in fig. 1.5 of the revised draft.
36537	13	37	13	37	The word "significant" is subjective and has no place in a scientific report. [John McLean, Australia]	Taken into account. Changed to "substantially"
36543	13	37	13	40	This is speculation that depends on various assumptions within the model, including the duration for which CO2 remains in the atmosphere (which can't be long given that the annual increase in atmospheric CO2 is around 50% of the estimated anthropogenic emissions) and on the downwards transfer of heat from the atmosphere to the ocean which seems to ignore the fact that heat rises. [John McLean, Australia]	Rejected. The reviewer is wrong. All references peer-reviewed and based on basic understanding of carbon cycle
77155	13	37	13	44	text is of more interest for policy than some material contained in the exec summary [Emer Griffin, Ireland]	Noted. No action.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
115017	13	37		40	It says, "Simulations with coupled climate models in which CO2 emissions are reduced to zero show a long-term warming that persists for many centuries even after emissions have ceased... due to the combined effect of the very slow uptake of CO2 by the ocean and the large heat reservoir of the ocean." That nonsense just proves what garbage the GCMs are. If anthropogenic GHG emissions ceased, then GHG levels would rapidly fall, because the oceans and biosphere would continue to remove CO2 from the atmosphere. That would cause a increasingly negative radiative forcing, reducing global temperatures. The oceans contain about 50x as much CO2 as the atmosphere, which means that, practically speaking, they have a nearly limitless capability to remove CO2 from the atmosphere. Although CO2 dissolves only in surface water, biological processes, such as calcifying coccolithophores, and currents, are constantly transporting that carbon to the ocean depths. So, even after the biosphere ceases greening, the oceans will continue to rapidly remove CO2 from the atmosphere. Here's an article: https://hub.jhu.edu/2015/11/26/rapid-plankton-growth-could-signal-climate-change/ [David Burton, United States of America]	Rejected. If anthropogenic GHG emissions cease, the oceans will release excess co2 in order to maintain equilibrium.
107127	13	37		40	It says, "Simulations with coupled climate models in which CO2 emissions are reduced to zero show a long-term warming that persists for many centuries even after emissions have ceased... due to the combined effect of the very slow uptake of CO2 by the ocean and the large heat reservoir of the ocean." That nonsense just proves what garbage the GCMs are. If anthropogenic GHG emissions ceased, then GHG levels would rapidly fall, because the oceans and biosphere would continue to remove CO2 from the atmosphere. That would cause a increasingly negative radiative forcing, reducing global temperatures. The oceans contain about 50x as much CO2 as the atmosphere, which means that, practically speaking, they have a nearly limitless capability to remove CO2 from the atmosphere. Although CO2 dissolves only in surface water, biological processes, such as calcifying coccolithophores, and currents, are constantly transporting that carbon to the ocean depths. So, even after the biosphere ceases greening, the oceans will continue to rapidly remove CO2 from the atmosphere. Here's an article: https://hub.jhu.edu/2015/11/26/rapid-plankton-growth-could-signal-climate-change/ [David Burton, United States of America]	Rejected. The reviewer is wrong. If anthropogenic GHG emissions cease, the oceans will release excess co2 in order to maintain equilibrium as evidence in the studies referred to in the text.
105061	13	38	13	38	"emissions reduced to zero" => when? [Masa KAGEYAMA, France]	Taken into account. Text revised to read "eliminated"
24219	13	38			"many centuries" is inconsistent with Ch. 4 [Bryan Weare, United States of America]	Taken into account. Text clarified. Simulations in cited references extend up to year 3000, i.e. many centuries. We have however clarified the text and now state "Warmer GMST persisting for many centuries" instead of "long-term warming".
85931	13	40	13	40	"very slow uptake of CO2" – why is 30% absorption of excess CO2 (p32) considered "very slow"? [Debra Roberts and the Durban WGII TSU, South Africa]	Not applicable. Text removed.
101417	13	40	13	41	As I understand it, the ZEC is roughly zero? But could still make the general point by tweaking e.g. "Persistent warm conditions...would represent" and maybe moving with before the zero emissions sentence. [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Text revised for clarity. We note that here we use "many centuries" not equilibrium for which ZEC is defined.
36545	13	40	13	44	You have tried to take speculation based on reconstructions clouded in assumptions and simulations that also have numerous assumptions and somehow tried to make from them an emphatic statement. This is unacceptable. [John McLean, Australia]	Rejected. The reviewer does not provide scientific evidence to support his claim.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
107129	13	40		42	It says, "Such persistent warm conditions in the atmosphere represent a multi-century commitment to long-term sea level rise..." There's no reason to suppose that a continuation of our current climate optimum will cause substantial sea-level rise. "Since the rate of sea level rise has not increased significantly in response to the last 3/4 century of CO2 emissions, there is no reason to expect that it will do so in response to the next 3/4 century of CO2 emissions. The best prediction for sea level in the future is simply a linear projection of the history of sea level at the same location in the past..." doi:10.1007/s11069-012-0159-8 Here's a graph of a particularly high quality long measurement records, with a typical trend: https://sealevel.info/150-021_Harlingen_Netherlands_vs_CO2_to_2018-12_annot5.png -- this report needs some graphs like that one! [David Burton, United States of America]	Rejected. The reviewer does not provide scientific evidence to support his claim. The referenced link is of no scientific value.
125125	13	43	13	43	Consider addressing oceanic freshening and resulting consequences for marine and terrestrial life briefly here. [Trigg Talley, United States of America]	Rejected. No action. It is unclear what the reviewer is referring to with "oceanic freshening". The impact on marine and terrestrial life are outside the remit of WGI, but will be addressed by WGII in detail.
35443	13	43	13	44	Bibliographic citations in chronological order [Carlos Antonio Poot Delgado, Mexico]	Accepted. This will also be taken care of in the copy-editing process.
74293	13	46	13	46	"The" is not needed [Christopher Hollis, New Zealand]	Accepted. Text revised.
104505	13	46	13	47	"particularly during the ice ages" - perhaps important to note that abrupt shifts also occurred during the warmer-than-today Eemian, which is more relevant for the future than the ice age climate (e.g. Salonen et al. 2018; Tzedakis et al. 2018). References: Salonen et al. 2018: Abrupt high-latitude climate events and decoupled seasonal trends during the Eemian. Nature Communications 9, 2851, https://doi.org/10.1038/s41467-018-05314-1 Tzedakis et al. 2018: Enhanced climate instability in the North Atlantic and southern Europe during the Last Interglacial. Nature Communications 9, 4235, https://doi.org/10.1038/s41467-018-06683-3 [Frederik Schenk, Sweden]	Noted. The reviewer makes a good point. But here we focus on the largest and most robust findings of instabilities in paleoclimate records only.
101419	13	46	13	57	I didn't find this paragraph as clear/focused as the previous ones - is it about centennial-to-millennial variations, or instabilities, or attribution of climate change to GHGs based partly on ice age correlations? For me the most successful/useful parts were the mention of AMOC change and the middle bit about being near thresholds. [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. We have deleted the part on the causal connection of CO2 and temperature etc.
70473	13	46		50	This assessment overlaps with that of 2.3.3.4.1, paragraph 2, which is not cited. [Gillett Nathan, Canada]	Accepted. Reference to Ch2 added. Note that the text and figure in this section have been revised for coherency. we now consistently refer to the thorough Chapter 2 assessments.
29679	13	47	13	47	Add "(AMOC)" after "Atlantic Meridional Overturning Circulation". [Hernan Edgardo Sala, Argentina]	Accepted. Text revised.
85933	13	47	13	51	Please explain what the AMOC is and what "bipolar seesaw" means. "opposite-phase temperature changes" is not really an explanation. Does it flow backwards? If there is some seesaw, then how is it "irreversible"? This paragraph needs to be rephrased in plain language. [Debra Roberts and the Durban WGII TSU, South Africa]	Noted. AMOC is defined in the Glossary; the term "seesaw" is explicitly explained in the half-sentence following the term.
4473	13	50	13	51	It is unnecessary to promote the concept of tipping points here. None of these are generally accepted by the scientific community and represent still just vague concepts. [Sebastian Luening, Switzerland]	Noted. We provide here the more technical terminology for "tipping points", but do refer to section 1.4..4 for more details.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
36547	13	50	13	51	You've taken a narrow and incomplete set of possible explanations and built it into mutterings about critical thresholds. This is unacceptable. Other possible explanations must be shown. [John McLean, Australia]	Rejected. No action. All statements are based on the scientific peer-reviewed literature and in-line with the thorough assessment in the subsequent Chapters; we have added a reference for the AMOC example.
70475	13	50		51	This assessment that 'instabilities and irreversible changes could develop if critical thresholds are passed' is vague and lacks a confidence qualifier. It would be better not assess the probability of an AMOC collapse here and leave this to Chapter 9, where this is assessed in 9.2.3.1. [Gillett Nathan, Canada]	Accepted. Reference to other Chapters, incl. Ch9 added. We note that the text does not assess probability.
125129	13	52	13	52	Insert "currently": "...some of which may CURRENTLY be close to critical thresholds." [Trigg Talley, United States of America]	Taken into account. Added "now".
125127	13	52	13	53	This statement about ice sheets and AMOC suggests that instabilities identified in climate models "may be close to critical thresholds (Joughin et al., 2014) (see also Chapter 9)." But the executive summary of Chapter 9 concludes that "By 2300, GMSL rise under SSP1-2.6 will likely be 0.3-2.9 m and extremely likely be below 4.7 m while GMSL rise under high emissions scenarios exhibits deep uncertainty." There seems to be inconsistency in the message and sense of urgency conveyed about GMSL rise in the two chapters. [Trigg Talley, United States of America]	Taken into account. The "may be" and further reference to chapter 9 are consistent.
4475	13	53	13	56	This statement is misleading. In most cases, temperature is preceding CO2 changes by a few 100 years, indicating that the CO2 rise is mostly due to de-gassing of CO2 from the warming oceans during the Pleistocene glacial-interglacial transitions. There are many papers which have documented this. The ones that are cited here are cherry-picked. [Sebastian Luening, Switzerland]	Not applicable. Text deleted from Ch1. See Ch2 for an assessment
36549	13	53	13	57	The unscientific and illogical implying that correlation demonstrates cause is unfortunately typical of IPCC reports. Worse, it's all based on speculations and assumptions that underpin reconstructions. [John McLean, Australia]	Not applicable. Text deleted from Ch1. See Ch2 for an assessment
115019	13	53		57	[pt 1 of 3] It says, "High-resolution paleoclimate data also confirm the synchronicity between changes in greenhouse gas concentrations and global mean temperature... This underlines the important role of greenhouse gas variations as a significant characteristic of climate change in the past." As I already pointed out in my comments on the FOD, that is dead wrong. Since, in the paleoclimate record, the changes in GHG concentrations follow, rather than precede, the temperature changes, the "synchronicity" tells us only that temperatures affect GHG levels. That synchronicity tells us nothing about the importance of the GHGs as drivers of climate change. [David Burton, United States of America]	Not applicable. Text deleted from Ch1. See Ch2 for an assessment
107131	13	53		57	[pt 1 of 3] It says, "High-resolution paleoclimate data also confirm the synchronicity between changes in greenhouse gas concentrations and global mean temperature... This underlines the important role of greenhouse gas variations as a significant characteristic of climate change in the past." As I already pointed out in my comments on the FOD, that is dead wrong. Since, in the paleoclimate record, the changes in GHG concentrations follow, rather than precede, the temperature changes, the "synchronicity" tells us only that temperatures affect GHG levels. That synchronicity tells us nothing about the importance of the GHGs as drivers of climate change. [David Burton, United States of America]	Not applicable. Text deleted from Ch1. See Ch2 for an assessment

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
107133	13	53		57	[pt 2 of 3] Of course I am not disputing that GHGs cause warming. I'm only pointing out that the correlation between CO2 levels and temperature proxies in the ice core records is not evidence of it, and tells us nothing about the magnitude or "importance" of the GHGs' effects. The solubility of gases like CO2 (and CH4) in water decreases as the water gets warmer (per the temperature dependence of Henry's law), so as the oceans warm they outgas CO2 (or, if they're absorbing CO2, as is currently the case in most places other than the tropics, they absorb it more slowly). (Some researchers also report other mechanisms through which glacial retreat releases CO2 and CH4.) The CO2, in turn, works as a GHG to cause warming. [cont'd] [David Burton, United States of America]	Not applicable. Text deleted from Ch1. See Ch2 for an assessment
107135	13	53		57	[pt 3 of 3] The fact that CO2 level changes cause temperature changes, and temperature changes also cause CO2 level changes, is what make this a (modest, slow) positive (amplifying) climate feedback mechanism. http://archive.is/oXxGb#selection-1215.21-1215.30 That positive feedback loop is undoubtedly one of the causes for the apparent hysteresis in the temperature and CO2 records (oscillating between long, cold glaciations, and shorter, milder interglacials, and relatively brief, unstable transitions between. ### [David Burton, United States of America]	Not applicable. Text deleted from Ch1. See Ch2 for an assessment
113029	13	54	13	56	the synchronicity between changes in greenhouse gas concentrations and global mean temperature [...] underlines the important role of greenhouse gas variations' feels like an overstatement. It may 'suggest' but not 'confirm'. By itself it does not unequivocally prove any causal relation, needless to say the directionality of that causal relation. [Diego Miralles, Belgium]	Not applicable. Text deleted from Ch1. See Ch2 for an assessment
14483	13	54	13	56	check hyphenation of compound adjectives, should be "greenhouse-gas emissions" [Amy East, United States of America]	Noted. Editorial. Text has been deleted here.
74295	13	56	13	56	Can a "characteristic" be described as a "role"? I don't think so. Needs a clearer statement on the "role" of GHG variations. [Christopher Hollis, New Zealand]	Not applicable. Text deleted from Ch1. See Ch2 for an assessment
125131	13	56	13	56	Consider clarifying sentence by re-phrasing to read: "This underlines the important role of VARIATIONS IN ATMOSPHERIC greenhouse gas CONCENTRATIONS as a significant..." [Trigg Talley, United States of America]	Not applicable. Text deleted from Ch1. See Ch2 for an assessment
70841	13	56	13	57	Surely it needs to be said somewhere that the long-term palaeoclimate changes are not simply CO2 increases causing warming, because the external forcings are not of CO2 directly, so CO2 variations represent a feedback. [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. Text deleted from Ch1. See Ch2 for an assessment
102461	14	1	14	1	"Global average temperature" should read "global average surface temperature" for consistency [Philippe Tulkens, Belgium]	Accepted. Text revised
36551	14	1	14	2	The concatenating of two datasets derived by different means is unprofessional and unethical. [John McLean, Australia]	Noted. Text revised for clarity. We now write: "the reconstructed, observed and projected ranges of changes "
101421	14	1	14	13	Minor, sorry, but can you put CO2 at the start of the sentence? "The CO2 values...". And explain how "the paleoclimate record" is distinct from ice core data? And suggest "low emissions" instead of "strong mitigation" [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Text revised for clarity. We now write: "the reconstructed, observed and projected ranges of changes "
125133	14	2	14	2	Insert "atmospheric" before CO2. [Trigg Talley, United States of America]	Accepted. Text revised

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
115021	14	4		9	It continues, "Projections of these three indicators for the end of the 21st century, however, show that for all but strong mitigation scenarios..., these global-scale indicators will move outside of their natural range on a multi-millennia timescale: CO2 and temperature within the next few decades, and sea level potentially over the next few millennia;" That's wrong, except for CO2, which has already done so. Temperatures would have to rise at a dramatically accelerated rate, despite the certainty that there will be no acceleration in GHG forcing trend, to reach HCO levels before we run too short on fossil fuels to continue to drive CO2 levels higher. Here's a NOAA graph, showing their best estimate that the Eemian peaked 3.25°C warmer than the HCO (which, in turn, was warmer than our current climate): https://sealevel.info/Temperature-change-and-CO2-change-measured-from-the-EPICA-Dome-C-ice-core-v3_200pct.png There's not enough coal, oil and natural gas in the ground to continue the exponential increase in CO2 emissions, and thereby continue the linear increase in CO2's forcing, to the end of this century. When GHG forcing falls below linear, the warming trend will surely do so, as well. Even Hansen et al '88, for all its flaws, admitted that "finite resource constraints" must eventually limit emissions. GHG levels and temperatures will certainly fall before we reach Eemian peak temperatures, and long, long before "the next few millennia." [David Burton, United States of America]	Rejected. The statement is factually correct. We have however revised the text for clarity, and separated the indicators to be more nuanced. We have added a reference for the SLR.
107137	14	4		9	It says, "global average temperature and sea level were higher than today during several interglacials of that period..." They were both probably higher during our current interglacial, as well: sea-level certainly so, and temperatures probably so (during the HCO, and perhaps also the BAWP, RWP, and/or MWP). [David Burton, United States of America]	Noted. No action. We have revised the text for clarity, and separated the indicators to be more nuanced. We have added a reference for the SLR.
107139	14	4		9	It continues, "Projections of these three indicators for the end of the 21st century, however, show that for all but strong mitigation scenarios..., these global-scale indicators will move outside of their natural range on a multi-millennia timescale: CO2 and temperature within the next few decades, and sea level potentially over the next few millennia;" That's wrong, except for CO2, which has already done so. Temperatures would have to rise at a dramatically accelerated rate, despite the certainty that there will be no acceleration in GHG forcing trend, to reach HCO levels before we run too short on fossil fuels to continue to drive CO2 levels higher. Here's a NOAA graph, showing their best estimate that the Eemian peaked 3.25°C warmer than the HCO (which, in turn, was warmer than our current climate): https://sealevel.info/Temperature-change-and-CO2-change-measured-from-the-EPICA-Dome-C-ice-core-v3_200pct.png There's not enough coal, oil and natural gas in the ground to continue the the exponential increase in CO2 emissions, and thereby continue the linear increase in CO2's forcing, to the end of this century. When GHG forcing falls below linear, the warming trend will surely do so, as well. Even Hansen et al '88, for all its flaws, admitted that "finite resource constraints" must eventually limit emissions. GHG levels and temperatures will certainly fall before we reach Eemian peak temperatures, and long, long before "the next few millennia." [David Burton, United States of America]	Rejected. The statement is factually correct. We have however revised the text for clarity, and separated the indicators to be more nuanced. We have added a reference for the SLR.
52587	14	5	14	5	Figure 2.33 and not Figure 2.38 [Gema Martínez-Méndez, Germany]	Accepted. Text revised. SLR covered in Fig 2.33

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
125135	14	5	14	16	[PRECISION] If authors retain this section, much work needs to be done to more accurately reflect the reality. Did *all* NDCs really call for a reduction in GHG emissions -- even those from all developing countries (as implied by the text in line 7)? NDCs were never intended - - in and of themselves -- to meet the goals of the Paris Agreement: They were 5- or 10-year pledges. What has been submitted was only the first round of NDCs. To characterize them as insufficient in meeting the Paris Agreement is like saying my computer doesn't facilitate me getting to work. It was never designed to. [Trigg Talley, United States of America]	Accepted. Paragraph revised to reflect the complexities of the NDCs. Now reads: Numerous studies on the NDCs submitted since adoption of the PA in 2015 (Fawcett et al., 2015; Fischlin et al., 2015; Lomborg, 2016; Rogelj et al., 2016, 2017; UNFCCC, 2016; Benveniste et al., 2018; Gütschow et al., 2018; United Nations Environment Programme, 2019) conclude that they are insufficient to meet the Paris temperature goal, unless strengthened for more ambitious targets under the ratcheting mechanism (high confidence). In the present IPCC Sixth Assessment cycle, a Special Report on Global Warming of 1.5°C (SR1.5, 2018) assessed possible pathways to the lower end of the Paris long-term temperature goal range. SR1.5 assessed a median warming (50% probability in 2100) of 2.7-3.4°C above pre-industrial levels if both conditional (e.g. conditional on financial assistance) and unconditional NDC commitments are successfully implemented (de Coninck et al., 2018, Cross-Chapter Box 11). The PA includes a ratcheting mechanism designed to increase the ambition of voluntary national pledges over time. Under this mechanism, NDCs will be communicated or updated every five years. Each successive NDC will represent a "progression beyond" the "then current" NDC and reflect the "highest possible ambition" (Article 4). These updates will be informed by a five-yearly periodic review including "Structured Expert Dialogue" (SEDx), as well as a "global stocktake", to assess collective progress
42847	14	5			There is no Fig 2.38. You may mean cross chapter box 2.1, Fig 1, though this only covers temperature and not sea level. [Eric Wolff, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Text revised. SLR covered in Fig 2.33
109477	14	6	14	6	Both climate change mitigation and air pollution mitigation exist, the term "mitigation" should be replaced by "climate change mitigation", it's all the more confusing when dealing with SSP scenario as air pollution control is higher in SSP5 than in SSP3 for example. [Sophie Szopa, France]	Rejected. We think it very clear from context that "mitigation" refers to climate here.
114163	14	6	14	6	I suggest you say which scenarios [Jan Fuglestedt, Norway]	Noted. We think the sentence is clearer if we do not add details on scenarios here..
115245	14	6	14	8	Here you should add something on the rate of change to make it clear that anthropogenic climate change is already outside past ranges of climate change in terms of the first derivative. Make this to avoid that the impression comes up that things are still fully within past climatic changes. [Andreas Fischlin, Switzerland]	Noted. Current rates of change are discussed in the second para in this section 1.2.1.2 and placed in the long-term context, so we do not repeat this here.
26543	14	7	14	7	We suggest to mention that the Agreement contains an enhanced transparency framework to track action and support. [Eric Brun, France]	Noted. No action. Misplaced comment, we cannot identify what it refers to.
26541	14	8	14	8	The notion of "into effect" is not defined in the Paris Agreement. It entered into force in November 2016, most of the nationally determined contributions are implemented from 2020 (but some for Kyoto countries are effectively from 2021 [Eric Brun, France]	Noted. No action. Misplaced comment, we cannot identify what it refers to.
125137	14	8	14	8	Clarify text so it reads: "... timescale: ATMOSPHERIC CO2 CONCENTRATIONS and GMST within the next few..." [Trigg Talley, United States of America]	Accepted. Text revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
74297	14	9	14	9	Comment on abrupt change needs a separate sentence and clarification as to whether abrupt increases or decreases in the parameters are implied. [Christopher Hollis, New Zealand]	Taken into account. New sentence. However, we do not specify if this is about increases or decreases here. We refer to Section 1.4.4 for details.
125139	14	9	14	9	Need to provide context around "abrupt change." Is this multi-decadal? Multi-centennial? Multi-millennial? Most people probably don't interpret "abrupt" or "ice sheet collapse" in the same way as the authors do. [Trigg Talley, United States of America]	Noted. No action. We refer to Section 1.4.4 for details.
45599	14	9	14	13	Regarding glacier mass loss and the work of Marzeion et al. 2014, I would not say that is has been demonstrated by so long that the anthropogenic forcing is ruling the glacier mass loss. Following Marzeion et al. 2014, only 25% of the glacier mass loss between 1851 and 2010 is attributable to anthropogenic forcing. Nevertheless, when you look closer in time, the emergency of the anthropogenic signal is more evident. So, I suggest reformulating this sentence to clearly shown or acknowledged the time of emergency of the anthropogenic signal at each of the climate variables. [Lucas Ruiz, Argentina]	Not applicable. Text deleted from Ch1. See Ch3 for an assessment
70477	14	9		13	This discussion og attribution of climate change in global mean temperature, sea level and glacier mass, does not cite Chapter 3. Also the assessment is imprecisely worded, lacks confidence qualifiers. It would be better to leave the assessment of attribution in these large-scale indicators to Chapter 3. [Gillett Nathan, Canada]	Not applicable. Text deleted from Ch1. See Ch3 for an assessment
26545	14	10	14	10	We suggest to add at the end of the sentence ", although countries can also submit their adaptation communication through other means" [Eric Brun, France]	Not applicable. The reviewer is not indicating the right page/line
125141	14	11	14	11	Insert "atmospheric" before "GHG concentrations" [Trigg Talley, United States of America]	Not applicable. Text deleted from Ch1. See Ch3 for an assessment
74299	14	12	14	12	What "development" is being referred to? [Christopher Hollis, New Zealand]	Not applicable. Text deleted from Ch1. See Ch3 for an assessment
629	14	12	14	12	It is unclear what "this development" is referring to...what development? [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. Text deleted from Ch1. See Ch3 for an assessment
631	14	12	14	12	Figure 1.3. The y-axis range chosen for some of the panels could be experimented with. It is not obvious that this is currently optimal, because neither the recent or paleo changes are clear in some panels. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Figure substantially revised and improved
32489	14	12	14	12	development'? Sounds strange -- suggest : 'change' [Robert Colman, Australia]	Not applicable. Text deleted from Ch1. See Ch3 for an assessment
112287	14	15	14	16	An important time period in the assessment of anthropogenic climate change is the last 2000 years, particularly the preindustrial time period, when instrumental data were scarce or absent altogether (see Chapter 2.3). Instead of An important time period in the assessment of anthropogenic climate change is the last 2000 years, in particular the time before 1850, when instrumental data are scarce or absent altogether (see Chapter 2.3). [Kamal Mohammedi, Algeria]	Not applicable. This part of the sentence has been deleted.
93661	14	15	14	25	Oral history and Indigenous Knowledge (IK) is not represented in local or regional records, and could help fill data gaps for the last 2,000 years, at a minimum, where climate instrumental data is insufficient. [Bridget Doyle, Canada]	Noted. No action. This is part of Section 1.3 of this report
74301	14	16	14	16	altogether is a redundant word [Christopher Hollis, New Zealand]	Accepted. Text revised.
13137	14	16	14	16	use is instead of are [Maria Amparo Martinez Arroyo, Mexico]	Not applicable. This part of the sentence has been deleted.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
4477	14	17	14	20	There are several important new papers that summarize the Medieval Climate Anomaly in the Southern Hemisphere in terms of temperature and hydroclimate for South America, Africa and Oceania: Lüning et al. (2019): The Medieval Climate Anomaly in South America. <i>Quaternary International</i> , 508: 70-87. doi: 10.1016/j.quaint.2018.10.041; Lüning et al. (2018): Hydroclimate in Africa during the Medieval Climate Anomaly. <i>Palaeogeogr., Palaeoclimatol., Palaeoecol.</i> , 495: 309-322, doi: 10.1016/j.palaeo.2018.01.025; Lüning et al. (2017): Warming and cooling: The Medieval Climate Anomaly in Africa and Arabia. <i>Paleoceanography</i> 32 (11): 1219-1235, doi: 10.1002/2017PA003237; Lüning et al. (2019): The Medieval Climate Anomaly in Oceania. <i>Environmental Reviews</i> , doi: 10.1139/er-2019-0012 [Sebastian Luening, Switzerland]	Noted. No action. The references provided in the text seem sufficient.
74303	14	18	14	18	"with global relevance" is an ambiguous phrase. What is meant? [Christopher Hollis, New Zealand]	Accepted. Text revised.
109001	14	20	14	20	change mid 19th to mid-19th [Belen Martrat, Spain]	Accepted. Text revised.
112279	14	20	14	23	Before the anthropogenic global warming signs that appear around the mid 19th century (Abram et al., 2016), the Northern Hemisphere experienced a "Little Ice Age" during the last 400 to 500 years of a slow multi-centennial cooling, consistently recorded in paleoclimate archives (PAGES 2k Consortium, 2013; McGregor et al., 2015) and primarily driven by a clustering of volcanic eruptions (PAGES 2k Consortium, 2013; Owens et al., 2017; Brönnimann et al., 2019b). The past 150 years exhibited a coherent global post warming period that is unprecedented in the last 2000 years (Neukom et al., 2019). Instead of Before the global warming that began around the mid 19th century (Abram et al., 2016), a slow multi-centennial cooling in the Northern Hemisphere is consistently recorded in paleoclimate archives (PAGES 2k Consortium, 2013; McGregor et al., 2015), with the last 400 to 500 years often termed the "Little Ice Age". These changes were primarily driven by a clustering of volcanic eruptions (PAGES 2k Consortium, 2013; Owens et al., 2017; Brönnimann et al., 2019b). The subsequent warming over the past 150 years exhibits a global coherence that is unprecedented in the last 2000 years (Neukom et al., 2019). [Kamal Mohammedi, Algeria]	Taken into account. Text slightly revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
111401	14	20	14	25	<p>I feel that this paragraph is a little bit misleading and confusing. The referee agrees that closely-paced volcanic eruptions may have a strong influence on climate variability, yet, one single large volcanic eruptions can also have significant impact on the climate system. Therefore I would use the term cluster carefully. After reading the sentence one may also think that volcanism only influenced our climate system during the LIA. There is now a large number of studies that agree that volcanism explains a substantial portion of pre-industrial (0–1800 CE) variability. I would state this more clearly in the manuscript. Also no information is provided about solar variability.... This is how I would rephrase the paragraph... Feel free to keep the sentence as it is or to modify it:</p> <p>“Before the global warming that began around the mid 19th century (Abram et al., 2016), paleoclimate archives record a nearly global centuries-long cold climate period, called “Little Ice Age” (LIA) that occurred between roughly 1300 CE and 1850 CE. The LIA was preceded by the Medieval Climate Anomaly (800 CE -1300 CE), which is characterized by warmer temperatures. There is an increasing number of evidence showing that volcanism was the primary driver of inter-annual to decadal variability over the pre-industrial period (1 CE – 1850 CE) (PAGES 2k Consortium, 2013; Sigl et al., 2015; Stoffel et al., 2015; Wilson et al., 2016; Anchukaitis et al., 2017; Owen et al., 2017; PAGES 2k Consortium 2019; Brönnimann et al., 2019b), and that variations in solar variability had relatively small influence on Northern Hemisphere climate (Schurer et al., 2013; PAGES 2k Consortium 2019).”</p> <p>References:</p> <p>Anchukaitis KJ, et al. Last millennium Northern Hemisphere summer temperatures from tree rings: Part II, spatially resolved reconstructions. Quaternary Science Reviews. 2017;163:1–22.</p> <p>PAGES 2K Consortium, Consistent multidecadal variability in global temperature</p>	Taken into account. Text revised slightly, e.g. "clustering" deleted.
109003	14	22	14	23	Change 'the last 400 to 500 years often termed the "Little Ice Age" to "from the mid-13th century to mid-19th century often termed the "Little Ice Age"' [Belen Martrat, Spain]	Not applicable. Term LIA longer used in the text.
37725	14	22	14	25	there is no evidence for higher volcanic activity pre LIA than in the 19th and 20th Century - poor argument--delate [Howard Brady, Australia]	Rejected. The statement is based on the references included in the text. In contrast, the reviewer does not provide any scientific support for his claim.
70479	14	22		23	The Little Ice Age is defined in XC Box 2.1, Table 1 as 1450 to 1850. The text here defines it as the 'the last 400 to 500 years. This is incorrect. [Gillett Nathan, Canada]	Not applicable. Term LIA longer used in the text.
74305	14	23	14	23	Replace "These changes were" with "This cooling was" [Christopher Hollis, New Zealand]	Taken into account. Text revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
10337	14	23	14	23	The IPCC should refrain from using the inaccurate term "Little Ice Age" to describe a period of perceived climate change. The term is highly misleading for a number of reasons. Climate was nowhere near as cool as an actual ice age. As described in the Glossary, whilst it is associated with glacial expansion, there is no single defined period used by all studies. Elsewhere in this chapter much is made of the definition of the "pre-industrial" period, which ends up being in the middle of the IPCC's definition of "LIA" period, which does not seem right. Its continued use will only cause further confusion (Lockwood et al, "Frost fairs, sunspots and the Little Ice Age", Astronomy and Geophysics, 2017; Neukom et al., "No evidence for globally coherent warm and cold periods over the preindustrial Common Era", Nature 2019). [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Accepted Term LIA longer used in the text.
125143	14	23	14	23	"clustering" invokes thoughts of spatial clustering. But what is meant, presumably, is temporal clustering. Suggest changing text to read: "a series of volcanic eruptions occurring over a small number of years." [Trigg Talley, United States of America]	Taken into account. Text revised slightly, e.g. "clustering" deleted.
111911	14	23	14	24	These changes were primarily driven by a clustering of volcanic eruptions (PAGES 2k Consortium, 2013; Owens et al., 2017; Brönnimann et al., 2019b). Actually, I am aware of the shift in the LIA explanation, but still it is not exactly said there is no influence of solar activity I would say. At least, the recent papers referred are not so strong in the statement, Owens et al. (2017) is saying that "Overall, it is likely that the effect of volcanic eruptions was the largest influence, followed by the drop in solar activity and changes in land use." and Brönnimann et al. (2019b) titled the paper Last phase of the Little Ice Age forced by volcanic eruptions, thus, no mention of the solar effects seems to me not to be fully appropriate. Maybe should be elaborated in more details, with some calibration. One could expect it perhaps in the Section 2.2, where solar and volcanic forcing are summarized in the past, but this is not the case, there is nothing about these relations, as well as in the Ch7 [Tomas Halenka, Czech Republic]	Taken into account. Text revised and reference added. More details are given in section 3.3
4479	14	23	14	24	The idea of the Little Ice Age (LIA) being caused by the "clustering of volcanic eruptions" is hard to defend. In reality, the second half of the Medieval Climate Anomaly (MCA) saw significant volcanic activity whilst about half of the LIA was characterized by low volcanic activity. One has to accept that changes in volcanic activity cannot explain the warm MCA and the cool LIA. See Sigl et al. 2015, https://www.nature.com/articles/nature14565 [Sebastian Luening, Switzerland]	Taken into account. Text revised and reference added.
81281	14	23	14	24	The statement regarding the cause of the little ice age as due to a series of volcanic eruptions seems a bit weird to me as data from borehole temperature records in Canada, show some areas with a LIA signal and others without is. I interpret these as evidence that the LIA was not a generalized event, but may have been more of a regional event, or that it showed different "strength" in different areas. That feels inconsistent to the volcanic effect that I would assume would be more or less global and short-term. However, I confess I have not read the volcano papers.. [Hugo Beltrami, Canada]	Accepted Term LIA longer used in the text.
70481	14	23		24	Attribution of temperature change through the Little Ice Age period overlaps with Section 3.3.1.1, Paleoclimate context, paragraph 2, which is not cited. [Gillett Nathan, Canada]	Taken into account. Text revised and reference added.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
36553	14	24	14	25	Firstly the sentence is unclear. Secondly it is unsubstantiable nonsense that there was global warming; it is nothing more than a possibility. Even by the generous system by which the coverage of HadCRUT4 data is determined global coverage was less than 50% until 1904 and coverage of the Southern Hemisphere was not consistently above 50% until 1949. You simply do not know what the temperatures were in the parts of the world for which you have no coverage. [John McLean, Australia]	Rejected. The statement is based on the references included in the text. In contrast, the reviewer does not provide any scientific support for his claim.
114161	14	24	14	25	This is a very strong and important statment that should be an outcome of the assessment in this report. The way this is said now - with only one single reference - is a bit odd. [Jan Fuglestedt, Norway]	Taken into account. Text revised and reference to Section 3.3. added.
74307	14	25	14	25	"global coherence" needs to be contrasted with a statement on greater geographic variability in the preceding 1850 years. [Christopher Hollis, New Zealand]	Taken into account. Text revised and we do now mention "regional differences"
26547	14	25	14	25	We suggest to replace " NDCs will be updated every five years." with "successive NDCs will be communicated every 5 years and will represent a progression beyond the previous NDC" (sticks closer to art 4.9 and 4.3) [Eric Brun, France]	Taken into account. Refers to Section 1.2.2 - not the page and lines specified. Text has been revised to reflect complexities of the NDCs and the ratcheting mechanism.
83921	14	27	14	27	proposal: In continuation of the changes to the climate system started with the industrial revolution, the rate, scale and magnitude of anthropogenic changes since the mid20th... Just: the changes to the climate system did not start in the mid-20th cent., but much earlier. There was an intensification at that point, however, the process began earlier, when the direction of changes was established. [Marco Tulio Cabral, Brazil]	Noted. We do clarify that this is not an accepted, but a suggested term: "suggested the definition of a new geological epoch, the Anthropocene (Crutzen and Stoermer, 2000; Steffen et al., 2007), i.e., an era in which human activity is altering major components of the Earth system and leaving measurable imprints that will remain in the permanent geological record."
4481	14	27	14	31	There is no need to promote the Anthropocene here. This concept has been rejected by the International Commission on Stratigraphy. [Sebastian Luening, Switzerland]	Noted. We do clarify that this is not an accepted, but a suggested term: "suggested the definition of a new geological epoch, the Anthropocene (Crutzen and Stoermer, 2000; Steffen et al., 2007), i.e., an era in which human activity is altering major components of the Earth system and leaving measurable imprints that will remain in the permanent geological record."
36555	14	27	14	31	I have rarely seen a sentence of such utter balderdash. Epochs are named on the basis of geology, not some fantasy by climate activists. [John McLean, Australia]	Noted. We do clarify that this is not an accepted, but a suggested term: "suggested the definition of a new geological epoch, the Anthropocene (Crutzen and Stoermer, 2000; Steffen et al., 2007), i.e., an era in which human activity is altering major components of the Earth system and leaving measurable imprints that will remain in the permanent geological record."

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
112281	14	27	14	36	<p>The impacts of anthropogenic changes in the climate system since the mid-20th century support the concept of an Anthropocene epoch (Crutzen and Stoermer, 2000; Steffen et al., 2007), i.e., an era in which human activity is altering the Earth system on a magnitude and scale similar to geophysical forces, that will remain in the permanent geological record (IPCC, 2018b) (Figure 1.3). The Earth system alterations include climate change, but also chemical and biological changes such as ocean acidification due to uptake of anthropogenic carbon dioxide, massive destruction of tropical forests, a worldwide loss of biodiversity and the sixth mass extinction of species (Hoegh-Guldberg and Bruno, 2010; Ceballos et al., 2017; IPBES, 2019). According to IPBES (2019), climate change is a “direct driver that is increasingly exacerbating the impact of other drivers on nature and human well-being”.</p> <p>Instead of</p> <p>The rate, scale, and magnitude of anthropogenic changes in the climate system since the mid-20th century support the concept of an Anthropocene epoch (Crutzen and Stoermer, 2000; Steffen et al., 2007), i.e., an era in which human activity is altering major components of the Earth system on a magnitude and scale similar to geophysical forces, leaving measurable traces which will remain in the permanent geological record (IPCC, 2018b) (Figure 1.3). These alterations include not only climate change itself, but also chemical and biological changes in the Earth system such as rapid ocean acidification due to uptake of anthropogenic carbon dioxide, massive destruction of tropical forests, a worldwide loss of biodiversity and the sixth mass extinction of species (Hoegh-Guldberg and Bruno, 2010; Ceballos et al., 2017; IPBES, 2019). According to IPBES (2019), climate change is a “direct driver that is increasingly exacerbating the impact of other drivers on nature and human well-being”. [Kamal Mohammedi, Algeria]</p>	Noted. We have reworded parts of the para.
70053	14	27	14	36	<p>It seems that the concept of "anthropocene" is a notion that could be elevated to the ES, in particular the fact that we are in the middle of the sixth mass species extinction since the existence of the Earth. [Sonia Seneviratne, Switzerland]</p>	Noted. No action.
36563	14	27	14	36	<p>This paragraph is the kind of subjective nonsense produced by Greenpeace or other climate activists; it has no place in a report like this. I just wonder who was foolish enough to approve the claims for publication in scientific journals. [John McLean, Australia]</p>	Noted. We do clarify that this is not an accepted, but a suggested term: "suggested the definition of a new geological epoch, the Anthropocene (Crutzen and Stoermer, 2000; Steffen et al., 2007), i.e., an era in which human activity is altering major components of the Earth system and leaving measurable imprints that will remain in the permanent geological record."
70483	14	27		36	<p>Not clear that supporting the creation of the Anthropocene epoch is within scope of an IPCC report. [Gillett Nathan, Canada]</p>	Noted. We do clarify that this is not an accepted, but a suggested term: "suggested the definition of a new geological epoch, the Anthropocene (Crutzen and Stoermer, 2000; Steffen et al., 2007), i.e., an era in which human activity is altering major components of the Earth system and leaving measurable imprints that will remain in the permanent geological record."

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
7487	14	28			Throughout the AR6 there is a similarity between a series of terms indicative of different lapses of time (epoch, period or era) written in lowercase and other geological terms that express hierarchical subdivisions of geological time with a very precise significance (Epoch, Period, Era) written in uppercase in order to differentiate between them. -Consequently, in the sentence "... the concept of an Anthropocene epoch (Crutzen and Stoermer, 2000; Steffen et al., 2007) ..." should be better as "... the concept of an Anthropocene Epoch (Crutzen and Stoermer, 2000; Steffen et al., 2007) ..." [Alejandro Cearreta, Spain]	Noted. Editorial.
42849	14	28			"support the concept of an Anthropocene epoch". This is a highly political and completely unnuanced statement about an issue that is highly controversial in the geological community. It seems totally unnecessary in what is meant to be a scientific document. By all means say that the data support the idea that "human activity is altering major components of the Earth system on a magnitude and scale...", and that some have suggested this would justify considering that we have entered an Anthropocene epoch, but I don't think it's at all appropriate for IPCC to support the creation of such an epoch, which is how this statement reads. [Eric Wolff, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. We do clarify that this is not an accepted, but a suggested term: "suggested the definition of a new geological epoch, the Anthropocene (Crutzen and Stoermer, 2000; Steffen et al., 2007), i.e., an era in which human activity is altering major components of the Earth system and leaving measurable imprints that will remain in the permanent geological record."
38299	14	29	14	29	According to the executive summary of Chapter 1, WGI report mainly evaluates the changes in the climate system, on which A1.1 and A1.2 in this chapter both focus. However, it is the expression "Earth system" that is used here. It is suggested that authors standardize the use of relevant concepts to enhance the scientific nature of the report. [Yaming LIU, China]	Noted. Earth System seems to be correct here, where the text refers to changes beyond climate.
130465	14	29	14	29	In many chapters, simply using "Earth system" to replace "climate system". Chapter 1 should clearly explain why in some cases using Earth System, which is mainly used in models. And also, in Line 10, another expression of "physical climate system " which is confusing for readers. [Panmao Zhai, China]	Noted. Earth System seems to be correct here, where the text refers to changes beyond climate.
115023	14	31		34	[pt 4 of 4] Ocean acidification is a red herring. It is minuscule, and harmless, and dwarfed by natural spatial and temporal variations in ocean pH. It does not and cannot make the oceans acidic, only slightly less caustic. The reduction in ocean pH is limited almost entirely to the most alkaline part of the ocean: the surface waters, which are much more caustic than the rest of the ocean. The main effect seems to be to stimulate the growth of calcifying coccolithophores, which remove carbon from the upper ocean, sequestering it in carbonates. Here are some references: https://academic.oup.com/icesjms/article/73/3/529/2459146 https://hub.jhu.edu/2015/11/26/rapid-plankton-growth-could-signal-climate-change/ https://dx.doi.org/10.1073%2Fpnas.1117508109 http://science.sciencemag.org/content/350/6267/1533 ### [David Burton, United States of America]	Rejected. The statement is based on the references included in the text. In contrast, the reviewer does not provide any scientific support for his claim.
107141	14	31		34	[Part 1 of 4] It says, "These alterations include not only climate change itself, but also chemical and biological changes in the Earth system such as rapid ocean acidification due to uptake of anthropogenic carbon dioxide, massive destruction of tropical forests, a worldwide loss of biodiversity and the sixth mass extinction of species..." Good grief, that's a lot of crackpottery to cram into just one sentence! [cont'd] [David Burton, United States of America]	Rejected. The statement is based on the references included in the text. In contrast, the reviewer does not provide any scientific support for his claim.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
107143	14	31		34	[pt 2 of 4] There is no sixth mass extinction of species. If you want serious people to take this report seriously, you need to delete the crackpottery, like the "cumulative carbon budget" and "sixth mass extinction." See: https://www.theatlantic.com/science/archive/2017/06/the-ends-of-the-world/529545/ [cont'd] [David Burton, United States of America]	Rejected. The statement is based on the references included in the text. In contrast, the reviewer does not provide any scientific support for his claim.
107145	14	31		34	[pt 3 of 4] Tropical forest destruction is driven, not by climate change, but largely by demand for biofuels, for climate change mitigation. [cont'd] [David Burton, United States of America]	Noted. No action. This is exactly what the text states: "These alterations include not only climate change itself, but also chemical and biological changes in the Earth system...."
107147	14	31		34	[pt 4 of 4] Ocean acidification is a red herring. It is minuscule, and harmless, and dwarfed by natural spatial and temporal variations in ocean pH. It does not and cannot make the oceans acidic, only slightly less caustic. The reduction in ocean pH is limited almost entirely to the most alkaline part of the ocean: the surface waters, which are much more caustic than the rest of the ocean. The main effect seems to be to stimulate the growth of calcifying coccolithophores, which remove carbon from the upper ocean, sequestering it in carbonates. Here are some references: https://academic.oup.com/icesjms/article/73/3/529/2459146 https://hub.jhu.edu/2015/11/26/rapid-plankton-growth-could-signal-climate-change/ https://dx.doi.org/10.1073%2Fpnas.1117508109 http://science.sciencemag.org/content/350/6267/1533 ### [David Burton, United States of America]	Rejected. The statement is based on the references included in the text. In contrast, the reviewer does not provide any scientific support for his claim.
36557	14	32	14	32	You don't seem to understand that ocean pH varies naturally from about 7.8 to 8.3, nor is it clear that you understand what a pH scale means, nor is there any evidence that the oceans are absorbing *only* anthropogenic carbon dioxide. Also how can the oceans be absorbing more carbon dioxide if sea surface temperatures are rising? The oceans will be absorbing less, not more. [John McLean, Australia]	Rejected. The statement is based on the references included in the text. In contrast, the reviewer does not provide any scientific support for his claim. And btw, he is wrong.
36559	14	33	14	33	Do enlighten us all as to how a one degree (or less given that you are talking about the tropics) temperature change is causing "massive destruction of tropical forests" [John McLean, Australia]	Rejected. The statement is based on the references included in the text. In contrast, the reviewer does not provide any scientific support for his claim.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
96057	14	33	14	34	<p>Although authors of several chapters of the IPBES Global Assessment Report (2019) have analysed publications which discuss a "sixth mass extinction", the IPBES authors themselves have not used this term neither in their SPM nor in the associated 6 chapters. Reason: From the scientific perspective, the term "sixth mass extinction" cannot be supported, particularly because experts use a quite common definition used in the field of ecology, which only talks about "mass extinction" if at least three-quarters of the species become extinct within a relatively short period of time. Against this background, we kindly ask the authors to reformulate this sentence.</p> <p>Proposal: You may, however, wish to consider the following quotation taken from the IPBES SPM of the Global Assessment Report (2019: 16) that would clearly strengthen the discussion on the connection between climate change and biodiversity loss, and, thus, support the development of a strong message that should make it from this IPCC chapter into the associated SPM: "Climate change is projected to become increasingly important as a direct driver of changes in nature and its contributions to people in the next decades. (...) For example, a synthesis of many studies estimates that the fraction of species at risk of climate-related extinction is 5 per cent at 2°C warming and rises to 16 per cent at 4.3°C warming." Source: IPBES (2019: 16). The complete quotation can be found at: https://ipbes.net/sites/default/files/2020-02/ipbes_global_assessment_report_summary_for_policymakers_en.pdf [Nicole Wilke, Germany]</p>	Rejected. Statement A5 of IPBES 2019 states: "Human actions threaten more species with global extinction now than ever before." This plus the terms used in Ceballos et al and Hoegh-Guldberg and Bruno, justify the use of this term.
70055	14	33	14	34	Is it possible to compare the species extinction numbers in the current phase with those in the 5 preceding phases and also list this explicitly e.g. in a table? The general public might be interested to know that the 5 preceding phases happened long before the existence of humans. [Sonia Seneviratne, Switzerland]	Noted. No action. Such table would be beyond the scope of this section and the WGI report
36561	14	33	14	34	Climate change is causing "the sixth mass extinction of species"? What utter piffle! What was the author who wrote this smoking at the time. [John McLean, Australia]	Rejected. The statement is based on the references included in the text. In contrast, the reviewer does not provide any scientific support for his claim.
96059	14	35	14	35	This is a quotation from the IPBES SPM of the global assessment report (2019: 13). We therefore invite you to include the full reference. https://ipbes.net/sites/default/files/2020-02/ipbes_global_assessment_report_summary_for_policymakers_en.pdf [Nicole Wilke, Germany]	Taken into account. Reference added.
125147	14	39	15	28	[SCOPE] Section 1.2.2 is significantly too long, presenting information that the audience of this report do not need. It is not accurate to frame the AR4 and AR5 as being designed to provide scientific insights on limiting warming to 2°C. Most of this should be removed. [Trigg Talley, United States of America]	Taken into account. Revised to read "The Fourth and Fifth Assessment Reports (IPCC, 2007, 2013a) provided scientific background for the second major accord under the UNFCCC..."

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
109673	14	39	16	41	This entire section focuses heavily on the Paris Agreement and uses it as the exclusive frame of reference for policy and governance context without any introspection or acknowledging other perspectives on how climate change mitigation might best be approached. This feels a little irresponsible. Its many virtues notwithstanding, the Paris Agreement was a highly technocratic approach that seems to have missed some basic realities of democratic governance, helping explain its lukewarm popular reception. More broadly, there are, as many have pointed out, fundamental errors with the assumptions made in its approach: near-complete failure to address the central role of population growth in climate change, for example, or the well-known economic injustice of carbon taxes which makes them politically unpopular. See for example: Murtaugh and Schlabach, 2009, Reproduction and the carbon legacies of individuals, Global Environmental Change, 19, 14-20; Wynes and Nicholas, 2017, The climate mitigation gap: Education and government recommendations miss the most effective individual actions, Environmental Research Letters, 12, 072024; https://www.weforum.org/agenda/2016/03/what-is-carbon-inequality-and-how-do-we-tackle-it . Some recognition of these issues is required here for basic credibility; otherwise it will just look like a sales pitch. [Sean Fleming, United States of America]	Rejected. The first paragraph here mentions the many initiatives underway, but they are far too many to describe in detail. The IPCC is a United Nations body and while it is independent of the UNFCCC, its principal role has been to inform the processes and negotiations of the UNFCCC. The purpose of this section is to set AR6 into the context of what has happened since AR5. It does not attempt to assess the Paris Agreement as a political structure, nor would that be appropriate for a WGI report.
66611	14	39	25	14	Really uncomfortable with parts of 1.2.2. It's not really very WGI, and because of this I think it has a lot of risk for us. [Dave Frame, New Zealand]	Rejected. The report is framed in the context of Global Stocktake mitigation adaptation and risk assessment . It does make sense to set the socio economic and policy context
125145	14	39	26	11	[SCOPE] Delete Sections 1.2.2 (policy and governance context) and 1.2.2.1 (risk and solution framing). They are beyond the scope of WGI, unnecessary, and the chapter is already way too long, so it makes sense to delete them. Moreover, integrating this UNFCCC-specific text into an IPCC document will only complicate the approval process. Strongly suggest taking a lot of this content out, drafting a .INF and submitting to the appropriate workstream of the UNFCCC. Section 1.2.2.1 is more for WGII, not a physical science assessment. [Trigg Talley, United States of America]	Rejected. The approved outline states that we are to frame the report "in the context of the Global Stocktake, mitigation, adaptation, and risk assessment." The Paris Agreement is the most important new aspect of context since AR5, so it's essential to mention/discuss.
36579	14	39	26	13	The role of the IPCC is "to assess on a comprehensive, objective, open and transparent basis the scientific, technical and socio-economic information relevant to understanding the scientific basis of risk of human-induced climate change, its potential impacts and options for adaptation and mitigation. IPCC reports should be neutral with respect to policy, although they may need to deal objectively with scientific, technical and socio-economic factors relevant to the application of particular policies." ("Principles Governing IPCC Work"). The text on these 13 pages deals with matters outside the IPCC's role and therefore the text should ALL be deleted. [John McLean, Australia]	Rejected. As noted by the reviewer, this report must treat "socio-economic factors relevant to the application of particular policies." That's what this context-setting section does.
87221	14	39			At the beginning of section 1.2.2 a mention to the ongoing crisis of multilateralism could or should be considered, because it is having a significant impact on climate efforts and looks unrealistic to omitt that. [Rodolfo Sapiains, Chile]	Noted. It would be inappropriate to "mention" this in a report of this nature without explaining and documenting it, which would add considerably more text and detail to what is intended to be a brief overview of the policy context.
111361	14	41	14	42	Provide the context and explain climate emergency [Neeshad Shafi, Qatar]	Noted. "Climate emergency" is mentioned on p. 31 line 1.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
15901	14	41	14	47	<p>Add international security to the list of international agendas in the statement:</p> <p>"The contexts of both policy making and social understanding about climate change have evolved since the last IPCC assessment in 2013. Increasing recognition of the urgency of the climate change threat, along with still-rising emissions and unresolved issues of adaptation and equity, have led to new policy efforts. They have also brought together several previously independent international agendas through rising awareness that climate change, disaster risk, economic development, and human well-being are tightly interconnected. Meanwhile, public perception of climate change concerns varies around the world. This section summarizes these contextual developments and how they have shaped the approach of this report."</p> <p>So, it reads as:</p> <p>"The contexts of both policymaking and social understanding about climate change have evolved since the last IPCC assessment in 2013. Increasing recognition of the urgency of the climate change threat, along with still-rising emissions and unresolved issues of adaptation and equity, have led to new policy efforts. They have also brought together several previously independent international agendas through rising awareness that climate change, disaster risk, economic development, human well-being and international security agreements are tightly interconnected. Meanwhile, though public perception of climate change concerns varies around the world, the emerging picture of international security is continuing deterioration with unconstrained arms races emerging and conflict spreading, and much of this has climate change as its root cause. This section summarizes these contextual developments and how they have shaped the approach of this report." [Kevin Lister, United Kingdom (of Great Britain and Northern Ireland)]</p>	Noted. No action. The suggested addition would require considerable documentation of a contested claim, and add length, when we are called upon to cut by 10pct.
85935	14	41	14	47	<p>"have evolved", "unresolved issues of adaptation and equity", "public perception ..concerns varies" – please write explicitly, even about potentially politically sensitive issues. Avoid vague wording that does not speak clearly. [Debra Roberts and the Durban WGII TSU, South Africa]</p>	Rejected. No alternative proposed. Unpacking each of these issues would add excessive length (when we are called upon to cut length by 10pct.)
93663	14	41	14	47	<p>Inherent Indigenous rights, which are also recognized and affirmed by international law (the United Nations Declaration on the Rights of Indigenous People; UNDRIP), and climate justice should be incorporated in the policy and governance context. Globally, Indigenous people are taking a strong leadership and governance position on climate action and are leading the global movement to demand a transition away from a carbon-intensive economy, while also working to restore and protect natural ecosystems. Indigenous leaders and knowledge holders who are protecting the sacred, and speaking on behalf of the lands, waters, air, minerals, and all life within, rightfully deserve a voice in IPCC reports. [Bridget Doyle, Canada]</p>	Noted. We briefly describe the human rights context in Section 1.2.3. The term "equity" is used to capture this and many similar concerns of many other groups. "Climate justice" is a phrase with political valence, inappropriate for an IPCC report. Indigenous knowledge and indigenous knowledge are assessed in WG II
28667	14	41		47	<p>I did not gain any solid information from this paragraph. Could it be removed? [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]</p>	Taken into account. Paragraph now briefly introduces this section of the report.
112289	14	42	14	42	<p>last IPCC assessment report in 2013. Increasing recognition of the urgency of the climate change threat, along with instead of last IPCC assessment in 2013. Increasing recognition of the urgency of the climate change threat, along with [Kamal Mohammadi, Algeria]</p>	Noted. Proposal is to add a single word "report" after "assessment" - not useful or necessary.

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114165	14	42	14	42	Re "the last IPCC assessment in 2013": If you mean WGI here, please indicate that. (Keep in mind that the Synthesis report was the last part of the full AR6 assessment and was published in 2014) [Jan Fuglestedt, Norway]	Accepted. Sentence now reads "...since the fifth IPCC assessment in 2013-14."
66613	14	42	14	43	"Increasing recognition of the urgency of the climate change threat, along with still-rising emissions and unresolved issues of adaptation and equity, have led to new policy efforts." Suggest deleting this. What business do physical scientists have pronouncing on whether or not equity issues remain "unresolved"? And does the causal chain flow the way the sentence suggests? Are there really "new policy efforts"? Are they really driven by unresolved equity concerns? I think this stuff is risky. [Dave Frame, New Zealand]	Rejected. Chapter authors include an LA and CAs who are competent to "pronounce" on these issues.
36565	14	42	14	43	You have not demonstrated that emissions (of something you don't specify) has any influence on temperature. As I said earlier, IPCC climate assessment reports keep changing their so-called evidence for man-made warming (and I expect different "evidence" again in this report) so please don't assert that the matter is settled. [John McLean, Australia]	Rejected. It is normal and salutary for the evidence supporting scientific work to be continually re-assessed, re-evaluated, and updated in light of new knowledge.
125149	14	42	14	43	Why are the only "unresolved issues" adaptation and equity? While equity is important, couldn't one argue that mitigation is important especially if one would like to achieve the 1.5°C goal of the Paris Agreement? This sentence should be broadened out a bit to be less policy-prescriptive and agenda-setting. [Trigg Talley, United States of America]	Rejected. Sentence does not say that these are the *only* unresolved issues, and paragraph clearly implies that mitigation (of the rising emissions mentioned) is important. This paragraph is neither policy-prescriptive nor agenda-setting; it is a presentation of the actual current context.
5033	14	46	14	46	Suggested insertion between next-last and last sentence of the policy-introduction paragraph: "This explains a need for a meta-level of robust boundary conditions for social and ecological sustainability, with the capacity of informing, and unifying, sectors, disciplines, frameworks, concepts, tools and indicators around futures that can be as well as methodological support of relevant transition-routes to get there. This most commonly and dangerously missing piece of sustainability negotiations cannot be left to "soft" process instruments for management, dialogue and negotiations [1]. This understanding is instrumental to improve negotiations between private and public sectors, deepens the understanding of the organizational self-benefit of strategic sustainable development, and avoids the crippling concept of "prisoner's dilemma" that currently infects the interface between business, policy making, and climate summits [2]. [1] Göran Broman and Karl-Henrik Robèrt 2017. A framework for strategic sustainable development. J. Clean. Prod. Volume 140, Part 1, pages 17-31. [2] Karl-Henrik Robèrt and Göran Broman, 2017. Prisoner's dilemma misleads business and policy making. J. Clean. Prod. Volume 140, Part 1, pages 10-16. [Karl-Henrik Robèrt, Sweden]	Rejected. The proposed sentence is introducing some words and concepts that need to be explained, will lengthen the paragraph and it is not WG1 mandate to assess policy.
1697	14	47	14	47	I suggest to add the issue of school strike as it indicated the awareness and concern of young generation for their future [Ruba Ajjour, Jordan]	Accepted. Now mentioned in 1.2.3.4.
114943	14	49	14	53	Is there a reason why TAR is omitted in this paragraph? I believe it should be included possibly highlighting development and use SRES scenarios [Zbigniew Klimont, Austria]	Accepted. Sentence on TAR added
81487	14	49	14	54	Recommend to add developments on policy and governance from Third Assessment Report. [Ee Ling Lee, Malaysia]	Accepted. Sentence on TAR added
26219	14	49	15	3	There is no reference to the Third Assessment Report (TAR), therefore, there is no reference to the start or boost of the assessment on impacts and adaptation to climate change. [Tania Guillén Bolaños, Germany]	Accepted. Sentence on TAR added

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
86181	14	49			This paragraph should also call out the Third Assessment report which highlighted the impacts of climate change and need for adaptation. [Debra Roberts and the Durban WGII TSU, South Africa]	Accepted. Sentence on TAR added
36569	14	51	14	51	The statement is true in so much as it is an honest description of a sham. How could the UNFCCC make such claims when it had no evidence for them? The first IPCC report did not provide that evidence. The second IPCC report claimed that it had such evidence, in a paper that was published over 12 months after the report was published (and the paper was quickly dismissed as nonsense). The UNFCCC has been a fraud from the day it was formed. [John McLean, Australia]	Taken into account. No changes proposed or required.
70485	14	51			Replace 'signatories' with 'parties'. [Gillett Nathan, Canada]	Accepted.
36571	14	52	14	54	I haven't laughed so much in along time as I did when I read these two sentences. Limiting global warming to 2 degrees from some unspecified and unknowable base temperature that existed at an unspecified time in the past? [John McLean, Australia]	Taken into account. No changes proposed or required.
82155	14	53	14	53	Third Assessment Report is missing [Borbála Gálos, Hungary]	Accepted. Sentence on TAR added
21281	14	53			Why no mention of the third assessment report? Seems very strange. [Peter Thorne, Ireland]	Accepted. Sentence on TAR added
125151	14	54	14	55	This statement incorrectly characterizes AR4 and AR5. These reports were much more than "background related to limiting global warming to 2°C". That was not the purpose of these IPCC assessments and it is terribly misleading to describe them so narrowly. [Trigg Talley, United States of America]	Accepted. Sentence now reads: "The Fourth and Fifth Assessment Reports (IPCC, 2007, 2013a) provided scientific background for the second major accord under the UNFCCC..."
65649	14	54	15	3	Suggest using the exact text of the Paris Agreement. Suggest changing to: "The Fourth and Fifth Assessment Reports (IPCC, 2007, 2013a) informed on the scientific background related to limiting global warming to 2°C. These assessments supported the second major accord under the UNFCCC: the Paris Agreement (2015), which set a long-term goal to limit global average temperature to "well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognising that this would significantly reduce the risks and impacts of climate change." [Kushla Munro, Australia]	Reject. Sentence already quotes the exact text of the Paris accord, omitting only a few inconsequential words to decrease length.
70059	14	54	15	5	For the flow of text, I would shift the last sentence of the paragraph finishing with "... impacts of climate change" to be the first sentence of the following paragraph. This gives a better focus on the Paris agreement and its key statement. [Sonia Seneviratne, Switzerland]	Accepted; Thanks
70489	14	55	15	1	Describing keeping temperatures well below 2C as a 'long-term goal' of the Paris Agreement underplays the commitment made. The Paris Agreement is an agreement to keep temperatures to well-below 2C i.e. this is a commitment of the parties, not just a goal. Replace 'which set a long-term goal to' with 'in which Parties agreed to'. [Gillett Nathan, Canada]	Accepted. Sentence now reads: "Parties to the Paris Agreement committed to limiting global average temperature increase to "well below 2°C above pre-industrial levels..."
36573	14	55	15	3	More utter nonsense about specific amounts of warming from an unspecified base temperature, at an unspecified time, that is supposedly within two degrees of being ideal for the world. I'm not sure now if I'm reading something from a supposedly scientific organisation or a fantasy document by climate alarmists. [John McLean, Australia]	Rejected. Baselines and timelines are discussed extensively elsewhere in Chapter 1 and other chapters of this report.
115689	14		15		Section 1.2.2 may need to provide insights on the anticipated effects of the COVID-19 pandemic on the policy context. [Valerie Masson-Delmotte, France]	Accepted. Section 1.2.2 does now briefly mention COVID-19. Also, COVID-19 is covered in Section 1.4.4.3 Abrupt change, tipping points and surprises. Cross-Chapter Box 6.1 covers the COVID-19 pandemic and its impact on emissions, climate and air quality in more detail.

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114167	15	3	15	3	I suggest you mention Art 4 as well here [Jan Fuglestedt, Norway]	Accepted. Added "Each Party to the Paris Agreement is required to submit a Nationally Determined Contribution (NDC), and pursue domestic mitigation measures with the aim of achieving the objectives of its NDC (Article 4)."
26223	15	5	15	5	As specific reference to the goals of the agreement is made in following paragraphs, it would be useful to add here a reference to Cross-Chapter Box 1.1 where the goals are included. [Tania Guillén Bolaños, Germany]	Accepted. Reference added.
85937	15	5	15	5	Please point out that the Kyoto protocol placed the responsibility on the highest emitting countries, while in the Paris Agreement this clear statement of responsibility is partially lost by allowing all countries to voluntarily do what they can – at the insistence of the Annex-1 countries. [Debra Roberts and the Durban WGI TSU, South Africa]	Taken into account. We add NDCs are on voluntary basis
26129	15	5	15	6	To be consistent with WG3 Ch14 (international cooperation), you need to be clear that the Paris Agreement addresses mitigation (and adaptation) primarily through its provisions on finance, technology transfer, capacity-building, and education. That's how it works. The sentence here gives the impression that these provisions are in addition, but really they are the primary mechanism by which the agreement will influence national mitigation actions. [Anthony Patt, Switzerland]	Accepted. Paragraph now reads: "The PA further addresses mitigation (Article 4) and adaptation to climate change (Article 7), as well as loss and damage (Article 8), through the mechanisms of finance (Article 9), technology development and transfer (Article 10), capacity-building (Article 11) and education (Article 12). To reach its long-term temperature goal, the PA recommends 'achieving a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century', a state commonly described as 'net zero' emissions (Article 4) (Section 6, Box 1.4). Each Party to the PA is required to submit a Nationally Determined Contribution (NDC) and pursue, on a voluntary basis, domestic mitigation measures with the aim of achieving the objectives of its NDC (Article 4)."
66615	15	5	15	11	Suggest deleting this paragraph. No WGI content. [Dave Frame, New Zealand]	Rejected. This is important context for the assessment.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
65651	15	5	15	11	<p>1. Suggest clarification. The current list of issues addressed by the Paris Agreement is incomplete (it excludes, for example, the issues addressed by Articles 5, 6, and 13) and appears selective. Suggest reframing to refer to the purpose of the Agreement (Article 2) or include the full list.</p> <p>2. If choosing to refer to Article 8, we suggest using the full term “averting minimizing and addressing loss and damage” .</p> <p>3. Paragraph two – the current reference to the obligation related to NDCs is inaccurate. Suggest correction to: e.g. Each Party has a binding obligation to submit and NDC, which is different to a voluntary pledge by signatories. The Agreement entered into force in 2016. There is no formal date that it “came into effect”.</p> <p>Suggested text: “The Paris Agreement aims to strengthen the global response to the threat of climate change including by holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 °C above pre-industrial levels, Increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production; and making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development. Each Party to the Paris Agreement is required to submit a Nationally Determined Contribution (NDC), and pursue domestic mitigation measures with the aim of achieving the objectives of its NDC. The Agreement entered into force in 2016. Some lower-income countries, whose emissions may increase as their populations and affluence grow, included conditional elements in their NDCs, that are dependant on international financial and technical assistance (Rose et al., 2017). The majority of NDCs make reference to adaptation (Kato and Ellis, 2016).” [Kushla Munro, Australia]</p>	<p>Accepted. Paragraph now reads: "Parties to the Paris Agreement committed to limiting global average temperature increase to “well below 2°C above pre-industrial levels, and to pursue efforts to limit the temperature increase to 1.5°C” in order to “significantly reduce the risks and impacts of climate change.” Parties also agreed to increase their “ability to adapt to the adverse impacts of climate change, foster climate resilience, and support low-greenhouse-gas-emissions development in a manner that does not threaten food production,” and to make “finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development” (Article 2). The accord addresses mitigation and adaptation to climate change, as well as loss and damage, through the mechanisms of finance, technology transfer, capacity-building and education. Each Party to the Paris Agreement is required to submit a Nationally Determined Contribution (NDC), and pursue domestic mitigation measures with the aim of achieving the objectives of its NDC (Article 4). S</p>
50555	15	5	15	11	<p>Suggestion mentioning here also long term mitigation and adaptation strategies. [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]</p>	<p>Noted. We do refer to both mitigation and adaptation in section 1.2.2 as well as in Cross-Chapter Box 1.1. In the latter, we explicitly refer to both mitigation and adaptation in the context of the long-term goals of the Paris Agreement.</p>

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
112283	15	5	15	11	<p>The Paris Agreement addresses climate change mitigation and adaptation, as well as loss and damage assessment, financial mechanisms, technology transfer, capacity-building and education. More than 195 countries pledged to submit Nationally Determined Contributions (NDCs), including adaptation (Kato and Ellis, 2016) and GHGs emissions mitigation components. Lower-income countries, whose emissions may increase as their populations and GDP grow, are conditional on international financial and technical assistance (Rose et al., 2017).</p> <p>Instead of</p> <p>The Paris Agreement addresses both mitigating and adapting to climate change, as well as loss and damage, finance, technology transfer, capacity-building and education. Each signatory pledged to submit a Nationally Determined Contribution (NDC), including a mitigation component of reduction of greenhouse gases (GHG) emissions. The Agreement came into effect in 2020. NDCs of many lower-income countries, whose emissions may increase as their populations and affluence grow, are conditional on international financial and technical assistance (Rose et al., 2017). The majority of NDCs also include an adaptation component (Kato and Ellis, 2016). [Kamal Mohammedi, Algeria]</p>	Accepted. Paragraph now reads: "Parties to the Paris Agreement committed to limiting global average temperature increase to "well below 2°C above pre-industrial levels, and to pursue efforts to limit the temperature increase to 1.5°C" in order to "significantly reduce the risks and impacts of climate change." Parties also agreed to increase their "ability to adapt to the adverse impacts of climate change, foster climate resilience, and support low-greenhouse-gas-emissions development in a manner that does not threaten food production," and to make "finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development" (Article 2). The accord addresses mitigation and adaptation to climate change, as well as loss and damage, through the mechanisms of finance, technology transfer, capacity-building and education. Each Party to the Paris Agreement is required to submit a Nationally Determined Contribution (NDC), and pursue domestic mitigation measures with the aim of achieving the objectives of its NDC (Article 4).
24221	15	5	15	11	Some recognition of the resistance to the Paris Agreement by large sections of the public in many countries needs to be acknowledged. [Bryan Weare, United States of America]	Rejected. Not appropriate for WGI assessment
70487	15	6			Replace 'signatory' with 'party'. [Gillett Nathan, Canada]	Accepted. Done.
18449	15	8	15	8	may find "developing" to be a more palatable term [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Sentence deleted
82557	15	8	15	8	Check date - my understanding is that the Paris Agreement came into effect in 2016 (although some of its provisions were not implemented until later). [Blair Trewin, Australia]	Accepted. Corrected in text.
85939	15	8	15	8	"lower-income countries, whose emissions may increase as their populations and affluence grow" – the point about low-income countries is that so far they have been excluded from the benefits of industrialization and development on the back of fossil fuels, and their cumulative contribution to climate change is small compared to the industrialized countries Please read WGIII Chapter 5 opening sections for a good, clear handling of this subject. Current NDCs are not sufficient to halt climate change mainly because major Annex 1 countries are unwilling to do what is required. This report will inform the Global Stocktake, and it is important that these issues are very clearly presented. The world needs to be reminded of historical, cumulative emissions, per country, region and importantly, per capita, while also remembering the need for non-Annex 1 countries to catch up to the development enjoyed by Annex 1 countries. [Debra Roberts and the Durban WGII TSU, South Africa]	Accepted- Sentence deleted
36321	15	8	15	10	Quote from Rose et. Al, 2017 about lower-income countries emissions increasing as their populations and affluence grow, is unbalanced. It does not take into account the fact that lower income countries such as SIDS and LDCs are MOST affected, yet contributed very LITTLE to the emissions thus far. Proposal to add this to balance the sentence. [PENDO MARO, Belgium]	Accepted. Sentence deleted.

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87477	15	10	15	10	Add ', technology transfer' before 'and technical assistance. (Many countries' NDCs provide two mitigation scenarios -- a steeper reduction path is followed where technology is transferred). [Stephen Humphreys, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Revised to read: The PA further addresses mitigation (Article 4) and adaptation to climate change (Article 7), as well as loss and damage (Article 8), through the mechanisms of finance (Article 9), technology development and transfer (Article 10), capacity-building (Article 11) and education (Article 12). To reach its long-term temperature goal, the PA recommends 'achieving a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century', a state commonly described as 'net zero' emissions (Article 4) (Section 6, Box 1.4). Each Party to the PA is required to submit a Nationally Determined Contribution (NDC) and pursue, on a voluntary basis, domestic mitigation measures with the aim of achieving the objectives of its NDC (Article 4).
125153	15	10	15	11	What percentage of NDCs include mitigation activities? Adaptation is specifically called out here, but mitigation is an important aspect of WGIII and the how the world would limit warming to 1.5°C or below 2°C. It seems essential to provide a balanced perspective with respect to adaptation and mitigation (as well as any activities that provide co-benefits for both). [Trigg Talley, United States of America]	<p>Taken into account. Sentence deleted, paragraphs rewritten as follows: "The PA further addresses mitigation (Article 4) and adaptation to climate change (Article 7), as well as loss and damage (Article 8), through the mechanisms of finance (Article 9), technology development and transfer (Article 10), capacity-building (Article 11) and education (Article 12). To reach its long-term temperature goal, the PA recommends 'achieving a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century', a state commonly described as 'net zero' emissions (Article 4) (Section 6, Box 1.4). Each Party to the PA is required to submit a Nationally Determined Contribution (NDC) and pursue, on a voluntary basis, domestic mitigation measures with the aim of achieving the objectives of its NDC (Article 4).</p> <p>Numerous studies of the NDCs submitted since adoption of the PA in 2015 (Fawcett et al., 2015; UNFCCC, 2015, 2016; Lomborg, 2016; Rogelj et al., 2016, 2017; Benveniste et al., 2018; Gütschow et al., 2018; United Nations Environment Programme (UNEP), 2019) conclude that they are insufficient to meet the Paris temperature goal. In the present IPCC Sixth Assessment cycle, a Special Report on Global Warming of 1.5°C (SR1.5, IPCC, 2018) assessed high agreement that current NDCs 'are not in line with pathways that limit</p>
114169	15	11	15	11	Do you need a ref for this? And is Kato, T., and Ellis, J. (2016). Peer reviewed? [Jan Fuglestedt, Norway]	Noted. Sentence deleted.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
77157	15	13	15	14	Not clear what is being stated here. Perhaps leave for a later chapter or for WGIII [Emer Griffin, Ireland]	Noted. Paragraph revised as follows: Numerous studies of the NDCs submitted since adoption of the PA in 2015 (Fawcett et al., 2015; UNFCCC, 2015, 2016; Lomborg, 2016; Rogelj et al., 2016, 2017; Benveniste et al., 2018; Gütschow et al., 2018; United Nations Environment Programme (UNEP), 2019) conclude that they are insufficient to meet the Paris temperature goal. In the present IPCC Sixth Assessment cycle, a Special Report on Global Warming of 1.5°C (SR1.5, IPCC, 2018) assessed high agreement that current NDCs 'are not in line with pathways that limit warming to 1.5°C by the end of the century'. The PA includes a ratcheting mechanism designed to increase the ambition of voluntary national pledges over time. Under this mechanism, NDCs will be communicated or updated every five years. Each successive NDC will represent a 'progression beyond' the 'then current' NDC and reflect the 'highest possible ambition' (Article 4). These updates will be informed by a five-yearly periodic review including the 'Structured Expert Dialogue' (SED), as well as a 'global stocktake', to assess collective progress toward achieving the PA long-term goals. These processes will rely upon the assessments prepared during the IPCC sixth assessment cycle (e.g., Schlessner et al., 2016b; Cross-Chapter Box 1.1).
50557	15	13	15	22	It would be useful to spell out here the risks of higher warming levels, as well as those projected under central estimates. [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Noted. These risks are briefly summarized in Section 1.3, where we discuss SR1.5 and SROCC. Risks in the full sense are discussed mainly in the WG2 report; WG1 reports on hazards.
28669	15	13			"emissions mitigation components" was a bit confusing [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Sentence deleted.
36575	15	14	15	19	While strictly speaking the sentence is correct the whole thing is a fantasy because the IPCC hasn't proven, with consistent evidence, that greenhouse gas emissions cause dangerous warming. Estimates of future temperatures are based on the output of climate models and yet text box 9.2 of IPCC 5AR showed that 111 of 114 climate model runs predicted greater temperatures for the previous 15 years than the data from temperature observations indicated and 5AR WGI SPM section D.1 bullet point 2 said that "in some models [most?], an overestimate of the response of increasing greenhouse gases", which together show that the output of climate models is unreliable. [John McLean, Australia]	Rejected. Does not address AR6. The anomaly mentioned by the reviewer is fully discussed in Chapter 3, Cross-Chapter Box 3.1.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
115247	15	17	15	19	<p>You should here also add the report of the Structured Expert Dialogue that provided a substantive input for the Paris Agreement and which states this also in the summary, in particular message 8 "The world is not on track to achieve the long-term global goal, but successful mitigation policies are known and must be scaled up urgently" (Fischlin et al., 2015). One of the reasons why the global stock take is an essential part of the Paris Agreement (e.g. Fischlin, 2017) as you also write further below (p. 15, lines 24 to 28).</p> <p>Possible citation: Fischlin, A., Ji, Z., Vladu, F. & Bisiaux, A., 2015. Report on the Structured Expert Dialogue on the 2013–2015 Review of the United Nations Framework Convention on Climate Change (UNFCCC). UNFCCC, Subsidiary Body for Implementation (SBI) and Subsidiary Body for Scientific and Technological Advice (SBSTA), Bonn, Germany. Final Report FCCC/SB/2015/INF.1, 182pp. http://unfccc.int/resource/docs/2015/sb/eng/inf01.pdf</p> <p>Fischlin, A., 2017. Background and role of science. In: Klein, M., Carazo, M.P., Doelle, M., Bulmer, J. & Higham, A. (eds.). The Paris Agreement on Climate Change. Oxford University Press, Oxford, UK, 448pp., 3-16. https://global.oup.com/academic/product/the-paris-agreement-on-climate-change-9780198789338 Fi222 [Andreas Fischlin, Switzerland]</p>	Accepted. The Structured expert dialogue is introduced earlier in the section and references added
35445	15	17	15	19	Bibliographic citations in chronological order [Carlos Antonio Poot Delgado, Mexico]	Editorial. This kind of issue will be fixed during the copy-editing phase.
70491	15	17			Cross-chapter box 11 should be 1.1. Also by referring here to another part of the chapter, it is unclear which section is making the primary assessment on whether the NDCs are sufficient to reach the Paris Agreement targets. I think the primary assessment is here, in which case consider removing the references to XC Box 1.1. [Gillett Nathan, Canada]	Taken into account. Reference is *not* to XC Box 1.1, but to XC Box 11 of SR1.5, Chapter 4. Inserted the following sentence to clarify: "The IPCC Special Report on Global Warming of 1.5°C assessed a median warming (50% probability in 2100) of 2.7-3.4°C above pre-industrial levels if both conditional and unconditional NDC commitments are fully implemented (de Coninck et al., 2018, Cross-Chapter Box 11)."
106245	15	19	15	21	This number is different from the IPCC SR1.5 assessment, despite citing a reference already cited in SR1.5 as well. Unless there is new evidence that the IPCC SR1.5 assessment should be revised, I suggest to reflect the IPCC SR1.5 assessment here as found in "Cross-Chapter Box 11 Consistency Between Nationally Determined Contributions and 1.5°C Scenarios" in SR1.5 Chapter 4. [Rogelj Joeri, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Relevant sentences now read: "Numerous studies of the NDCs submitted since adoption of the PA in 2015 (Fawcett et al., 2015; UNFCCC, 2015, 2016; Lomborg, 2016; Rogelj et al., 2016, 2017; Benveniste et al., 2018; Gütschow et al., 2018; United Nations Environment Programme (UNEP), 2019) conclude that they are insufficient to meet the Paris temperature goal. In the present IPCC Sixth Assessment cycle, a Special Report on Global Warming of 1.5°C (SR1.5, IPCC, 2018) assessed high agreement that current NDCs 'are not in line with pathways that limit warming to 1.5°C by the end of the century'.
26221	15	19	15	21	This information should be elevated to Executive Summary (first stateent Framing and context). [Tania Guillén Bolaños, Germany]	Accepted. Elevated in the ES. Thanks

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
18451	15	19	15	22	the 2015 NDCs were "intended" (INDCs). And may have been conditional. Much more omn this in WG III Ch 4. [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Language has been clarified and aligns with WG3 Ch 4. Now says "the NDCs submitted after adoption of the Paris Agreement in 2015..." (no longer "at the time of the Paris Agreement," but "after adoption...")
114171	15	19	15	22	I am not sure this fits here. Check if this is covered elsewhere , e.g. in ch4. If you keep it here, you may need to elaboratae a bit more and do your own assessment. Please also consider if this should be in this ES or not. [Jan Fuglestedt, Norway]	Taken into account. It is not assessed elsewhere in WG1, but was assessed in SR1.5. Relevant sentences now read: "Numerous studies of the NDCs submitted since adoption of the PA in 2015 (Fawcett et al., 2015; UNFCCC, 2015, 2016; Lomborg, 2016; Rogelj et al., 2016, 2017; Benveniste et al., 2018; Gütschow et al., 2018; United Nations Environment Programme (UNEP), 2019) conclude that they are insufficient to meet the Paris temperature goal. In the present IPCC Sixth Assessment cycle, a Special Report on Global Warming of 1.5°C (SR1.5, IPCC, 2018) assessed high agreement that current NDCs 'are not in line with pathways that limit warming to 1.5°C by the end of the century'.
36577	15	21	15	22	What have annual carbon emissions got to do with anything when precipitates such as carbon are captured in most industrial processes? Do you not mean carbon dioxide? [John McLean, Australia]	Accepted. Changed to "carbon dioxide emissions."
5035	15	22	15	22	We suggest that the following is added after the end of line 22: "So we have a double problem: We know that proposed and/or agreed policies are not sufficient for climate stability, and at the same time not even those policies are followed. This signifies the comments in this review, that the IPCC document needs to be equipped with methodological support at the first approximation level, which increases the value of all tools and concepts for sustainable development. for strategic sustainable development. [1, 2]. [1] Göran Broman and Karl-Henrik Robèrt 2017. A framework for strategic sustainable development. J. Clean. Prod. Volume 140, Part 1, pages 17-31. [2] Karl-Henrik Robèrt and Göran Broman 2017. Prisoner's dilemma misleads business and policy making. J. Clean. Prod. Volume 140, Part 1, pages 10-16." [Karl-Henrik Robèrt, Sweden]	Rejected. WG3 issue.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
26549	15	23	15	23	In addition to finance (art. 9), technology development and transfer (art. 10) and capacity building (art. 11) are important aspects of means of implementation. We suggest to mention them. [Eric Brun, France]	Accepted. Now reads: "The PA further addresses mitigation (Article 4) and adaptation to climate change (Article 7), as well as loss and damage (Article 8), through the mechanisms of finance (Article 9), technology development and transfer (Article 10), capacity-building (Article 11) and education (Article 12). To reach its long-term temperature goal, the PA recommends 'achieving a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century', a state commonly described as 'net zero' emissions (Article 4) (Section 6, Box 1.4). Each Party to the PA is required to submit a Nationally Determined Contribution (NDC) and pursue, on a voluntary basis, domestic mitigation measures with the aim of achieving the objectives of its NDC (Article 4)."
106247	15	24	15	28	The Global Stocktake is scheduled to take place in 2022-2023 (i.e. to start in 2022 and to be concluded in 2023). This could be clarified. Furthermore, equally pertinent policy context is the Paris Agreement's "Periodic Review", as decided and described in Decision 5/CP.25 of the Lima/Madrid COP. The forthcoming second Period Review will include an Structured Expert Dialogue, as was the case for the 2013-2015 review, set to start in 2020 and relying on input of the IPCC AR6 WG reports which provide the best available science. [Rogel] Joeri, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Sentence now reads: "Each successive NDC will represent a 'progression beyond' the 'then current' NDC and reflect the 'highest possible ambition' (Article 4). These updates will be informed by a five-yearly periodic review including the 'Structured Expert Dialogue' (SED), as well as a 'global stocktake', to assess collective progress toward achieving the PA long-term goals. These processes will rely upon the assessments prepared during the IPCC sixth assessment cycle (e.g., Schleussner et al., 2016b; Cross-Chapter Box 1.1)."
77159	15	24	15	28	mention of UNFCCC Art 2 and long term strategies is warranted here [Emer Griffin, Ireland]	Noted. Comment is unclear - Article 2 has already been addressed.
50559	15	25	15	25	Suggest making the following addition (in bold) to reflect the Paris Agreement more accurately: ' NDCs will be communicated or updated' [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Added "communicated." Cannot use bold in body text, per IPCC style.
50561	15	25	15	26	Suggest making the following addition (in bold) to reflect the Paris Agreement more accurately: 'These updates will be informed by the outcomes of a 'global stocktake'" [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. Cannot use bold in body text, per IPCC style
50563	15	26	15	26	Suggest making the following addition (in bold) to reflect the Paris Agreement more accurately: 'to assess collective progress' [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. "Collective" added, but cannot use bold in the body text per IPCC style
50565	15	26	15	26	Suggest making the following amendment to the end of the sentence (in bold) to reflect the Paris Agreement more accurately: 'progress toward achieving the purpose of the Paris Agreement and its long-term goals' [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Now reads: "... to assess collective progress toward achieving the PA long-term goals." Cannot use bold in the body text per IPCC style

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
115249	15	27	15	28	Again as I mentioned before, there is not only the GST taking place in UNFCCC where scientific input matters. There is also the 2nd period review with its structured expert dialogue SED that will be relevant (https://unfccc.int/topics/science/workstreams/periodic-review). Use the GST only as an example or better, mention that the timing of AR6 cycle is timed very well with several UNFCCC processes, which depend critically on scientific inputs from the IPCC. Moreover, modalities and scope of the SED are already decided (Decision 5/CP.25, https://unfccc.int/sites/default/files/resource/cp2019_13a01E.pdf), while those of the GST 2023 are less clear. [Andreas Fischlin, Switzerland]	Accepted. Sentence now reads: "These updates will be informed by a five-yearly periodic review including the 'Structured Expert Dialogue' (SED), as well as a 'global stocktake', to assess collective progress toward achieving the PA long-term goals. These processes will rely upon the assessments prepared during the IPCC sixth assessment cycle (e.g., Schleussner et al., 2016b; Cross-Chapter Box 1.1)."
66625	15	31	23	1	I think the Box reads pretty well, though its tone is still a wee bit variable. [Dave Frame, New Zealand]	Noted. Thanks.
18453	15	31	24	2	This box focuses (at length) on the global stocktake; The Paris Agreement is not everything, This report is likely to be in time for the second periodic review of the long-term goal under the convention itself. The modalities are pretty clear. [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	Noted. There seems to be a misunderstanding regarding the purpose of the Cross-Chapter Box. It is meant to point reader to information in the WGI report that might potentially be relevant for the global stocktake, as mandated by the IPCC in the approved outline of WGI. We have revised the language to be make this very clear.
125155	15	31	24	2	[SCOPE] The need for this cross-chapter box is unclear. It is rather arrogant to tell policymakers what they need. They certainly don't need the background information on the Paris Agreement, which is written as if for an academic journal. Suggest just keeping the paragraph on page 17 from lines 13-19. It is inappropriate for WGI to opine on needs in the other WGs, such as adaptation barriers and constraints, without including authors from those WGs. Further, the table could best be handled in a few FAQs. The rest of the table would make a useful academic publication. [Trigg Talley, United States of America]	Noted. There seems to be a misunderstanding regarding the purpose of the Cross-Chapter Box. It is meant to point reader to information in the WGI report that might potentially be relevant for the global stocktake, as mandated by the IPCC in the approved outline of WGI. We have revised the language to be make this very clear.
86665	15	31	24	4	We appreciate the formulations and theme covered by Cross-Chapter Box 1.1. However, we do not see a reference to this material in the current version of the SPM. Please consider to include some wording in the SPM e.g. in the Introduction section (SPM page 2), including a specific reference to Cross-Chapter Box 1.1. Such wording that would be appropriate for the SPM could for instance be the two sentences from page 17 line 13-17. It is good that this is currently reflected better in the Technical Summary, but still, please consider if this might be something that would be worth mentioning in the SPM as well. [Oyvind Christophersen, Norway]	Noted. For the SPM drafting team to decide
41359	15	31			Cross-Chapter Box1.1: This is a very useful and important box. Wherever possible, please shorten the box table without removing the key policy-relevant information. [Alexander Nauels, Germany]	Noted. Thanks.
19619	15	32	15	32	don't you find slightly unnerving this way of putting forward WG1 (which is found in many other places throughout the report: 132 cases in this chapter of SOD excluding headers)? Possibly the reader knows his way through IPCC production, and then there is no need to remind him/she that science of climate is the domain of the 1rst working group. Alternatively, the reader is an outsider, and then what matters for him is that he is reading an IPCC document. To me, the relevant reference is to AR6. Of course, when other WG are involved, it is legitimate to assign WG1's role. [philippe waldteufel, France]	Noted. No action.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
64721	15	32	24	1	Recommend to include in the box the UNFCCC/PA information about the GST, and introduce the rest of the text of the box as a section in the chapter. Its entity is sufficient to be part of the text and not a box. However, the question that arises is if should be in this chapter the relevance and contribution or in other chapter, while the box (only with the PA text) remains here. [Sanz Sanchez Maria Jose, Spain]	Noted. We prefer to keep the amount of information in the box as is. We have added some additional text to the main text of Chapter 1.
111807	15	32	24	2	without taking any position how deep & broad the focus on the GST should be, I think that it should be done similarly in all three WGs. In WG1, the GST coverage is much broader than it is in FODs of WG2 and WG3, and I'm not sure if they plan to devote so much space to it. This could lead to the impression that WG1 content is much more relevant to the GST than WG2 and WG3 content. That's probably not an impression you'd want to create. The table works quite well in providing entry points for more detailed information within the report [Oliver Geden, Germany]	Noted. Thanks. We agree. However, WGs II and III will take their own decisions as to how to present the material.
125157	15	32	24	2	[SCOPE] The approved outline for Chapter 1 calls for "Framing of the physical science information relevant for mitigation, adaptation, and risk assessment in the context of the Global Stocktake". But the 9-page table on these pages is surely not what they had in mind. The authors should write a couple of paragraphs for the text and provide their typology and lengthy list of questions and relevance of the WGI report as supplementary information via some other IPCC mechanism. The entire 9-page table should be deleted from Chapter 1. [Trigg Talley, United States of America]	Noted. There seems to be a misunderstanding regarding the purpose of the Cross-Chapter Box. It is meant to point reader to information in the WGI report that might potentially be relevant for the global stocktake, as mandated by the IPCC in the approved outline of WGI. We have revised the language to be make this very clear.
125159	15	32	24	2	[SCOPE] Cut Cross-Chapter Box 1.1. Like Section 1.2.2, take this content out, convert it into an .INF, and submit to the relevant workstream in the UNFCCC. Chapter 1 is far too long as it is, and this content -- while useful in some contexts -- is not necessary for WGI of the IPCC. Leaving it in just invites politicization of the IPCC and challenges in the approval session. [Trigg Talley, United States of America]	Noted. There seems to be a misunderstanding regarding the purpose of the Cross-Chapter Box. It is meant to point reader to information in the WGI report that might potentially be relevant for the global stocktake, as mandated by the IPCC in the approved outline of WGI. We have revised the language to be make this very clear.
39147	15	32	24	4	Cross-chapter Box 1.1 will be very helpful to policy makers. [Lourdes Tibig, Philippines]	Noted. Thanks.
26551	15	34	15	34	The position of the reference to footnote "2" tends to confirm that the paragraph 36 of - /CMA says that the latest IPCC's reports are a central source of information, which is not written anywhere. The reference could be put elsewhere, e.g. after "the sources of input envisaged for the global stocktake". [Eric Brun, France]	Accepted. Text revised.
44345	15	34	15	37	shouldn't the authors of cross-chapter boxes be listed alphabetically? [Jana Sillmann, Norway]	Noted. Mainly responsible authors are listed first, then all others alphabetically.
79861	15	34	15	37	These are all highly qualified authors, but it is a bit disconcerting that in an IPCC AR text about "the vehicle to reflect on whether the collective level of action is commensurate with the Paris Agreement purpose and long-term goals", the poorest two countries out of ten represented are China and New Zealand. Is there no expertise in poorer countries in terms of monitoring global climate change activities? If so then that should be a major point in the ES! [Dáithí Stone, New Zealand]	Noted. No action.
106249	15	40	15	41	Minor clarification: the Global Stocktake is scheduled to take place in 2022-2023 (i.e. to start in 2022 and to be concluded in 2023). [Rogelj Joeri, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The text states "due in 2023".
26553	15	41	15	41	Footnote 2 must be corrected : it is in paragraph 37(b) and not 36 that "latest reports of the Intergovernmental Panel on Climate Change" are included as a source of input. [Eric Brun, France]	Accepted. Text revised.
50567	15	42	15	43	Suggest making the following additions (in bold) to reflect the Paris Agreement more accurately: 'commensurate with achieving the Paris Agreement purpose and its long-term goals' [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. Text deleted.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
50569	15	43	15	43	Suggest adding 'inter alia' or something of similar meaning between 'captured' and 'in', because Decision 19/CMA.1 on the GST from COP24 specifically mentions 'including Article 2' in paragraph 6, as Parties didn't necessarily agree on what constitute the long-term goals of the Paris Agreement. [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Text revised.
1699	15	43	16	2	i suggest to modify as follows: These are captured in Article 2 as mitigation, adaptation and means of implementation where it states: "This Agreement, in enhancing the implementation of the Convention, including its objective, aims to strengthen the global response to the threat of climate change, in the context of sustainable development and efforts to eradicate poverty, including by: (a) Holding the(b) (c)...." [Ruba Ajjour, Jordan]	Rejected. The current text seems to be capturing what the reviewer suggests.
50571	15	47	15	47	Suggest removing 'mitigation' as Article 2.1 a, b and c don't exactly match up to the concepts of mitigation, adaptation and means of implementation for Parties (probably less true for mitigation, but this is especially contentious for Art.2.1c which isn't seen as encompassing all the elements of means of implementation) [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. We prefer keeping these labels. In addition, we have included a footnote clarifying that the labels of mitigation, adaptation and means of implementation and support are here provided for reader's guidance only, with no presumption about the actual legal content of the paragraphs and to which extent they encompass mitigation, adaptation and means of implementation in its entirety
50573	15	51	15	51	Suggest removing 'adaptation' for the same reason as above [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. We prefer keeping these labels. In addition, we have included a footnote clarifying that the labels of mitigation, adaptation and means of implementation and support are here provided for reader's guidance only, with no presumption about the actual legal content of the paragraphs and to which extent they encompass mitigation, adaptation and means of implementation in its entirety
104809	15	51	15	53	Adaptation of food production may include other methods of production (hydroponic) such as currently being developed at scale in Dubai. Finding natural methods and practices that evolve disease resistance in crops. Less intense methods from the "Kill, overfertilise and grow" quote from Danone CEO (Monsanto "Feed the world model") to reduce impact of soil degradation 29% globally in 2016 (UNEP 2019) and pollinator/insect extinction 50 to 70% since 1970.The adaptation challenge will be to maintain adequate levels of food production to sustain the global population. UNEP 2019 (DOI: 10.1017/9781108627146) at https://www.unenvironment.org/resources/global-environment-outlook-6 [Paul Dumble, United Kingdom (of Great Britain and Northern Ireland)]	Noted. No action. Direct quote.
24223	15	53			"Food production" is not the only constraint on adaptation. [Bryan Weare, United States of America]	Noted. No action. Direct quote.
44973	15		17		Consistency in use of abbreviations throughout the Cross-Chapter box. Examples include i) p16 L15 use of "GHG" vs p15 L52 and p17 L5 use of "greenhouse gas emissions" and ii) p16 L14 use of "NDC" vs p17 L7 use of "nationally determined contributions" [Maysoun Mustafa, Malaysia]	Noted. Copy edits.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
19129	15		24		This is a valuable and of course highly policy-relevant box. Nevertheless some governments have objected to the inclusion in other reports of references to the Paris Agreement and NDCs on the grounds that they are in the areas of policy and negotiation and not science. It might therefore be helpful to include some references to scientific literature(if any) on the Paris Agreement and/or global stocktake to head off this argument. It might also be useful to include a reference to the "Structured Expert Dialogue" which will give negotiators an opportunity to interact with authors in detail on the report during the UNFCCC COP (or subsidiary body meetings) and for which this box would be very helpful. The timing of the Dialogue is currently uncertain and depends to an extent on revisions to the UNFCCC and IPCC timetables, but should be clearer in the coming months. [Jonathan Lynn, Switzerland]	Noted. We do refer to the SED in the box. The main text in section 1.2.2 just preceding the Cross-Chapter Box covers the scientific literature on the PA and the global stocktake.
50575	16	1	16	1	Suggest removing 'means of implementation' for the same reason as directly above [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. We prefer keeping these labels. In addition, we have included a footnote clarifying that the labels of mitigation, adaptation and means of implementation and support are here provided for reader's guidance only, with no presumption about the actual legal content of the paragraphs and to which extent they encompass mitigation, adaptation and means of implementation in its entirety
104811	16	1	16	2	Not much on this subject of financing climate a global annual figure of about 4 to 5% GDP (\$3 to 4 trillion/ annum) is doing the rounds. Some interesting non-growth models emerging from green groups. The fossil fuel companies view of net zero such as Adani off setting their renewable capacity with for example their growth of coal mines in India and Australia (Includes a plan to produce hydrogen from a lignin coal - a fossil fuel source); or Blackrock (\$7 trillion in mainly Fossil fuel assets) offsetting new fossil fuel developments with new investments in.renewable capacity - though working with the McAuthur Foundation.. This strategy depends on the tolerance of governments often too reliant or addicted to a fossil fuel economy which wil prop up the value of fossil fuel assets whilst they are off loaded to naive investors. Perhps we should be talking about coordinating the future investments of these large fossil fuel companies withn transition timeline (A job for the UN Secretary Generals Office/ World Bank). Wortha mention somewhere in the document. [Paul Dumble, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Financing is outside the remit of WGI and this report.
50577	16	7	16	7	Suggest removing 'in these three areas' based on previous comments, as the long-term goals haven't explicitly been defined anywhere. [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Not Applicable - paragraph deleted
115251	16	8	16	8	Replace "will also" by "intends also to". IPCC cannot and should not predict whether that will actually happen. [Andreas Fischlin, Switzerland]	Not Applicable - paragraph deleted
26555	16	8	16	9	It might be more relevant to stick more closely to the agreed text of the decision [Eric Brun, France]	Not Applicable - paragraph deleted
66617	16	11	16	15	The Article 4 stuff should be preceded by the Article 2 stuff, since that's the way it works in the PA. I know it's a restatement of the stuff a wee bit above, but I think it's important. [Dave Frame, New Zealand]	Not Applicable - paragraph deleted
8605	16	11	16	15	Add quotation marks around direct use of Paris Agreement text [Robert Kopp, United States of America]	Not Applicable - paragraph deleted

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
26131	16	13	16	15	This sentence doesn't quite make sense, and doesn't quite agree with WG3 Ch 14. Parties to the Paris Agreement have various procedural obligations, including to prepare NDCs, and with respect to transparency, finance, etc. All of these are designed to support efforts at mitigation. This sentence gives the impression that it is the NDCs that allow countries to meet their objectives. But really the NDCs are a reflection of what countries intend to do, and it is the other elements of Paris (finance, technology, etc.) that are designed to lead to increasing levels of ambition over time. [Anthony Patt, Switzerland]	Not Applicable - paragraph deleted
50579	16	14	16	14	Suggest making the following addition (in bold) to reflect the Paris Agreement more accurately: ' 5-yearly NDC communication or update' [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Not Applicable - paragraph deleted
26225	16	16	16	21	Article 7 recognizes the strong relation between mitigation efforts and adaptation needs. This is worthy to be mentioned here. [Tania Guillén Bolaños, Germany]	Not Applicable - paragraph deleted
36323	16	22	16	23	Some inconsistency with Chapter 1 page 15 lines 8-10. The former speaks to lower-income countries' NDCs being conditional on finance, but does not make reference to text on page 16 (line 22-23) stating that under the Paris Agreement means of implementation "developed country Parties shall 22 provide financial resources to assist developing country Parties with respect to both mitigation and 23 adaptation in continuation of their existing obligations under the Convention". [PENDO MARO, Belgium]	Not Applicable - paragraph deleted
66619	16	22	16	24	(c) is not WGI material. [Dave Frame, New Zealand]	Not Applicable - paragraph deleted
26569	16	34	23	1	Cross-Chapter Box 1.1 Table 1 is very policy relevant and should be maintained. [Eric Brun, France]	Noted. Thanks.
102463	16	48	23	1	Cross-Chapter Box 1.1, Table 1. Table entry: "How much of the observed warming since preindustrial or early industrial times was due to anthropogenic influences?". The (undefined) concept of early industrial times is surprisingly introduced. [Philippe Tulkens, Belgium]	Accepted. Text revised.
115253	17	1	17	1	Parties needs to be written with a capital [Andreas Fischlin, Switzerland]	Not applicable. Text deleted.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
65653	17	1	17	11	<p>Suggest correction. The current reference to Article 4, para 15 of the Paris Agreement in point (a) appears to be an error, please correct to refer to Article 4, para 19. In this Chapter "L" document references should be updated to reference the final decision number and document in which it is recorded. ("L" documents referenced in this chapter refer to documents containing draft decisions. Final decisions on these matters have now been taken and so the final decision number and document number should be referenced). Suggested changes below to better capture how the work of WG1 will contribute to the GST.</p> <p>(a) The state of greenhouse gas emissions by sources and removals by sinks, including information that can facilitate discussions on long-term low greenhouse gas emission development strategies (Art. 4, paragraph 19 of the Paris Agreement) (paragraph 36 (a) of decision 19/CMA.1, FCCC/PA/CMA/2018/3/Add.2). Footnoted URL should also be updated to https://unfccc.int/sites/default/files/resource/CMA2018_03a02E.pdf?download</p> <p>(b) Information on the overall global effect of nationally determined contributions and overall global progress made in reducing greenhouse gas emissions (paragraph 36 (b)).</p> <p>(c) Information that enhances understanding of efforts related to averting, minimizing and addressing loss and damage associated with the adverse effects of climate change (paragraph 36 (e)), cognizant of the important contribution of WGII on this matter. [Kushla Munro, Australia]</p>	Not Applicable - paragraph deleted
50589	17	4	17	11	<p>Not able to comment myself on where the WGI assessment might be particularly relevant, so it might be worth you looking at paragraph 36 of Decision 19/CMA.1 to see if there is anything else beyond a, b and c that could be covered and should be highlighted here as a result. [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]</p>	Not Applicable - paragraph deleted
114175	17	13	17	17	<p>I suggest you also mention current state of climate; such a level of warming to date [Jan Fuglestedt, Norway]</p>	Accepted. Text revised
114173	17	14	17	14	<p>Insert "AR6" [Jan Fuglestedt, Norway]</p>	Accepted. Text revised
39953	17	16	17	16	<p>As it will be important for the SyR, perhaps "near-term" could be defined? [TSU WGI, France]</p>	Noted. We however prefer to remain unspecific and not be quantitative here to avoid hindering the comparison with other WGs as part of the SYR. We expect some flexibility in the use of the terms "near-term", "mid-term", "long-term".
857	17	21	1	29	<p>The text in this text box is somewhat lengthy, but this rationale for the structure of the WG-I report is very good [Bart van den Hurk, Netherlands]</p>	Noted. Thanks.
89975	17	21	17	21	<p>"WGI contribution to stocktake" is sensitive; line 13 has the proper guarded language. [Jochem Marotzke, Germany]</p>	Accepted. Text revised
114177	17	21	17	29	<p>Check the labels "long term" and "near term" wrt how these are used across chapters and WG reports [Jan Fuglestedt, Norway]</p>	Noted. Thanks.
4751	17	21	17	29	<p>The text in this text box is somewhat lengthy, but this rationale for the structure of the WG-I report is very good [Bart van den Hurk, Netherlands]</p>	Noted. Thanks.
66621	17	25	17	40	<p>Could cut without much loss if you need to save space. That's quite a few words for essentially background material. [Dave Frame, New Zealand]</p>	Accepted. Text shortened.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
68025	17	32	19	29	Expand the question to include estimation of the amplitude of the unforced variability. Is the unforced variability, estimated from detection and attribution studies, consistent with that estimated from unforced climate simulations and with that estimated from actual climate variation under low-forcing conditions? Discussion of this in section 1.4.2 can be cited. [Michael Evans, United States of America]	Noted. No change. Unclear which question this refers to.
18455	17	32	24	2	I find the table quite excessive in detail. [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	Noted. No action.
18603	17	32	24	2	Cross-chapter Box 1 Table on climate changes includes several discussions of key CH12 topics and would benefit from more references to corresponding portions of CH12, including discussions of regional CID changes, climate services, and reasons for concern (some are already mentioned, but other possibilities are noted below): - Part 1 (observations): sea ice (12.4.9), snow cover and meltwater (12.4), sea level rise (12.4), extreme events (12.3, 12.4, given that focus is on societally-relevant changes). - Part 2 (long-term): regional changes in precipitation, runoff, and evaporation (12.4), regional SLR (12.4), extremes (12.4) - Part 3 (near-term): impact-relevant indices (12.3, 12.4, 12.5.2), mountain glaciers (12.4), regional climate information (12.6; cross-chapter Box 12.1), large near-term changes (12.5.2). [Alexander Ruane, United States of America]	Accepted. Text revised, references added
125161	17	32	24	2	[SCOPE] Cut Cross-Chapter Box 1.1, Table 1. This table COULD be helpful if it actually had the answers to the questions in it. But it doesn't. And it occupies a LOT of space in a chapter that is already way too long. Like the surrounding Section 1.2.2 and the box it sits in, all of this content should be converted into an .INF and submitted to the relevant workstream of the UNFCCC. [Trigg Talley, United States of America]	Noted. We appreciate that this information is seen as relevant. The purpose of the table is to point the interested reader to the Chapters/sections in the WGI AR6 report, where relevant information can be found. It was a deliberate decision not to collect answers to these questions here. We also appreciate the suggestions for shortening. It is not IPCC's mandate for AR6 to produce INF documents for the UNFCCC process (although IPCC information can be used for such). Given the interest to a broader audience than just UNFCCC negotiators, we hence keep a revised version of the table.
88153	17	32			Cross Chapter box 1.1 Table 1 - Section 2 last row, 3rd column (pg 22) - Change "permafrost melting" to "permafrost thawing". Why not use "ice sheet melting" rather than "ice sheet disintegration". [Sharon Smith, Canada]	Accepted. Text revised
85941	17	34	17	34	Some of the texts in the column on potential relevance in CCB 1.1. speak to the impacts of the changes rather than the observed changes (e.g. ocean warming, ocean acidification and changes in sea ice extent). It is important to check all entries and ensure that the responses are aligned to the questions. [Debra Roberts and the Durban WGI TSU, South Africa]	Taken into account. The right hand columns are however not considered responses to the questions though, but rather the indication of the potential relevance. Therefore, impacts are mentioned as potential relevance for some geophysical changes and impacts.
50581	17	34	17	44	There are some tautological statements here - some suggestions for more meaningful statements given below [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Thanks.
78671	17	34	24	2	This refers to a column name for the table 1 here: The column titled "Potential Relevance" sometimes gives explanations to the questions, hence this column title might better be expanded, e.g.,: "Potential Relevance and Explanatory Remarks" (for all three subsections of this table) [Heike Wex, Germany]	Accepted. Text revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
87479	17	34	24	2	Although this table is very informative, it does feel like a lot of a precious wordcount budget on information that exists elsewhere? Might this be an annex or a faq? (That said, I found the brief note on aerosols very useful here -- could it be used in the SPM which has nothing as succinct or clear on this matter?) [Stephen Humphreys, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Editorial ; Layout to be decided as part of the publication process.
111917	17	34			Table 1: Section 1, sea-ice - I would expect explicitly mentioned sea-ice albedo feedback in Relevance [Tomas Halenka, Czech Republic]	Taken into account. Text revised. ice-albedo explicitly mentioned now.
111919	17	34			Table 1: Section 2, remaining carbon budget - evaluation of cumulative emissions of CO2, discussed the effect of a ton of CO2 - see comment for whole report - unifying of the unit and characteristic of presentation of this parameter (C, CO2, CO2eq) [Tomas Halenka, Czech Republic]	Noted. Consistency across full report is established.
50587	17	36	17	37	"Section 1 "State of the Climate" is focused on the state of the climate" - suggest the second state of the climate could be changed to something like "observed warming and other changes" to avoid repetition [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Text revised.
39779	17	37	17	38	"Long-term Future Projections" seems redundant. "Long-term Projections"? Does not seem to be quoted as such in the Paris Agreement. https://unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement.pdf [TSU WGI, France]	Taken into account. Text revised.
50583	17	38	17	38	"long-term future projections" can you say instead something like "projections to the end of the 21st century and following x centuries" to make this statement more specific? [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Noted. We however prefer to remain unspecific and not be quantitative here to avoid hindering the comparison with other WGs as part of the SYR. We expect some flexibility in the use of the terms "near-term", "mid-term", "long-term".
50585	17	41	17	41	"near-term" can you say instead something like "2020s and 2030s" if it possible to quantify this term? [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Noted. We however prefer to remain unspecific and not be quantitative here to avoid hindering the comparison with other WGs as part of the SYR. We expect some flexibility in the use of the terms "near-term", "mid-term", "long-term".
26557	17		17		Bottom row of the Table page 17 : The question of equity will be important and sensitive input to the stocktake. The contribution of parties to historical emissions is not identical, some have contributed more than others. The report will need to inform this discussion. [Eric Brun, France]	Noted. Country-specific emissions and their climate effect are outside the remit of WGI and this report.
45601	18	0	18	0	Cross chapter box 1 Table 1. Regarding mountain glaciers you need to include section 9.5.1. Section 9.5.3 is only about snow. [Lucas Ruiz, Argentina]	Accepted. Text revised
45603	18	0	18	0	Regarding "How much did sea level rise in past centuries and what is the current trend? " The correct section is 9.6 instead of 9.2 [Lucas Ruiz, Argentina]	Accepted. Text revised
859	18	1	0	0	Table: I would argue that sea ice is also an important precursor of the future mass balance of Greenland and Antarctica [Bart van den Hurk, Netherlands]	Taken into account. Text revised. We now mention "adjacent land and ice masses" explicitly.
4753	18	1	18	1	Table: I would argue that sea ice is also an important precursor of the future mass balance of Greenland and Antarctica [Bart van den Hurk, Netherlands]	Taken into account. Text revised. We now mention "adjacent land and ice masses" explicitly.
40609	18	1	18	1	oceans -> ocean, to be consistent with the other chapters. Perhaps this could be checked throughout-- I found 27 examples of "oceans" in Chapter 1. [TSU WGI, France]	Accepted. Text revised.
76791	18	1	19	1	Just an observation that the questions posed here are very ocean and cryosphere oriented. Should some land-based questions also be added? [Nerilie Abram, Australia]	Taken into account. Question added on land - "How much have the land areas warmed ..."
16273	18	1	24	1	This cross-chapter box 1 is excellent. Thank you. [Sarah Sutton, United States of America]	Noted. Thanks.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
16093	18	5	18	5	Table entry on Arctic and Antarctic sea ice: please refer to 9.3, not 9.3.1 [Gerhard Krinner, France]	Accepted. Text revised.
16091	18	6	18	6	Table entry on mountain glaciers and snow: please refer to 9.5, not 9.5.3 [Gerhard Krinner, France]	Accepted. Text revised. It however still needs to be decided to what level of subsection the referencing should go. We will apply a common standard.
66623	18	11	18	11	We could perhaps put something like "central role" or "primary role" of WGII to make it clear that this is really more their domain, even if not exclusively so. [Dave Frame, New Zealand]	Noted. We prefer to refer to WGs II and III important roles upfront in the table, but not throughout the specific points addressed.
105527	18	24	18	27	"And sea-ice extent is also related to complex dynamical changes in atmospheric flows.: Ocean circulation is omitted from this box, suggest rephrasing this sentence as "Sea-ice extent is also related to complex dynamical changes in atmospheric flows, and sea-ice formation drives deep ocean convection." [Inga Jane Smith, New Zealand]	Accepted. Text revised
26559	18		18		4th row of the Table page 18 : It is not clear how this point addresses the contribution of historic emissions. This should perhaps be two points - one on the overall contribution of historic emissions, the second on attribution of extreme events [Eric Brun, France]	Taken into account. Reference to "historical" has been deleted.
115691	18		18		The implications of how to measure warming and what are pre industrial levels could be more explicitly highlighted in the first box. [Valerie Masson-Delmotte, France]	Taken into account. Text revised. We now state that "Many of the report's findings are provided against a proxy for pre-industrial temperature levels with Cross-Chapter Box 1.4 examining the difference between pre-industrial levels and the 1850-1900 period."
46575	18		18		In the row on sea ice, please change every occurrence of "extent" to "area" (3 times), as sea-ice area is the preferred metric in AR6 as described in chapters 2, 4 and 9. [Dirk Notz, Germany]	Accepted. Text revised
29681	18		18		In the Cross-Chapter Box 1.1, Table 1, please consider replacing the content of the cell of "Potential Relevance" corresponding to the question "How did the sea ice extent change..." by the following: "Sea ice extent influences mass and energy (solar radiation, heat and momentum) exchange between the atmosphere and oceans, modulating polar life and complex dynamical flows in the atmosphere." [Hernan Edgardo Sala, Argentina]	Taken into account. Text revised and more important aspects related to sea-ice have been included.
46577	18		18		Changes in sea-ice area also affect tracer exchange between ocean and atmosphere, ocean circulation, shipping operations, to name but a few [Dirk Notz, Germany]	Taken into account. Text revised and more important aspects related to sea-ice have been included.
112533	18		19		None of the questions address committed near-term changes which are incredibly policy-relevant and where we have the highest confidence. Relevant questions include: -What is the committed warming and sea level rise (if concentrations were kept constant at 2020 levels) until the end of the century? -What are committed changes in regional climate (if concentrations were kept constant at 2020 levels) until the end of the century? [Suraje Dessai, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. We have deleted here "near-term" in conjunction with "committed" as we focus on current state of the climate. This said, arguably, the most policy-relevant "commitments" are the "feasible scenario commitment", i.e. quantifying the warming, the impacts of the lowest scenarios. Holding GHG concentrations constant is a somewhat academic exercise, although it might also be insightful.
81107	18		19		Please include table headings at the top of each page when table spans more than 1 page [Mary Matthews, Azerbaijan]	Noted. Editorial ; Layout to be decided as part of the publication process.
81109	18		19		why are there no questions about fresh water availability? This seems to be missing here. [Mary Matthews, Azerbaijan]	Noted. Freshwater is mentioned in the context of glaciers in the table. However, availability of freshwater is outside the remit of WGI and will be addressed by WGII.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
24225	18				comments on CO2 need to be at or near the top of this table. Other sections need to be reordered. [Bryan Weare, United States of America]	Taken into account. Sequence of entries has been updated.
52137	18				In the last row of the table ("How much have..."), I suggest adding a very brief explanation regarding other GHG in the right column (similar to the information provided for CO2). I think this is necessary as other GHG is mentioned in the right column. [Mohammad Rahimi, United States of America]	Taken into account. Text revised, CH4 and N2O explicitly mentioned.
40997	19	1	19	1	The Paris Agreement had goals, not targets, right? This comment relates to use of the word "target" throughout this Chapter. [TSU WGI, France]	Taken into account. Replaced targets with goals in the Cross-Chapter Box
101423	19	1	19	1	SLR question perhaps sounds a little ambiguous - could be clearer that global SLR is inevitable in short and long-term, even if shorter term coastal changes are mixed? [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Text revised and long-term commitment mentioned.
28291	19	1	19	1	1st table row on that page (sea level): Maybe specify after "hundreds of years" something like "even under emission reductions following the Paris Agreement" (or something similar. This table is an extremely good idea to help even unexperienced readers to navigate the report, but this also means that the severity of the most important consequences should not be "hidden"). [Alexander Graf, Germany]	Taken into account. Text revised.
28293	19	1	19	1	3rd table row on that page (warming attribution to human influence): For the same reasons as given above for the sea level, and also for consistency with the table rows on p 18 (which actually give some of the most important facts) it would be better if the "Potential Relevance" text was shorter and already included a clear brief statement on the results "how much warming is due to human activities". [Alexander Graf, Germany]	Noted. The aim of the table is to provide the interested reader with a pointer towards the Chapters/Sections where the thorough and comprehensive assessment is performed. This table does not include any of the answers to the question or quantitative assessment results.
16095	19	1	19	1	Table entry on sea level: please also refer to section 9.6 (Sea level change and commitment) [Gerhard Krinner, France]	Accepted. text revised.
107149	19	1			[pt 1 of 2] In Cross-Chapter Box 1.1, Table 1, the text for section 2.3.3.3 says: "Sea level rise is a comparatively slow consequence of a warming world, with potential multi-metre increases over hundreds of years. Current sea level change (both rising and falling) around the coastlines of the world is complicated by local factors and can have strong impacts on storm surge flooding, coastal erosion, etc., posing coastal adaptation challenges." As I already pointed out in my FOD comments, that's wrong. The "global" rate of sea-level rise is really just an average, and it is so minuscule that in many places local processes, like erosion, sedimentation, and vertical land motion are more rapid than global sea-level rise. [cont'd] [David Burton, United States of America]	Rejected. No scientific evidence provided to support the claim. We rely here on the comprehensive and thorough assessment of Chapter 2.
107151	19	1			[pt 2 of 2] There is no potential for "multi-metre increases over hundreds of years." The highest-quality long measurement records show that ninety years of global warming have caused no significant, detectable acceleration in coastal sea-level rise. In fact, the global trend is so slight that at about 20% of the best sea-level measurement sites local ("relative") that sea-level is falling, rather than rising: because the land is rising faster than the ocean. Stockholm is an example: https://sealevel.info/050-141_Stockholm_Sweden_1889-2017_smoothed_vs_CO2_annot1.png As you can see from that graph, coastal sea-level trends are not accelerating, either. That's unfortunate for Stockholm, because global sea-level rise acceleration would be helpful there, because it would reduce their dredging expenses. https://www.dredgingtoday.com/2014/03/07/sweden-stockholm-harbour-to-initiate-dredging-project/ ### [David Burton, United States of America]	Rejected. No scientific evidence provided to support the claim. We rely here on the comprehensive and thorough assessment of Chapter 2.
79069	19	1			in the first row, the cross-reference to ch9 for sea level rise should be 9.6.1 [Aimee Slangen, Netherlands]	Accepted. Text revised

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
83923	19	6			please insert Foraminifera in line 6, after " In addition, paleoclimate archives such as corals, Foraminifera [Marco Tulio Cabral, Brazil]	Rejected. Unclear what this comment is referring to. Paleoclimate is not mentioned here in the Cross-Chapter Box
40007	19		19		Chapter refers to 'early industrial' before defining what this is. [TSU WGI, France]	Noted. Early-industrial has been deleted.
26561	19		19		Last row of the Table page 19 : This needs to explain further the interaction between historical emissions and remaining carbon budgets since this point is at the heart of some aspects of the equity debate. [Eric Brun, France]	Rejected. Issues of equity with regard to historical emissions and remaining carbon budgets are outside the remit of this WGI report. WGIII will address some of these aspects.
861	20	1	#REF!	#REF!	In the entry on confidence in climate scenarios I miss a remark on the unknown (or at least very uncertain) unfolding of anthropogenic emissions, which is an important contributor to (lack of) confidence in projections [Bart van den Hurk, Netherlands]	Rejected. That scenario uncertainty or "choice" is discussed in section 1.6. In the interest of space, we won't pick that up here. We do however clarify that these projection ranges are for a particular scenario.
101425	20	1	20	1	Confidence in climate models - I think it's too subtle to distinguish "ensemble evaluation" from "model performance", and weighting is also a complex topic, so maybe "regarding evaluating model performance"? And the interdependencies is also a complex topic for such a small box. More importantly, is it contradictory to give this as an improvement when model weighting by skill and independence is not done in the headline assessments? Would it be helpful instead to focus on concrete improvements (e.g. resolution & processes) or multiple lines of evidence (e.g. ECS is not just from the MME)? Or performance of AR5/other models judged against more years of data? [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Text revised.
4755	20	1	20	1	In the entry on confidence in climate scenarios I miss a remark on the unknown (or at least very uncertain) unfolding of anthropogenic emissions, which is an important contributor to (lack of) confidence in projections [Bart van den Hurk, Netherlands]	Rejected. That scenario uncertainty or "choice" is discussed in section 1.6. In the interest of space, we won't pick that up here. We do however clarify that these projection ranges are for a particular scenario.
96061	20	1			Cross-Chapter Box 1.1, Table 1, section 2, first question and answer on confidence of climate projections: Question and answer do not quite match. Question about level of confidence, is answered by update information on new modelling techniques. We suggest to add a conclusion concerning the effect of these new techniques on the level of confidence of applied models. In addition, strongly encourage the authors to mention the difference between the use of CMIP5 vs. CMIP6 projections and to explain, why CMIP6 data are used differently in the AR6 when compared to CMIP5 data in the AR5. [Nicole Wilke, Germany]	Taken into account. Text revised. We have shortened the question (i.e. leaving out the "confidence"). We feel that the CMIP5 versus CMIP6 difference is too detailed for this table as it shall be reduced and the issue is complex (different forcings, different sensitivities) etc.
101427	20	3	20	3	I felt the point about TCRE and past/present/future CO2 was too hard for this box, and not needed, so could delete. [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. We have rephrased the TCRE explanation and relevance. However, we feel it is a key policy relevant metric so it should be considered.
41099	20	14	20	14	Throughout the chapter could Paris Agreement "targets" or "objectives" be changed to goals? There are around 13 instances of the word "target" being used in this way. I understand that articles may use this term, but it often poses a problem in the approval of the text. [TSU WGI, France]	Taken into account, at least here in the box. We have replaced targets with goals. We think it is ok to keep "objectives" in some places.
16677	20		20		X-chapter box 1.1 table 1. Row on the remaining climate budget: "while this is not true of short-lived climate forcers". This could be more usefully written "while the global warming from short-lived climate forcers is dependent on their rate of emission rather than their cumulative emission". Chapter 6 and also chapter 7 discuss this. [William Collins, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Text revised.
13139	20		20		TCRE must be expanded acronym has not been used [Maria Amparo Martinez Arroyo, Mexico]	Accepted. Done.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
109493	20		20		"under the assumption of accelerated and effective climate policy implementation to very high emission scenarios that are projected in the absence of climate policies", please specify "very high LL-GHG emission" or "very high CO2 emission" (idem p21, 95 and 104) and for low emissions p20 and 95 [Sophie Szopa, France]	Rejected. Inserting CO2 here is confusing, since all these scenarios are multi-gas scenarios and are generally across the board high emission scenarios.
50625	20		20		Cross Chapter Box 1.1 Table 1. Row 3 of table on page 20. The SSP-RCPs are described here as emission scenarios, but in the rest of the report they are used as concentration pathways, eg. when presenting the CMIP6 projections which are concentration-driven [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Noted. However, the SSPX-Y scenarios can be categorized by low and high emissions, whether the model setup is emission or concentration driven. The effective difference is only that the uncertainty in one part of the cause-effect chain is not considered. Therefore, for the ease of general understanding, we would keep the description here as SSP1-1.9 being a very low and SSP5-8.5 being a very high emission scenario.
115695	20		20		Could RCP4.5 be also introduced here? [Valerie Masson-Delmotte, France]	Taken into account. Text revised. RCP4.5 mentioned.
115697	20		20		"while this is not true of short lived climate forcers" = where is this assessed in this report? [Valerie Masson-Delmotte, France]	Noted. Text revised. The assessment that short-lived climate forcers are short-lived, i.e. have short lifetimes and hence IRF in the temperature domain that are temporary and not constant like that from CO2 are considered in Ch.6 or Ch7 figures.
114183	20				Last box on page 20: Check definition and consistency with Ch5. [Jan Fuglestedt, Norway]	Accepted. Done.
114185	20				Re "Remaining carbon budgets should...": I am not sure if this sentence is needed here. And it goes into the policy applications beyond the remit of WGI. It would work if you change "should" to "can" [Jan Fuglestedt, Norway]	Taken into account. changed "should " to "can"
71405	20				Chapter 10.3 also assesses the confidence we can have in climate model projections at the regional scale, which is relevant for regional impact assessment and adaptation planning. So it could be entered in the top row (How much confidence...). [Douglas Maraun, Austria]	Accepted. Text revised
85943	21	0	21	0	"Understanding water cycle changes over land, and its uncertainties, is important to estimate food production and water supply adaptation challenges" – add "and ecosystem functioning" [Debra Roberts and the Durban WGII TSU, South Africa]	Accepted. Text revised.
77161	21	1	21	2	Box 7.2.2 suggests that the Earth's energy imbalance is measured by distance from equilibrium temperature/ This may be simplistic as issues such as sea-level rise due to phase change of water are also part of this. [Emer Griffin, Ireland]	Taken into account. Text revised. Tough we are completely sure, what the this comment is aiming at... Maybe the misunderstanding is clarified by changing the word "indicates" to "implies", as the text on the right side did not mean to provide a definition, rather an implication. And yes, phase-change of ice (and in general all system components with effectively non-linear heat capacity) would not allow a straightforward correlation between energy imbalance and additional warming, but the implicit claim of the text, i.e. that the monotonic relationship holds (that positive energy imbalance means additional warming to be expected) is correct for the Earth System (unless in weird theoretical cases). We also tried to clarify by deleting the near-redundancy between first and second sentence and provide an explanatory note that commitment is different.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
101429	21	5	21	5	A bit unclear - combines two concepts of nonlinearity together - and doesn't really answer the question? How about saying that sea level will rise no matter what emissions are, but higher emissions increase the potential for rapid/accelerating sea level rise - in particular due to possible instability of the Antarctic ice sheet. Could also make the point that long-term sea level rise will continue under all emissions scenarios, i.e. commitment. [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Text revised to account more clearly for the commitment and to separate the part about ice sheet instability.
16097	21	5	21	5	Table entry on sea level: Why refer to 9.6 AND 9.6.3.4? [Gerhard Krinner, France]	Accepted. Text revised.
26227	21	7	21	7	CCB1.1- Change "those hazard indices will include" to "those hazard indices include" [Tania Guillén Bolaños, Germany]	Accepted. Text revised.
14789	21	50	21	50	possible abrupt changes in polar ice sheets need to be considered' -> 'possible abrupt changes and practically irreversible thresholds in polar ice sheets need to be considered' [Jeremy Fyke, Canada]	Taken into account. Added Tipping points to the sentence.
13141	21		21		WAIS GIS AMOC and ENSO must be expanded acronym has not been used [Maria Amparo Martinez Arroyo, Mexico]	Taken into account. Updated as part of the editorial process.
113031	21		21		Because of this non-linearity, possible abrupt changes in polar ice sheets need to be considered.' Why because of being nonlinear? If it were linear abrupt changes would not need to be considered? [Diego Miralles, Belgium]	Accepted. Text revised.
26563	21		21		1st row of the Table page 21 / last line of the right column : we suggest to add at the end of the last line "including slow onset events" [Eric Brun, France]	Noted. No Action. Unclear to which part of the table this belongs. It does not seem to fit where the comment proposes to place the text addition.
26565	21		21		Second row of the Table page 21 / right column : the verb "weigh" could imply a choice between one or the other, it might better be "measure on a comparable basis" [Eric Brun, France]	Taken into account. Text revised to state this more clearly.
83441	21		21		In Chapter 2 (p. 61 line 36) GrIS is defined as acronym for Greenland Ice Sheet. Also, Chapter 9 is using GrIS. [Antje H. L. Voelker, Portugal]	Not Applicable. Term not used anymore.
46579	21		21		In the first row, please change "sea ice extent" to "sea-ice area", as sea-ice area is the preferred metric in AR6 as described in chapters 2, 4 and 9. [Dirk Notz, Germany]	Accepted. Text revised
71407	21				Chapter 10.4 and 10.6 provide detailed regional case studies. These could be listed under changes in precipitation (second row from below) [Douglas Maraun, Austria]	Accepted. Text revised.
831	22	1	#REF!	#REF!	Last row on regional climate information: also Atlas has material on this topic (regional assessments and section on communication) [Bart van den Hurk, Netherlands]	Accepted. Text revised.
4757	22	1	22	1	Last row on regional climate information: also Atlas has material on this topic (regional assessments and section on communication) [Bart van den Hurk, Netherlands]	Accepted. Text revised.
101431	22	1	22	6	Could lose "and attribution" in first question as it was covered earlier. Near-term lists example extreme events / sections - could these be listed when first mentioned i.e. state of the climate [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Attribution discussed in a separate sentence now to highlight the importance for projections. Listing of examples of extremes moved to Section 1.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
57439	22	1	22	50	At the bottom of page 22 in the last box it states that Adaptation challenges are predominantly local. However local is not defined. Location and scale are disputed concepts. Location and 'scale' reflects the dimensions of specific landscapes in relation to human or biophysical processes (Smith 2000) – a mutable hierarchy of nested locales (Soja 1989), socially constructed, contested, and political in nature (Martson 2000; McCarthy 2005; Tsing 2000). •Marston S A (2000) The social construction of scale.Progress in Human Geography24:219–242. •McCarthy, J. 2005. Rural geography: multifunctional rural geographies – reactionary or radical? Prog hum Geogr 29:773 doi:10.1191/0309132505ph584pr. •Smith, N. 1995. Remaking scale: competition and cooperation in prenational and postnational Europe. In Eskelinen, H. and Snickers, F., editors, Competitive European peripheries, Heidelberg: Springer, 59–74. •SING, Anna, 2000, "The Global Situation", Cultural Anthropology, 15 (3): 327-360. DOI : 10.1525/can.2000.15.3.327 [Margot Hurlbert, Canada]	Noted. No change. We do not think that it is necessary to go into the discussion or definition of "local" here. In this context, it is anything below continental/regional.
71149	22	9			Melting permafrost does not exist. It can thaw or degrade, but permafrost is not a material (see glossary) that can melt like ice or steal. [Lukas Arenson, Canada]	Accepted. Text revised
50591	22	Cross Chapter	22	Cross Chapter	I think between the ECS section, and potential surprises section, the risk of higher than expected temperatures (as well as the central scenario) is covered but would be good to include this if not. [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Noted. No Action. Points was already addressed as indicated by the reviewer.
50593	22	Cross Chapter	22	Cross Chapter	It would be useful to ensure the links between ECS, surprises, tipping points, feedbacks etc and the carbon budget are clearly brought out [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Text revised in places. though we are not sure we have fully understood what was requested.
13143	22		22		Gas names or formula used [Maria Amparo Martinez Arroyo, Mexico]	Accepted. Text revised
106075	22		22		Looking at CCB 1.1, Table 1, this statement, "Case examples for regional projections are discussed for Cape Town, the Mediterranean region and Hindu Kush Himalaya (10.6)", needs fixing. In {10.6}, the examples are for Cape Town, the Indian Monsoon and the Mediterranean region. The Hindu Kush Himalaya was never part of {10.6}, and of course it is now becoming a CCB. In addition, it is not clear what the table's intent is with this sentence. Is it in reference to the sentence before it? Perhaps the table entry should then say, "Case examples of these challenges for regional projections are ..." [William Gutowski, United States of America]	Accepted. Text revised.
115699	22		22		I think that irreversibility needs to be introduced in section 2 explicitly [Valerie Masson-Delmotte, France]	Taken into account. Text revised. Added "irreversibility" to the Section 2 SLR row, both in question and potential relevance entry.
115701	22		22		"reduce emissions of CO2 versus those of other forcers" (not just gases?) [Valerie Masson-Delmotte, France]	Accepted. Text revised
71339	22				In the first left-hand box of Section 3 of Cross-Chapter Box 1.1 Table 1 change "What are the projected key climate indices ..." to "What are the projected values of the key climate indices ...". (To make it clear that the question is not about which climate indices are key ones, but about what the future values of these key climate indices will be). [David Wratt, New Zealand]	Rejected. Here it really about the indices, not about the what their future values are.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
23607	23	0			Table entry: "How important are reductions in short-lived climate forcers...": The answer provided in the table doesn't actually address the question. I suggest that the last sentence is modified to say "..., while for short-lived greenhouse gases such as methane, reducing emissions will reduce their on-going contribution to climate change, but emissions do not have to be reduced to net-zero globally to ensure a stable climate." Or some other way for saying "the lower emissions of SLCFs can go, the better, but they don't have to go all the way to zero (but if they could, they should)". [Andy Reisinger, New Zealand]	Not applicable. Sentence deleted.
14485	23	1	23	1	where middle box mentions extreme events: add mention of wildfires here [Amy East, United States of America]	Noted. Bushfires are mentioned at the first occurrence of "extreme events"
26571	23	11	23	13	It is strange to mention only the feedbacks from SRCLL on the climate system, and not the impacts of climate on biodiversity which both SRCLL and SROCC picked up [Eric Brun, France]	Noted. No change. It is unclear what exactly that comment is referring to. More examples for biodiversity and ocean related impacts could be mentioned, but we do not have case studies in the WGI AR6 on those aspects.
19491	23	30	23	30	mitigation of and adaptation" of must delete [Hamideh Dalaei, Iran]	Rejected. No "of" after "mitigation in the table.
78673	23	30	23	30	This refers to the last row of table 1 on this page, on "How important are reductions in ...". Maybe move this whole row up to below the second point in Section 3, as they deal with related topics. [Heike Wex, Germany]	Taken into account. Sequence of entries has been updated.
32643	23	30	23	30	Delet "of" after "mitigation" [sadegh zeyaeyan, Iran]	Rejected. No "of" after "mitigation in the table.
32973	23	30	23	30	Delet "of" after "mitigation" [Sahar Tajbakhsh Mosalman, Iran]	Rejected. No "of" after "mitigation in the table.
26573	23	31	23	33	The SR15 SPM included an analysis of synergies and trade-offs between SDGs and climate action on energy supply, energy demand and land. We suggest to refer to it explicitly. [Eric Brun, France]	Noted. This is outside the remit of the WGI AR6. We thus refer to the WGIII report for more details on these topics.
114945	23		23		Last row in the Box; I find the last sentence a bit confusing. How does it relate to the near-term or it is meant as a more general statement highlighting the urgency (higher importance) of CO2 mitigation? I wonder if the current formulation could not be hijacked to actually delay action on methane. [Zbigniew Klimont, Austria]	Not applicable. Text deleted from revised draft.
16679	23		23		X-chapter box 1.1 table 1. Row on the SLCFs: "while this is not the case with short-lived greenhouse gases". This could be more usefully written "while for short-lived greenhouse gases such as methane this requires stabilisation of emissions". This is implied in section 7.6 - though may not be explicitly stated. This is explored in detail in Fuglestad et al. Phil Trans. A. 2018. [William Collins, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. Text deleted from revised draft.
15149	23		23		CCbox1.1 table1.1 : Note that if the 'small island' case study (now in Ch10.4) will be moved to a Cross-chapter box, the reference to ch10.4.2 needs to be modified. [Alessandro Dosio, Italy]	Noted. No change necessary.
81489	23		23		Recommend to define 'aerosol species' and add into the existing 'Glossary'. [Ee Ling Lee, Malaysia]	Noted. Text revised and added "especially sulphate"
9081	23		23		"Net zero emissions" mean that a greenhouse gas' sources (emissions) and sinks are in balance. This applies to CO2 as well as methane. Just methane has a shorter lifetime and hence a larger offset due to natural sinks, relative to the rate of emission, than CO2. For methane this means much smaller relative reductions in emissions would be necessary than for CO2 to achieve "net-zero". But the last half-sentence on the page remains slightly incorrect. [Olaf Morgenstern, New Zealand]	Not applicable. Text deleted from revised draft.
50627	23		23		Cross Chapter Box 1.1 Table 1. Row 3 of table on page 23. Short-lived forcings are mentioned, but not land use / land cover change, which is an additional non-GHG climate forcing. [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Noted. For reasons of space, we can't include every aspect in this table. We think that SLCF warrants to be spelled out separately.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
26567	23		23		Second row of the Table page 23 / right column : there are two sorts of surprises here: surprises from the way the climate system responds (such as more sensitive climate response) and unforeseen contributions to climate forcing (such as major volcanic eruptions). It would make sense to separate them. [Eric Brun, France]	Noted. We prefer to keep them in one single entry, but to more clearly separate them.
110827	23		23		In the entry of the table with the question "What are the capacities and limitations ... for adaptation?", the potential relevance mentions the "case examples for regional projections", which should be written (for completion and better linking to the previous sentence) "case studies of these challenges for regional projections", of "Cape Town, the Mediterranean region and Hindu Kush Himalaya", when it should be "Cape Town, the Mediterranean region and the Indian summer monsoon" [Francisco Doblaz-Reyes, Spain]	Taken into account. Text revised and clarified.
115703	23		23		in the second paragraph, you may consider if attribution makes sense in relationship to future events; and consider extreme sea level too (chapter 9). [Valerie Masson-Delmotte, France]	Taken into account. Paragraph has been deleted, attribution merged with a similar paragraph in Section 2. Sea level extremes added to the list of extremes in Section 1.
70493	23				Cross-chapter box 1.1, Table 1. 'However, robust and reliable attribution of current regional climate change is challenging due to...'. This depends on the region and variable being considered. See e.g. Section 3.3.1.1, 'The AR5 found high confidence for a major role for anthropogenic forcing in driving warming over each of the inhabited continents, except for Africa where they found only medium confidence because of limited data availability (Bindoff et al., 2013).' More qualification should be added to this sentence, since robust and reliable attribution on regional scales is possible in many cases, especially for temperature. [Gillett Nathan, Canada]	Not applicable. Row deleted.
70495	23				Cross-chapter Box 1.1, Table 1. 'many aerosol species tend to cool the climate'. Since the warming agents are named explicitly, why not name the cooling agents? Insert 'especially sulphate' after 'aerosol species'. Also, I suggest replacing 'many' with 'most'. [Gillett Nathan, Canada]	Accepted. Text revised, partially. Not the "many" -- "most" change.
23781	23				In the top box on this page, the listing given of case examples (better phrased "case studies") from Section 10.6 is not correct. The 10.6 examples are Cape Town, Indian monsoon and Mediterranean region. There is a separate cross-chapter box based in Chapter 10 on the Hindu Kush Himalaya. [Andrew Turner, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Text revised
863	24	1	#REF!	#REF!	last entry in table: there are many more potential surprises giving adaptation challenges, such as many of the tipping points listed before. Surprises in ice sheet stability, for instance, have large potential implications for adaptation to sea level rise [Bart van den Hurk, Netherlands]	Noted. Given length limits, the list here can not be exhaustive. We need to focus on some key aspects. And since this is the near-term section, ice sheets do not really fit here.
96063	24	1	24	1	Cross-Chapter Box 1.1, Table 1, section 3, first question on co-benefits of climate mitigation: As to distinguish the addressed co-benefits from further (long-term) co-benefits and to improve comprehensibility, please add "near term" and change question into "What are the near term co-benefits (and co-challenges) of climate mitigation?" [Nicole Wilke, Germany]	Rejected. No change. Reduced air pollution is also a long-term benefit... Since we say CO-benefit, we kind of imply that we are not discussing the MAIN benefit, which is reduced climate change.
66627	24	1	24	1	I think it might pay to rearrange the final box - most people will be expecting surprises in terms of processes rather than forcing. So I think it may be worthwhile to preface it by saying something like "Surprises can come from a range of sources: from incomplete understanding of the climate system, from surprises in emissions of natural (e.g. volcanic) sources, or from disruptions to the carbon cycle associated with a warming climate (e.g. permafrost methane release, tropical forest dieback)." And then discuss processes first and then emissions. [Dave Frame, New Zealand]	Accepted. Text revised accordingly.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
4759	24	1	24	1	last entry in table: there are many more potential surprises giving adaptation challenges, such as many of the tipping points listed before. Surprises in ice sheet stability, for instance, have large potential implications for adaptation to sea level rise [Bart van den Hurk, Netherlands]	Noted. Given length limits, the list here can not be exhaustive. We need to focus on some key aspects.
26229	24	1	24	6	CCB1.1- One of the greatest benefits of mitigation is that it might reduce future adaptation needs (as also recognized in the PA) which could also lead to fewer loss and damage. This aspect is missing in the current text. [Tania Guillén Bolaños, Germany]	Noted. Good point, however, this is not necessarily a "co-benefit" as it is the primary benefit of mitigation.
107153	24	1			[pt 1 of 4] In Cross-Chapter Box 1.1, Table 1, the text for 6.1; 6.7.5 the text for "What are the co-benefits (and co-challenges) of climate mitigation?" says, "The reduction of fossil-fuel-related emissions often goes hand-in-hand with a reduction of air pollutants, such as aerosols. Those reductions in air pollutants can accrue cobenefits in terms of increased air quality and improved human health and could be factored into a response strategy to climate change." But that misses the boat, by a mile. The three worst consequences of climate change mitigation are (not necessarily in this order): (cont'd) [David Burton, United States of America]	Noted. No action.
107155	24	1			[pt 2 of 4] A. It causes wholesale destruction of wildlife habitat for biofuel production. In the USA, alone, nearly 50 million acres are devoted to growing monoculture Roundup-Ready corn to make ethanol, for motor fuels, to mitigate climate change. That's more than the land area of the nine smallest American states, combined: Maryland, Vermont, New Hampshire, Massachusetts, New Jersey, Hawaii, Connecticut, Delaware and Rhode Island. In the Amazon, rainforest is being destroyed to replace farmland which is now used to grow sugarcane, to make ethanol. Elsewhere in the tropics, vast tracts of land are being converted into monoculture palm plantations, for biofuels. (cont'd) [David Burton, United States of America]	Noted. Those topics are outside the remit of WGI AR6. We refer to WGIII for further information of biofuels and agricultural production.
107157	24	1			[pt 3 of 4] B. It causes great human suffering due to exorbitant energy prices. Even in relatively prosperous Europe, soaring energy prices due to "renewable energy" projects are causing dangerous "energy poverty" ("fuel poverty"). It causes people living "on the edge" to sometimes have to choose between eating and staying warm — and either choice can be deadly. One estimate is that energy poverty killed 40,000 mostly-elderly people in Europe, just in 2014. Here are a few articles about it (the first two are about the UK, the third is about all of Europe): https://web.archive.org/web/20150517070357/https://www.independent.co.uk/news/uk/home-news/fuel-poverty-killed-15000-people-last-winter-10217215.html https://www.express.co.uk/news/uk/533907/Elderly-person-dies-every-SEVEN-minutes-fuel-poverty-scandal https://translate.google.com/translate?sl=de&tl=en&js=y&prev=_t&hl=en&ie=UTF-8&u=http%3A%2F%2Fwww.focus.de%2Fimmobilien%2Fenergiesparen%2Fenergie-die-grosse-stromluege-warum-strom-zum-luxus-wird_id_5388458.html (cont'd) [David Burton, United States of America]	Noted. Those topics are outside the remit of WGI AR6. We refer to WGs II and III for further information energy prizes and their influence on society.
107159	24	1			[pt 4 of 4] C. It foregoes some of the benefits of higher CO2 levels, which are greening the Earth, making agriculture considerably more productive and efficient, and helping to end famines. Here are some references: https://www.thegwpf.org/content/uploads/2016/10/benefits.pdf http://co2coalition.org/publications/what-rising-co2-means-for-global-food-security/ ### [David Burton, United States of America]	Noted. We appreciate the reviewers comments. These synergies and trade-offs that is being referred to here are dealt with in WGIII. This WGI reports is covering the physical science of climate change.
66629	24	7	24	7	Suggest amending the text to "place alongside other major environmental problems" - because "in the context of" implies that the other issues are the larger (hence context-setting) issues. I'm not sure we should imply that. [Dave Frame, New Zealand]	Accepted.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
64723	24	7	24	12	The reference to IPBES should be move to the below paragpah and this paragraph deboted to the intorduction of the special rept on CCL and the 1.5 SR should be the link and not otherwise with the AR6. [Sanz Sanchez Maria Jose, Spain]	Accepted. Sentences switches
66631	24	7	24	33	Quite a lot of this material reads like a brochure - I don't think we need this level of detail, and I don't think it's a good idea to quote things like "The seventeen goals are integrated indivisible, and balanced between the economic, social..." without quotation marks. (1) It's plagiarism; (2) as it stands it reads like we are simply cheerleading for these programmes, and IPCC should be very wary about being seen to do that. (It feeds perceptions that we are trying to further a UN political agenda.) I think we could cut 80% of this and just describe that IPCC is working with a number of other initiatives from international environmental, sustainability and development programmes, and we think WGI has an important role to play in the development of climate services in support of many aspects of these programmes. [Dave Frame, New Zealand]	Taken into account. Paragraph on SDGs shorten
125163	24	7	24	33	[SCOPE] These two paragraphs about IPBES findings and SDGs should be in the working Group II report. Stick with the physical climate science in this volume. [Trigg Talley, United States of America]	Rejected. Ch 1's job is to frame the report, including relevant context. This is relevant context.
125165	24	7	25	14	This text is not needed and can be removed. [Trigg Talley, United States of America]	Rejected. No argument provided
96065	24	9	24	10	Please provide the reference, and the complete correct wording for this IPBES quotation. Source: UNEP, 2012. Report of the second session of the plenary meeting to determine modalities and institutional arrangements for an intergovernmental science-policy platform on biodiversity and ecosystem services. UNEP/IPBES.MI/2/9. The original wording is: "The Platform's objective is to strengthen the science-policy interface for biodiversity and ecosystem services for the conservation and sustainable use of biodiversity, long-term human well-being and sustainable development". [Nicole Wilke, Germany]	Accepted. Rephrased as proposed. thanks
96067	24	11	24	12	We encourage the authors to consider revising this statement according to the wording used in Decision IPBES-7/1: "(...) The rolling work programme of IPBES up to 2030 will address the interlinkages among biodiversity, water, food and health. This assessment will use a nexus approach to examine interlinkages between biodiversity and above-mentioned issues, including climate mitigation and adaptation. Furthermore, under the rolling work programme, IPBES and IPCC will directly collaborate on biodiversity and climate change under the rolling work programme. " Reference: Decision IPBES-7/1 (https://ipbes.net/sites/default/files/decision_ipbes-7_1_en.pdf). See also the results of IPCC's 52nd Session regarding the planned collaboration between IPCC and IPBES. [Nicole Wilke, Germany]	Accepted. Reworded as proposed. Thanks
29675	24	12	24	12	Consider replacing "Special Report on Climate Change and Land" by "SRCL". [Hernan Edgardo Sala, Argentina]	Editorial. Corrected
7217	24	12	24	13	Assessment to the relation between changes in biodiversity and climate system are affected terrestrial and ocean, and reported on both special reports: the IPCC Special Report on Climate Change and Land (SRCL-2019) and Special report on Ocean and Cryosphere in a changing climate (SROCC – 2019). [Aasad Irawan, Indonesia]	Accepted. Thanks
40515	24	12	24	13	Maybe cite the full name of the report as a footnote? Full name: PCC Special Report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems [TSU WGI, France]	Taken into account. SRCL instead of the full name already mentioned
32645	24	12	24	13	Drop "to" after "both adaptation" and add "impacts" after "climate change" [sadegh zeyaeyan, Iran]	Not applicable- The lines indicated do not contain the expressions

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
32975	24	12	24	13	Drop "to" after "both adaptation" and add "impacts" after "climate change" [Sahar Tajbakhsh Mosalman, Iran]	Not applicable- The lines indicated do not contain the expressions
67819	24	12	24	13	There is a need to mention the relationship between changes in biodiversity and climate system, as both terrestrial and marine biodiversity are affected, and this has been reported in both special reports: the IPCC Special Report on Climate Change and Land (SRCL-2019) and Special report on Ocean and Cryosphere in a changing climate (SROCC – 2019). [Ruandha Agung Sugardiman, Indonesia]	Accepted. Thanks
19493	24	13	24	13	after" of" add" impact of" [Hamideh Dalaei, Iran]	Not applicable- The lines indicated do not contain the expressions
99923	24	15	24	33	Would it be possible to include the UN Sustainable Development Goals report in it's entirety? Maybe as an Annex? If not the whole report, perhaps just a list of the 17 goals with a summary for each. It could be a Box or Sidebar. The inclusion of this information would support Chapter 1, Chapter 6 and the Technical Summary where they are discussed. [Dan Helman, United States of America]	Rejected. Ch1 is just setting the context of international agendas but not aiming to fully describe the SDGs
93665	24	15	24	33	Emphasizing SDG 14 could help elevate the importance of oceans in this context. [Bridget Doyle, Canada]	Accepted. Link SDG14v and SROCC mentioned
96069	24	16	24	19	Sentences starting with "Many interactions..." and "Updated in support...": The second sentence stating that the SDGs were updated in support of the 2030 Agenda seems to be not fully correct. The cited text fragment is part of the Agenda's preamble, not of the SDGs themselves (Reference: UN 2030 Agenda on Sustainable Development). We suggest to change those two sentences into "Many interactions among environmental problems and development are addressed in the UN 2030 Agenda for Sustainable Development and its Sustainable Development Goals (SDGs). The 2030 Agenda supported by the finance-oriented Addis Ababa Action Agenda (UN Department of Economic and Social Affairs, 2015) calls nations to "take the bold and transformative steps which are urgently needed to shift the world onto a sustainable and resilient path." [Nicole Wilke, Germany]	Accepted; change accordingly
54871	24	16	24	19	Recommend clarifying that the SDGs were not updated in support of the 2030 Agenda, but rather developed as part of the agenda. For consideration: Updated In support of the 2030 Agenda for Sustainable Development and the finance-oriented Addis Ababa Action Agenda (UN Department of Economic and Social Affairs, 2015) to support their implementation, the SDGs urge nations to "take the bold and transformative steps which areurgently needed to shift the world onto a sustainable and resilient path..." [Nancy Hamzawi, Canada]	Accepted, clarified as proposed.
102465	24	17	24	17	A "the" is missing in the section heading: "the IPCC" [Philippe Tulkens, Belgium]	Editorial. Corrected
87481	24	20	24	20	Indivisible'. The idea that the SDGs are indivisible is motivational, but it's not exactly scientific... [Stephen Humphreys, United Kingdom (of Great Britain and Northern Ireland)]	taken into account. paragraph revised and shorten. Sentence "indivisible" dropped
26597	24	20	24	22	We suggest to add ", including some aspects related to the limits of adaptation" between "can complement each other (Forino et al., 2015)" and " and climate change" [Eric Brun, France]	Not applicable. Wrong reference for pages and lines in the comments provided by this reviewer.
96071	24	23	24	24	Coherent language: Please consider to change "Goal 13" in "SDG 13". [Nicole Wilke, Germany]	Accepted

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
96073	24	23	24	24	Gap, improved comprehensibility: As the 2030 Agenda was agreed some months before the Paris Agreement the following addition would stress the stated high relevance of 2030 Agenda and climate change (process) to each other. We suggest to change the sentence into: "SDG 13 deals explicitly with climate change, establishing several targets on adaptation, awareness-raising and finance while acknowledging UNFCCC as the main forum to negotiate the global response to climate change." [Nicole Wilke, Germany]	Accepted; Rephrased, thanks.
109469	24	25	24	26	SDG 7 and 11 are not really discussed in chapter 6: the way SDG are related to SLCF mitigation is evocated but not detailed per SDG. In this paragraph, the way air pollution is discussed throughout this report (ch6 and 12) and how does it complement the wg2 and 3 analysis of air quality could be explained. As well, a clear definition of air pollution as considered in the report could take place here. Indeed, WHO definition ("contamination of the indoor or outdoor environment by any chemical, physical or biological agent that modifies the natural characteristics of the atmosphere. ") is larger than the air pollution components discussed in this report. [Sophie Szopa, France]	Taken into account. Rephrased
82559	24	26	24	26	"Chapter 6 of this report" - did you mean Chapter 6 of the WG2 report? [Blair Trewin, Australia]	Taken into account-Clarified Chapter 6 of the WG1 report
112285	24	29	24	30	and foster mitigation of and adaptation to climate change instead of and foster mitigation of and adaptation to climate change [Kamal Mohammedi, Algeria]	Editorial. Corrected
114187	24	31	24	31	I think you mean non-CO2 components, and not SLCF? [Jan Fuglestvedt, Norway]	Not Applicable. paragraph reduced
81491	24	31	24	31	Abbreviation given to short-lived climate forcers (SLCFs) shall be given in first mention. [Ee Ling Lee, Malaysia]	Editorial. Corrected
29677	24	31	24	32	Consider replacing "Special Report on Global Warming of 1.5 °C" by "SR1.5" [Hernan Edgardo Sala, Argentina]	Editorial. Corrected
81493	24	35	24	35	Recommend to remove the extra 'l' in the sentence. [Ee Ling Lee, Malaysia]	Editorial. Corrected
64725	24	35	25	10	The introduction of climate services is not justified here. Should be deleted and moved to some more appropriated location [Sanz Sanchez Maria Jose, Spain]	Accepted. Paragraph on climate services moved to 1.2.3 subsection on climate information
81111	24	35	25	10	a clearer definition of "climate services" would be very helpful here. As it is, it is dropped in, but like "environmental services" could have multiple meanings, even to specialists. [Mary Matthews, Azerbaijan]	Accepted. Definition of climate services provided. Paragraph on climate services moved to 1.2.3 subsection on climate information
114947	24		24		First row in the Box on page 24; The reduction in air pollutants will result, beyond health impacts' reduction, also in environmental benefits, e.g, acidification, eutrophication as well as reduced crop losses due to lower ozone. The language could be also stronger since aerosol reduction will result in improved air quality, rather than just 'can accrue co-benefits'; exception might be targetted NOx reduction and local (urban) increase in ozone but for deep climate mitigation scenarios this will be compensated with other reductions and reduced health impacts from deduced PM. The potential 'co-challenges' are not addressed/mentioned and while some will be similar to establishing climate mitigation policy, I'd rather see here a potential opportunity and another co-benefit linked to a potential to use the air pollution co-benefits as a support for the climate policy. [Zbigniew Klimont, Austria]	Taken into account. Text revised, new sentences added. We added a brief reference to the broader environmental benefits, since Chapter 5 seems rather silent on this.
39511	24		24		In the tabel there is the question 'what are the co-benefits (and co-challenges) of climate mitigation', consider to add or either expand to 'co-benefits between mitigation and adaptation', this is in particular relevant for mitigation in the AFOLU sector and the co-benefits between mitigation and adaptation. [Tamara van 't Wout, Qatar]	Noted. No change. That topic is crucially important, but more dealt with in WGII, WGIII and the Synthesis report.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
13145	24		24		VolMIP must be expanded acronym has not been used [Maria Amparo Martinez Arroyo, Mexico]	Accepted. Text revised.
9083	24		24		(top panel): Air quality cannot be "increased" -- it's a non-countable concept. How about "improved air quality and human health"? [Olaf Morgenstern, New Zealand]	Accepted. Replace increased with improved. We do not add "and human health" as this is not covered in this WGI report.
9085	24		24		(second panel): I'm surprised that volcanoes are discussed here. While undoubtedly eruptions cannot be predicted and might present adaptation challenges, the fact that there are such eruptions, and the likely climatic consequences, are quite well studied (hence not a surprise). I was expecting to read about tipping points here, the AMOC stalling, ENSO doing unusual things, ice sheets collapsing, some non-linear behaviour typical of chaotic systems that climate models might not be simulating. [Olaf Morgenstern, New Zealand]	Taken into account. Paragraph has been expanded and lists sources of surprises.
112535	24		24		last table row: Wouldn't temporary cooling help cope with global warming in an adaptation context? The precipitation changes impact on adaptation depends on magnitude of change and direction of change [Suraje Dessai, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Text revised.
50629	24		24		Cross Chapter Box 1.1 Table 1. Row 1 of table on page 24. Implications of the use of land for climate mitigation should also be mentioned. [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Text revised, new sentences added.
70497	24				Cross-Chapter Box 1.1, Table 1. What is a 'co-challenge'? I have not seen this term before. I suggest replacing 'co-challenges' with 'side-effects'. [Gillett Nathan, Canada]	Accepted. Text revised
109727	25	1	25	1	We need to have focuses at the local level as well so I would add "local" in with national, regional, and global levels. [Eric Nolan, United States of America]	Accepted. Local level added
87483	25	1	25	2	Such services provide science-based information for risk management and adaptation'. I still come away from this feeling as though I don't know what 'climate services' are for the purposes of the rest of the para. [Stephen Humphreys, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Definition of climate services provided and paragraph moved in 1.2.3 to a new subsection on climate information
57467	25	4	25	4	I've not seen the GFCS cited as Lucio and Grasso (2016) before. I suggest the following two references either in addition or instead: Hewitt, C. D., S. Mason and D. Walland, 2012: The global framework for climate services, Nature Climate Change, 2, 831-832, doi:10.1038/nclimate1745 Hewitt, C. D., E. Allis, S. J. Mason, M. Muth, R. Pulwarty, J. Shumake-Guillemot, A. Bucher, M. Brunet, A. M. Fischer, A. M. Hama, R. K. Kolli, F. Lucio, O. Ndiaye and B. Tapia, 2020: Making society climate-resilient: international progress under the Global Framework for Climate Services, Bull. Amer. Meteor. Soc., E237-E252, DOI: 10.1175/BAMS-D-18-0211.1 [Chris Hewitt, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. One reference added. Hewitt et al, 2012
77163	25	4	25	6	is this fully correct? [Emer Griffin, Ireland]	Not applicable. Paragraph extensively revised and shortened
26231	25	4	25	6	NAPs were established as part of the Cancun Adaptation Framework (CAF) in the COP16, for LDCs but also extended to all developing countries (due to LDCs circumstances there have been more support for them, but NAPs are not only meant for them) (see Adaptation Committee, 2019) [Tania Guillén Bolaños, Germany]	Not applicable. Paragraph extensively revised and shorten; The paragraph is no longer considered in the text
107801	25	12	25	14	Here we have the statement indicating the changed structure of WG1. An FAQ on this point should be considered [Linda Mearns, United States of America]	Rejected. It is too late to consider this in a FAQ. However the structure is now extensively explained in section 1.1
114189	25	13	25	13	insert "report" before "structure" [Jan Fuglested, Norway]	Editorial. Corrected

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
85945	25	17	25	17	“solution” – would it be better to call it “response options”? “Solutions” is not universally popular. [Debra Roberts and the Durban WGII TSU, South Africa]	Not applicable- Subsection content split in the paragraph on SFDRR and in the cross-chapter risk box in 1.4
85947	25	17	25	17	It would be helpful to separate the various ‘frameworks’ by paragraph. [Debra Roberts and the Durban WGII TSU, South Africa]	Accepted. Done, thanks
66633	25	17	25	47	I think the Risk section reads really well. [Dave Frame, New Zealand]	Taken into account; Thanks but merged to the Risk box in 1.4
77165	25	17	25	47	Is this not WGII material? Consider dropping this type of material [Emer Griffin, Ireland]	Rejected. section content has been moved in the risk box anyway. Risk is a cross-cutting issues in which you have hazards, exposure and vulnerability. the hazards are assessed for the 1st time in WG1 in CH 12 and there is a need to consider the risk framing in order to assess hazards. Also CH1 is a framing chapter it is setting the context of AR6
125167	25	17	25	47	[SCOPE] Section 1.2.1.1 on societal risks, disaster risk reduction, and SDGs should be deleted. These topics should be taken up in the WGII report on risks, vulnerability, and adaptation. Stick with the physical climate science in this volume. [Trigg Talley, United States of America]	Rejected. Risk is a cross-cutting issues in which you have hazards, exposure and vulnerability. the hazards are assessed for the 1st time in WG1 in CH 12 and there is a need to consider the risk framing in order to assess hazards
57441	25	19	25	47	An addition might be 'solutions space'. •••aasnoot, M., Biesbroek, R., Lawrence, J., Muccione, V., Lempert, R., Glavovic, b. 2020. Defining the solution space to accelerate climate change adaptation. Regional Environmental Change. 20: 37 doi.org/10.1007/s10113-0202-01623-8 [Margot Hurlbert, Canada]	Not applicable- Subsection content split in the paragraph on SFDRR and in the cross-chapter risk box in 1.4
57443	25	19	25	47	Another addition might be that of transformation. See••ew, R., Morchain, D., Spear, D. et al. 2016. Transformation, Adaptation and Development: relating concepts to practice. PALGRAVE COMMUNICATIONS 3:17092 DOI: 10.1057/palcomms.2017.92 www.nature.com/palcomms ••coones, Ian & Stirling, Andy & Abrol, Dinesh & Atela, Joanes & Charli-Joseph, Lakshmi & Eakin, Hallie & Ely, Adrian & Olsson, Per & Pereira, Laura & Priya, Ritu & Van Zwanenberg, Patrick & Yang, Lichao. (2020). Transformations to sustainability: combining structural, systemic and enabling approaches. Current Opinion in Environmental Sustainability. 42:65-75. [Margot Hurlbert, Canada]	Not applicable- Subsection content split in the paragraph on SFDRR and in the cross-chapter risk box in 1.5
39055	25	19	25	47	Is there any systematic evaluation of impacts and risks at varying level of climate change? [Glenn Banaguas, Philippines]	Rejected. The reviewer perhaps means various warming levels; That is assessed in CH 12. CH 1 is a framing chapter
50595	25	19	25	47	The AR6 risk and solution-oriented framing is a very important and welcome development and will provide vital information communicated in a policy-relevant way to decision-makers. In particular, the focus on integrating across risks from climate change, and risks from action to tackle climate change, is helpful. Thank you to the authors for their hard work in implementing this across the Report. [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Thanks for the comment. However, the Subsection content split in the paragraph on SFDRR and in the cross-chapter risk box in 1.4
125169	25	19	25	47	Another section that is too long, containing information not necessary for IPCC focal points. [Trigg Talley, United States of America]	Taken into account partly. Section reduced but the information is important to frame AR6 WG1 assessment

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
109467	25	22	25	22	The references supporting this statement are opinion papers rather than rational analysis. They do not explain at which level/scale the decisions regarding the two problematics are taken nor the cobenefit/tradeoffs that the policymakers are/will be facing to fight both pollution and climate change. The affirmation in the paper are not supported by results or strong analysis of the decision making processes. [Sophie Szopa, France]	Taken into account. Other references added and consistency with CH 6 ensured, thanks.
85949	25	22	25	22	Mitigation and adaptation can also work together. Mention 'co-benefits' or 'synergies' and 'trade-offs' here. [Debra Roberts and the Durban WGII TSU, South Africa]	Not applicable. Section content partly moved to the risk box and the text related to this comment is no longer considered
87219	25	25			Wouldn't be more appropriate to talk about human-made hazards instead of manmade ones? [Rodolfo Sapiains, Chile]	Accepted; Changed accordingly
101453	25	26	25	26	I think you haven't defined TAR as Third Assessment Report? Only FAR [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. In the FGD draft Third Assessment Report mentioned earlier. Thanks
15863	25	31	25	31	after "for society, the economy and the environment", add this text : "(biotic and abiotic elements)". It helps to precise what do you intend with environment. It is important, at this stage, to have more precision about what is environment for the comprehension of this paragraph. [Emmanuel Garbolino, France]	Not applicable. This subsection content is partly merged to the risk box and the text related to this comment is no ,longer considered
115255	25	33	25	33	Add at end (Zommers et al., 2020) Cited References: ----- Zommers, Z., Marbaix, P., Fischlin, A., Ibrahim, Z.Z., Grant, S., Magnost, A.K., Pörtner, H.-O., Howden, M., Calvin, K., Warner, K., Thiery, W., Sebesvari, Z., Davin, E.L., Evans, J.P., Rosenzweig, C., O'Neill, B.C., Patwardhan, A., Warren, R., Aalst, M.v. & Hulbert, M., 2020. Burning Embers: Towards more transparent and robust climate change risk assessments. Nat. Rev. Earth & Environ.: accepted. Zo014 [Andreas Fischlin, Switzerland]	Not applicable. Section no longer considered
833	25	35	#REF!	47	Moving risk into the domain of decision-taking is a good development, but this decision-taking is usually on mitigating or adaptation of these risks. So a risk framework that only addresses CID, exposure and vulnerability, but no adaptation or mitigation dimension is almost per definition incomplete [Bart van den Hurk, Netherlands]	Not applicable. This subsection content is partly merged to the risk box and the text related to this comment is no longer considered
4761	25	35	25	47	Moving risk into the domain of decision-taking is a good development, but this decision-taking is usually on mitigating or adaptation of these risks. So a risk framework that only addresses CID, exposure and vulnerability, but no adaptation or mitigation dimension is almost per definition incomplete [Bart van den Hurk, Netherlands]	Not applicable. This subsection content is partly merged to the risk box and the text related to this comment is no longer considered
39149	25	35	25	47	How exactly is the risk question moved from the prediction to the decision-making space in the context of the complexity of the interacting climate impact drivers and human responses? [Lourdes Tibig, Philippines]	Taken into account. This subsection content is partly merged to the risk box and the comment is considered in the box
70499	25	35		39	Is the statement that this report 'adopts a risk and solution-orientated framing' true of the whole report? As an author of Chapter 3, I can't say we adopted a risk and solution-orientated framing for our chapter. I think this applies to some parts of the report, but isn't generally true for the whole report. I would write something like 'aims to include a risk and solution orientated-framing'. [Gillett Nathan, Canada]	Accepted. Instead we mention that the " AR6 has adopted a unified framework of climate risk" in the chapter. Anyway this section is no longer considered
112291	25	36	25	36	this report adopts a risk and solution-oriented approach instead of this report adopts a risk and solution-oriented framing [Kamal Mohammadi, Algeria]	Taken into account. This subsection content is partly merged to the risk box and the comment is considered in the box

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
29707	25	39	25	39	SREX has not been defined yet (nor along all this chapter). [Hernan Edgardo Sala, Argentina]	Taken into account. This subsection content is partly merged to the risk box and the comments is considered in the box
125171	25	39	25	40	Risk is probabilitiy times consequence. That is implied in the subsequent sentences but could be made clear from the beginning. [Trigg Talley, United States of America]	Taken into account. This subsection content is partly merged to the risk box and the comment is considered in the box
23609	25	40	25	41	Add after "Risks to human and natural systems FROM CLIMATE CHANGE ITSELF..." to make clear that this is only one aspect of climate related risks - risks from responses to climate change is the other (novel) dimension considered in the AR6 cycle. [Andy Reisinger, New Zealand]	Taken into account. This subsection content is partly merged to the risk box and the comment is considered in the box
50597	25	42	25	43	It would be more useful to select a different, more likely, risky response. Eg replace "large-scale SRM" with "large-scale expansion of biomass cultivation". [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. No evidence is provided that the proposed example is either more likely or more risky than SRM. Subsection is now split with some content in the risk box in 1.4 and some context in SFDRR in 1.2.2.
107999	25	42	25	45	Risk and solution-oriented framing should flow into this sentence. Change from "Some Human responses to climate..." to "Some proposed solutions (or adaptations/mitigations) to climate change may also generate risks..." Also note that highlighting SRM here is also an editorial decision - risks to SES goals, for example, are equally or more valid for land use changes and economic growth considerations. [Kelly Wanser, United States of America]	Not applicable. Nothing required. This subsection content is partly merged to the risk box and the text related to this comments is no longer considered
23611	25	43	25	44	The phrasing "Some human responses ... may also generate risks." makes it sound as if this is secondary and applies only in some instances. This is not consistent with the definition of risk - it depends on the actual assessment whether risks related to response options are secondary or not. It is also somewhat misleading to point to SRM here, since many other responses, not just the most radical ones, can be sources of risk (in fact, ANY mitigation response will present the "potential of adverse consequences" for somebody or something that somebody values - it is the key reasno why it is so difficult to make progress on mitigation!) Suggest rephrasing: "At the same time, human responses to climate change can also have adverse consequences on natural or human systems and therefore also constitute relevant sources of risk." It might also help if you bring into this para the element of the risk definition that says that we recognise the diversity of values - i.e. we're not saying that the (often local, stakeholder-specific) risks associated with mitigation are commensurable with the (often global) risks from climate change impacts, but a politician losing credibility with his/her core constituency if they implement carbon pricing is clearly a potentially adverse outcome (for that politican/constituency) and thus a highly relevant risk to that decision-maker. We have to recognise that that's what it is, and then use the risk framework to allow a more transparent weighing up of those different risks - not diminish risks related to responses up-front by applying it only to the most extreme scenarios of responses. [Andy Reisinger, New Zealand]	Taken into account. This subsection content is partly merged to the risk box and the comments is considered
87485	25	43	25	44	Given the importance of the concept of equity to the Paris Agreement, should this be, 'responses might fail to achieve their objective(s), or to do so equitably, or they might negatively affect other societal objectives' [Stephen Humphreys, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. Section content partly moved to the risk box. text related to this comment is no longer considered

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
15865	25	45	25	45	after "Development Goals.", it would be useful to give at least one example of SDG that can be affected by climate change. For example, one of the target of the SDG #15 is to develop policies and measures in order to "Progress towards sustainable forest management". Climate change may affect such activity because its effects can modify the structure and functioning of forest ecosystems. [Emmanuel Garbolino, France]	Not applicable. This subsection content is partly merged to the risk box and the text related to this comment is no longer considered
66635	25	50	26	10	This section blends very diverse points, and I found it very choppy. Part of it is about climate change not being uniform (which is a WGI point, albeit an obvious one) while some of the other stuff, such as the references to Shelia Jasanoff's work, doesn't really add much to a WGI document. It's not clear what you want us/readers to take away from this introduction. The sentence on political cultures seems unnecessary. The same, no doubt, is true of religious culture, or the cultures of urban folks vs rural folks. Why should WGI highlight political culture? Overall, I don't think this section reflects how WGI / physical climate scientists perceive themselves, their practices as scientists, or their role in society. Many of us take pride in political agnosticism in science, or political scepticism. If you said to WGI scientists that their science was any sort of function of political culture, I think most would take considerable offence. (I know things are different for many in the social sciences - but I would guess that many of us still regard "activist" as a slur on our scientific integrity and independence.) [Dave Frame, New Zealand]	Noted. Nothing in the paragraph mentioned here suggests that science is a function of political culture. Everything in the paragraph is about how climate science knowledge is interpreted BY THE PUBLIC in the broader framework of other socio-cultural influences. The second sentence lists a number of such influences. Perhaps the reviewer is objecting to the word "interacts," but we do not see any basis for changing that. It's a fact, not an opinion, that scientific knowledge is interpreted by non-scientists in the context of other knowledge and belief, including political culture. It would be disingenuous to say otherwise.
85951	25	50	26	11	Is it possible to consider grappling (in an academic way) with the sort of discussions published on https://www.nytimes.com/interactive/projects/cp/climate/2015-paris-climate-talks/where-in-the-world-is-climate-denial-most-prevalent . or https://www.ft.com/content/e5374b6c-d628-11e9-8367-807ebd53ab77 or "strongly held beliefs... traditions, religion..." and "political cultures" - many of these issues are strongly regionally determined. It is not everywhere that people still doubt climate change. In this report, or perhaps WGII or III, this could be unpacked more extensively. [Debra Roberts and the Durban WGII TSU, South Africa]	Noted. The paragraph is not only about denialism, and we cannot use journalism as a peer-reviewed source. However, we have added the following: "Socio-political cultures also give rise to geographical variation in how climate science knowledge is interpreted, used, and challenged (Oreskes and Conway, 2010; Jasanoff, 2011; Brulle et al., 2012; Dunlap and Jacques, 2013; Mahony, 2014, 2015; Brulle, 2019). Recent meta-studies (McCright et al. 2016; Ruiz et al. 2020) indicate that in some societies, political groups and corporate lobbies play a prominent role in shaping the public perception of climate change, so that political orientation can sometimes be as important as socio-altruistic and pro-environmental values (high confidence)."
81113	25	50	26	12	regarding the lack of the public's understanding of IPCC information by public and decision makers - it is CRITICAL that IPCC find a way to make this important information accessible to people who are not graduate level scientists. If people do not understand this they will not be able to change. This divide frustrates everyone, and all audiences will remember how you make them feel more than the details of what you say. If they don't understand, they feel stupid, and unempowered. If they feel like they understand the information, they feel positive and are much more empowered to make changes. [Mary Matthews, Azerbaijan]	Noted. No action suggested wrt this section.
1701	25	50			I suggest to add the issue of school strike as it indicated the awareness and concern of young generation for their future [Ruba Ajjour, Jordan]	Accepted. Added a mention.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
70067	25	50			Section 1.2.3: This section addresses several aspects of the communication of IPCC Assessments but is missing a main one, namely the legal aspect. How are IPCC assessments likely to be interpreted in a legal framework? What are most useful levels of confidence or likelihood in IPCC assessments? See on this topic among others a recent paper of Lloyd et al. currently in review in the journal "Studies in the History and Philosophy of Science" (can share with Ch1 authors). Also attribution science has a high relevance in a legal framework because it is tied to the question of liability. [Sonia Seneviratne, Switzerland]	Rejected. National legal frameworks differ, and the PA does not have a structure that would support legal actions based on science.
26133	25	52	25	53	I don't know of any references that support this statement. Indeed the work of Mike Thompson and others on cultural theory suggest the opposite: that it isn't necessary (or indeed possible) for such a common literacy to occur. Effective solutions to complex problems are those that can different political actors can agree on even if they do not have either a common literacy or a common set of concerns. For example, one group of actors might want to stop climate change, whereas another might want to enhance local energy independence, and they might agree on a policy to support wind and solar. [Anthony Patt, Switzerland]	Taken into account. The paragraph does not say shared literacy is "necessary," but rather that shared literacy *facilitates* governance, and that is clearly supported by the literature. Governance is not the same as government policy; it occurs at many levels in many contexts. Revised to read: Governance responses to climate change are facilitated when leaders, policymakers, resource managers, and their constituencies share basic understanding of the causes, effects, and possible future course of climate change, and iterate their understanding through dialogue with scientists (high confidence) (Ostrom, 2012; Lemos et al., 2012; Kirchoff et al., 2013; IPCC SR1.5, 2018; IPCC SRCCL, 2019). Achieving shared understanding is complicated by the fact that scientific knowledge interacts with pre-existing conceptions of weather and climate built up in diverse world cultures over centuries and often embedded in strongly held values and beliefs such as ethnic and national identity, traditions, religion, and relationships to land and sea (Rayner and Malone, 1998; Hulme, 2009, 2018; Nakashima et al., 2012).
57445	25	52	25	53	The reference to governance seems awkward. Governance is not defined so what exactly 'governance responses' are is unclear. There could be policy responses by government. The Land and Climate report has many sections relating to governance and policy. [Margot Hurlbert, Canada]	Taken into account. Revised to read: Governance responses to climate change are facilitated when leaders, policymakers, resource managers, and their constituencies share basic understanding of the causes, effects, and possible future course of climate change, and iterate their understanding through dialogue with scientists (high confidence) (Ostrom, 2012; Lemos et al., 2012; Kirchoff et al., 2013; IPCC SR1.5, 2018; IPCC SRCCL, 2019). Achieving shared understanding is complicated by the fact that scientific knowledge interacts with pre-existing conceptions of weather and climate built up in diverse world cultures over centuries and often embedded in strongly held values and beliefs such as ethnic and national identity, traditions, religion, and relationships to land and sea (Rayner and Malone, 1998; Hulme, 2009, 2018; Nakashima et al., 2012).

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
87487	25	52	25	53	This sentence reads well, but the term 'governance' is not as transparent as it appears here. In SR15, it rather appears to be something that is lacking. At a minimum it presupposes some idea about what it is to 'govern' about which there doesn't appear to be much agreement in the climate field. See S Humphreys, 'Ungoverning the Climate' forthcoming (accepted) in Transnational Legal Theory. [Stephen Humphreys, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Revised to read: Governance responses to climate change are facilitated when leaders, policymakers, resource managers, and their constituencies share basic understanding of the causes, effects, and possible future course of climate change, and iterate their understanding through dialogue with scientists (high confidence) (Ostrom, 2012; Lemos et al., 2012; Kirchoff et al., 2013; IPCC SR1.5, 2018; IPCC SRCCL, 2019). Achieving shared understanding is complicated by the fact that scientific knowledge interacts with pre-existing conceptions of weather and climate built up in diverse world cultures over centuries and often embedded in strongly held values and beliefs such as ethnic and national identity, traditions, religion, and relationships to land and sea (Rayner and Malone, 1998; Hulme, 2009, 2018; Nakashima et al., 2012).
125173	25	52	26	11	The purpose of this text is unclear. [Trigg Talley, United States of America]	Noted. Purpose of text is to accomplish the context-setting role of Ch 1.
87489	25	53	25	53	in' rather than 'on' [Stephen Humphreys, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Done.
14487	25	54	25	54	delete the "s" at the end of "understanding" [Amy East, United States of America]	Rejected. The whole point here is that there are multiple understandings.
131357	25	54	26	4	The tone of this sections sounds lika that values and beliefs, traditions, religion etc. are more or less in the way towards a scientific understanding of climate change. From my understanding this is more or less the opposite of the purpose of the section to link science and society. [Hans Poertner and WGII TSU, Germany]	Noted. The section's purpose is to accurately describe the complexity of the communication processes that link science and society.
115705	25		26		Section 1.2.3 could also refer to SR15 on this matter (chapter 4 of SR15). No use of confidence language? [Valerie Masson-Delmotte, France]	Accepted. Added confidence language, SR1.5 and SRCCL references.
115707	25		26		Could the use of "likely range" and "very likely range", and "deep uncertainty" be represented in the figure corresponding to box 1.1 as done in SROCC chapter 1? Could the use of deep uncertainty across chapters be introduced in this box? [Valerie Masson-Delmotte, France]	Taken into account. The information about the ranges is included in the main text providing the background to the use of the IPCC uncertainty language and now visually presented in the figure. In contrast, we have decided not to include "deep uncertainty" in the figure, but to expand on it in the main text. There was not enough space to appropriately explain what is meant by deep uncertainty in the figure and we thus prefer to introduce it properly in the main text.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
36325	26	1	26	5	Coprehensiveness and balance of the assessment there is a strong leaning towards showing a negative effects of "other" (traditional, cultural...) knowledges compared to scientific/geographical knowledge. Propose to balance with a sentence showing that traditional/cultural/local knowledge can also enrich the debate and provide useful understanding of the casues/impacts of climate change and to some extent, adaptation solutions. Please see Policy paper with references at https://intraacpgccaplus.org/wp-content/uploads/2020/04/IntraACP_LIK_Issue-Paper-VF2_EN.pdf and high-level webinar (14.05.2020) discussing Policy Paper at https://intraacpgccaplus.org/high-level-international-teams-stress-key-role-for-oacps-to-further-exchanges-and-learning-on-indigenous-peoples-and-local-knowledge-in-the-context-of-climate-change/ [PENDO MARO, Belgium]	Taken into account. Added "and enrich" to this sentence. The statement as written does not imply that "other" knowledges are worse, but rather that other UNDERSTANDINGS inevitably interact with scientific knowledge. This is true of everyone, including scientists.
114191	26	1	26	11	Your write and acknowledge that there are many perspectives; depending on culture, region etc. Then it is impornat to avoid the impression that some can decide the "right" perspective and apply that. [Jan Fuglestvedt, Norway]	Taken into account. Added a concluding sentence: "For these reasons, as detailed in Chapter 10, scientific climate information often requires "tailoring" to meet the requirements of specific policy and governance contexts."
87493	26	1	26	26	This is all true and important. Two questions arise though. First, the media. You get to this in page 30/31, but is it not important to at least flag it in this passage on 'govenance' and 'literacy'? Second, 'governance' (since that's the theme in this passage) doesn't need consensus, and in much of the world it doesn't even need broad agreement -- it would be wonderful for everyone to understand climate science and agree on the response -- but it's not necessary (nor feasible) to do so for the purposes of govenance. Governments frequently govern against majority opinion. (The point about literacy is correct, of course, but I wonder does it need a little rebalancing.) [Stephen Humphreys, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. These paragraphs have been heavily revised to convey more of the complexities of governance. Added a sentence on media coverage.
70843	26	2	26	4	The tension between the global and the local scale (not just in space, but also in time) for the understanding of climate change has been recently discussed by Shepherd and Sobel (2020), "Localness in climate change", doi: 10.1215/1089201X-8185983 [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Reference added, thanks.
69157	26	2	26	5	Jasahoff(2011) is not a refereed paper. For example, Both Leiserowitz(2006) and van Asselt & Rotman(1996) shows how social contexts and values influence the interpretation of science in each countries. Though Painter(2011) is not a refereed paper either, it contains much survey results among countries. These articles are much appropriate instead of referring Jasanoff twice in a paragraph. Leiserowitz, A. 2006: "Climate change risk perception and policy preferences: the role of affect, imagery, and values," Climatic Change, 77, 45–72. Painter, J. 2011: Poles apart: the international reporting of climate skepticism, Reuters Institute for the Study of Journalism. van Asselt, M. B. A. and Rotmans, J. 1996: "Uncertainty in perspective," Global environmental change, 6(2), 121-57. [Kaoru Magosaki, Japan]	Accepted. Deleted Jasanoff 2011 ref, added Leiserowitz and van Asselt refs.
78675	26	4	26	4	"Political cultures" are mentioned here as a reason for variation in how reactions are, towards climate change. Could also social and psychological reasons for inaction be explicitly mentioned in this paragraph, ot paint a fuller picture? (I can't provide text for that as I am not an expert, but I know these are important aspects.) [Heike Wex, Germany]	Noted. This paragraph isn't specifically about reasons for inaction, but about the principal causes of differences in understanding. Social causes are prominently mentioned already.
87491	26	4	26	5	climate science knowledge'.... Is that a solecism? Or just redundancy... [Stephen Humphreys, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. Not a solecism. The contrast is with e.g. indigenous knowledge or raw belief.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
18605	26	5	26	11	On the discussion of non-uniformity of perception, this would also be a good opportunity to note that the same changes that are hazardous to some may be beneficial to others, and vice versa. This would be good link from risk framework toward climatic impact driver approach of WGI. [Alexander Ruane, United States of America]	Accepted. Added "most regions experience greater hazard, but some may see benefits (see Chapters 11, 12, and Atlas."
114193	26	8	26	8	you may consider inserting "...and evaluation of the challenge" after "threats" [Jan Fuglestedt, Norway]	Noted. Sentence now reads: "Increasing recognition of the urgency of the climate change threat, along with still-rising emissions and unresolved issues of mitigation and adaptation, including aspects of sustainable development, poverty eradication and equity, have led to new policy efforts."
125175	26	14	26	26	[SCOPE] Section 1.2.3.1 (climate change communication and uncertainty) is unnecessary and can be deleted. Chapter 1 is already way too long and this section is not critical to include. If it is to be retained, blend it into Box 1.1 on uncertainty. As written, Section 1.2.3.1 leaves the reader asking, "So what's been done to improve or avoid the situation?" [Trigg Talley, United States of America]	Noted. Section is retained, after revision.
39151	26	14	28	50	A revisit oof this uncertainty dguideline is most helpful even as the comparisons of uncertainties remain difficult. In some of the chapters, uncertainty language are sorely missing. [Lourdes Tibig, Philippines]	Noted. The decision to use the AR5 Guidance Note was taken early on in the AR6. No revisions possible at this point in time. All chapters are working hard to implement formal uncertainty assessments where deemed possible and necessary.
26257	26	14	28	54	A paper that could be part of this assessment has been just published: "Confident, likely, or both? The implementation of the uncertainty languageframework in IPCC special reports" (Janzwood, 2020; DOI https://doi.org/10.1007/s10584-020-02746-x). [Tania Guillén Bolaños, Germany]	Accepted. Added this reference.
70421	26	14	31	14	Given that Chapter 1 is over length, and that the topic is not in the approved outline of Chapter 1, I wonder whether '1.2.3 Linking Science and Society: communication, values and the IPCC assessment process' is needed, with the exception of Box 1.1 on calibrated uncertainty language. Aside from the box, this section includes text on communication and uncertainties; text on values in science; and text on media messaging of climate change. The latter in particular seems in danger of being overly self-referential, and also by comparing perceptions of climate change across countries, unnecessarily political. While this section contains interesting discussion, and of course assesses valid research, I wonder if this is really needed within the report itself? [Gillett Nathan, Canada]	Noted. Discussion of values in science was explicitly solicited by the IPCC leadership and hammered out in a cross-chapter working group.
70061	26	14			This section is not addressing the legal relevance of the IPCC assessments of confidence/likelihood of changes in the climate system. A paper currently in review in the journal "Studies in the History and Philosophy of Science" highlights that in a legal framework in US civil courts the standard of evidence "more likely than not" (i.e. >50%) is sufficient (Lloyd et al, in review, submitted before December 31, 2019, "The mismatch between scientific and legal standards of demonstration in climate science" - I can provide a copy of this article to the TSU and the chapter 1 authors). However, most assessments of IPCC focus on "likely" or "very likely" levels. This shows that information that is less reliable than "likely" (66%) but that is strong enough to be ranked at the level "more likely than not" (>50%) would be very useful for societal decisions and policymaking. It would be useful to highlight this point in this section. Note that this could also have implications for the selection of statements in the Executive summaries, TS and SPM. [Sonia Seneviratne, Switzerland]	Noted. While this is interesting, it seems outside the purview of WG1, and it also would seem odd to promote or discuss one legal standard (the USA's "beyond a reasonable doubt") over others given the huge range of legal practices around the world.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
81115	26	16	26	16	As per comment above, PLEASE avoid academic obfuscation for climate change communications. MOST people are smart and want to understand but most are not trained in academic fields that use a highly exclusive language. This section is a case in point. Certainly the role of uncertainty in scientific literature and exploration is critical to the scientific method. But this should be explained in an easily understandable manner. As is, it seem to blame the audience for not understanding and perpetuates this issue as a "scientists only" ingroup/outgroup dynamic. Recommend revising this for an audience that wants to understand, but are not highly trained scientists. [Mary Matthews, Azerbaijan]	Noted. Additional examples have been added, and the second part of this paragraph has been further clarified. Unclear what "academic obfuscation" is referring to here since only one line is mentioned.
112537	26	16	26	17	different political cultures influence how climate science is undertaken; this should be acknowledged in this sentence/section. You could reference: Heymann, M., Gramelsberger, G., & Mahony, M. (Eds.) (2017). Cultures of prediction in atmospheric and climate science: Epistemic and cultural shifts in computer-based modelling and simulation. New York: Routledge. Skelton, M., et al. (2017). "The social and scientific values that shape national climate scenarios: a comparison of the Netherlands, Switzerland and the UK." Regional Environmental Change 17(8): 2325-2338. [Suraje Dessai, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Added these references in Section 1.2.3.2.
125177	26	16	28	48	Box 1.1 contains academic discussions without a clear point, other than describing the uncertainty guidance that will be used in the AR6. Keeping to that guidance would improve clarity. [Trigg Talley, United States of America]	Noted. Framing and introduction of the uncertainty guidance is considered relevant and important.
115257	26	18	26	18	Using here "deeper" is (i) a misconception and (ii) misleads readers to consider the term "deep uncertainty" as being the alternative to likelihood statements. Part of this misconception seems to come from the fact that in physical sciences uncertainty is often equated with variance or variability. This understanding implies often the questionable world view of a deterministic world, while arguments can be made that there exists absolute chance, the latter creating uncertainties for any predictions for stochastic processes. Of course deterministic chaos blurs such concepts, yet the many disciplines involved in IPCC assessments require to remain open minded and to be cognizant of the fact that there exist several approaches to the understanding of uncertainty. Accordingly our IPCC guidelines on uncertainty offer much more than merely "evidence is sufficient to assign a range of probability to a conclusion" and then "deeper uncertainties". There may be large (deep?) uncertainties expressed with a likelihood statement, while a confidence statement not based on a probabilistic analysis may come with a much smaller (less deep?) uncertainty. Moreover, the sequence for any IPCC uncertainty assessment begins from evidence and agreement and advances from that to confidence and only last to a probabilistic statement. This sentence seems also to imply a reverse sequence. Please avoid all these issues and potential misunderstandings. [Andreas Fischlin, Switzerland]	Taken into account. This isn't an assessment statement. "Deeper" here refers to many different ways that knowledge can be uncertain, including epistemic uncertainty (things we don't know we don't know). Revised to read: In some cases, evidence and agreement are sufficient to assign probability ranges and confidence levels to conclusions; in others, uncertainty is deeper and will be more accurately characterized in alternative ways (Kandlikar et al., 2005). Cross-AR6 glossary definition of "deep uncertainty": A situation of deep uncertainty exists when experts or stakeholders do not know or cannot agree on: (1) appropriate conceptual models that describe relationships among key driving forces in a system; (2) the probability distributions used to represent uncertainty about key variables and parameters; and/or (3) how to weigh and value desirable alternative outcomes (Lempert et al., 2003).
39049	26	19	27	11	How are you going to prevent a certain level of uncertainty using the standardised calibrated language? [Glenn Banaguas, Philippines]	Noted. Comment unclear. The goal of the calibrated language is not to "prevent" uncertainty, but to explicitly evaluate the range of uncertainty.
90937	26	21	26	21	"cannot prevent" could perhaps be "cannot entirely prevent"? [Wendy Parker, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Done.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
29221	26	21	26	26	The given example is not very clear [nathalie fagel, Belgium]	Noted. Sentence revised to read: "One study of 24 countries found that even when shown IPCC uncertainty guidance, lay readers systematically misunderstood IPCC likelihood statements. When presented with a "high likelihood" statement, they understood it as indicating a lower likelihood than intended by the IPCC authors. Conversely, they interpreted "low likelihood" statements as indicating a higher likelihood than intended (Budescu et al., 2014)."
19621	26	21	26	26	Following this biased interpretation, one would obviously like to know whether the IPCC uncertainty language was changed in order to correct the biases. [philippe waldteufel, France]	Taken into account. Added: "However, suggested alternatives (such as always including numerical values along with calibrated language) are impractical. This report therefore retains the calibrated language. As with previous reports, it also includes FAQs expressing its chief conclusions in plain language designed specifically for lay readers."
50599	26	21	26	26	Have the authors drawn any conclusions about how IPCC can respond to these findings (communication of calibrated IPCC language), or is this mis-interpretation something that can't be avoided? An additional sentence here would be welcome. [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Added: "However, suggested alternatives (such as always including numerical values along with calibrated language) are impractical. This report therefore retains the calibrated language. As with previous reports, it also includes FAQs expressing its chief conclusions in plain language designed specifically for lay readers."
15151	26	21	26	27	I wonder if, given the misunderstanding that the calibrated language sometimes leads to, as described (see also interesting discussion on the calibrated language in e.g. https://royalsocietypublishing.org/doi/10.1098/rspa.2019.0013 and https://journals.ametsoc.org/doi/full/10.1175/BAMS-D-18-0280.1?af=R&mobileUi=0) the IPCC should/would revise it. Also, it is not clear if this AR addresses this problem or not. [Alessandro Dosio, Italy]	Taken into account. Added: "However, suggested alternatives (such as always including numerical values along with calibrated language) are impractical. This report therefore retains the calibrated language. As with previous reports, it also includes FAQs expressing its chief conclusions in plain language designed specifically for lay readers."
835	26	22	#REF!	26	Choice of language of this phrase is not very clear and repetitive, and the reference to Budescu (2014) is also given in the text box below. Consider to remove phrase [Bart van den Hurk, Netherlands]	Noted. Sentence revised to read: "One study of 24 countries found that even when shown IPCC uncertainty guidance, lay readers systematically misunderstood IPCC likelihood statements. When presented with a "high likelihood" statement, they understood it as indicating a lower likelihood than intended by the IPCC authors. Conversely, they interpreted "low likelihood" statements as indicating a higher likelihood than intended (Budescu et al., 2014)."

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
73941	26	22	23	24	The indicated problem of misunderstanding of IPCC likelihood statements was only partly solved in the present report. [Elena Kozlovskaya, Finland]	Noted. Sentence revised to read: "One study of 24 countries found that even when shown IPCC uncertainty guidance, lay readers systematically misunderstood IPCC likelihood statements. When presented with a "high likelihood" statement, they understood it as indicating a lower likelihood than intended by the IPCC authors. Conversely, they interpreted "low likelihood" statements as indicating a higher likelihood than intended (Budescu et al., 2014)."
111995	26	22	26	26	This sentence "One study of 25 samples in 24 countries found that even when shown IPCC uncertainty guidance, lay readers 23 systematically misunderstood IPCC likelihood statements, interpreting both higher and lower likelihood statements as conveying probabilities closer to 50 percent than intended" seems grammatically incorrect. Do you mean "... probabilities closer to 50 percent lower (or higher) than intended? The next sentence "That is, when presented with a high likelihood statement they understood it as having a lower likelihood than intended, and they interpreted low likelihood statements as having a higher likelihood than intended by the IPCC authors (Budescu et al., 2014)" clarifies a bit, but seems redundant. Consider rewording/combining the sentences. [Cynthia Randles, United States of America]	Accepted. Sentence revised to read: "One study of 24 countries found that even when shown IPCC uncertainty guidance, lay readers systematically misunderstood IPCC likelihood statements. When presented with a "high likelihood" statement, they understood it as indicating a lower likelihood than intended by the IPCC authors. Conversely, they interpreted "low likelihood" statements as indicating a higher likelihood than intended (Budescu et al., 2014)."
4763	26	22	26	26	Choice of language of this phrase is not very clear and repetitive, and the reference to Budescu (2014) is also given in the text box below. Consider to remove phrase [Bart van den Hurk, Netherlands]	Noted. Sentence revised to read: "One study of 24 countries found that even when shown IPCC uncertainty guidance, lay readers systematically misunderstood IPCC likelihood statements. When presented with a "high likelihood" statement, they understood it as indicating a lower likelihood than intended by the IPCC authors. Conversely, they interpreted "low likelihood" statements as indicating a higher likelihood than intended (Budescu et al., 2014)."
70847	26	22	26	26	In a more recent study, albeit with a more limited set of countries, Juanchich et al. (2020 Climatic Change, in press, doi: 10.1007/s10584-020-02737-y) found that there was not so much of a discrepancy as reported by Budescu et al. (2014). [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Reference added.
35447	26	26	26	26	Different letter font [Carlos Antonio Poot Delgado, Mexico]	Noted. Editorial.
55479	26	31	28	49	Given the pre-LAM discussions on GMST/GSAT and baseline periods in would be important to discuss the influence of the choice of metric & definitions on the uncertainty or rather the numbers. Could refer also to attribution box where it's explained how the way you define an event determines the exact outcome of the assessment. It seems important to highlight that it of cours affects the numbers but is different to other uncertainties and doesn't change the impacts but how you count them. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Noted. This would go beyond the remit of this box which focuses on introducing the guidance itself. The assessment of the influence of choice of metric follows in the particular chapters of the report.
81117	26	31	28	49	Again, Box 1.1 is another case in point where academic obfuscation goes too far for more readers. This would be great for an upper level course on statistics and the scientific method, but perhaps here would be better distilled to a half page, and with the main body included in an annex. [Mary Matthews, Azerbaijan]	Rejected. The technical detail of the guidance is necessary here to give the background and context of the assessment which follows in the subsequent chapters, forming the basis of the TS and SPM.
70501	26	31	28	50	This box is well-written and complete. [Gillett Nathan, Canada]	Noted. With Thanks.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
19357	26	31	28	50	Is it possible to include a table that explains confidence intervals / statements of likelihood in a visual format, with explanations mapped to each level of confidence/likelihood? This might make this more understandable for regular readers. [Lia Cairone, United States of America]	Rejected. This is what Box1.1, Figure 1 does, we believe.
70065	26	31			This box (Box 1.1) is not addressing the legal relevance of the IPCC assessments of confidence/likelihood of changes in the climate system. A paper currently in review in the journal "Studies in the History and Philosophy of Science" highlights that in a legal framework in US civil courts the standard of evidence "more likely than not" (i.e. >50%) is sufficient (Lloyd et al, in review, submitted before December 31, 2019, "The mismatch between scientific and legal standards of demonstration in climate science" - I can provide a copy of this article to the TSU and the chapter 1 authors). However, most assessments of IPCC focus on "likely" or "very likely" levels. This shows that information that is less reliable than "likely" (66%) but that is strong enough to be ranked at the level "more likely than not" (>50%) would be very useful for societal decisions and policymaking. It would be useful to highlight this point in this box (see also comments to overall section 1.2.3 and to subsection 1.2.3.1) [Sonia Seneviratne, Switzerland]	Noted. While this is interesting, it seems outside the purview of WG1, and it also would seem odd to promote or discuss one legal standard (the USA's "beyond a reasonable doubt") over others given the huge range of legal practices around the world.
115259	26	34	26	34	Yes was important, but was also a big struggle since not harmonized (also for reasons I just tried to explain in my previous comment). Only thanks the Himalaya blunder WGs accepted to follow really the same uncertainty guidance as of AR5 on recommendation of the IAC. [Andreas Fischlin, Switzerland]	Noted.
131359	26	34	26	36	When talking about the First IPCC Assessment Report here this report should be properly cited. [Hans Poertner and WGII TSU, Germany]	Taken into account.
115261	26	38	26	39	Replace 'updated' by "updated and unified across all WGs" [Andreas Fischlin, Switzerland]	Accepted. Revised accordingly.
31331	26	41	26	41	"Considerable critical" sounds rather negative. Is this "critical attention" somehow different from scientific analyses and studies? [Markku Rummukainen, Sweden]	Accepted. Deleted "Considerable"
70845	26	44	26	45	The context dependence also involves whether readers interpret uncertainty as objective or subjective (Løhre et al. 2019 doi: 10.1175/WCAS-D-18-0136.1). This is related to the discussion about reliability vs informativeness. [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account.
107803	26	47	26	54	This paragraph could do with an example. For example, what are the different evidence bases across the WGs? [Linda Mearns, United States of America]	Taken into account. Text revised and moved outside of the guidance box.
3223	26	51	26	51	scales, the differences more directly reflected the (omit different) evidence bases across the WGs. [Sergio Aquino, Canada]	Accepted. Revised accordingly.
87223	26	52			Section 1.2.3 A focus on literacy seems inappropriate if we talk about what happens in the US or countries where climate change is highly politized. A wider perspective on the psychological and social factors is presented later in the report and I would consider strengthening that. In fact, that is the approach used in CH10, p. 102 when discussing values of different stakeholders. [Rodolfo Sapiains, Chile]	Taken into account. Reference to literacy no longer appears, and section discusses a wide variety of factors that influence public understanding and acceptance of climate science.
115263	26	54	26	54	I suggest to delete the parantheses '(or "deep")'. Same rationale as given above on the term "deeper" on line 18 [Andreas Fischlin, Switzerland]	Accepted. But was added in response to reviewer comments to the FOD....

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
115265	27	1	27	4	For the same reasons I suggest to reverse the parts of this sentence so that it reads: "As the existing framework may not be sufficient to ensure the desired consistency or guide robust findings when conditions of deep uncertainty are present (Adler and Hirsch Hadorn, 2014), the treatment of deep uncertainty in IPCC assessments has recently received particular attention in the context of the SROCC (SROCC (2019), Chapter 1, Box 5)". [Andreas Fischlin, Switzerland]	Accepted.
24227	27	1			remove "deep" [Bryan Weare, United States of America]	Accepted. But was added in response to reviewer comments to the FOD, I think.
13147	27	2	27	2	SROCC must be expanded acronym has not been used [Maria Amparo Martinez Arroyo, Mexico]	Rejected. SROCC already used in Section 1.1.
131361	27	2	27	7	Please provide the appropriate citation for Chapters in Special reports, in this case, for SROCC Chapter 1, it should be Abrams et al. (2019). Please make also sure this is correctly listed in the reference list [Hans Poertner and WGII TSU, Germany]	Accepted. Reference updated.
111921	27	2			Again, SROCC (2019) - actually, referred in References as IPCC (2019b). Check throughout the report [Tomas Halenka, Czech Republic]	Done. Editorial.
73943	27	9	27	11	Concept of 'storylines' or '*narratives' would be useful, if it is necessary to present uncertainty information for decision-making bodies, but the number of cases considered in the present report is insufficient to demonstrate that this concept is really working. [Elena Kozlovskaya, Finland]	Noted. No change requested.
36581	27	14	27	27	What's missing here are statements that the reader will be told the basis on which Confidence and Likelihood are determined whenever these are expressed in the document. (e.g. for Confidence, the user will be told if it is based on data, mechanistic understanding, theory, models or expert judgment). [John McLean, Australia]	Rejected. The issue of traceability is explicitly addressed in this Box 1.1
115267	27	17	27	17	Replace 'underlying scientific understanding' by "the underlying scientific evidence and agreement in the scientific literature" [Andreas Fischlin, Switzerland]	Rejected. "Understanding" here captures what we intend to say. Evidence/Agreement are introduced right thereafter.
112539	27	19	27	22	SROCC is not the original sources of this definition; the original definition comes from Rob Lempert, probably from Lempert, R. J., et al. (2003). Shaping the next one hundred years: new methods for quantitative, long-term policy analysis. Santa Monica, CA, RAND. [Suraje Dessai, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Reference is here made to the AR5 guidance note, which forms the basis for the definitions used here, not the SROCC.
125179	27	19	27	22	Emphasize "qualitative" and "quantative" in these definitions with an underline or bold-face or something. This is a key distinction that should really be brought to the forefront for readers. [Trigg Talley, United States of America]	Rejected. Editorial.
109729	27	19	27	27	These definitions need to be laid out earlier. We're almost 30 pages in and this would have been helpful to read earlier in following the language. [Eric Nolan, United States of America]	Noted. Different options for placing the box have been considered. This placement with Section 1.2.3 seemed most appropriate.
90939	27	21	27	21	"degree of agreement" -- It is unclear whether this is agreement among lines of evidence or agreement among experts on how to interpret that evidence / what it indicates. It would be helpful to have more clarity on this. [Wendy Parker, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The intent of the guidance was the agreement among the lines of evidence, though the two can't be very properly separated in all instances.
115269	27	24	27	24	Add " and implies high or very high confidence" [Andreas Fischlin, Switzerland]	Rejected. This is a question of application not of the definition. This is introduced later on in the Box.
107805	27	26	27	26	What does 'where appropriate' mean here? Seems like a slightly dangerous catch-all term [Linda Mearns, United States of America]	Taken into account. Deleted "Where appropriate".

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
54873	27	26	27	29	Box on treatment of uncertainty: here it says that the assessed 90% uncertainty interval is "sometimes referred to as" the very likely range in the AR6 report. Can this text be written to be more explicit about whether or not the 90% uncertainty interval can always be assumed to be (interpreted as) the very likely range even if the authors do not refer to it as such? An explicit statement would be very helpful for many users of IPCC findings. [Nancy Hamzawi, Canada]	Accepted. "Sometimes" removed. [NOTE: Comment refers to page 28, not 27]
101433	27	31	27	36	This is a really helpful figure. Can you move the labels "Likelihood" and "Outcome probability" closer to the table, because at first I thought they were labels for the two pdfs. When you replace the first statement example, could you choose one that doesn't include both mechanism and magnitude/attribution? - something simpler. And medium evidence, high agreement sounds like medium-high confidence to me, so could you choose a lower agreement example? [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Done. Examples replaced with AR6 statements.
115271	27	46	28	40	<p>While there is nothing wrong with this text I fear it is too detailed and reads much like a cookbook for authors. Why do readers have to read that? I suggest to strongly shorten that text and focus on reviewing literature on this subject (notably the critical ones) and give perhaps good arguments why AR6 sticks to the guidance (Mastrandrea et al., 2010) despite some of the critiques (see literature listed below and I can provide many more if you wish).</p> <p>Cited References: -----</p> <p>Mastrandrea, M.D., Field, C.B., Stocker, T.F., Edenhofer, O., Ebi, K.L., Frame, D.J., Held, H., Kriegler, E., Mach, K.J., Matschoss, P.R., Plattner, G.K., Yohe, G.W. & Zwiers, F.W., 2010. Guidance note for lead authors of the IPCC Fifth Assessment Report on consistent treatment of uncertainties. IPCC: Intergovernmental Panel on Climate Change, Geneva, Switzerland. Author Guidance, 5pp. https://www.ipcc.ch/site/assets/uploads/2018/05/uncertainty-guidance-note.pdf Ma465</p> <p>Risbey, J. S. & O'Kane, T. J., 2011. Sources of knowledge and ignorance in climate research. <i>Clim. Chang.</i>, 108(4): 755-773. http://dx.doi.org/10.1007/s10584-011-0186-6 Ri135</p> <p>Curry, J., 2011. Reasoning about climate uncertainty. <i>Clim. Chang.</i>, 108(4): 723-732. http://dx.doi.org/10.1007/s10584-011-0180-z Cu028</p> <p>Tol, R. S. J., 2011. Regulating knowledge monopolies: the case of the IPCC. <i>Clim. Chang.</i>, 108(4): 827-839. http://dx.doi.org/10.1007/s10584-011-0214-6 To065</p> <p>Ekwurzel, B., Frumhoff, P. C., & McCarthy, J. J., 2011. Climate uncertainties and their discontents: increasing the impact of assessments on public understanding of climate risks and choices. <i>Clim. Chang.</i>, 108(4): 791-802. http://dx.doi.org/10.1007/s10584-011-0194-6</p>	Taken into account. The box provides the guidance, whereas the main text includes the assessment of the literature.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
23613	28	3	28	4	I think you can and should go further and say that a low confidence statement still means that the statement is the best (truest) conclusion that the authors can come up with, it's just that further research may change this conclusion substantially. As written, this is not clear, as it just says that the opposite to a low confidence statement does not necessarily have a higher level of confidence - it OUGHT to have even lower confidence. On a more editorial note, for many readers, the use of brackets will be confusing; I suggest you rephrase this last sentence to say "When confidence in a finding is assessed to be low, this does not necessarily mean that confidence in the opposite finding is high, and vice versa." [Andy Reisinger, New Zealand]	To be considered. Revised last sentence as suggested (use of brackets).
89977	28	3	28	4	Alan Robock had a nice letter in Eos in 2010 stating, appropriately, that expressions in parantheses should never be used to express opposites. Easy for the author, terrible for the reader. Use "vice versa" instead. [Jochem Marotzke, Germany]	Accepted. Revised accordingly.
23615	28	6	28	19	It might be useful to clarify that likelihood does NOT simply represent the statistical outcome from an ensemble of opportunity (e.g. a set of model runs) but includes an expert judgement that the collection of available model runs does indeed reflect as best as possible an outcome in the real world, not just in the model space. (And then double-check that this is indeed how it is applied in all instances in this assessment.) [Andy Reisinger, New Zealand]	Noted. The text does explicitly state that the probabilistic judgements may build on, a.o. things, expert judgement. We prefer to limit here to the most general level of the guidance. Details on how it has been applied need to be given by the author teams in the Chapters.
26575	28	7	28	9	Certain values are found in the Convention and the Paris Agreement (in particular its preamble) but it is not clear where this particular list comes from. It would be wise to align this wording more closely with the preamble of the Paris Agreement. [Eric Brun, France]	Noted. No action. Not sure I get the point. It seems that this comment refers to Cross-Chapter Box 1.1 page 16 instead?
70849	28	10	28	12	I wonder whether the IPCC has considered the implications of expressing low probabilities using a negative lexicon. Juanchich et al. (2020 Climatic Change, in press, doi: 10.1007/s10584-020-02737-y) compared the IPCC lexicon with an alternative positive lexicon for the low-probability outcomes, and found that whilst it did not alter participants' perception of the likelihood, it did alter their decision-making. In particular, using a positive lexicon increased risk awareness and promoted cautious decision-making. This shows that the prediction space cannot be separated from the decision-making space. [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	Noted. No the IPCC has not considered this. Guidance is now how it is, we have to work with it.
19623	28	10	28	15	these lines indicate from which data are build the likelihood estimates. On the other hand, in CCBox 1.4 P57 L51-52, it is written that attribution of observed changes to one or more causes form the basis of likelihood statements. There is a serious inconsistency here, since the attributions are not even present in the list mentioned above. This inconsistency weakens the impact of likelihood statements, all the more so that the sentence P28 L14-15 is vague and almost casual. It is necessary to explicit with more detail how likelihood statements are built from attribution studies and eventually other data. [philippe waldteufel, France]	Rejected. The text here introduces in a very general manner the basis for likelihood assessments and associated probabilistic judgements. It is clear from the text that this builds on all the evidence available, to arrive at confidence statements, i.e., incl. observations and attribution of observed changes to causes. Attribution studies are part of the available evidence and of the "statistical or modelling analyses, expert judgement, or other quantitative analyses".
109321	28	11	28	11	The "extremely likely" (95-100%) step in the calibrated language is missing here. [Paul Edwards, United States of America]	Rejected. It is included in the next sentence. Historically, some were not included.
36583	28	21	28	23	Given that 2 standard deviations represents 95% please explicitly state how you arrive at 90% uncertainty interval. [John McLean, Australia]	Rejected. How the uncertainty is assessed is part of the chapters, not the guidance note.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
43997	28	21	28	29	precision required: In this report, an assessed 90% uncertainty interval is sometimes referred to as a "very likely range", in line with the definition of the calibrated uncertainty terms introduced above. Similarly, an assessed 66% uncertainty interval is sometimes referred to as a "likely range". The use of the narrative in quotes should be consistently applied not just 'sometimes'. [David Russell, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account.
90941	28	22	28	22	Should "expected" be "estimated"? Use of "expectation" in an informal sense in statistical contexts can be confusing. [Wendy Parker, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Revised to clarify this.
633	28	23	28	25	"The range encompasses the median value and there is an estimated 5% likelihood of the value being below the lower end of the range (x) or above its upper end (y)." The chances of it being either below OR above is 10%. I know what you mean but I think the wording needs some work. e.g. "The range encompasses the median value and there is normally an estimated 5% likelihood of the value being below the lower end of the range (x), and a 5% likelihood of the value being above its upper end (y)." Or alternatively "The range encompasses the median value and there is an estimated 10% likelihood of the value being either below the lower end of the range (x) or above its upper end (y)." [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Revised to clarify this.
89979	28	24	28	24	The "or" makes this ambiguous -- could be read that it doesn't matter whether the 5% are above or below. But what's meant here is that it is 5% above and 5% below. [Jochem Marotzke, Germany]	Accepted. Revised to clarify this.
28671	28	24			just to clarify, it is a 10% probability that the value is outside the estimated range but a 5% probability it is below the lower limit and also a 5% probability it is above the upper limit. So I'm not sure what is written conveys this quite. [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Revised to clarify this.
90943	28	26	28	26	Referent of "that value" is unclear. [Wendy Parker, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Revised to clarify this.
131363	28	31	28	40	Which "uncertainty guidance note" are you talking about here? The standard one by Mastandrea et al (then please provide again citation), or are you referring to this Box? Please clarify to avoid confusion [Hans Poertner and WGII TSU, Germany]	Accepted.
43999	28	31	28	40	Where multiple combinations of confidence are possible to characterize key findings. 'For example, a very likely statement might be made with high confidence, whereas a likely statement might be made with very high confidence.' In such instances, the author teams need to be consistent in the use of combinations of confidence to convey the most balanced information to the reader. [David Russell, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. Our text states correctly states that "In these instances, the author teams consider which statement will convey the most balanced information to the reader." This exactly captures what the author teams are expected to do. The proposed change to "need to be consistent in the use of combinations of confidence to convey the most balanced information to the reader." would not be correct.
23617	28	37	28	40	... rather than making an either/or choice, authors might also chose to state both likely and very likely conclusions and since it may be important for decision-makers to understand how the degree of confidence you require in a statement alters the likely/very likely outcomes that can be described. [Andy Reisinger, New Zealand]	Noted. While correct, we are not convinced that this adds much. It might actually be more confusing, in our view.
21283	28	38	28	40	This sentence sounds like guidance being given to the authors whereas presumably it should instead be recast to state that this is how the authors have decided what term to use? [Peter Thorne, Ireland]	Accepted. Wording adapted

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
70503	28	42	28	48	I would suggest deleting or considerably shortening this paragraph, which is written almost as a disclaimer to comparing uncertainties in this report with previous reports. Comparing our assessment with AR5, and how the confidence and likelihood of key assessments have changed is what is done throughout the report, and this is very useful to readers of the report. Also, the availability of new information and improved scientific understanding are legitimate reasons why uncertainties may have changed in this report compared to previous reports, not a reason why direct comparisons of uncertainties are difficult - and assessed uncertainties can and should reflect this additional information and understanding. The only legitimate reason provided why comparison of uncertainties may be difficult is the application of the revised guidance note on uncertainties in AR5 and later. But since readers may want to compare uncertainties with earlier IPCC reports (and indeed such uncertainties are compared in this chapter, for example the assessed uncertainty in climate sensitivity is compared between assessments in Table 1.1), it would be more useful to briefly state how uncertainty assessment in IPCC changed after the publication of the revised guidance note on uncertainties, rather than just saying that this makes comparisons difficult. [Gillett Nathan, Canada]	Accept. Paragraph deleted.
81121	29	1	29	1	suggest not using the term "values" as it can be misconstrued by multiple disciplines. As a social scientist the term here is not correct and as communication is largely social, perhaps another term would be more suitable for communicating what is meant here. [Mary Matthews, Azerbaijan]	Noted. While some social scientists and psychologists may ascribe "values" to individuals rather than social systems, all acknowledge some amount of social shaping. Ethicists, legal scholars, and other social scientists use the term as expressed here. The explanation of our usage here is clear.
31333	29	1	29	45	This would seem to be mainly discussive, on a general textbook level. The meaning of "value" is rather specific and not the same as in everyday use. It is not clear what all this means, specifically for AR6. What additional value is the reader expected to pick up from this? [Markku Rummukainen, Sweden]	Noted. While some social scientists and psychologists may ascribe "values" to individuals rather than social systems, all acknowledge some amount of social shaping. Ethicists, legal scholars, and other social scientists use the term as expressed here. The explanation of our usage here is clear.
111809	29	1	30	1	Congratulations on this subsection, I think these reflections are very 'valuable' [Oliver Geden, Germany]	Noted. Thanks!
87495	29	1	30	31	It is great to have this discussion in here. I wonder, though, whether it (still) adopts an overly relativist position rather quickly. It is true that different disciplines prioritise different values, but that doesn't mean that a set of values are not compatible or shared across disciplines. The point is surely that whereas some values are relative, culturally distinct, etc, others are common and agreed explicitly (in the UNFCCC and Paris Agreement for example -- equity and so on). This point is well made in the excellent first paragraph, but it doesn't get much breathing space, and is lost again in the second para on 'scientific values' as though these are 'internal' and somehow distinct from other possible values (I don't think this is intended, but it feels implicit). These are well-known debates and can be summarised very succinctly. You might use Kolstad et al, 'Social, Economic, and Ethical Concepts and Methods' (IPCC AR5, WGIII, Chapter 3) -- which is in addition to Fleurbey et al (AR5 WGIII Chapter 4), already referred (albeit imprecisely) here. My sense is the discussion at present doesn't always use the term 'values' consistently -- sometimes it is an ethos or practice, other times it is a moral priority. These are not the same thing. [Stephen Humphreys, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Clarified this with language that is less relativist and separated values from norms and practices that operationalize those values. Added suggested references.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
81119	29	1	30	31	as per comments above, this is an important section but out of place if you want to empower readers. A discussion of Type I errors will not make sense to most readers. Recommend simplification and putting the body of the text into an annex on the scientific method [Mary Matthews, Azerbaijan]	Taken into account. Text on Type I errors has been heavily revised.
36585	29	1	30	31	This text is not related to "understanding the scientific basis of risk of human-induced climate change". Remove it. [John McLean, Australia]	Rejected. It is relevant.
77167	29	1	31	14	Not clear on the value of this material here? Consider removing or use in other IPCC reports [Emer Griffin, Ireland]	Noted. Section is retained following numerous discussions of its relevance to this report among Chapter 1 authors and other AR6 Lead Authors.
125181	29	1	31	14	[SCOPE] Section 1.2.3.2 (values in science...) and Section 1.2.3.3 (media messaging...) should be cut in their entirety. It's noble what the authors are trying to do in providing so much context to the reader, but Chapter 1 is exceedingly long already and this content is not directly germane to an assessment of the physical science. Consider turning into a peer-reviewed journal article for Nature Communications. [Trigg Talley, United States of America]	Rejected. Sections are retained following numerous discussions of their relevance to this report among chapter 1 authors and other AR6 Lead Authors .
109731	29	3	29	5	When defining values it might help to reference moral theorists such as Kohlberg (1977), Gilligan (1983), and Bandura (1999) as they wrote extensively on the moral reasoning constructs we determine on our own and in tandem with others. Bandura, A. (2001). Social cognitive theory: An agentic perspective. Annual Review of Psychology, 52(1), 1–26. Gilligan, C. (1977). In a different voice: Women's conceptions of self and of morality. Harvard educational review, 47(4), 481-517. Kohlberg, L. (1981). Essays on Moral Development (Vol. One). San Francisco: Harper & Row. Kohlberg, L. (1984). Essays on Moral Development (Vol. Two). San Francisco: Harper & Row. [Eric Nolan, United States of America]	Noted. Added references to discussions of values and ethics in AR5 WGIII and SR1.5.
57437	29	3	29	9	Human rights are very important to advancing adaptation to climate change. See Hall, M.J. and Weiss, D.C. 2012. Avoiding Adaptation Apartheid: Climate Change Adaptation and Human Rights Law. The Yale Journal of International Law. 37: 308-365. Peel, J. and Osofsky, J.H. 2018. A Rights Turn in Climate Change Litigation. Symposium Article. Transnational Environmental Law. 7:1 37-67. Setzer, J., and Vanhala, L.C. 2019. Climate Change Litigation: A Review of Research on Courts and Litigants in Climate Governance. WIREs Climate Change. http://doi.org/10.1002/wcc.580 [Margot Hurlbert, Canada]	Accepted. Added references.
125183	29	3	30	31	Is the take away that the uncertainty language is unreliable? If so, then what should be used instead? [Trigg Talley, United States of America]	Noted. Clarified that while the uncertainty language is imperfect, no better alternative currently exists.
44001	29	7	29	7	Recognition of the costs and benefits of climate impacts and policies should recognise externalities [David Russell, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Not sure what the reviewer means or wants to change.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
41211	29	11	29	22	This is a neat discussion of a complex discourse on the role of values in science. However I thought that the two sentences preceding "Practices embodying these values include ..." didn't quite capture the values that are expressed in those practices. I wondered whether a reference to Robert Merton might be helpful here, who foregrounded not just the cognitive commitments of scientists (like Popper), but also the social norms which govern scientific work, such as a commitment to common ownership of scientific goods and 'organized scepticism'. The practices mentioned, like the MIPs, appear to embody a number of Mertonian norms, some of which might profitably be mentioned in the second sentence of this paragraph. [Martin Mahony, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Space limitations preclude adding much, but paragraph now reads: Values also shape how knowledge is created, verified, and communicated (Persson et al., 2015). Science as an institution values objectivity, openness, and "organized scepticism" (Merton, 1973), operationalized as well-defined methods, and fully documented evidence, publication, and peer review (Institute of Medicine et al., 2009). In recent decades, open data, open code, and scientific cyberinfrastructures have facilitated scrutiny from a larger range of participants. Climate science norms and practices embodying these scientific values include publication of data and model code, multiple groups independently analysing the same problems and data, model intercomparison projects (MIPs), explicit evaluations of uncertainty, and comprehensive assessments by national academies of science and the IPCC.
21285	29	12	29	13	I suspect Institute of medicine et al. is somehow a mucked up reference. It feels a very odd citation. [Peter Thorne, Ireland]	Noted. Reference is correct. It's a handbook published by multiple national science, medicine, and engineering societies: On Being a Scientist: A Guide to Responsible Conduct in Research.
837	29	13	#REF!	14	I think that climate science has an additional value that could be added to this list, being society relevant, leading to practices as co-creation and service development [Bart van den Hurk, Netherlands]	Rejected. The list in question is about "values internal to science," that is, values that affect how science *in general* is practiced. Societal relevance is probably a value to most climate scientists, but it's not a value of science in general - consider particle physics or astronomy.
4765	29	13	29	14	I think that climate science has an additional value that could be added to this list, being society relevant, leading to practices as co-creation and service development [Bart van den Hurk, Netherlands]	repeated comment
19625	29	13	29	14	maybe "truth" - rejecting alternative facts – might deserve being added to the list... [philippe waldteufel, France]	Noted. No change.
11333	29	14	29	14	Please add citation "Ludwik Fleck: Genesis and development of a scientific fact. Edited by Thaddeus J. Trenn and Robert K. Merton. The University of Chicago Press, Chicago 1979" [Michael Schmitt, Germany]	Noted. Fleck is an important figure but not widely known outside science and technology studies.
14489	29	20	29	20	explain what is meant by "Mode 2" or "post-normal" science [Amy East, United States of America]	Taken into account. Relevant sentences no longer appear.
90945	29	24	29	26	"Risk" is used several times here in different ways, which is confusing. Suggest changing "warning of risks that never materialize" to "warning of possible outcomes that never materialize" and likewise "missed warnings of low-probability, high-impact outcomes". [Wendy Parker, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Paragraph no longer appears.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
15903	29	24	29	27	Clarify the comments about the Type 1 and Type 2 errors, so it references the problem of selecting significance levels, so it reads: "Such assessments must balance the risk of Type 1 errors (false alarms from warning of risks that never materialize) against the risk of Type 2 errors (missed warnings of low-probability, high-impact risks; Shepherd, 2019, Cross Chapter Box 1.3). The balance between these risks informs the certainty we should accept before we take action and the significance level that must be accepted before a decision is made. For example, if the consequence of a type 2 error is unaddressed and irreversible runaway climate change with 25 metre sea level rises, and the consequence of a type 1 error is a reversible economic depression, then action should be taken to tackle climate change with lower levels of confidence in the science. " [Kevin Lister, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Paragraph no longer appears.
85953	29	24	29	45	Please discuss the relationship between relative risk perception and absolute risk, in the light of type 1 and 2 errors. Just because someone does not believe in a real risk, does not mean they are not going to get affected. On the other hand, if someone is really not very much at risk (in absolute terms), then you will not see the urgency. These are potentially useful messaging tools. Perhaps cross-check with WGIII. [Debra Roberts and the Durban WGI TSU, South Africa]	Taken into account. Paragraph no longer appears.
90947	29	26	29	26	"This balance is a form of value judgment." The balance is a feature of the methodology or investigation. The choice to opt for that balance rather than a different one can reflect a value judgment. So it would be more accurate to say something like: "Preferentially guarding against one type of error can reflect a value judgment." [Wendy Parker, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Paragraph no longer appears.
19495	29	26	29	27	it is not clear meaning of " confidence straitjacket" in recent climate change literature. Please explain this. [Hamideh Dalaei, Iran]	Taken into account. Paragraph no longer appears.
39051	29	30	29	31	Aside from story lines, are there any other mechanisms that need to be used to communicate climate science to the different stakeholders? [Glenn Banaguas, Philippines]	Taken into account. Paragraph no longer appears.
67001	29	31	29	31	change "Storylines" to "Scenario storylines" to differentiate from physical climate storylines [Liese Coulter, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Paragraph no longer appears.
109733	29	36	29	36	I would include the work of Dr. Dana Zeidler after "societal relevance." Dr. Zeidler has written extensively on socioscientific issues and how we construct the sociocultural components of science through teaching and learning. Zeidler, D. L., Herman, B. C., Ruzek, M., Linder, A., & Lin, S.-S. (2013). Cross-cultural epistemological orientations to socioscientific issues. <i>Journal of Research in Science Teaching</i> , 50(3), 251–283. [Eric Nolan, United States of America]	Rejected. Ref. not closely aligned with purpose of paragraph.
26235	29	36	29	37	"The human imperative of stabilizing global climate change at 1.5°C" (Hoegh-Guldberg et al. 2019; http://dx.doi.org/10.1126/science.aaw6974) can be also added here. [Tania Guillén Bolaños, Germany]	Accepted. Reference added.
114197	29	37	29	37	No ref needed here. [Jan Fuglestedt, Norway]	Accepted. Reference to 2018 report deleted, but replaced with "The human imperative of stabilizing global climate change at 1.5°C" (Hoegh-Guldberg et al. 2019; http://dx.doi.org/10.1126/science.aaw6974)

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
101435	29	37	29	42	Suggest citing Porter and Dessai (2017) for a tangible and accessible study of co-production not working well: https://www.sciencedirect.com/science/article/pii/S1462901116308875 . In fact, I notice the word co-production doesn't appear...should it? [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Co-production discussion (brief) appears in second para. of 1.2.3. Included this ref. as a critique; most refs on co-production are positive.
90949	29	42	29	45	This material seems largely redundant -- it is repeating the point just made a couple of paragraphs earlier about Type I/II errors and values. Given this, as well as an issue I raised in another comment (for p.29, line 26), the sentence at p.29, line 26 that currently says "This balance is a form of value judgment." might instead read: "Preferentially guarding against one type of error can reflect a value judgment about how bad the consequences of that type of error would be (Douglas, 2009; Lloyd and Oreskes, 2018)." The sentences at lines 42-45 could then be deleted. [Wendy Parker, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Paragraph no longer appears.
14491	29	43	29	44	it's unclear whether "error" as used in this context is meant to refer to quantifiable uncertainty or to inaccuracy (as in, mistakes). [Amy East, United States of America]	Taken into account. Paragraph has been heavily revised.
26233	29	47	29	53	Here a couple of papers that could be assessed to support this paragraph: "Learning from the Experiences of the Intergovernmental Panel on Climate Change: Balancing Science and Policy to Enable Trustworthy Knowledge" Gustafsson 2019 (https://doi.org/10.3390/su11236533) & "Early-career scientists in the Intergovernmental Panel on Climate Change. A moderate or radical path towards a deliberative future?" (Gustafsson & Berg 2020) (https://doi.org/10.1080/23251042.2020.1750094) [Tania Guillén Bolaños, Germany]	Noted. With apologies, due to an oversight, we missed the opportunity to include these references.
19627	29	47	29	53	I commented earlier on the need to clarify what is meant by assessment, and recommended to include this clarification in Box SPM.1. This paragraph illustrates why. What is meant by evaluating literature? Is there a judgment (judgment is listed among the synonyms of assessment)? What about peer-reviewed material? Grey literature? I don't remember having read anywhere in the SOD a statement like "this article supplies important/reliable/controversial conclusion". Such 100% neutral assessments do not contribute to incite the reader to trust the IPCC reports [philippe waldteufel, France]	Taken into account. Now says "by evaluating evidence and agreement across all relevant peer-reviewed..." Not clear what the rest of the comment is asking for.
31335	29	47	30	31	Suggest moving and integrating in Box 1.1. which discusses the same complex. [Markku Rummukainen, Sweden]	Noted. No change.
71409	29	49	29	50	The decision what is relevant literature is of course itself value-based. I am wondering whether this should be made transparent here. [Douglas Maraun, Austria]	Noted. No change.
99415	29	50	29	53	Philosopher Helen Longino articulated a philosophical analysis of just this sort of investigation and famously defended it in her legendary 1990 book, Science as Social Knowledge, Princeton University Press. It launched a new way of thinking about scientific objectivity in philosophy of science, as an interactive, inclusive process. [Elisabeth Lloyd, United States of America]	Noted, but reference doesn't fit this context.
39053	29	55	30	11	Do you think that the use of "extremely likely" or "likely" can create any difference in terms of communicating climate science to the public? What is the degree of uncertainty? [Glenn Banaguas, Philippines]	Noted. Not sure what the reviewer is asking for.
26577	30	1	30	2	We suggest to add the useful reference : Maxwell Boykoff, Olivia Pearman, Now or Never: How Media Coverage of the IPCC Special Report on 1.5°C Shaped Climate-Action Deadlines, One Earth, Volume 1, Issue 3, 2019, Pages 285-288, ISSN 2590-3322, https://doi.org/10.1016/j.oneear.2019.10.026 . (http://www.sciencedirect.com/science/article/pii/S259033221930140X) [Eric Brun, France]	Noted. With apologies, due to an oversight, we missed the opportunity to include this reference.
9087	30	3	30	3	"entails" (present tense) [Olaf Morgenstern, New Zealand]	Noted. Phrase no longer appears.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
13149	30	6	30	6	GSAT must be expanded acronym has not been used [Maria Amparo Martinez Arroyo, Mexico]	Accepted. Editorial.
70851	30	8	30	11	I'm not sure what this third option is meant to illustrate. On the face of it, it sounds the same as the first option, if we interpret "main driver" as equivalent to "more than half". The likelihood statement is the same, so the only difference is the time range. Thus this option does not seem to illustrate a trade-off, just that likelihoods will saturate at some point. [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Paragraph no longer appears.
101437	30	12	30	15	This statement is from SR15, right? If so please can you reference as you do for the other examples. [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Paragraph no longer appears.
70505	30	12		15	The authors assert that the assessment 'Human influences are the dominant factor in the warming of the past 50 years' is 'the same information' as the Chapter 3 assessment that 'It is extremely likely that human influence is the main driver of the observed increase in global-mean surface air temperature in 2010-2019 relative to 1850-1900'. These are not the same at all. The first is a statement of fact (i.e. certain). The latter is a statement made using IPCC calibrated uncertainty language at the 'extremely likely' level i.e. P>= 95%. This process for arriving at such calibrated uncertainty assessments is well-explained two pages earlier in Box 1.1. The exact wording was carefully chosen by the author team of Chapter 3 based on the assessed literature and traceable accounts of the uncertainty are included there. Chapter 1 should not formulate new assessments here. In addition, this text includes the assessment 'The best estimate of the human contribution to the observed warming is 110%, with a possible range of 80% to 150%. Estimates exceed 100% because natural factors are estimated to have exerted a small cooling influence'. It is not clear where this information comes from, and even if references were included, assessing attribution of observed temperature change is out of scope for Chapter 1. This is offered as an example of communication of uncertainties, but by asserting that this assessment conveys 'the same information', the authors are making an alternative attribution assessment for global mean temperature. Chapter 1 should stick to using actual example assessments from other chapters or previous assessments in this discussion, and not use made-up examples. This should be deleted. [Gillett Nathan, Canada]	Accepted. These examples no longer appear.
114199	30	17	30	17	As well as context? [Jan Fuglestad, Norway]	Noted. Paragraph no longer appears.
90951	30	17	30	17	What is most useful to policymakers is not the same thing as their values. An alternative wording could be: "what is believed to be of most use to policymakers, which in turn can depend on their values." [Wendy Parker, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Paragraph no longer appears.
87497	30	17	30	17	A really interesting discussion here. It seems a little let down by the last word 'values'. Is it really 'values' that are at stake here? It seems to me the choice of communication is related rather to questions of concision, urgency and effect. Are these 'values'? [Stephen Humphreys, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Paragraph no longer appears.
87499	30	19	30	19	Again an important point, but it feels as though the trade-off could be better articulated. Perhaps it is a trade-off between 'precision and clarity'? (Rather than 'reliability and informativeness?') I would think this frame would not require much change to the remaining text in the para. [Stephen Humphreys, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. We decided that the reliability vs. informativeness language was clearer for most readers.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
107807	30	19	30	21	Here is where the sentences clarifying reliability vs. informativeness are found. They should be added at pl. 6 48-49. [Linda Mearns, United States of America]	Accepted. Done.
85955	30	19	30	31	In the context of variable systems it would also help to distinguish between confidence in mean conditions, and confidence about range or frequency of extremes. It may be extremely uncertain at what point mean rainfall will become significantly lower, while it may be more certain that the frequency of extreme low or high rainfall events will become significantly more frequent. The frequency of high sea level events or heatwaves is also highly relevant. And people do understand the implications of this. [Debra Roberts and the Durban WGII TSU, South Africa]	Rejected. Great comment, but space constraints limited us to a small number of examples of value trade-offs.
71411	30	19	30	31	Whether to focus on the type I or type II error depends also on whether one is discussing, e.g., attribution statements (focus on reliability) or low probability high risk changes (focus on informativeness). When discussing risks, you don't want to miss the greatest risks. This should be added here. A potential reference could be the already cited Shepherd 2019 (but not sure he explicitly covers the issue). [Douglas Maraun, Austria]	Noted. This part of the paragraph now reads: "Recent work also recognizes that choices made throughout the research process can affect the relative likelihood of false alarms (overestimating the probability and/or magnitude of hazards) or missed warnings (underestimating the probability and/or magnitude of hazards), known respectively as Type I and Type II errors. Researchers may choose different methods depending on which type of error they view as most important to avoid, a choice that may reflect social values (Douglas, 2009; Knutti, 2018; Lloyd and Oreskes, 2018). This reflects a fundamental trade-off between the values of reliability and informativeness." "Social values" captures the "we don't want to miss the greatest risks" mentioned in the reviewer's comment.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
90953	30	19	30	33	This text gives the impression that researchers have great latitude in choosing their conclusions, which is misleading. If uncertainty is recognized to be large, then a high-likelihood statement for a narrow range should not be given! I suspect it would be better to say something like: "When there is uncertainty about the range of outcomes that plausibly can be assigned a given level of confidence or probability, opting for a narrower but still plausible range will be more informative but less reliable, while opting for a broader range will be more reliable but less informative." [Wendy Parker, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Revised to read: Recent work also recognizes that choices made throughout the research process can affect the relative likelihood of false alarms (overestimating the probability and/or magnitude of hazards) or missed warnings (underestimating the probability and/or magnitude of hazards), known respectively as Type I and Type II errors. Researchers may choose different methods depending on which type of error they view as most important to avoid, a choice that may reflect social values (Douglas, 2009; Knutti, 2018; Lloyd and Oreskes, 2018). This reflects a fundamental trade-off between the values of reliability and informativeness. When uncertainty is large, researchers may choose to report a wide range as 'very likely', even though it is less informative about potential consequences. By contrast, high-likelihood statements about a narrower range may be more informative, yet also prove less reliable if new evidence later emerges that widens the range. Furthermore, the difference between narrower and wider uncertainty intervals has been shown to be confusing to lay readers, who often interpret wider intervals as less certain (Løhre et al., 2019).
70853	30	21	30	21	I think that "high-likelihood" needs to be replaced by "lower-likelihood here, otherwise the statement is confusing. [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Revised to read: Recent work also recognizes that choices made throughout the research process can affect the relative likelihood of false alarms (overestimating the probability and/or magnitude of hazards) or missed warnings (underestimating the probability and/or magnitude of hazards), known respectively as Type I and Type II errors. Researchers may choose different methods depending on which type of error they view as most important to avoid, a choice that may reflect social values (Douglas, 2009; Knutti, 2018; Lloyd and Oreskes, 2018). This reflects a fundamental trade-off between the values of reliability and informativeness. When uncertainty is large, researchers may choose to report a wide range as 'very likely', even though it is less informative about potential consequences. By contrast, high-likelihood statements about a narrower range may be more informative, yet also prove less reliable if new evidence later emerges that widens the range. Furthermore, the difference between narrower and wider uncertainty intervals has been shown to be confusing to lay readers, who often interpret wider intervals as less certain (Løhre et al., 2019).

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
115711	30	23	30	23	Link to box 1.1 on deep uncertainty. Check if this is the best example of deep uncertainty in this report. [Valerie Masson-Delmotte, France]	Taken into account. Sentence no longer appears. Deep uncertainty discussion moved to 1.2.3.1, linked to XC Box 1.2 and SROCC.
8607	30	23	30	24	Will there be a report-wide definition of "deep uncertainty", as in SROCC? [Robert Kopp, United States of America]	Noted. Here is the Cross-AR6 definition of "deep uncertainty" (from IPCC glossary): A situation of deep uncertainty exists when experts or stakeholders do not know or cannot agree on: (1) appropriate conceptual models that describe relationships among key driving forces in a system; (2) the probability distributions used to represent uncertainty about key variables and parameters; and/or (3) how to weigh and value desirable alternative outcomes (Lempert et al., 2003).
67003	30	26	30	26	change "storylines" to "physical climate storylines" to differentiate from scenario storylines [Liese Coulter, United Kingdom (of Great Britain and Northern Ireland)]	Noted. No change.
87501	30	28	30	31	exposure' rather than exposures? This is an important sentence! [Stephen Humphreys, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Editorial; no change.
125185	30	34	30	14	[SCOPE] Section 1.2.3.3 about media messaging should be deleted. The section does not present physical climate science; it is about human reaction to it. There are many other and more appropriate places to publish something like this. [Trigg Talley, United States of America]	Rejected. Section presents significant social context relevant for this report.
3231	30	34	30	34	Climate change and the media [Sergio Aquino, Canada]	Noted. Changed to "Media coverage of climate change."
107809	30	34	31	14	This section needs to be compared with Atals section 6.1, which also concerns communicating climate information, for redundanceis. Minimally each section should refer to the other. [Linda Mearns, United States of America]	Taken into account. Revised to coordinate with Ch 10, 12, and Atlas.
31337	30	34	31	14	This would seem to be very out of place (probably well suited for WGII), is detached from the flow of text, concepts and topics here, and would be a target for deletion. [Markku Rummukainen, Sweden]	Rejected. Section presents significant social context relevant for this report.
19629	30	34	31	14	I am surprized that you do not mention at all the climate sceptics, and the room various media make for them. [philippe waldteufel, France]	Noted. No action.
87505	30	34	31	14	I wonder might the question of values be carried through more explicitly into this section? The media shapes values but is also prone to manipulation itself, of course: good sources for this are Jasanoff or Oreskes (both of whom are cited elsewhere). Habermas remains a basic theoretical source (Structural Transformation of the Public Sphere). The para on social media is good and important, but again it is relatively mild given the well-established concerns about partiality and 'fake-news'. [Stephen Humphreys, United Kingdom (of Great Britain and Northern Ireland)]	Noted. No action.
81123	30	34	31	14	To induce buyin of the public, stakeholders, and decision makers the epistemic communities must learn how to speak to these audiences on their own terms. People desparatly want and need to know what to do regarding climate change. Recommend working to launch this report with social media campaign designed to reach them, rather than criticize them for not understanding. People thrive when they feel empowered. Please please help them to feel that way. [Mary Matthews, Azerbaijan]	Noted. No action.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
66641	30	34	31	15	Section 1.2.3 is not WGI material. It does not form a bridge to any other part of the report, so it should be deleted. The selection of examples is very selective, and jarringly contrasts with the pieties regarding IPCC's "comprehensiveness" immediately above in the section on values. [Dave Frame, New Zealand]	Rejected. Section presents significant social context relevant for this report. As we note in revised version, "specific characteristics of media coverage play a major role in climate understanding and perception (high confidence), including how IPCC assessments are received by the general public."
36587	30	34	31	16	What is said in the media is not related to "understanding the scientific basis of risk of human-induced climate change". Remove it. [John McLean, Australia]	Rejected. Section presents significant social context relevant for this report. As we note in revised version, "specific characteristics of media coverage play a major role in climate understanding and perception (high confidence), including how IPCC assessments are received by the general public."
112541	30	36	30	38	this sentence makes a broad generalisation for the entire AR6 (or is it just WG1? It's unclear) which is incorrect. At one end of the reliability-informativeness trade-off is storylines while at the other end are probability density functions. [Suraje Dessai, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Cannot tell which sentence the reviewer means. p. 30 lines 36-38 are about media coverage of climate change.
44975	30	36	31	2	For better representation on climate change communication and media coverage from around the world; include examples from Africa and Asia [Maysoun Mustafa, Malaysia]	Noted. No change.
115713	30	36	31	14	This section would benefit from review from WGII and WGIII too (related to the assessment of media messaging about climate change). The topic of "settled science" would deserve to be examined in more detail (what does it mean). [Valerie Masson-Delmotte, France]	Noted. Due to an oversight, we failed to seek review from WGII and WGIII. The phrase "settled science" no longer appears, and it would require an extended discussion; it's the topic of numerous books and articles.
125187	30	36	31	14	This section does not comprehensively review the literature on media messaging. Cherry-picking which publications to highlight provides a biased-view of the situation in various countries. Recent surveys report that about 75% of Americans agree that actions should be taken to reduce climate change-related risks. Without a clear purpose for this section and the lack of a comprehensive assessment, this section could be removed. [Trigg Talley, United States of America]	Noted. Section has been heavily revised. Several LAs, CAs, and numerous reviewers have contributed to this section. As we note in revised version, "specific characteristics of media coverage play a major role in climate understanding and perception (high confidence), including how IPCC assessments are received by the general public."
41213	30	36	31	14	It's great to see this kind of material being given space in WG1, and the authors are to be congratulated on effectively laying out the socio-political context within which IPCC assessments operate. Some of the strongest passages link these wider developments to changes in how IPCC assessments have been conducted. Perhaps this is out-of-scope, but I wonder whether there is an opportunity to do that here too. The IPCC has evolved its communications strategy over the years. How is it responding, as an institution, to this kind of evidence about how climate communication happens in the real world? How will AR6 be communicated in a way which seeks to support "dialogic approaches to climate communication"? Perhaps a sentence or two could be added at the end of this section to link the discussion back to the IPCC's own practices. [Martin Mahony, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Authors and leadership have discussed social media strategies for release of this report.
70507	30	36		47	While the literature discussed here is of course valid research, I am not convinced that assessment of media reporting of climate change and links to public perception are within scope for WGI, and this topic was not included in the approved outline for Chapter 1. Also by highlighting differences in public perceptions of climate change between countries, this text is unnecessarily political for a WGI assessment. [Gillett Nathan, Canada]	Rejected. Section presents significant social context relevant for this report. As we note in revised version, "specific characteristics of media coverage play a major role in climate understanding and perception (high confidence), including how IPCC assessments are received by the general public."

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
34819	30	43	31	3	The 1896 paper of Arrhenius is quoted (which said doubling of CO2 would cause 5-6°C temperature rise), but not his subsequent paper of 1906 ("Die vermütliche Ursache der Klimaschwankungen") is not mentioned, in which he greatly reduced that estimate. [Jim O'Brien, Ireland]	Rejected. Irrelevant in this context; we present Arrhenius 1896 as the first, not the definitive, estimate of climate sensitivity.
87503	30	44	30	48	something doesn't scan in this sentence. [Stephen Humphreys, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Sentence no longer appears.
24229	30	46			Does this mean that possible links are exaggerated or unspecified? What are "appropriate"? [Bryan Weare, United States of America]	Taken into account. Revised to read: "fails to link extreme weather events to climate change."
101439	30	49	30	49	I think here "quality" means "type", but it might better to choose a word that doesn't also mean "good"? [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Deleted "quality of"
35449	30	53	30	53	Bibliographic citations in chronological order [Carlos Antonio Poot Delgado, Mexico]	Editorial. This kind of issue will be fixed during the copy-editing phase.
635	30	55	30	55	Recently, a selection of media has begun...". Needs a reference? [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Ref. added
70509	30	55	31	2	No references are cited in support of this assessment. [Gillett Nathan, Canada]	Accepted. Ref. added
87225	30				There is an article on climate change and media from Chile that could be included to increase the number of studies from the Global South and also because it is interesting. It could be something like this: "Chilean media moves mitigation and adaptation actions to climate change away from people and the local level, favoring adjustment adaptations over transformational ones, with significant economic bias (Hasbún-Mancilla et al., 2017)" Hasbún-Mancilla, J. O., Aldunce-Ide, P. P., Blanco-Wells, G., & Browne-Sartori, R. (2017). Framing climate change in Chile: Discourse analysis in digital media. <i>Convergencia</i> , 24(74), 161–186. https://doi.org/10.29101/crcs.v0i74.4387 . [Rodolfo Sapiains, Chile]	Noted. Due to an oversight, we failed to include this citation.
125189	31	4	31	14	Are there studies on other social media platforms such as Facebook? And how are there potential political biases with respect to climate communication between these different platforms? [Trigg Talley, United States of America]	Noted. We are unaware of comparative studies of how this issue appears across social media platforms, and in any case, we lack space to extend this section further.
114201	31	4	31	14	Are there any publications discussing experience after SR1.5 that you can use here? (I think there was a paper in 2019 in <i>Climatic Change</i>) [Jan Fuglestedt, Norway]	Noted. Due to an oversight, we failed to seek this citation.
18087	31	4			Social media has definitely helped bring the issue of climate change into the mainstream. It has been particularly impactful on the younger generation - see Greta Thunberg case. This emphasis on young people should be pointed out. [Vlad Macovei, Germany]	Taken into account. School strike movement is mentioned in this section.
109735	31	13	31	14	Perhaps referencing some studies done on dialogue in social media might help give folks ideas on how to engage with scientific content on various online platforms. Briones, R. L., Kuch, B., Liu, B. F., & Jin, Y. (2011). Keeping up with the digital age: How the American Red Cross uses social media to build relationships. <i>Public relations review</i> , 37(1), 37-43. [Eric Nolan, United States of America]	Noted. Due to an oversight, we failed to include this citation.
125191	31	14	31	14	"dialogic approach to climate communication": What does this mean? Have more dialogs? [Trigg Talley, United States of America]	Noted. Dictionary definition: "relating to or in the form of dialogue." Clear enough.
87507	31	14	31	14	Good point about the potential for 'dialogic' communication. Hopefully the word is self-explanatory, but even if so, this might benefit from a little massaging. [Stephen Humphreys, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Dictionary definition: "relating to or in the form of dialogue." Clear enough.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
77169	31	17	32	3	This material could be used at the start of the chapter. It introduces heat and energy in a clear manner. [Emer Griffin, Ireland]	Rejected. It would break up the flow of the historical material.
87509	31	17	35	31	The unparalleled source for these pages is the compendious and excellent Edwards 2010 -- it could be cited more frequently! [Stephen Humphreys, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Thanks!
85009	31	17	42	43	No comments [Katrine Husum, Norway]	Noted.
70511	31	17	45	25	This is a well-written section. It provides useful background and context to the WGI report, and does not significantly overlap with material assessed elsewhere in the report. [Gillett Nathan, Canada]	Noted.
21315	31	17			Repeatedly throughout section 1.3 there is selective quoting of different reports from FAR through AR5. However, there is very little consistency and no justification given for which ARs are being discussed / left out in each case. It would be very helpful to section 1.3 I think to have a table for a small set of key aspects such as observational evidence, paleo context, forcing, attribution etc. where the key findings in each AR are articulated. The text could then be built around such a table. This should reduce the propensity for selective quotation and aid a reader to understand how our knowledge has evolved from before the FAR to the AR5. For example radiative forcing jumps straight from a substantive characterisation of the FAR straight to AR5 with no mention of SAR, TAR, or AR4. Was there really absolutely nothing in these as could presently be erroneously implied from the text as it stands by the unwary reader? [Peter Thorne, Ireland]	Noted. Key findings are already summarized in the Appendix table. We have updated the text here and there, and added additional references to guide readers to this table.
107811	31	19	31	19	The term unequivocal was also used in AR4. That was when it was first used, I believe.. [Linda Mearns, United States of America]	Noted.
21287	31	19	31	24	This feels a somewhat odd opening in that it implies that AR5 only had something to say about the observational evidence. If you are going to have an opening paragraph that tries to encapsulate AR5 it surely is required to also touch upon the findings that human influence is clear and that our choices matter. Otherwise the unwary reader may believe that all AR5 assessed was the observational evidence basis and AR5 did far more than that. I think you could just delete this paragraph. The alternative would be to expand it. [Peter Thorne, Ireland]	Accepted. Deleted this paragraph.
36589	31	19	31	24	Why are you stating the obvious, that changes in climate have occurred, when changes are to be expected (and the absence of any change would be more remarkable)? [John McLean, Australia]	Noted. Paragraph deleted.
111923	31	19	32	3	The scientific context could be a bit more broadly described, I am not sure it can be limited just to some history of teh Earth and greenhouse effect, one could epect some connections in Earth System, present science knowledge development in the individual components and their interactions etc. should be mentioned. [Tomas Halenka, Czech Republic]	Noted. It is unclear exactly what is being suggested, but this is brief background information for an assessment of the current state of climate (change), not a climate science textbook.
28673	31	19			this repeats p.10 L43 [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Fixed.
15867	31	20	31	20	Add this reference (Willett, H.C., 1950. Temperature trends of the past century. Centenary Proceedings. Royal Meteorological Society. London, England, 195-206.) [Emmanuel Garbolino, France]	Noted. Paragraph has been deleted.
15869	31	20	31	20	Add this other reference (Shapley, H., 1955. Climatic Change. Evidence, Causes and Effects. Science and Society, vol. 19 (1), 88-89.) [Emmanuel Garbolino, France]	Noted. Paragraph has been deleted.
11335	31	21	31	24	Change order, "atmospheric concentrations of greenhouse gases have increased" should be first [Michael Schmitt, Germany]	Noted. Paragraph has been deleted.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
36667	31	26	31	26	"Major lines of evidence" for what? Is it that climate has changed? Is it that mankind has caused it? [John McLean, Australia]	Noted. It is clear from the context that this means "evidence relevant to climate science, including natural and anthropogenic climate change."
34821	31	26	31	36	The homogenization of the six temperature databases (NOAA, NASA, JMA, Berkeley, Hadley-CRU and Cowtan & Way) creates more questions than answers. Please see general comment #1 above. [Jim O'Brien, Ireland]	Noted. Refers to p 32, not p 31. No change suggested or required.
107815	31	27	31	29	This description is confusing, particularly the number of stations for 1880-2005 vs. 1753-2011. There must be something wrong here. [Linda Mearns, United States of America]	Accepted. Revised version: A pioneering study for 1880-1935 used fewer than 150 stations (Callendar, 1938). A benchmark study of 1880-2005 used 4300 stations (Brohan et al., 2006). A study of the 1753-2011 period included previously unused station data, for a total of 36,000 stations (Rohde et al., 2013).
114203	31	29	31	30	Make it more clear that this is about WGI statements. [Jan Fuglestedt, Norway]	Accepted. Added "WGI."
28675	31	33		35	"ancient times" and "geological 'deep time'" are vague. How does 1.3 extend previous historical context in AR4 Chapter 1? [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Noted. In this brief overview section, defining those terms more precisely is unnecessary. AR4 Chapter 1 is an excellent historical overview, much longer than this one, but 1.3 here adds details not mentioned in AR4 and presents the historical background supporting key AR5 conclusions.
111997	31	36	31	36	In the spirit of egalitarianism that is upheld by the IPCC, this statement attributed to Tyndall should, at the very least, also be attributed to Eunice Foote, who is known to have made these findings prior to Tyndall (https://royalsocietypublishing.org/doi/10.1098/rsnr.2018.0066 , https://www.climate.gov/news-features/features/happy-200th-birthday-eunice-foote-hidden-climate-science-pioneer) [Cynthia Randles, United States of America]	Accepted. Added: "Foote (1856) measured solar heating of CO2 experimentally and argued that higher concentrations in the atmosphere would increase Earth's temperature."
125193	31	38	31	38	Consider changing "Orbital theories" to "Theories related to variability in Earth's orbit around the Sun." [Trigg Talley, United States of America]	Rejected. Length constraints prohibit this level of detail, and further explanation is given later in this same paragraph. Changed "theories" to "hypotheses."
17383	31	38	31	38	Reference for Herchel: Herschel (1832). On the astronomical causes which may influence geological phenomena. Transactions of the Geological Society of London, Second Series 2, vol 3, pp 393-399, https://doi.org/10.1144/transglb.3.2.293 . [Graham Weedon, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Thanks!
17385	31	38	31	38	Note that Herschel (1832) discussed orbital precession, obliquity and eccentricity cycles in a presentation to the Geological Society in London, but actually considered their influences to be too small to cause climate changes. [Graham Weedon, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Changed verb from "suggested" to "considered."
17387	31	38	31	38	On the other hand, Lyell (1830, vol 1, p 110) had previously discussed orbital precession as potentially causing climatic cycles (subsequently developed into a hypothesis by Croll and quantified by Milankovitch). [Graham Weedon, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Added reference.
17389	31	38	31	38	Lyell, C., 1830. Principles of Geology, John Murray, London, 511 pp. [Graham Weedon, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Thanks!
28677	31	44			"the absorbed fraction of incoming solar radiation" or "absorbed solar radiation" or the statement ignores reflected sunlight in the balance [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Changed "incoming" to "absorbed."

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
36591	31	45	31	45	Why do you repeat the fallacy of the atmosphere being like a greenhouse when the essential feature of a greenhouse is that it prevents the convection of warm air? Just because someone made an incorrect statement in the past is no reason for you to try to endorse it. [John McLean, Australia]	Rejected. The sentence is discussing Fourier 1822, who introduced this analogy. Further, the phrases "greenhouse effect" and "greenhouse gases" have been commonly and widely adopted in a metaphorical sense.
107813	31	46	31	47	It would be good to cite Eunice Foote's work, presented at the AAAS in 1856, which demonstrated the ghg effect, several years before Tyndall. [Linda Mearns, United States of America]	Accepted. Added: "Foote (1856) measured solar heating of CO2 experimentally and argued that higher concentrations in the atmosphere would increase Earth's temperature."
36593	31	46	31	47	Again, a greenhouse functions by blocking - repeat BLOCKING - convection. The radiatively active gases (to use terminology from Villach 1985) do not BLOCK convection. Further, any atmospheric physicist will tell you that radiatively active gases are necessary to COOL the atmosphere, so why are you only telling the half of the facts that suits your argument? [John McLean, Australia]	Rejected. The sentence is discussing Fourier 1822, who introduced this analogy. Further, the phrases "greenhouse effect" and "greenhouse gases" have been commonly and widely adopted in a metaphorical sense.
125195	31	47	31	47	Consider changing "longwave radiation" to "longwave infrared radiation emitted by Earth's surface". [Trigg Talley, United States of America]	Rejected. Length considerations preclude adding words to this brief summary.
100887	31	47	31	47	Actually it is now acknowledged (e.g. Jackson 2019 - https://royalsocietypublishing.org/doi/10.1098/rsnr.2018.0066#FN1) that Eunice Foote, made a similar discovery in 1856, three years before Tyndall (Eunice Foote, 'Circumstances affecting the heat of the Sun's rays', Am. J. Sci. Art.22, 382–383 (1856).) In addition, she suggested that variations in the amounts of water vapour and carbon dioxide in the atmosphere could cause changes in climate. Jackson's paper linked above tries to shed light on the reasons why Foote's work was not recognized for a long time, even if she did publish it in a respectable Journal and it was presented at the Annual Meeting of the American Association for the Advancement of Science (AAAS). However, I think that WG1 AR6 should finally properly recognize her pioneering work. [Corti Susanna, Italy]	Accepted. Added: "Foote (1856) measured solar heating of CO2 experimentally and argued that higher concentrations in the atmosphere would increase Earth's temperature."
101451	31	47	31	47	Please add (infrared) after longwave - I think this is better known (and better defined). Or possibly thermal. [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Added (infrared).
41215	31	47	31	47	Eunice Foote's 1856 experiments should be cited here. Eunice Foote, 'Circumstances affecting the heat of the Sun's rays', Am. J. Sci. Art.22, 382–383 (1856); for a historical treatment, see Jackson, R. (2020) 'Eunice foote, John Tyndall and a question of priority', Notes and Records of the Royal Society 74(1), pp. 105–118. [Martin Mahony, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Added: "Foote (1856) measured solar heating of CO2 experimentally and argued that higher concentrations in the atmosphere would increase Earth's temperature."
36595	31	49	31	49	Natural CO2 doesn't only come from volcanoes. [John McLean, Australia]	Noted.
26243	31	50	30	51	An article, about social and intergenerational justice that can be considered here: "Granny Solidarity: Understanding Age and Generational Dynamics in Climate Justice Movements" (Chazan and Baldwin, 2019: https://doi.org/10.26522/ssj.v13i2.2235) [Tania Guillén Bolaños, Germany]	Rejected. Comment refers to p 30, not 31. Reference not appropriate here.
26579	31	51	31	51	30% seems in contradiction with SROCC SPM A2.5 which says "20-30% (very likely)" [Eric Brun, France]	Accepted. Changed to "some 20-30%" and added reference.
36597	31	52	31	55	Why do you not state that in 1906 Arrhenius, who as you say had estimated in 1896 that a doubling of atmospheric CO2 would cause 5 to 6C warming, revised that earlier estimate down to just 1.9C? Even if it is because to do so would make people aware that warming of 1.9C would take more than 100 years IPCC principles direct you to be comprehensive, open and transparent. (The 1906 document by Arrhenius is "Die vermutliche Ursache der Klimaschwankungen".) [John McLean, Australia]	Accepted. Added a phrase about the 1906 revision.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
107373	31	53	31	54	The range of uncertainties found by Arrhenius were also close to recent IPCC estimates. However his calculations were wrong even if his principle of correlation between the geometric progression of carbonic acid and arithmetic progression of temperature was kept and merely simplified by Myrhe (1998). [Mounia Mostefaoui, France]	Noted. No change suggested or required.
19141	31	55	32	1	The name of the author is Ångström, with a scandinavian å [Thorsten Mauritsen, Sweden]	Accepted.
36599	31	55	32	1	I can see that you turn a blind eye to failings in published papers if the papers support your arguments. [John McLean, Australia]	Rejected. No change suggested or required.
28679	31	55			Could probably remove Anonymous, 1901 as you have the Angstrom reference [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. Anonymous ref. is an English-language summary.
125197	32	2	32	2	Insert "the": "... major role of CO2 in THE heat balance..." [Trigg Talley, United States of America]	Accepted.
85957	32	6	32	6	This section could be used not just to say that measurements have improved, but also highlight simple main findings. There is the potential to include powerful examples here for general messaging of observed evidence that climate change is real and what it looks like. Not all the detail, these can follow in later chapters, but some of the highlights. [Debra Roberts and the Durban WGII TSU, South Africa]	This historical section covers the period through AR5. We have included findings from AR5 wherever possible.
21301	32	6			I feel that section 1.3.1 lacks a strong narrative that can help the reader really understand what it is trying to do. It keeps jumping around between surface / upper air / ocean and between periods and technologies. It would be really helpful to reconsider the structure of this section to tell a much more coherent overall storyline. It also occasionally slips into performing a substantive assessment causing overlaps with later chapters - in particular chapter 2. The section is also not comprehensive e.g. mentions satellite estimation of temperatures and cryosphere but not SST, TOA or biospheric components (to name but a few). As written this section feels like a half way house. I think it would help to draw it together as a timeline of increasing capabilities through time and a schematic figure may well help to draw the strands together. [Peter Thorne, Ireland]	We have tried to give the section a more coherent narrative structure and explain the structure of the section at the beginning. We discussed - but decided against - a detailed timeline figure because it would occupy at minimum one full page, and still could not possibly contain all the relevant information in a readable form. We have added a schematic timeline of paleo + observations data sources.
125199	32	8	32	8	Consider including "biosphere" in this list. [Trigg Talley, United States of America]	Accepted. Added this word.
21291	32	8	32	14	It feels odd not to make reference to proxy sources in this paragraph even if it is to make a forward throw to a later segment. Our evidence basis includes directly instrumented, documentary and proxy indicators after all so giving only 2 of the 3 here and implying it is comprehensive set to the reader may be problematic? [Peter Thorne, Ireland]	Accepted. Removed "documentary" from the observations section and placed it in paleo/historical climatology section. 1.3.1 only treats instrumental observations now.
21289	32	10	32	10	The use of the term accurate here is inadvisable and inconsistent with metrological best practices. Accuracy implies that the true value is known / knowable which can never be the case in some logical limit. All measurements, ultimately, are a proxy for the true measurand. Better here would be to talk about the highest quality evidence arising from instruments that are designed to measure key features of climate system such as [,,,] [Peter Thorne, Ireland]	Accepted. Changed "most accurate" to "highest quality".
125201	32	11	32	11	Clarify that "pressure" is "BAROMETRIC pressure". [Trigg Talley, United States of America]	Rejected. The sentence is discussing instruments that measure variables. Barometric pressure literally means "pressure as measured by a barometer," so there is no need to clarify.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
111403	32	12	32	12	<p>This is a minor comment... Nonetheless I would here provide more details and rephrase the sentence as follows:</p> <p>These can be usefully supplemented by qualitative records, such as annals, chronicles or diaries recording for instance heatwaves, cold temperatures, drought, floods, first frost and thaws, spring flowers and harvest dates (Ogilvie and Farmer, 1997; Brazdil et al., 2005; Ogilvie, 2010), as well as indigenous and traditional knowledge, especially for locations and time periods where instrumental records are unavailable.</p> <p>References:</p> <p>Brázdil R, Pfister C, Wanner H, Von Storch H, Luterbacher J (2005) Historical climatology—the state of the art. <i>Clim Change</i> 70:363–430</p> <p>Ogilvie AEJ, Farmer G (1997) Documenting the medieval climate. In: Hulme M, Barrow E (eds). <i>Climates of the British Isles</i>. Routledge, London, pp 112–133.</p> <p>Ogilvie, A.E.J. Historical climatology, Climatic Change, and implications for climate science in the twenty-first century. <i>Climatic Change</i> 100, 33–47 (2010). https://doi.org/10.1007/s10584-010-9854-1 [Sébastien Guillet, France]</p>	Noted. Added Brazdil 2005 reference. Space limits prevent adding more text.
101441	32	12	32	12	Are dates "qualitative" records? Feels like the distinction is more between measured with instruments vs observed here. [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Changed to "documentary records."
36601	32	16	32	17	A rudimentary thermometer, showing difference in temperature rather than temperature values, was invented in 1593 but the alcohol thermometer was not invented until 1709 and the mercury thermometer not until 1714. [John McLean, Australia]	Noted. What you describe is a thermoscope, not a thermometer. Several rudimentary thermometers were invented in the 1600s, including a liquid-in-glass thermometer using brandy, published in 1629.
12407	32	16	32	18	WOCE is not everything before Argo, and it is more important for below-2000m ocean. Most of the upper 2000m was observed by scientific and commercial ships based observations: XBTs (see my previous comments), MBTs, CTDs etc. A useful description is thoroughly reviewed by Abraham et al. 2013, and also can be found in recent review: Meyssignac B et al (2019) (see their figures 1-4 and discussions about ocean observation system) Referenec: (1). Abraham, et al. 2013: A review of global ocean temperature observations: Implications for ocean heat content estimates and climate change, <i>Reviews of Geophysics</i> , 51, 450-483, http://dx.doi.org/10.1002/rog.20022 (2) Meyssignac B et al (2019) Measuring Global Ocean Heat Content to Estimate the Earth Energy Imbalance. <i>Front. Mar. Sci.</i> 6:432.doi: 10.3389/fmars.2019.00432 [Lijing Cheng, China]	Accepted. Added several sentences on MBTs, XBTs, and other ocean observing systems. Added Abraham et al. 2013 and Goni et al. 2019 to references.
36603	32	16	32	24	Well done. You've shown that no widespread and standardised temperature was available in pre-industrial times, which you glossary says is 1750 (the only year?). By why didn't you say this earlier in the chapter when you discussed variations from (supposedly) a pre-industrial temperature? [John McLean, Australia]	Noted. No change suggested or required.
36605	32	16	32	24	Critical to all this is the global standardisation of all collection, management of processing of weather data, which was started by the International Meteorological Organization (founded 1873) and then continued when the IMO became the World Meteorological Organization (founded in 1950 and a United Nations agency since 1951). [John McLean, Australia]	Noted. No change suggested or required. References offered in the text provide thorough discussions of IMO and WMO.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
82565	32	22	32	22	Suggest clarifying that the 1905 date refers to the first global compilation of observations, not the observations themselves. [Blair Trewin, Australia]	Accepted. Changed "collection" to "compilation."
12405	32	22	32	24	"well sampled" and "sparsely sampled" are very subjective description. Something like the following text will be better: 700-2000m ocean was less sampled than the upper 700m because the scientific and commercial ships deploys many XBTs from 1960s to early 2000s, most of the XBTs are only capable of observing upper 700m ocean layers (Goni et al. 2019). Reference: Goni GJ et al(2019) More Than 50 Years of Successful Continuous Temperature Section Measurements by the Global Expendable Bathythermograph Network, Its Integrability, Societal Benefits, and Future. Front. Mar. Sci. 6:452. doi: 10.3389/fmars.2019.00452 [Lijing Cheng, China]	Accepted. Added several sentences on MBTs, XBTs, and other ocean observing systems. Added Abraham et al. 2013 and Goni et al. 2019 to references.
21293	32	26	32	36	The ordering of this paragraph is problematical because the SST records are introduced after and not prior to the global estimates. Yet the global estimates are based upon a combination of land and SST records. It would surely make more sense to introduce both components underpinning the global assessments first? Also this section should reference 2.3.1 and Box 2.3 for further substantive assessment? [Peter Thorne, Ireland]	Accepted. Moved SST paragraph to connect better with surface temperature obs. paragraph.
98767	32	26	32	36	No mention in first part of paragraph of marine observing systems. Although 6 research groups produce global temperature products, the largest component (SST) derives from only 2 different products - this text implies there are 6 largely independent products which is not true. [Elizabeth Kent, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Rewritten as: "NOAA and Hadley produce SST datasets independently calculated from instrument records. These are incorporated into global land-ocean surface temperature datasets calculated separately by five different research groups (NOAA, NASA, JMA, Berkeley, and Hadley-CRU). Each group aggregates the raw measurement data, applies various adjustments for non-climatic biases such as urban heat-island effects, and addresses unevenness in the geospatial and temporal sampling with various techniques."
107375	32	29	32	30	When did the SST first measures start? Especially do we have any measurement before the industrial era? [Mounia Mostefaoui, France]	Taken into account. Sentences now read: " By the mid-19th century, semi-standardized naval weather logs recorded winds, currents, precipitation, air pressure, and temperature at sea, initiating the longest continuous quasi-global instrumental record (Maury and United States Naval Observatory, 1849; Maury, 1855, 1860). Because the oceans comprise over 70 percent of global surface area and constantly exchange energy with the atmosphere, both air and sea surface temperatures (SST) recorded in these naval logs are a crucial variable in climate studies."

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
89981	32	31	32	31	Ch02 uses five products, not six. JMA produced a reanalysis. It's crucial that there is no inconsistency here with Ch02. References should be provided for the products. [Jochem Marotzke, Germany]	Accepted. Rewritten as: "NOAA and Hadley each produce SST datasets independently calculated from instrument records. These are incorporated into global land-ocean surface temperature datasets calculated separately by five different research groups (NOAA, NASA, Berkeley, Hadley-CRU, and CMST). Each group aggregates the raw measurement data, applies various adjustments for non-climatic biases such as urban heat-island effects, and addresses unevenness in geospatial and temporal sampling with various techniques (see Chapter 2, section 2.3.1.1.3 and Table 2.4 for references)."
82567	32	31	32	32	There is also a Chinese-led data set (CMST), although only its land component (CLSAT) is considered in Chapter 2. [Blair Trewin, Australia]	Accepted. Rewritten as: "NOAA and Hadley each produce SST datasets independently calculated from instrument records. These are incorporated into global land-ocean surface temperature datasets calculated separately by five different research groups (NOAA, NASA, Berkeley, Hadley-CRU, and CMST). Each group aggregates the raw measurement data, applies various adjustments for non-climatic biases such as urban heat-island effects, and addresses unevenness in geospatial and temporal sampling with various techniques (see Chapter 2, section 2.3.1.1.3 and Table 2.4 for references)."
6429	32	31	32	33	Reanalysis centres such as ECMWF also provide global surface temperature datasets as part of their portfolio of products. Data quality has been shown in the peer-reviewed literature to be comparable with that of the products of the listed providers, at least from 1979 onwards. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Space limitations (10 pct length cut) preclude discussion of reanalysis here.
70513	32	31		34	Cowtan and Way is not a group which 'aggregates the raw measurement data, applies various adjustments for non-climatic biases..'. The Cowtan and Way dataset is an estimate of GMST, derived from HadCRUT4 with adjustments for regions of low coverage. It shouldn't be listed together with the other datasets which are gridded products derived from raw station data. [Gillett Nathan, Canada]	Accepted. Rewritten as: "NOAA and Hadley each produce SST datasets independently calculated from instrument records. These are incorporated into global land-ocean surface temperature datasets calculated separately by five different research groups (NOAA, NASA, Berkeley, Hadley-CRU, and CMST). Each group aggregates the raw measurement data, applies various adjustments for non-climatic biases such as urban heat-island effects, and addresses unevenness in geospatial and temporal sampling with various techniques (see Chapter 2, section 2.3.1.1.3 and Table 2.4 for references)."
88155	32	32	32	32	Cowtan and Way - Is this a research group or are you making reference to a particular paper? [Sharon Smith, Canada]	Accepted. Reference to C&W removed.
105747	32	33	32	33	Is it really fair to consider Hadley-CRU and Cowtan & Way different research groups? Esp given the following sentence that states "Each group aggregates the raw measurement data", and these two groups use the same aggregation. [Chris Brierley, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Reference to C&W removed.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
101443	32	34	32	35	Great to make this point - wonder if it could be made more clearly the other way around, e.g. "On average these adjustments have tended to reduce the estimates of warming". ("appear" seemed not quite right too).] [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Sentence now reads "on average these adjustments have tended to reduce estimates of GMST warming."
13151	32	35	32	35	GMST must be expanded acronym has not been used [Maria Amparo Martinez Arroyo, Mexico]	Rejected. Acronym is expanded in Exec Summary and again, more than once, in section 1.2. Also available in glossary.
36607	32	35	32	36	This claim is based on a single speculative paper. It is disputed by section 9.9 and Appendix 5 of my document "An audit of the Creation and Contents of the HadCRUT4 Temperature Dataset" when I show that adherence to the WMO's recommended methods of data adjustment or methods similar to them, fail to take into account the very common situation of gradually increasing non-meteorological skewing of recorded data (e.g. increasing urbanisation, screens deteriorating, nearby vegetation growing). [John McLean, Australia]	Rejected. IPCC cannot consider unpublished, non-peer-reviewed literature. Adjustment methods have been subjected to many rounds of review and revision in the scientific literature.
36609	32	38	32	44	A serious omission from this paragraph is the use of satellite-based microwave sounder units (MSUs) to measure temperature in the lower troposphere, the mid troposphere and the stratosphere. In order for this report to be "comprehensive" they must be mentioned and for the report to be "open and transparent" they must be mentioned in terms by which they are understood. [John McLean, Australia]	Rejected. MSU and other satellite soundings are discussed at length on p 33.
21295	32	38	32	44	Paragraph is incomplete. Reference needs to be made to microwave satellite estimate techniques and from the more recent past hyperspectral sounders. These are key aspects assessed in chapter 2 so this text needs to be considerably expanded to include them. Also, there were more radiosonde products produced in the early 2000s than implied here. Furthermore, what is being observed - generally temperature and humidity - is not sufficiently apparent as drafted. [Peter Thorne, Ireland]	Rejected. MSU and other satellite soundings are discussed at length on p 33.
101445	32	39	32	41	If possible please define radiosonde and homogenization, and define or ideally replace occultation [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Defined all three terms in the text.
82569	32	42	32	44	The radio occultation material may sit better with the other satellite upper atmosphere data discussed at P33 L37-46 - but those two paragraphs are closely related so it may work better if the paragraphs are reordered so they sit together? [Blair Trewin, Australia]	Accepted. Moved to the satellite section.
7357	32	44	32	44	We have updated the radio occultation part of Chapter 2 with some more recent information. In order to align the part here, and the one in Chapter 2 (Page 42, first paragraph), the two references on radio occultation should also be updated and made more current. Thus, can you please use "Ho et al., 2010; Anthes, 2011" here too? The full references, as taken from Chapter 2 are: Ho, S.-P., Kuo, Y.-H., Schreiner, W., and Zhou, X. (2010). Using SI-traceable Global Positioning System Radio 61 Occultation Measurements for Climate Monitoring [In "State of the Climate in 2009]. Bull. Am. Meteorol. Soc. 91, S36–S37. Anthes, R. A. (2011). Exploring Earth's atmosphere with radio occultation: contributions to weather, climate and space weather. Atmos. Meas. Tech. 4, 1077–1103. doi:10.5194/amt-4-1077-2011. Note: this is a purely professional suggestion, I am not author or co-author. [Axel von Engel, Germany]	Taken into account. Added Anthes reference and removed Kuo. Kept Foelsch since this is a historical section. Ho et al. is a 2-page summary.
125203	32	46	32	46	Clarify the text so it reads: "Keeling established ATMOSPHERIC CO2 CONCENTRATION monitoring stations..." [Trigg Talley, United States of America]	Rejected. Unnecessary, since the next sentence describes what was measured (atmospheric).

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
79361	32	46	32	49	It is important to point out in the long history of observations that those made by Keeling by 1960 (https://doi.org/10.1111/j.2153-3490.1960.tb01300.x) had already alerted the scientific community to the rising CO ₂ concentrations in the atmosphere and attributed the cause to human fossil fuel burning and land-use change. [Jaime Toney, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Added a phrase and the indicated reference.
71549	32	46	37	12	I believe that the contribution that the WMO/GAW programme has made to the expansion of the greenhouse gas observation network should be clearly stated. [Takashi Maki, Japan]	Rejected. Lack space to discuss.
18089	32	46			Keeling is mentioned but no previous reference to who this is. The author assumes the reader knows this. I suggest at least adding the first name too, maybe even the institution he was working for at the time. [Vlad Macovei, Germany]	Rejected. We face 10 pct. text reduction; Keeling's bio is readily available.
37727	32	51	40	20	comments on pH changes should reference high CO ₂ periods (eg mesozoic) and ocean is still alkaline [Howard Brady, Australia]	Accepted in part. Changed to "approximately a 30 % increase in acidity" to reflect that the oceans are not "more acidic" (i.e. still alkaline), but that "acidity" has increased (less alkaline).
36611	32	53	32	54	Why are you repeating a nonsense argument about ocean pH increasing 0.1 since the beginning of the industrial era when data from that time is sparse and you rely only on proxies whose accuracy is uncertain? [John McLean, Australia]	Rejected. Statement reports the thorough WGI AR5 assessment.
101447	32	54	32	54	I think "more acidic" implies to the non-expert that it starts off acidic, so would be good to give values or clarify this. [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Changed to "approximately a 30 % increase in acidity".
36357	32	54			When discussing ocean acidification, the IPCC report should not use the words "acid" or "acidic." "Acidic" waters are considered those with pH of < 7; except for some extreme environments, the oceans are alkaline. I recommend this be worded as "indicating that it is increasing in acidity" as called for by Gattuso et al. here: https://news-oceanacidification-icc.org/2015/08/26/a-plea-to-ocean-acidification-scientists/ [Adrienne Sutton, United States of America]	Accepted. Changed to "approximately a 30 % increase in acidity".
21297	33	1	33	12	Most of this is covered in chapter 2 and that which isn't should be merged into the earlier paragraph on surface temperatures. There is too much reference to new literature in the first half of the paragraph which is then redundantly reassessed in chapter 2. [Peter Thorne, Ireland]	This has been adjusted. Where post-2013 literature is cited, it describes the history covered here.
82571	33	1	33	12	The move towards drifting and moored buoys (well beyond the 70 TOGA ones) should be mentioned here, especially given the bias adjustment issues involved (for which Huang 2017 and Kennedy 2019 are good references). [Blair Trewin, Australia]	Added drifting and moored buoys.
453	33	1	33	27	I would suggest the inclusion of the SOCAT database, i.e. Surface Ocean CO ₂ Atlas www.socat.info , a international effort to compile surface ocean quality-controlled fCO ₂ (fugacity) observations, many time performed by Ships of Opportunity (merchant and or military). SOCAT exists since 2007 and has so far circa 100 scientists as contributors. data is made freely available. surface ocean CO ₂ measurements are extremely useful for the global carbon budget and estimates of ocean acidification rates. Articles from the SOCAT group: Bakker, D. C. E., Pfeil, B., Landa, C. S., Metzl, N., O'Brien, K. M., Olsen, A., et al. (2016). A multi-decade record of high-quality fCO ₂ data in version 3 of the Surface Ocean CO ₂ Atlas (SOCAT). Earth Syst. Sci. Data 8, 383–413. doi:10.5194/essd-8-383-2016. Pfeil, B., Olsen, A., Bakker, D. C. E., Hankin, S., Koyuk, H., Kozyr, A., et al. (2013). A uniform, quality controlled Surface Ocean CO ₂ Atlas (SOCAT). Earth Syst. Sci. Data 5, 125–143. doi:10.5194/essd-5-125-2013. Maybe include this information on page 67 in this chapter? [Leticia Cotrim da Cunha, Brazil]	Did not include in the historical section because too recent. Commenter asks to add this information in a different section of Ch 1 (p. 67).

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
98769	33	6	33	6	The tropical array has suffered from a decline in report numbers which is relevant in this context: Legler, D. M. and Hill, K. (2014), Tropical Pacific Observing for the Next Decade, Eos Trans. AGU, 95(23), 196. [Elizabeth Kent, United Kingdom (of Great Britain and Northern Ireland)]	This is partially addressed in Section 1.5.1.2, on Threats to observational capacity or continuity. "Fewer ocean observing buoys were deployed during 2020, and reductions have been particularly prevalent in the tropics and Southern Hemisphere."
36613	33	7	33	10	Are you serious? The ICOADS data is lacking any quality control. Reported temperature measuring locations are sometimes on land and often in ports, ICOADS records show large differences in temperatures for ships less than 5km apart, data transcription errors demonstrably exist in the ICOADS database. See chapter 8 of "An audit of the Creation and Contents of the HadCRUT4 Temperature Dataset". [John McLean, Australia]	Rejected. No peer-reviewed literature cited, no specific suggestion, self-citation to non-peer-reviewed lit.
98773	33	8	33	10	Although the statement is true that ICOADS have included some newly recovered data for the release with end date in 2014, no new historical sources have been ingested since then due to a lack of resources. There are several statements in this report about newly digitised data sources, and the huge volumes that have not yet been recovered -however the conversion of these new sources into reliable and well-documented climate records is likely to be a severe bottle-neck for improving the historical record. [Elizabeth Kent, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Forwarded to Section 1.5, where these issues are discussed, for possible inclusion there. This section evaluates historical trends up to 2013.
28681	33	8			missing "" [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Artefact of citation software. Will be fixed in final copyedits.
98771	33	10	33	10	There are only 2 different SST datasets used in the "multiple datasets" so this overstates the diversity of estimates. [Elizabeth Kent, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Changed to "available datasets"
85959	33	14	33	14	"vast majority" – what percentage? [Debra Roberts and the Durban WGII TSU, South Africa]	Noted. Percentage is mentioned at end of this paragraph.
79363	33	14	33	47	In addition to the referenced works in on compiled HMS Challenger data with historical and modern observations is Glecker et al. 2016 (Nature Geoscience). This study highlights the rate at which change is happening, with the 132 years from 1865 to 1997 seeing the ocean take up 150 zettajoules of energy and in the 18-years from 1997 to 2015 the ocean had absorbed another 150 zettajoules of energy. This study stands out to me as being particularly striking and compelling - so just wanted to bring it to light in case it is of interest to include/cite. [Jaime Toney, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Added a sentence on this study - thanks! "A study combining Challenger data with several other sources estimated that the oceans absorbed 150 zettajoules of additional energy from 1865-1996, and an additional 150 zettajoules from 1997-2015 (Gleckler et al., 2016)"
16275	33	15	33	18	Referencing HMS Challenger (Roemmich et at, 2012) reinforces comment #1 as historical collections and heritage material as descriptions of sources that broaden intellectual access and interest by a broader public. [Sarah Sutton, United States of America]	Noted.
29683	33	17	33	17	Please, add "WOCE" between the brackets (as it is mentioned in the Reference section (Gould, J. (2003)). [Hernan Edgardo Sala, Argentina]	WOCE no longer mentioned in text
23275	33	19	33	21	I appreciate that Argo's contribution is noted here. But current velocity from the surface to 2000 m has not been measured by Argo subsmersible floats. Float trajectory data provide Lagrangian velocity data at the parking depth, nominally 1000 m. Temperature and salinity fields for the top 2000 m based on Argo data, combining with the Lagrangian velocity data at 1000 m, provide geostrophic flow fields from the surface to 2000 m. The sentence here may mean this situation but could be misleading. [Toshio Suga, Japan]	Sentence has been revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
19143	33	24	33	27	I did not understand how ocean data alone can be used to determine the fraction of energy that is accumulated in the oceans. Doing so would require estimates of all the other storages, and a reasonable confidence that everything is accounted for. [Thorsten Mauritsen, Sweden]	Accepted. Global energy inventory/budget is used to determine this fraction. See end of this section.
19631	33	24	34	13	lines P33 24-27 and P34 L10-13 are mostly redundant [philippe waldteufel, France]	Noted. No action.
34823	33	25	33	32	The SOD claims that 1983-2012 was likely the warmest 30 years of the past 1400 years; the Medieval Warming Period was as warm or warmer. Please see rebuttal comments #1, #2 and #3 above. [Jim O'Brien, Ireland]	Rejected. MWP is deprecated as a global phenomenon in AR6 due to recent advances in understanding. We have no access to your own comment numbering scheme, so we cannot identify which comments you mean.
8609	33	29	33	35	this is contradictory -- GMSL cannot be measured at high spatial resolution, it is a single value. Altimetry measurements are less sparse, not more highly resolved (and, indeed, cannot resolve high-resolution features near the coast). Also note that GMSL has been estimated from tide gauges going back to at least Gutenberg 1941. [Robert Kopp, United States of America]	Accepted. 'resolutions' has been replaced with 'coverage'. See also comment #101499 from Tamsin Edwards.
71843	33	29	33	35	Not sure how you want to handle this but these measurements of sea level are all different. Global mean sea level change is usually used to specify the change in ocean volume - from the scientific understanding this is the most important quantity. But this is not what satellites measure or what tide gauges measure. [John Church, Australia]	Noted. Not clear what the reviewer means. The paragraph already hints at the complexity of measuring sea level.
115027	33	29		34	[pt 2 of 4] I suggest adding the following: "For most purposes, tide gauge measurement data is superior to satellite altimetry. Tide gauges measure sea-level where it matters for coastal planning: at the shoreline. Those measurements comprise the highest-quality long-term climate-related dataset in existence. The long length and high quality of this data enables direct comparison of sea-level trends under the influence of anthropogenic warming, with trends before that warming began. The primary limitation of that data is its uneven spatial distribution, with most of the long measurement records from harbours and channels, and a relative dearth of long, high-quality measurement records from the southern hemisphere. Satellite radar altimetry, in contrast, measures sea-level only in the open ocean. [cont'd] [David Burton, United States of America]"	Rejected. Space limitation prohibits to add lengthy additional text. Moreover, assessment of the quality of tide-gauge measurements and satellite altimetry data is outside the scope of chapter 1, and belongs in chapter 9. This comment duplicates comment #107173 by the same reviewer.
107171	33	29		34	[pt 1 of 4] It says, "Sea level can be measured by averaging across tide gauges, some of which date to the 18th century. However, translating tide gauge readings into global mean sea level (GMSL) is challenging, since their spatial distribution is limited to continental coasts and islands, and their readings are relative to local conditions such as land surfaces that may shift vertically over time. Satellite radar altimetry, introduced operationally in the 1990s... complements the sparse tide gauge record with absolute measurements of GMSL at much higher spatial resolutions." This is certainly better than the FOD version, but it still needs some work. It fails to convey the fact that the best tide gauge measurements are of vastly better quality than the satellite altimetry. [cont'd] [David Burton, United States of America]"	Rejected. The comment is not supported by the scientific literature.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
107173	33	29		34	[pt 2 of 4] I suggest adding the following: "For most purposes, tide guage measurement data is superior to satellite altimetry. Tide gauges measure sea-level where it matters for coastal planning: at the shoreline. Those measurements comprise the highest-quality long-term climate-related dataset in existence. The long length and high quality of this data enables direct comparison of sea-level trends under the influence of anthropogenic warming, with trends before that warming began. The primary limitation of that data is its uneven spatial distribution, with most of the long measurement records from harbours and channels, and a relative dearth of long, high-quality measurement records from the southern hemisphere. Satellite radar altimetry, in contrast, measures sea-level only in the open ocean. [cont'd] [David Burton, United States of America]	Rejected. Space limitation prohibits to add lengthy additional text. Moreover, assessment of the quality of tide-gauge measurements and satellite altimetry data is outside the scope of chapter 1, and belongs in chapter 9.
107175	33	29		34	[pt 3 of 4] Unlike tide gauges, satellite altimetry has near-uniform coverage over most of the globe, but it cannot measure sea-level at or near the coasts. The measurement record is very short: apart from a brief SeaSat mission in 1978, there are no satellite altimetry measurements of sea-level before 1993. Worse, the data is subject to numerous sources of error, and is of much lower quality than the best tide gauge measurements. The satellite altimetry data consists of a hodgepodge of different short measurement records (most of them no more than a decade in length), from different instruments, on different satellites, in different orbits, which decay at differing poorly-constrained rates. Data from different satellites often show substantially different sea-level trends, and the measurements are plagued by errors and repeated major revisions, often long after the data was collected. [cont'd] [David Burton, United States of America]	Rejected. The assessment of the quality of tide-gauge measurements and satellite altimetry data is outside the scope of chapter 1, and belongs in chapter 9.
107177	33	29		34	[pt 4 of 4] Refs: https://www.avoiso.altimetry.fr/en/data/products/ocean-indicators-products/mean-sea-level/processing-corrections.html https://realclimatescience.com/2016/04/more-on-the-cu-sea-level-fraud/#comment-7699 https://earth.esa.int/web/guest/missions/esa-operational-eo-missions/envisat/news/-/asset_publisher/x9cY/content/improvement-of-envisat-ra-2-reprocessed-data-v2-1 http://sealevel.colorado.edu/content/%E2%80%9Ccaal-mode%E2%80%9D-correction-topex-satellite-altimetry-and-its-effect-global-mean-sea-level-time-se https://sealevel.info/331k5ya_recaptioned2.png https://www.nature.com/articles/nclimate2159 https://sealevel.info/CU-2016-2018-With-Trend_with_caption.png http://joannenova.com.au/2012/05/man-made-sea-level-rises-are-due-to-global-adjustments/ http://sealevel.info/jnathaz1/MSL_Serie_ALL_Global_IB_RWT_NoGIA_Adjust.png [David Burton, United States of America]	Rejected. The assessment of the quality of tide-gauge measurements and satellite altimetry data is outside the scope of chapter 1, and belongs in chapter 9.
36615	33	32	33	34	Are you unaware that oceanographers are extremely sceptical of the satellite-based measurements of sea level? Perhaps too you should state why you seem to endorse the accuracy of this data when it is not freely available for independent assessment in the similar fashion to the MSU temperature data. [John McLean, Australia]	Rejected. Claim not supported by the available literature.
101449	33	34	33	34	I think "coverage" is a better term than resolution, as after all each tide gauge is a point measurement. [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. 'resolutions' has been replaced with 'coverage'.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
71841	33	34	33	34	What does absolute mean? A more specific word should be used - geocentric. See Jonathan M. Gregory, Stephen M. Griffies, Chris W. Hughes, Jason A. Lowe, John A. Church, Ichiro Fukimori, Natalya Gomez, Robert E. Kopp, Felix Landerer, Rui M. Ponte, Detlef Stammer, Mark E. Tamisiea and Roderik S.W. van de Wal, 2019. Concepts and terminology for sea level: mean, variability and change, both local and global. Surveys of Geophysics, 40:1251–1289. doi.org/10.1007/s10712-019-09525-z [John Church, Australia]	Accepted. 'absolute' has been replaced with 'geocentric'.
125205	33	37	33	46	The placement of this paragraph seems a bit odd. Consider moving up to line 13 (i.e., after the SST paragraph and before the OHC paragraph). [Trigg Talley, United States of America]	Accepted.
21299	33	37	33	46	My feeling is that this should be folded in to the prior paragraph on upper-air measurement for narrative continuity. [Peter Thorne, Ireland]	Accepted.
85961	33	41	33	41	"significant differences" – what are we talking about, in actual degrees? How important is this for messaging? If the differences is around 0.05°C then a general reader would not call that 'significant'. If it is around 0.1-0.2, then that affects where we are exactly, in terms of current warming, but probably not much in terms of the general message. If it is 0.5 or more, then that is a problem and one might ask, are these observations useful at all and do we really know what is going on. [Debra Roberts and the Durban WGII TSU, South Africa]	Noted. Several different trends and different calculations of each are in question here, so there is no way to describe these differences simply or with a single number. "Significant differences" is how they are described in some of this literature.
36617	33	43	33	43	Remove the mention of models. This section is only talking about measurement. Referring to models that are calibrated against measurements is a circular argument. [John McLean, Australia]	Rejected. Models are not "calibrated against measurements." Satellite "measurements" are in fact themselves heavily modelled (Edwards 2010).
36619	33	46	33	46	The UAH LLT data makes it very obvious that talk of any warming trend is based on the period of time over which that trend is calculated. A trend determined over the last 2000 years would probably be downwards. [John McLean, Australia]	Rejected. Comment unsupported by literature.
101455	33	46	33	46	This "stratospheric cooling" is left hanging - can you refer to a section that explains it, and/or briefly say that this is as expected from GHG+ozone changes? [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Sentence has been deleted.
87653	33	46	33	46	You say the stratosphere is cooling, but in chapter 3 it says the cooling has "levelled off", ie it is no longer cooling. I would say there is good evidence (Philipona et al JGR 2018 https://doi.org/10.1029/2018JD028901) it is in fact now warming. [Matthew Tully, Australia]	Taken into account. Sentence has been deleted.
85963	33	46	33	46	"stratosphere cooling" – briefly explain why, and/or refer to section where this is explained. [Debra Roberts and the Durban WGII TSU, South Africa]	Taken into account. Sentence has been deleted.
88157	33	48	33	48	Chapter 2 also utilizes satellite records in assessment of large scale trends in a number of cryospheric variables. Ref should also be made to ch 2 here. [Sharon Smith, Canada]	Accepted. Cross-reference also made to section 2.3.2.
7317	33	48	33	49	Clarification of 'Poles' would be required. Three poles: North pole, South pole, and Hindukush Himalayan Range have been acknowledged in the world. We would recommend to analyze ice sheet area change happening in the Hindukus Himalayan Range as the Range is driving weather seasonal pattern, watersheds upstreams and downstream quality, cultural vales of diverse races in countries in Asia and Southeast Asia Regions. San Win (2019) reported 'The Ayeyarwaddy River (Figure 3. 2 and Appendix8. 1) flows down from the Mount Hkakaborazi (at 5881 m the highest peak (Worldatlas, 2017) in Southeast Asia) in northern Myanmar, part of Hindukush Himalayr Range know as thrird pose after the South and North pole in thie world, into the Andaman Sea.' in his Ph. D. thesis 'Assessing the vulnerability of mangrove ecosystem to climate change in Myanmar'. Mount Everest in Nepal is the highest among mountains in Hindukush Himalayan Region. [SAN WIN, Myanmar]	Noted. 'Poles' does not exclude the third pole. Limited space prohibits to add additional material and references.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
125207	33	48	34	13	It is shocking -- and disappointing -- that there is not a single quantified finding in this paragraph of glacial, sea ice, and ice sheet loss. Add some numbers. [Trigg Talley, United States of America]	Rejected. The narrative of section 1.3.1 is to give a more qualitative overview of the observational evidence for changes of the climate system. Quantitative evidence is covered in chapter 2 (section 2.3.2) and chapter 9 (sections 9.3 to 9.5).
46581	34	1	34	1	Please change "sea-ice extent" to "sea-ice area" for consistency with the primary metric in chapters 2, 4 and 9 [Dirk Notz, Germany]	Accepted - wording changed.
26581	34	2	34	2	we suggest to replace "paleoclimate" with "paleoatmospheric" since the current sentence may led to believe that it is talking about the first paleoclimate reconstructions ever (and not only in ice records) [Eric Brun, France]	Not applicable. This comment does not belong here.
105529	34	3	34	4	"datasets for ice thickness emerged later from upward sonar profiling by submarines (Rothrock et al., 1999) and radar altimetry of sea-ice freeboards (Laxon et al., 2003)." Suggest amending last part to read "... (Laxon et al., 2003), although satellite-derived sea ice thickness datasets still have high uncertainty particularly for Antarctic sea ice." [Inga Jane Smith, New Zealand]	Rejected. The assessment of the limits of certain methodologies is outside the scope of chapter 1, and is dealt with in chapters 2 and 9.
85965	34	6	34	6	Of these 1100 glaciers, how many are retreating? [Debra Roberts and the Durban WGII TSU, South Africa]	Noted. The cited paper does not mention the fraction of retreating glaciers for which ice thickness has been measured, but supposedly virtually all do.
7319	34	8	34	8	Studies on ice sheet cover change in the Hindukus Himalay Range is better to be considered. [SAN WIN, Myanmar]	Noted. No action taken.
36621	34	14	34	14	Summary of subsection 1.3.1.: This section mixed comments about measurement with summaries of data trends, this despite the implied appending of data being obtained by different methods over time, which is scientifically inappropriate at any time, This whole section is not a "line of evidence" for man-made warming (if that is what the "evidence" is supposed to be supporting; it's not stated), it is merely a necessary pre-condition because you can't argue that mankind is causing warming if there is no warming. [John McLean, Australia]	Rejected. This structure (lines of evidence) follows the broad categories used in previous IPCC reports to describe the sources of information about Earth's climate. If combining data trends produced by different instruments and methods over time were "scientifically inappropriate," no science of the past, or of Earth systems of any kind, would be possible at all.
11013	34	16	35	31	Deep time paleoclimate on the time scale of million years is still understated in this part, or even in the entire chapter. As a result, I think the emphasis on orbital forcing of the glacial-interglacial cycle could be a bit misleading for readers. I would recommend more clarifications that orbital forcing is a key driver for the glacial-interglacial cycle, but not necessarily for the whole Earth's climate history. Indeed, CO2 may play a more important role on a longer time scale, which provides some analogous greenhouse periods in the past. [Mengxi Wu, United States of America]	The section describes the nature of evidence used to reconstruct paleoclimate, moving from recent to more distant periods of Earth's past. Added the following: In brief, paleoclimatology reveals the key role of carbon dioxide in past climatic change, the magnitude of recent climate change in comparison to past glacial-interglacial cycles, and the unusual abruptness of recent climate change (Section 1.2.1.2; Chapter 2, Cross Chapter Box 2.1). FAQ 1.3 provides a plain-language summary of its importance. Also added: However, paleoclimatology of multi-million to billion-year periods reveals that methane and carbon dioxide played a larger role than orbital cycles in climate changes during ice-free "hothouse" periods of Earth's distant past.
36623	34	16	35	31	None of these lines of text amounts to "evidence" per se, especially when you have never stated what it is supposed to be evidence of. [John McLean, Australia]	Noted. No suggested change.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
23463	34	16	35	31	There is no mention of speleothem records in this section. These and other records have led to a better understanding of the sensitivity of tropical precipitation patterns (monsoon, ITCZ) to changes in various climate drivers (Cheng et al 2016, https://www.nature.com/articles/srep36975 , Haug et al., 2001, Science, 293, 1304-1308, Wang et al., 2001, Science, 294, 2345-2348, Peterson et al., 2000, Science, 290, 1947-1951). This is in my mind one of the signature achievements of paleoclimatology. [Jean Lynch-Stieglitz, United States of America]	Accepted. Added "speleothems (stalactites and stalagmites)" and citations to Haug et al. and Wang et al.
29951	34	16	35	31	section 1.3.2. : The fundamental role of paleoclimatology in our understanding of climate change is not conveyed by the section. We would have no idea about what climate change really means without paleoclimate records. Paleoclimate reconstructions allowed to realize that the current climate is beyond the natural variability. That the abruptness of the change is outstanding compared to natural changes. That CO2 is closely linked to global temperature. Maybe most importantly, the fact that the increase of CO2 due to human activity is similar to the change corresponding to glacial interglacial cycles, and that the current amount of CO2 was last recorded in the late Miocene, ~5Million years ago shows the geological magnitude of the anthropogenic forcing. None of this is mentioned. Instead, the paragraph seems like a disorganized list of random elements of paleoclimatology that the reader is supposed to make sense of. [Matthieu Carré, France]	Taken into account. The section describes the nature of evidence used to reconstruct paleoclimate up until the time of AR5. It moves from recent to more distant periods of Earth's past. Added the following: "In brief, paleoclimatology reveals the key role of carbon dioxide in past climatic change, the magnitude of recent climate change in comparison to past glacial-interglacial cycles, and the unusual abruptness of recent climate change (Section 1.2.1.2; Chapter 2, Cross Chapter Box 2.1). FAQ 1.3 provides a plain-language summary of its importance. Also added: However, paleoclimatology of multi-million to billion-year periods reveals that methane and carbon dioxide played a larger role than orbital cycles in climate changes during ice-free "hothouse" periods of Earth's distant past (Frakes et al., 1992 doi: 10.1017/CBO9780511628948; Zeebe et al., 2016 doi: 10.1038/ngeo2681; Bowen et al., 2015 doi: 10.1038/ngeo2316)."
36737	34	16	35	34	This section on paleoclimate should include the well-known figure that shows CO2 concentration and temperature back more than 600 millions years. It can be found in multiple references, the most accessible being http://www.biocab.org/Carbon_dioxide_Geological_Timescale.html , where the sources are cited. It is important to note from this graph that the last 1.6 million years have been an unusually cool period in the last 290 million years (i.e. back to the Permian Period). [John McLean, Australia]	Rejected. Outside the scope of this chapter. The topic is assessed in Chapters 2 and 5.
101457	34	18	34	19	The definition slightly contradicts the later mention of written records.... can it be more like "pre-instrumental records, predominantly natural archives.." [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Revised.
21303	34	25	34	26	written records were also claimed by section 1.3.1. Can they really belong in both? [Peter Thorne, Ireland]	Accepted. The discussion of written records is deleted from 1.3.1 and is only mentioned in 1.3.2.
4193	34	26	34	26	"other traces" is a bit vague. Either delete or specify with an example. [Emily Dearing Crampton Flood, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Sentence was rewritten.
28683	34	27			There is some overlap with 1.3.1 which talks about historical records also [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Historical records are no longer discussed in 1.3.1.
26583	34	31	34	31	We suggest to mention the compilation of high-latitude records on a common, robust age scale showing warming during the LIP: Capron et al., 2015. Capron, E., A. Govin, E. J. Stone, V. Masson-Delmotte, S. Mulitza, B. Otto-Bliesner, T. L. Rasmussen, L. C. Sime, C. Waelbroeck & E. W. Wolff (2014) Temporal and spatial structure of multi-millennial temperature changes at high latitudes during the Last Interglacial. Quaternary Science Reviews, 103, 116-133. [Eric Brun, France]	Not applicable. Misplaced comment. The LIP is not mentioned at this place in the text.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
10339	34	31	34	32	Please reconsider the use of "LIA" and "MCA". Both are inaccurate terms that have been used to connect together climate changes in different parts of the world, in differing periods. Given them names gives the impression of well defined coherent climate events, when the evidence suggests otherwise (Neukom et al., "No evidence for globally coherent warm and cold periods over the preindustrial Common Era", Nature 2019)+132 [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Now reads: Climatic phenomena such as large-scale, regionally and temporally distributed warmer and cooler periods of the past 1000 years were originally reconstructed from European historical records (Lamb, 1965, 1995; Le Roy Ladurie, 1967; Neukom et al. 2019).
4489	34	31	34	32	Several important new papers have been published that summarize the Medieval Climate Anomaly in the Southern Hemisphere in terms of temperature and hydroclimate for South America, Africa and Oceania: Lüning et al. (2019): The Medieval Climate Anomaly in South America. Quaternary International, 508: 70-87. doi: 10.1016/j.quaint.2018.10.041; Lüning et al. (2018): Hydroclimate in Africa during the Medieval Climate Anomaly. Palaeogeogr., Palaeoclimatol., Palaeoecol., 495: 309-322, doi: 10.1016/j.palaeo.2018.01.025; Lüning et al. (2017): Warming and cooling: The Medieval Climate Anomaly in Africa and Arabia. Paleoceanography 32 (11): 1219-1235, doi: 10.1002/2017PA003237; Lüning et al. (2019): The Medieval Climate Anomaly in Oceania. Environmental Reviews, doi: 10.1139/er-2019-0012; Lüning et al. 2019: The Medieval Climate Anomaly in the Mediterranean region. Paleoceanography and Paleoclimatology, 34 (10): 1625-1649, doi: 10.1029/2019PA003734 [Sebastian Luening, Switzerland]	Noted. Self-citation. This period is discussed much more extensively in Chapter 2, where these papers are included in the assessment. No change.
29685	34	34	34	34	Consider using "Indigenous and traditional knowledge" instead of "Indigenous knowledge and traditional knowledge". [Hernan Edgardo Sala, Argentina]	Accepted. We have gone with "Indigenous and local knowledge" to correspond for consistency with WGII and the Special Reports.
29953	34	34	34	44	the paragraph interesting but anecdotal. A full paragraph seems disproportionate for this field of research that contributes more to social science than to paleoclimatology, while some fundamental aspects of paleoclimatology are overlooked. [Matthieu Carré, France]	Noted. Added: "This independent line of evidence is used most extensively by IPCC Working Group II."
82825	34	34	34	44	It is also relevant to mention the engagement between indigenous people and policymakers. [Rosario Carmona Yost, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Added: "This independent line of evidence is used most extensively by IPCC Working Group II."
16277	34	34	34	44	Thank you for making this important addition - including indigenous approaches. [Sarah Sutton, United States of America]	You're welcome!
93667	34	34	34	44	This is a valuable inclusion. However, it is recommended the IPCC also explicitly states that the lack of Indigenous knowledge (IK) in AR6 WG1 represents a data limitation, as IK should constitute a distinct line of evidence to WGI assessment reports. The IPCC should commit to strengthening this line of evidence for AR7. [Bridget Doyle, Canada]	Noted. Added: "This independent line of evidence is used most extensively by IPCC Working Group II."
93669	34	34	34	44	Tsleil-Waututh Nation can provide a case study on using myriad lines of evidence, including but not limited to: traditional knowledge, monitoring programs, seafloor observatories and paleoarchaeological data to develop a model of pre-contact ecological and climate conditions. [Bridget Doyle, Canada]	Noted, but without a reference to a publication, we cannot include at this stage. Please provide a reference!
72133	34	37			First use of ENSO, should be defined here. [Alexander Wall, Australia]	Taken into account. Phrase containing ENSO has been deleted.
125209	34	38	34	38	Consider inserting: "... community based monitoring ACROSS THE ARCTIC." [Trigg Talley, United States of America]	Accepted. Revised text as suggested.
8611	34	39	34	40	perhaps mention indigenous Australian oral history of deglacial sea-level rise (Nunn & Reid 2016) [Robert Kopp, United States of America]	Accepted. Added phrase and reference as suggested.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
82823	34	44	34	44	At the same time, indigenous people have struggled to be recognized and to participate in the processes of the UNFCCC (Dolma, 2019; Delgado, 2019). Thanks to their capacities and their willingness to share their knowledge, greater involvement can be achieved between different stakeholders and indigenous leaders through the Local Communities and Indigenous People Platform (LCIPP). [References: Delgado, Deborah (2019). La participación de los pueblos indígenas en la Convención Marco de las Naciones Unidas sobre el Cambio Climático. De actores "tradicionales" a actores frente al Antropoceno. Documentos de Trabajo no 22 (2a época), Madrid, Fundación Carolina. Dolma Sherpa, Pasang. (2019). The Historical Journey of Indigenous Peoples in Climate Change Negotiation. https://www.iucn.org/news/commission-environmental-economic-and-social-policy/201912/historical-journey-indigenous-peoples-climate-change-negotiation] [Rosario Carmona Yost, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Added: "This independent line of evidence is used most extensively by IPCC Working Group II."
34825	34	45	34	55	How can the SOD claim that CO2 is the planetary "control knob" when it can only claim that "more than half" of the temperature increase 1980-2018 is due to anthropogenic influence? How can there be any confidence in the "Global Carbon Budget" estimations under the Paris Agreement? Please see general comments #2, #3 and #13 above. [Jim O'Brien, Ireland]	Rejected. Not contradictory, since some anthropogenic factors (aerosols) also cool the planet, and in any case the sentence in question is about the relative importance of water vapor vs. other greenhouse gases.
18559	34	53	34	53	"large-scale temperature changes" ... and precipitation/hydroclimate? Since you cite PAGES Hydro2k Consortium, 2017. Another useful reference for hydroclimate change in the Common Era is Rodysill et al., 2018 Global and Planetary Change 162, 175-198 [Miriam Jones, United States of America]	Cannot find sentence to which this refers.
19633	34	54	35	1	Don't you think that the retrieval of past atmospheric composition from trapped air bubbles might deserve a reference? [philippe waldteufel, France]	Accepted. Added citation as suggested.
111405	35	2	35	2	This is again a minor comment... Ash or tephra layers are indeed found both in sediments and ice core records but we shouldn't forget about sulphate peaks in ice core... I would here rephrase the sentence as follows: Major volcanic eruptions are recorded through sulphate deposition in ice cores and ash layers within sediment records (Sigl et al., 2015). [Sébastien Guillet, France]	Noted. Sentence no longer appears
4195	35	2	35	2	May want to add that these tephra layers can be dated, which provides quite precise age constraints which can be used to calculate rates of change. [Emily Dearing Crampton Flood, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Sentence no longer appears
125211	35	5	35	5	Insert: "... assess that ATMOSPHERIC concentrations of CO2..." [Trigg Talley, United States of America]	Accepted. Revised text as suggested.
42851	35	5			"Analyses of these air samples" - change to "Analyses of air contained in these ice samples" [Eric Wolff, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Revised text as suggested.
52581	35	8	35	8	For no paleo-people and specially people with no scientific background the statement "Global reconstructions of sea surface temperature were developed from deep-sea sediment cores" may be confusing, SST? Deep-sea cores? Hence I suggest to be more specific: Global reconstructions of sea surface temperature were developed from material contained in deep-sea sediment cores [Gema Martínez-Méndez, Germany]	Accepted. Revised text as suggested.
4197	35	9	35	9	Pollen isn't really an archive as is suggested here. It is more of a proxy that resides in some archives e.g. lake cores. [Emily Dearing Crampton Flood, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Revised text to clarify that pollen is contained in sediment.
100565	35	9	35	9	Add: "plant and animal micro- and macro-fossils, soils" [Matthew Kohn, United States of America]	Accepted. Added "plants and animals".

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
29223	35	9	35	10	There are other archives to cite like speleothems (see e.g. Wong & Breecker, 2015, QSR 127, pages 1-18; Vansteenberghe et al. 2016. Clim. Past, 12, 1445–1458, www.clim-past.net/12/1445/2016/doi:10.5194/cp-12-1445-2016; McDermott et al., 2019, QSR 18, 1021-1028). Peatbog sediments are also continental archives that provide paleoclimate information, mainly for the Holocene (e.g., Roos-Barraclough et al., The Holocene 14, 7-16). [nathalie fagel, Belgium]	Accepted. Added speleothems and peat deposits as archive types. Rejected additional references because only classic work and reviews are considered here.
5037	35	9	35	10	A minor correction: pollen is not an archive for palaeoenvironmental information, it is a proxy which would perhaps be found in some of the other archives mentioned in this sentence (e.g. Lake sediment core). [Thomas Kelly, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Revised text to clarify that pollen is contained in sediment.
52577	35	9	35	11	Pollen is not a paleoclimate archive per se but a proxy contained in paleoclimate archives. I suggest to rephrase as follows: Paleoclimate archives, including loess deposits, corals, trees (rings and wood), ice cores, lake sediments, and marine sediments (which contain remains of plants, pollen, microorganism and organic compounds), have also contributed to past climate reconstructions, with temporal resolutions as high as monthly, in the case of corals (Stuiver, 1965; Eddy, 1976; Jones et al., 2009; Bradley, 2015). [Gema Martínez-Méndez, Germany]	Accepted. Revised text as suggested.
101459	35	9	35	23	All good info but I think missed the key point on first reading - can you emphasis/explain "archive" compared with the previous types of record mentioned? In general I am not sure of the logic of this paragraph and the ones before (tree rings etc) and after (sea level) - is it timescale, or record type, or variables? Please define or replace "loess deposits", and typo "Milankovich". [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Accepted in part. Explained archives (geological or biological materials that preserve evidence of past climate changes). Defined "loess" (dust sediments). The Serbian name Milanković is transliterated into English in several different ways, all equally correct (including this one).
72135	35	11			Devonian corals at least have been shown to have measureable daily growth bands (e.g., Wells, J. W. [1963]. Coral growth and geochronometry. Nature, 197(4871), 948-950.), thus "as high as monthly" could be strengthened and made more accurate by changing to "as high as daily." [Alexander Wall, Australia]	Not applicable. Sentence no longer appears.
52579	35	12	35	13	Being "picky", I do not find entirely correct the sentence "Marine sediment and ice core records provide quantitative..." I suggest to rephrase as follows: Records derived from marine sediment and ice cores provide quantitative estimates of past temperature, ice volume, sea level, and atmospheric chemistry associated with glacial–interglacial cycles over the past 800,000 years [Gema Martínez-Méndez, Germany]	Taken into account. Sentence revised.
52583	35	21	35	21	Not all changes in Atlantic Ocean Circulation over glacial-interglacial times are associated with "abrupt" changes in the NA, for example the change in circulation from an interglacial into a glacial period does not occur abruptly. Besides saying "over glacial-interglacial climate changes" implies to me the transition from interglacial to glacial or from glacial to interglacial leaving out for example MIS 3 or MIS 6 when there were indeed plenty of abrupt changes in ocean circulation and climate. Hence, I suggest rephrasing as: Paleoclimate data and modelling showed that the Atlantic Ocean circulation has not been stable over glacial-interglacial times, and that many changes in circulation are associated with abrupt transitions in climate in the North Atlantic region. [Gema Martínez-Méndez, Germany]	Accepted. Revised text as suggested.
52585	35	21	35	21	Alternatively, if indeed only the transitions from interglacial to glacial or from glacial to interglacial are implied, I would rephrase as: Palaeoclimate data and modelling showed that the Atlantic Ocean circulation has not been stable over glacial-interglacial climate transitions, and that changes in circulation are associated with abrupt shifts in climate in the North Atlantic region. [Gema Martínez-Méndez, Germany]	Taken into account. Adopted alternative statement suggested by this reviewer.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
89983	35	21	35	21	Given the difficulty of reliably estimating paleo-circulation, a more up-to-date assessment is needed. Currently ends in 1988. [Jochem Marotzke, Germany]	Rejected. An assessment of North Atlantic circulation is outside the scope for Chapter 1; it is the remit of other chapters, including Chapter 9.
74309	35	23	35	23	Why does this section not include commentary on pre-Quaternary paleoclimate research contributions? [Christopher Hollis, New Zealand]	Taken into account. Called-out Cross Chapter Box 2.1 where pre-Quaternary paleoclimate is discussed. Also omitted revised sentence to focus on just marine sediments, including those that extend back millions of years.
19635	35	25	35	26	Don't you agree that the reference to AR5 is enough? Every reader knows that climate science is WG1's business. I might repeat this comment many times [philippe waldteufel, France]	Noted. We reduced the number of times we use "WGI AR5" as opposed to "AR5," but we still think it's important to be specific about exactly what is being referenced.
4199	35	25	35	31	This paragraph is useful but appears a bit random at the end of this section. Maybe a better introducing sentence that connects it to previous paragraphs is needed. [Emily Dearing Crampton Flood, United Kingdom (of Great Britain and Northern Ireland)]	Not Applicable - text has been deleted given the length constraints.
8613	35	25	35	31	Suggest updating for consistency with AR6 assessment, which may not land in as confident a place. See chapters 2 and 9 [Robert Kopp, United States of America]	Not Applicable - text has been deleted given the length constraints.
19145	35	25	35	31	Here, and in several other places AR5 confidence statements are repeated. I find it slightly confusing, and I am not sure I understand the purpose of this. [Thorsten Mauritsen, Sweden]	Noted. Summarizing the AR5 key conclusions is part of the mandate given to Chapter 1 according to the government approved WGI AR6 outline. We have tried to better integrate the WGI AR5 key findings in the tex., THE core mandate in terms of the history from the approved outline.
105063	35	28	35	31	I am ill at ease presenting the last interglacial simply as a period when the climate was globally 2°C warmer. The insolation forcing is spatially and temporally heterogeneous, and the polar ice sheet response to this forcing mainly arises from the summer forcing. [Masa KAGEYAMA, France]	Not Applicable - text has been deleted given the length constraints.
125213	35	29	35	29	The text here suggests SLR was 5-10m higher than present in the last interglacial, but panel (c) of Figure 1.3 suggests more like 3-7.5m. Authors should explain the difference explicitly in the text. [Trigg Talley, United States of America]	Not Applicable - text has been deleted given the length constraints.
83399	35	29	35	29	This is first time in this chapter that you use the concept of "ka" without further explanation for non-expert readers. I recommend either to explain that ka stands for "thousand of years" or refer to Cross-Chapter Box 2.1, Table 1 where this is explained in the footnote. [Antje H. L. Voelker, Portugal]	Not Applicable - text has been deleted given the length constraints.
42853	35	30			"when temperatures were at least 2°C warmer than present". We no longer believe (as discussed in Ch 2) that global mean temperature was +2 degrees in the LIG. In fact the global temperature is rather irrelevant anyway as it is the polar temperature that matters. Why not just leave out the part about temperature from this sentence otherwise you are propagating a false conclusion. Let Ch 2 deal with this in correct detail, just don't put anything incorrect here. [Eric Wolff, United Kingdom (of Great Britain and Northern Ireland)]	Not Applicable - text has been deleted given the length constraints.
89985	35	34	36	18	Consistent with the overall level of discourse here, it seems worthwhile to include how we know that the increase in atmospheric CO2 is anthropogenic. [Jochem Marotzke, Germany]	Accepted. Added: Studies of radiocarbon (C14) in the 1950s established that increasing atmospheric CO2 concentration were due to fossil fuel combustion. Since all the C14 once contained in fossil fuels long ago decayed into non-radioactive C12, the CO2 produced by their combustion reduces the overall concentration of atmospheric C14 (Suess, 1955).

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
36641	35	34	36	19	None of this amounts to evidence per se. It is only a collection of claims, so it is nothing more than heresy [John McLean, Australia]	Rejected. Claim not supported by the available literature.
101461	35	36	35	43	Can you please make the link to warming in this paragraph, i.e. energy retention leads to warming. [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Done.
68027	35	36	35	43	WG1 AR5 had a very specific definition of external radiative forcings of climate (S. Planton (ed), AR5 WGI Glossary (Annex III), p. 1460.). Should the corresponding definition not be defined here? Or else reference made to the AR6 WG1 chapter in which it is defined? [Michael Evans, United States of America]	Accepted. Reference Glossary added.
125215	35	37	35	37	Consider inserting/clarifying: "Any net change in the energy retention [IN THE EARTH SYSTEM][AT THE TOP OF THE ATMOSPHERE], termed radiative forcing..." [Trigg Talley, United States of America]	Accepted. Revised as suggested.
36625	35	37	35	39	You fail to mention important qualifiers such as time and the flow of heat across the Earth's surface from equatorial regions to polar regions. [John McLean, Australia]	Rejected. Space does not allow to expand the text here.
110739	35	37	35	39	it should be more largely comprehensive to say (heating effect) and (cooling effect) in stead of (encreasing energy retention) and (reducing energy retention) [Bruno Korgo, Burkina Faso]	Accepted. Text revised.
28685	35	37			energy retention seems vague? I think "net energy budget of the Earth" or "Earth's energy balance" may be better [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Combined with comment #125215.
21305	35	39	35	39	Suggest "Past IPCC reports have generally assessed scientific [...]" [Peter Thorne, Ireland]	Accepted. Revised as suggested.
36627	35	39	35	41	Incorrect. IPCC reports have rarely quantified any forcing back to 1750, simply little or no meteorological data exists back to that time. The report have, very optimistically given the shortfall in data in early years, attempted to quantify the forcings back to 1850 (not 1750). [John McLean, Australia]	Reject. Radiative forcing is (and has been in previous reports) defined relative to 1750.
9089	35	40	35	40	Somewhere near here I think a discussion needs to be had why previous IPCC reports considered 1750 to be "preindustrial" whereas in this report it's chosen to be 1850. There has likely been some anthropogenic influence in the century inbetween. I understand that this is because measurements of climate in this period are much poorer than during the later period, but the later start of historical simulations does raise questions about discontinuities with preindustrial simulations of the past and whether "historical" simulations capture the full anthropogenic influence. At least a reference to CC box 1.2 would be good to have here. [Olaf Morgenstern, New Zealand]	Taken into account. Reference to the Cross-chapter box added. However, the reviewer is wrong: in this report pre-industrial is referring to the period around 1750 as in previous IPCC reports (see Cross-chapter Box 1.2)
36629	35	42	35	43	Rubbish! You talk of an increase but that's meaningless unless you state a period of time. You also have no evidence that changes in water vapour have not caused a greater change than CO2. (And FWIW, IPCC reports are not peer reviewed in the conventional sense, the authors are under no obligation to correct errors and the final draft is not reviewed before publishing it unchanged, so you are citing a document that has not been peer-reviewed.) [John McLean, Australia]	Reject. No evidence provided in support of reviewers claims.
36637	35	45	35	45	Other natural drivers quite possibly include solar particle flow, cosmic rays and solar magnetism. The fact that they are continuing to be investigated, including at CERN, is no reason to not mention them. [John McLean, Australia]	Rejected. These are minor factors, and this review is not intended to be exhaustive. Misinterprets CERN experiment (author says it tells us "nothing" about cosmic rays' role in climate change).
125217	35	45	35	45	Consider inserting: "... in solar irradiance AND OCEAN CURRENTS and natural currents..." [Trigg Talley, United States of America]	Accepted. Added this phrase.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
67547	35	45	35	46	The natural climate variability, like ENSO and decadal variability, should be mentioned here. [Baijun Tian, United States of America]	Noted. This discussion is about changes in the Earth's energy budget. Natural variability is internal to the climate system; not quite the same thing, and it can occur without any change to the total energy budget due to exchange between the atmosphere and oceans.
70515	35	45		46	Natural 'sources and sinks of radiatively active gases such as water vapor, carbon dioxide, methane and sulphur dioxide' are not 'natural drivers' of climate change. In an unperturbed climate these sources and sinks are in equilibrium. These processes are not 'drivers'. [Gillett Nathan, Canada]	Accepted. Added "in" to clarify that the sentence refers to *changes in* solar irradiance and *in* sources and sinks etc.
4483	35	49	35	50	Claim: "Measured changes in solar irradiance have been small and slightly negative since about 1980". This misleading statement hides the fact that the second half of the 20th century was one of the most active phases of the entire Holocene. See Steinhilber et al. 2012 (doi 10.1073/pnas.1118965109) and Solanki et al. 2004, https://www.nature.com/articles/nature02995 . In contrast to sun spots, the solar magnetic field reached its highest values in the late 20th Century. The solar climate effect is associated with time lags and energy is likely accumulated over several cycles. The brief solar high of the 1960s was much too short to have been fully implemented by the sluggish climate system. Non-linear links of solar activity with ocean cycles such as PDO, AMO, NAO are being described in the literature. Therefore: Either delete the claim or add the longer term centennial trend as based on solar magnetic field and cosmic rays. [Sebastian Luening, Switzerland]	Noted. Papers cited here do not argue for a significant solar effect on climate in recent decades, esp. since 1980. The Nature article specifically denies that solar activity played a significant role.
115715	35	50	35	52	missing reference to the residence time of water vapour (I had seen different orders of magnitude, for instance here : https://doi.org/10.1002/2015GL067449 discussed in https://www.hydrol-earth-syst-sci.net/21/779/2017/ , also https://www.nature.com/articles/s41597-019-0068-8 and other recent papers). [Valerie Masson-Delmotte, France]	Accepted. Added two references. 8-10 day RT is widely accepted.
36631	35	50	35	52	Don't make me laugh. You claim elsewhere that CO2 stays in the atmosphere for centuries or more but it would be wild speculation to claim that it's the same molecules (especially when the annual increase in atmospheric CO2 is about 50% of mankind's estimated emissions (which means the equivalent of 50% is absorbed by the biosphere within 12 months). Here you try to argue the opposite - that because specific molecules of water vapour stay in the atmosphere just 7 to 10 days the notion that water vapour might remain in the atmosphere for a longer period is dismissed. Water vapour varies from about 0.5% of the atmosphere up to about 4% and it's always present. [John McLean, Australia]	Rejected. CO2 *residence* time (individual molecules) is about 5 years. However, estimates of the *atmospheric lifetime* of CO2 vary between 100-500 years, taking into account exchanges between its various reservoirs. H2O residence time is 8-10 days, and the volume of its atmospheric reservoir is primarily a function of temperature (unlike other GHGs), so no atmospheric lifetime can be calculated.
125219	35	50	35	52	This statement is not entirely clear or true. It's not the residence time, right? What about the saturation of the absorptivity window (wavelength at which H2O absorbs is already saturated)? [Trigg Talley, United States of America]	Noted. Added a second reference. Please see references for explanation.
19637	35	50	35	52	While both statements about WV residence time and dependence on temperature are true, are you sure there is such a strong, exclusive causality relationship as pointed out by the text? Please then supply a reference. [philippe waldteufel, France]	Taken into account. Added a second reference.
28687	35	50			May need to specify again "top of atmosphere incoming solar radiation" to distinguish from surface changes which depend on aerosol, cloud, etc. [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Revised as suggested.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
36713	35	51	35	52	While temperature dictates how much water vapour can be held in the atmosphere and does contribute to evaporation, other factors also determine water vapour. Have you not heard of wind-driven evaporation? Have you not heard of weather systems that carry moist air, with the water vapour very possibly cooler than when it evaporated but not yet cool enough to have condensed? [John McLean, Australia]	Rejected. No specific suggestion or citation.
101463	35	53	35	53	Can you please change this to 'serve as "control knobs"', to avoid implying GHGs are the only one. [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Accepted.
111925	35	55	36	1	CO2 in terms of C, please unify throughout the report where appropriate [Tomas Halenka, Czech Republic]	Accepted. Figures now in GtCO2
3345	35		43	35	Please go deeper into the use of terms, so that you can clarify ideas to people who approach the technical document, and who are non-specialists [Eduardo Erazo Acosta, Colombia]	Noted. We have tried to offer more explanation of technical terms and reduce overall level of technical difficulty.
867	36	1	#REF!	#REF!	I think 37 GtC needs to be 37 GtCO2 here [Bart van den Hurk, Netherlands]	Accepted.
4769	36	1	36	1	I think 37 GtC needs to be 37 GtCO2 here [Bart van den Hurk, Netherlands]	Accepted.
70517	36	7		8	Add a reference to support the statement that 'the negative RF of smaller eruptions has also been included' in subsequent assessments since the FAR. Is this really true, e.g. for the SAR? [Gillett Nathan, Canada]	Accepted. Added a reference to Ch 2 Section 2.4.3 of SAR.
41217	36	10	36	11	This concern about forest clearance and climate change can be traced further back, to the 17th century - Grove, R. H. (1995) Green Imperialism: Colonial Expansion, Tropical Island Edens and the Origins of Environmentalism, 1600-1860. Cambridge: Cambridge University Press. [Martin Mahony, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Ref. added
115025	36	13		16	[pt 1 of 2] It says, "As coal combustion reached 900 Mt/yr, Arrhenius wrote that anthropogenic carbon dioxide might eventually warm the planet (Arrhenius and Borns, 1908)." That does not do Arrhenius justice. (Excerpts: https://sealevel.info/Svante_Arrhenius_1908_p56_and_p63.png) I suggest the following replacement: "As coal combustion reached 900 Mt/yr, Arrhenius wrote that anthropogenic carbon dioxide might eventually warm the planet, and predicted that it would be highly beneficial. He also predicted the benefits of "CO2 fertilization," and even predicted what is now called 'polar amplification' -- the fact that CO2's warming effect is disproportionately at chilly high latitudes. He wrote, 'By the influence of the increasing percentage of carbonic acid [CO2] in the atmosphere, we may hope to enjoy ages with... better climates,... when the earth will bring forth much more abundant crops than at present, for the benefit of rapidly propagating mankind.' (Arrhenius and Borns, 1908)." ### [David Burton, United States of America]	Rejected. Length constraints prohibit a longer discussion; this section is intended to note major developments in the history of this science.

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107169	36	13		16	[pt 1 of 2] It says, "As coal combustion reached 900 Mt/yr, Arrhenius wrote that anthropogenic carbon dioxide might eventually warm the planet (Arrhenius and Borns, 1908)." That does not do Arrhenius justice. (Excerpts: https://sealevel.info/Svante_Arrhenius_1908_p56_and_p63.png) I suggest the following replacement: "As coal combustion reached 900 Mt/yr, Arrhenius wrote that anthropogenic carbon dioxide might eventually warm the planet, and predicted that it would be highly beneficial. He also predicted the benefits of "CO2 fertilization," and even predicted what is now called 'polar amplification' -- the fact that CO2's warming effect is disproportionately at chilly high latitudes. He wrote, 'By the influence of the increasing percentage of carbonic acid [CO2] in the atmosphere, we may hope to enjoy ages with... better climates,... when the earth will bring forth much more abundant crops than at present, for the benefit of rapidly propagating mankind.' (Arrhenius and Borns, 1908)." ### [David Burton, United States of America]	Rejected. Length constraints prohibit a longer discussion; this section is intended to note major developments in the history of this science.
21307	36	15	36	15	accurately is a value laden statement that is not advisable here. Is an adjective even required here. Can you not say estimated rather than accurately calculated? Given that in chapter 2 the GMST is changed substantively by new understanding since AR5 it seems wrong to imply work in 1938 was accurate. That is without entering discussions around whether accuracy is a meaningful concept in measurements where the true state of the measurand is both unknown and unknowable. [Peter Thorne, Ireland]	Taken into account. Removed "accurately" but left "calculated," since that's what Callendar did.
36639	36	17	36	18	Claiming that someone attributed certain warming to anthropogenic CO2 does not amount to "evidence". [John McLean, Australia]	Rejected. This is a review of major developments in the history of this science.
41361	36	23			I am not sure how valuable this figure is. Please consider swapping with an alternative graphic that would highlight early climate research findings or remove altogether in the interest of reducing chapter length. [Alexander Nauels, Germany]	Noted. No change.
12409	36	25	36	25	It is not only "positive radiative forcing estimates", instead, "positive radiative forcing estimates and positive net earth's energy imbalance". [Lijing Cheng, China]	Noted. Comment does not seem to be related to Figure 1.4 (Callendar calculation of temp change).
21309	36	30	36	30	But what about the land sink? As written this implies the belief was the oceans absorbed everything and I doubt that was true then and it certainly isn't true now. [Peter Thorne, Ireland]	Accepted. "Studies in the 1950s established that the oceans were absorbing some anthropogenic CO2 emissions (thereby increasing ocean acidity), and these emissions were accumulating in the atmosphere as well (Section 1.3.1)."
13197	36	30	36	33	It's important to mention the feedback process in the interaction land surface - atmosphere and the ocean acidification process. [Maria Amparo Martinez Arroyo, Mexico]	Noted. Now says "Studies in the 1950s established that the oceans were absorbing some anthropogenic CO2 emissions (thereby increasing ocean acidity), and these emissions were accumulating in the atmosphere as well (Section 1.3.1)."
19147	36	31	36	34	Somewhere between substance and editorial, but why is a quotation made here? From my perspective it appears as an attempt to tease out feelings in a reader, but of course the authors may well just think it is a nice quotation. Anyway, I would suggest not doing this. [Thorsten Mauritsen, Sweden]	Noted. This is one of the best-known quotations in the history of science.
45733	36	35	36	36	"Methane and nitrous oxide were not considered systematically until the 1970s". An appropriate reference is Wang, W.-C., Y.L. Yung, A.A. Lacis, T. Mo, and J.E. Hansen, 1976: Greenhouse effects due to man-made perturbation of trace gases. Science, 194, 685-690, doi:10.1126/science.194.4266.685. [Twan van Noije, Netherlands]	Accepted. Added reference.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
125221	36	37	36	37	Insert: "...synthetic halocarbons THAT [WERE ALSO RADIATIVELY ACTIVE][ABSORB LONGWAVE INFRARED RADIATION EMITTED BY EARTH'S SURFACE] were depleting..." [Trigg Talley, United States of America]	Noted. Now says: "In the 1980s, scientists established that synthetic halocarbons (see Glossary), including widely used refrigerants and propellants, were depleting the stratospheric ozone layer. This discovery led to global regulation of those chemicals through the Montreal Protocol on the Ozone Layer (1987) and its successor agreements (Parson, 2003). Halocarbons are also extremely potent greenhouse gases.""
101465	36	37	36	37	Please define halocarbon [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. "In the 1980s, scientists established that synthetic halocarbons (see Glossary), including widely used refrigerants and propellants, were depleting the stratospheric ozone layer. This discovery led not only to global regulation of those chemicals through the Montreal Protocol on the Ozone Layer (1987), but also to knowledge of potency as greenhouse gases (Parson, 2003)."
21311	36	37	36	39	It feels odd here not to make allusion to the Montreal Protocol and its amendments explicitly. This would seem to be important context for the reader and a source of further information? [Peter Thorne, Ireland]	Accepted. Now says: "In the 1980s, scientists established that synthetic halocarbons (see Glossary), including widely used refrigerants and propellants, were depleting the stratospheric ozone layer. This discovery led to global regulation of those chemicals through the Montreal Protocol on the Ozone Layer (1987) and its successor agreements (Parson, 2003). Halocarbons are also extremely potent greenhouse gases."
19149	36	38	36	38	I suggest changing 'potent' to another word [Thorsten Mauritsen, Sweden]	Noted. No change.
45735	36	39	36	39	An appropriate reference is Ramanathan, V., 1975: Greenhouse Effect Due to Chlorofluorocarbons: Climatic Implications, Science, 190, 50-52, doi:10.1126/science.190.4209.50. [Twan van Noije, Netherlands]	Accepted. Added ref.
110741	36	41	36	44	Dust and other natural aerosols had been studied since the 1880s, particularly in relation to cloud nucleation, while atmospheric nuclear weapons testing (1940s-50s) and urban smog (1950s-60s) first provoked attention to anthropogenic aerosols in the troposphere at what period? [Bruno Korgo, Burkina Faso]	Noted. The periods are already indicated in the text.
125223	36	41	36	53	This paragraph really falls short in describing the radiative effects of aerosols. Authors should explicitly describe the direct effect of aerosols, then the indirect effect of aerosols, then end with the total radiative forcing from aerosols. [Trigg Talley, United States of America]	Accepted. Paragraph now ends with: Aerosols create numerous effects, some direct (e.g. reflection of radiation back into space) and others indirect (e.g. cloud nucleation); specific effects may cause either positive or negative radiative forcing. Since the 1980s, aerosols have been integral to comprehensive modelling studies of transient climate evolution and anthropogenic influences, through treatment of volcanic forcing, links to global dimming and cloud brightening, and their influence on cloud nucleation and other properties (e.g., thickness, lifetime, and extent) and precipitation (e.g. Hansen et al., 1981; Charlson et al., 1987, 1992; ALBRECHT, 1989; Twomey, 1991).

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
21313	36	46	36	46	Given the change of emphasis this feels to me like the start of a new paragraph rather than continuation of the existing one for readability [Peter Thorne, Ireland]	Taken into account. Revised to put CIAP research on aerosols before ozone depletion, to make the connection clearer. CIAP was the first large integrated assessment and a major milestone for aerosol research.
125225	36	52	36	52	Consider inserting: "... their influence on CLOUD PROPERTIES (E.G., THICKNESS, LIFETIME, EXTENT) AND precipitation." [Trigg Talley, United States of America]	Accepted. Added this phrase.
45737	36	52	36	52	Probably the most appropriate reference here is Hansen, J., D. Johnson, A. Lacis, S. Lebedeff, P. Lee, D. Rind, and G. Russell, 1981: Climate impact of increasing atmospheric carbon dioxide. Science, 213, 957-966, doi:10.1126/science.213.4511.957. [Twan van Noije, Netherlands]	Accepted. Added ref. to this as well as Toon and Pollack, 1976.
28689	36	52			which reference is "more recently, their influence on precipitation" referring to as the latest reference is 1991? Also, some mention of "acid rain" relating to SO2 pollution as a large issue in the 1980s for Europe could be mentioned e.g. see Grenfelt et al. (2020) https://link.springer.com/article/10.1007/s13280-019-01244-4 [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Phrase no longer appears. Space limitations preclude discussion of acid rain.
36633	36	53	36	54	Incorrect! Convection of air in general and the evaporation of water into water vapour, then convection, then condensation from water vapour into liquid water (and the release of energy) are prime contributors to atmospheric temperature because the energy transferred high in the atmosphere by these methods is then radiated into space by so-called greenhouse gases, such as carbon dioxide. This is crucial to regulating planetary temperature because without it there would be no means of cooling the atmosphere. An increase in greenhouse gases actually means more heat being radiated to space from the upper atmosphere. [John McLean, Australia]	Rejected. The mechanism described is real, but does not contradict the statement that non-condensing GHGs play "control knob" role.
13153	36	55	36	55	FAR must be expanded acronym has not been used [Maria Amparo Martinez Arroyo, Mexico]	Rejected. FAR expanded earlier on same page.
14493	36	55	36	55	line 55 and thereafter: is FAR the same as First Assessment Report = AR1? The convention/notation for later ARs is "AR5" and so on, so AR1 would be easier for readers to follow, if so [Amy East, United States of America]	Rejected. FAR expanded earlier on same page. This has been conventional IPCC notation: FAR, SAR, TAR, AR4, AR5.
36635	36	55	37	2	Why haven't you mentioned the amount of CO2 released by the ocean as it warms? [John McLean, Australia]	Rejected. Balance of chemical activity favours absorption, not release, so not mentioned here.
114205	37	3	37	3	Make it clear if you are basing this on Radiative efficacies or GWPs [Jan Fuglestedt, Norway]	Accepted. Changed "warming potentials" to "global warming potentials."
114207	37	5	37	7	Not sure if this is needed, but maybe for the context and flow. [Jan Fuglestedt, Norway]	Noted.
14897	37	6		7	suggest rewriting order of sources of methane from most to least important in this example, ie, fossil fuel extraction, agriculture, and landfills. [Robert Howarth, United States of America]	Accepted.
45739	37	7	37	7	Change "erupted" to "emitted". [Twan van Noije, Netherlands]	Rejected. "Emitted" can be at low altitudes with negligible ERF (Ch 7, 7.3.4.6).
36643	37	13	37	13	I don't accept the word "confirmed" because the IPCC does no research and therefore is hardly in a position to confirm anything. Using models to investigate scenarios is not research unless the models can be shown to be correct but text box 9.2 of WGI AR5 showed that to be untrue. [John McLean, Australia]	Taken into account. Changed to "assessed." Box 9.2 of AR5 did not show that models were "not correct."

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
125227	37	13	37	17	Authors should be more quantitative. What is the RF (W/m ²) of the (+) RF? How much offset and what is total? [Trigg Talley, United States of America]	Accepted. Paragraph now reads: Except for volcanic SO ₂ erupted into the stratosphere (a negative driver), the FAR characterized total aerosol RF as “highly uncertain,” and was unable even to determine its sign (positive or negative). Major advances in quantification of aerosol loads and their effects have taken place since then, and the overall historical forcing from tropospheric aerosols is now considered to be negative. However, due to their complexity and the difficulty of obtaining precise measurements, aerosol effects remain the largest single source of uncertainty in estimating total RF (Stevens and Feingold, 2009; IPCC, 2013). Overall, AR5 assessed that total aerosol effects, including cloud adjustments, resulted in a negative RF of –0.9 [–1.9 to –0.1] W m ^{–2} (medium confidence), offsetting a substantial portion of the positive RF resulting from the increase in greenhouse gases (high confidence) (IPCC, 2013).
36645	37	18	37	18	Summary of subsection 1.3.3: This subsection showed no evidence (of what?) per se, it simply cited a number of claims. This is the third subsection in which you show nothing that can be regarded as evidence for whatever you are trying to show evidence of. [John McLean, Australia]	Rejected. No science basis.
19639	37	20	37	20	P37 L20: While I find this subsection 1.3.4 quite good, this title does not reflect the content. this content offers a brief history of climate numerical simulation and then indicates how this tool can be used to establish that human influences have to be taken into account to explain the observations and close critical budgets. While of course this has to do with attribution, subsequent chapters mention other lines of evidence than numerical simulation [philippe waldteufel, France]	Noted. We inadvertently deleted two paragraphs on other lines of evidence during final editing of the SOD. Those have been restored.
85967	37	20	37	20	In this section one expects to find the current level of certainty that climate change is caused by human activities, - is it now “virtually certain”? Some high level messages. Also there is no mention yet of CMIP6? [Debra Roberts and the Durban WGII TSU, South Africa]	Accepted in part. Added "AR5 concluded that “it is extremely likely that human influence has been the dominant cause of the observed warming since the mid-20th century” (Stocker et al., 2013a)." This section treats the history of climate science through AR5; CMIP6 is treated extensively later in this chapter and in others.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
112873	37	20	37	40	Section 1.3.4 assumes that the climate models adopted by in the WGI AR5 are validated and are accurate in interpreting climate change. The report fails to mention the numerous studies questioning such a claim. For example, Scafetta (2013, 2019) contains a detailed critique regarding the claim that the used climate models were "accurate" in interpreting the data. Indeed, the same climatic data can be interpreted in a different way assuming a specific set of natural oscillations. In this case, the claimed anthropogenic influence on climate since 1950 is greatly reduced. The section just "assumes" that the adopted climate models are reliable, but no validation evidences of the claim are provided. Indeed, as explained in the paper below, these models do not properly reconstructs the past warm periods of the Holocene such as the Medieval Warm Period and the previous one and, therefore, they are missing key mechanisms necessary to also explain the warming observed in the last century which could be part of a quasi millennial oscillation. Scafetta, N., 2013. Discussion on climate oscillations: CMIP5 general circulation models versus a semi-empirical harmonic model based on astronomical cycles. Earth-Science Reviews 126, 321-357. Scafetta, N., 2019. On the reliability of computer climate models. Italian Journal of Engineering Geology and Environment, IJEGE 2019, 49-70. DOI: 10.4408/IJEGE.2019-01.O-05. [Nicola Scafetta, Italy]	Noted. Self-citation. Conclusion not supported by the available literature.
89987	37	20	38	51	Again in keeping with the overall historical account, it seems required to include the references to the seminal fingerprint papers (Hasselmann 1979, Santer et al. 1995, Hegerl et al. 1996), on which originally all IPCC D&A chapter were based. [Jochem Marotzke, Germany]	Accepted. All three refs added.
36647	37	22	37	22	As you well know, the statement made by WGI AR5 was bogus. Repeating a bogus claim does not make it true. The claim in AR5 relied heavily on the output of models but text box 9.2 showed that 111 of 114 climate models - probably the only honest instance of a meaningful 97% in the whole climate debate - predicted greater warming for the previous 15 years than the temperature data indicated. (AR5 actually said 1. "... the rate of warming over the past 15 years (1998–2012; 0.05 [–0.05 to 0.15] °C per decade) ... is smaller than the rate calculated since 1951 (1951–2012; 0.12 [0.08 to 0.14] °C per decade)." [WG I SPM, page 5, section B.1, bullet point 3, and in full Synthesis Report on page SYR-6].) In simple terms that means that despite the undisputed increase in atmospheric CO2 over the previous 15 years, there was no statistical certainty ANY warming had occurred. Despite an increase in CO2 there was no warming; your hypothesis fails! [John McLean, Australia]	Rejected. The reviewer is confusing climate change with climate variability. No evidence provided in support of reviewers claims.
80985	37	22	37	26	Perhaps specifically mention the warming of the ocean in this paragraph. [Jeffrey Philip OBBARD, Singapore]	Rejected. Ocean warming is part of the unequivocal warming across climate system components.

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4485	37	22	37	26	Attribution of 20th century warming is still hampered by the fact that climate models fail to replicate the warm climate of the Medieval Climate Anomaly both regionally and globally. This is an important criterion that has to be met before this attribution can be considered closed. The 100% anthropogenic attribution of SR15 does not reflect current scientific understanding. Significant natural warming rebound after the Little Ice Age is to be expected. Warming through CO2 during the early 20th century is limited. We are attributing a significant part of the warming 1980-2000 to multidecadal natural variability (PDO, AMO) which is neglected here. Climate models consistently overestimate warming. Where does the overconfidence of IPCC authors come from? Considering that the CMIP-6 models have mostly failed, it would now be the right moment to backtrack from the 100% anthropogenic claim and return to a more realistic mix of anthropogenic vs. natural climate drivers. Credibility of the IPCC is seriously at risk if these issues are not addressed in a more balanced way. [Sebastian Luening, Switzerland]	Noted. The text here provides a brief historical overview up to the AR5, it does not touch upon the SR1.5 report as mentioned by the reviewer. Subsequent chapters assess the most up-to-date scientific information and address the points raised by the reviewer. Please refer to Chapter 3 in particular for the most recent assessment.
19641	37	23	37	26	Although you cautiously imply, by incising "among others", that your list is not exhaustive, it seems that a least one item ought not to be missing, to wit the massive release of greenhouse gas by human activities. Otherwise there is no reason to look for human influence. [philippe waldteufel, France]	Accepted. Added GHG emissions from fossil fuel burning and land-use change
125229	37	24	37	25	Consider revising text to read: "... increasing CONCENTRATIONS OF greenhouse gasES IN THE ATMOSPHERE, positive RF estimates..." [Trigg Talley, United States of America]	Accepted. Done.
74339	37	24	37	25	I would like to suggest to add an example of increasing greenhouse gas concentrations (e.g. land-use change) [Yulizar Yulizar, Indonesia]	Accepted. Added GHG emissions from fossil fuel burning and land-use change
104507	37	26	37	26	In addition to the theoretical understanding, perhaps add "the complete absence of any other plausible explanations". Extremely likely should be virtually certain meanwhile, which is used elsewhere. [Frederik Schenk, Sweden]	Noted. This refers to the AR5 assessments. Subsequent chapters assess the most up-to-date scientific information and address the points raised by the reviewer. Please refer to Chapter 3 in particular for the most recent assessment.
36649	37	29	37	32	Thank you. You have confirmed that energy balance diagrams (such as Kiehl and Trenberth and diagrams derived from that) used in previous IPCC reports were incorrect because they failed to include this poleward transfer of energy. [John McLean, Australia]	Noted.
115717	37	30	37	30	Reference to the role of the rotation of Earth on movements of water and air missing [Valerie Masson-Delmotte, France]	Accepted. Added this.
125231	37	30	37	32	Delete the phrase: "well known to...ocean without instruments". It's unnecessary. [Trigg Talley, United States of America]	Accepted.
111927	37	30		33	the role of thermodynamics should be mentioned, energy conversion should not be omitted in the sequence to provide full understanding of the system behavior [Tomas Halenka, Czech Republic]	Accepted. Added "thermodynamic energy conversion". Thanks.
70519	37	32		33	The sentence 'In addition to radiative transfer, the circulation is driven by such forces as gravity, friction and Earth's rotation' is unclear and incorrect. First, Earth's rotation is not a force. Second, 'friction' is used to describe a force between solids, not gases. Re-phrase. [Gillett Nathan, Canada]	Taken into account. Revised to read: "'In addition to radiative transfer, the atmospheric circulation is determined by such forces and factors as gravity, surface friction, and the Earth's rotation.' Friction between the atmosphere and the surface, including the ocean surface (a liquid), is an important factor in the circulation; see AMS glossary "surface friction" or any textbook on atmospheric science.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
6431	37	33	37	33	"driven by" should perhaps be replaced by "determined by". Friction is a factor determining the circulation, but is part of the response to the fundamental forcing of the circulation. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Revised to read: "In addition to radiative transfer, the atmospheric circulation is determined by such forces and factors as gravity, surface friction, and the Earth's rotation."
125233	37	33	37	33	"Circulation" of what? Wind? Oceans? [Trigg Talley, United States of America]	Accepted. Now reads: In addition to radiative transfer, major forces and factors such as thermodynamic energy conversions, gravity, surface friction, and the Earth's rotation govern planetary-scale movements of air and water in the climate system.
125235	37	34	37	34	Insert: "...circulatory cells IN THE ATMOSPHERE driven by solar heating..." [Trigg Talley, United States of America]	Accepted.
14495	37	34	37	34	"began", past tense [Amy East, United States of America]	Accepted.
125237	37	35	37	35	Clarify whether this is referencing "atmospheric" circulation? [Trigg Talley, United States of America]	Accepted. Added "atmospheric."
125239	37	37	37	37	Clarify at the end of this sentence: Is it "across both the atmosphere and ocean"? [Trigg Talley, United States of America]	Accepted. Now reads: "Further understanding ultimately required the ability to simulate these complex circulatory processes in the atmosphere and oceans."
16955	37	39	37	40	This section mentions glaciers, permafrost and ice sheets; snow is missing. I suggest adding a sentence on recent progress in coordinated assessment of snow mass datasets, something like "For seasonal snow, significant progress was made in the SNOWPEX coordinated assessment of snow mass datasets (Mortimer et al., 2020), which produced refined trends for the northern hemisphere during the satellite era (Pulliainen et al., 2020; Mudryk et al., 2020)." Disclosure: I'm a coauthor of the Mudryk et al paper, so do not hesitate to ignore that one (or the whole sentence...). The references are: Mortimer, C., L. Mudryk, C. Derksen, K. Luojus, R. Brown, R. Kelly, and M. Tedesco. 2020. Evaluation of long term Northern Hemisphere snow water equivalent products. The Cryosphere. DOI: 10.5194/tc-14-1579-2020. Mudryk, L., M. Santolaria-Otín, G. Krinner, M. Ménégoz, C. Derksen, C. Brutel-Vuilmet, M. Brady, and R. Essery. 2020. Historical Northern Hemisphere snow cover trends and projected changes in the CMIP-6 multi-model ensemble, The Cryosphere, in press. doi:10.5194/tc-2019-320 Pulliainen, J., K. Luojus, C. Derksen, L. Mudryk, J. Lemmetyinen, M. Salminen, J. Ikonen, M. Takala, J. Cohen, T. Smolander, and J. Norberg. 2020. Patterns and trends of Northern Hemisphere snow mass from 1980 to 2018. Nature. DOI: 10.1038/s41586-020-2258-0. [Gerhard Krinner, France]	Noted. Section focuses on history up to AR5.
66643	37	39	37	47	There is some low-level redundancy here - much of the basic physical theory has already been covered earlier in the Chapter. There's probably an opportunitie to cut this and start the paragraph with "When electronic computers arrived..." (Although I might be tempted to rephrase this to something like "With the invention of electronic computers..." since the computers arriving sounds a bit like "when the guy from DHL turned up with our shipment.") [Dave Frame, New Zealand]	Noted. Changed to "when electronic computers became available."

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
36651	37	39	38	2	None of this shows that climate models have ever been accurate, in fact it implies that early climate models, such as those models from Bert Bolin's colleagues that produced output that scared the world into establishing the IPCC, were very inaccurate. [John McLean, Australia]	Rejected. No clear argument or science content; no citations offered.
19151	37	41	37	41	I disagree that climate models, here I assume the authors means ESMs, are the only way to compare effects of different variables. Even if models in this sense may be the currently best way, they are not the only way. [Thorsten Mauritsen, Sweden]	Noted. Sentence now reads: "...climate simulations also provide a major means to explore the effects of different variables, such as solar irradiance, aerosols, and greenhouse gases."
125241	37	44	37	44	Insert: "... effects of doubling ATMOSPHERIC carbon dioxide..." [Trigg Talley, United States of America]	Accepted.
85969	37	49	37	49	Please explain "three dimensional". In this paragraph one would expect to see the outputs of these early models (visually) and how observed climate has measured up to these. Or if this is presented elsewhere, a cross-reference. – ok, next section. Please cross-reference. [Debra Roberts and the Durban WGII TSU, South Africa]	Noted. 3-dimensional would appear to be self-explanatory.
9091	37	54	37	54	Replace "in" with "since". The maturing has certainly continued since the 1970s, and I would claim that in 1979 climate models were not "mature"... [Olaf Morgenstern, New Zealand]	Accepted. Deleted "matured in the 1970s" phrase.
28225	37		38		I believe that 1-2 figures might be good in Sect. 1.3.4. For example, previous Assessment Reports showed that the human fingerprint in the warming pattern in latitude-height coordinates matches the pattern expected from greenhouse forcing; or time series where observations are seen to fall in the range of modeled climate change with human forcing, but fall outside when neglecting anthropogenic forcing. These figures are useful for communicating the message. I might have overlooked that they exist elsewhere in the report; if so, one might think of combining these sections or referring to these sections. [Sebastian Bathiany, Germany]	Noted. We agree entirely, but lack the space to add a figure at this stage.
21319	38	4	38	15	It feels off not to be including a more explicit timeline of evolution through the 5 Ars here including the discernible human influence finding in the SAR which is particularly pertinent given the recent passing of Sir John Haughton [Peter Thorne, Ireland]	Taken into account. The evolution of key D&A statements from the SAR to the AR5 is now explicitly included. Reference to the Appendix added.
36653	38	6	38	13	This whole paragraph is subjective because no climate model has been validated. [John McLean, Australia]	Rejected. No revisions proposed. No evidence provided in support of reviewers claims.
4487	38	8	38	13	One of the alleged fingerprints of anthropogenic warming was the so-called "tropical hotspot" theory which essentially failed. In the interest of transparency it would be important that such changes in understanding are acknowledged in historical science paragraphs such as here. Another failed "fingerprint" is the cooling SST in the Iceland area. Try to be more balanced not only report one side of the debate. [Sebastian Luening, Switzerland]	Noted. We see no useful purpose in mentioning failed hypotheses here, since thousands of other failed hypotheses are also not mentioned.
36655	38	9	38	9	"borne out" is a subjective conclusion because other interpretations are possible. Nights warming faster than days can be attributed to minimum temperatures being more prone to distortions (e.g. urbanisation) than maximum temperatures (typically occur when the sun is high in the sky). The "probability of multi-year record-breaking high temperatures" says absolutely nothing about cause, neither does "a rising troposphere". [John McLean, Australia]	Taken into account. Reference to multi-year records deleted, several other fingerprints added.
101467	38	10	38	10	Is it possible to define or remove "tropopause"? [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Glossary provides a definition.
36657	38	13	38	13	Your claim that the evidence for human influence has grown is a subjective assertion based on papers that rely on climate models that IPCC AR5 showed were flawed. [John McLean, Australia]	Rejected. No evidence cited.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
125243	38	14	38	14	Is it really settled science that a human contribution to detected changes in the global water cycle has been found? [Trigg Talley, United States of America]	Noted. As stated, this was the AR5 finding.
13199	38	14	38	15	It could add to the effects of floods and droughts. [Maria Amparo Martinez Arroyo, Mexico]	Noted. No change. Unclear what the reviewer means by "it." The sentence in question already mentions "changes in the global water cycle" and "changes in some climate extremes." Space limitations precluded expansion of many elements in this chapter.
36659	38	17	38	17	I'm pleased to see you saying that earlier IPCC reports relied on flawed climate models, which indeed is what happened. The problem is that AR5 relied on the flawed models and what's more, the report told us that they were flawed. The problem is that chapter 1 this far at least has been trying to imply that the finding that AR5 were correct despite them being based on flawed models. How do you work that out? [John McLean, Australia]	Rejected. No evidence cited.
82157	38	17	38	25	Development of regional climate models could be mentioned [Borbála Gálos, Hungary]	Noted. Discussed in 1.3.6.
107179	38	17		35	[pt 1 of 2] The three key sentences say, "In the 1990s, coupled atmosphere-ocean GCMs (AOGCMs) were state of the art; by the 2010s, Earth system models (ESMs) and coupled carbon-cycle climate models incorporated land surface, sea ice, snow, vegetation, and other elements of the climate system. Over the past three decades, some major modelling centres such as the UK Met Office have deployed "unified" models for both weather prediction and climate modelling, with the goal of a "seamless" modelling approach that uses the same dynamics, physics, and parameterizations at multiple scales of time and space (Cullen, 1993; Brunet et al., 2015). Because weather models make short-term predictions that can be frequently verified, this approach allows major portions of the climate model to be validated as a weather model." That's an improvement over the FOD, because it at least mentions, at the end, the motivation for building unified models. But it still fails to convey the magnitude of the problem. I suggest adding the following explanation, probably inserted between the first and second of those three sentences: [cont'd] [David Burton, United States of America]	Rejected. Section 1.3.4 already contains a partial explanation of climate models and how they are evaluated. Paragraph now ends with: "However, all climate models exhibit unrealistic biases of different degrees and types, and the practice of 'tuning' parameter values in models to make their outputs match variables such as historical warming trajectories has generated concern throughout their history (Randall, 1997; Edwards, 2010; Hourdin et al., 2017). Overall, the WGI AR5 assessed that climate models had improved since previous reports (IPCC, 2013)." Section 1.5 says more about how climate models work and describes their limitations in greater detail (1.5.3.2), and there is even more in Chapter 7. Reviewer's claim that GCMs "are of dubious utility" is not supported by peer-reviewed scientific literature; in fact, as seen in Figure 1.9, past model projections as far back as 1970 project future temperature change well when actual historical forcings (rather than the future forcings projected at the time of modelling) are used.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
107181	38	17		35	[pt 2 of 2] "A 'model' is a computer program which simulates ('models') real processes for the purpose of predicting their progression. The utility and skillfulness of models is dependent on three things: 1) how well the processes which they model are understood; 2) how faithfully those processes are simulated in the computer code, and 3) whether the results can be repeatedly tested so that the models can be refined. Specialized models, which try to model reasonably well-understood processes, like PGR and radiation transport, are useful, because the processes they model are manageably simple and well-understood. Weather forecasting models are also useful, even though the processes they model are very complex, and understanding is incomplete, because the weather models' short-term predictions can be repeatedly tested, allowing the models to be validated and refined. But more ambitious models, like GCMs, which attempt to simulate the combined effects of many poorly-understood processes, over time periods too long to allow repeated testing and refinement, are of dubious utility." ### [David Burton, United States of America]	Rejected. Section 1.3.4 already contains a partial explanation of climate models and how they are evaluated. Paragraph now ends with: "However, all climate models exhibit unrealistic biases of different degrees and types, and the practice of 'tuning' parameter values in models to make their outputs match variables such as historical warming trajectories has generated concern throughout their history (Randall, 1997; Edwards, 2010; Hourdin et al., 2017). Overall, the WGI AR5 assessed that climate models had improved since previous reports (IPCC, 2013)." Section 1.5 says more about how climate models work and describes their limitations in greater detail (1.5.3.2).
21317	38	20	38	21	It would seem unwise to call out a single institution in the manner done here. [Peter Thorne, Ireland]	Accepted.
36661	38	20	38	25	Please describe how accurate the climate models used by the UK Met Office were for seasonal predictions. Readers need to understand the accuracy of your statement. [John McLean, Australia]	Rejected. No references to peer-reviewed science. Due to the chaotic nature of weather, near-term deterministic seasonal predictions are among the most difficult tasks for any weather/climate model; In the context of an assessment of *climate* science, the accuracy of seasonal predictions is not highly relevant, since climatic time scales are decades to centuries and climate models produce statistical averages over longer periods rather than deterministic predictions.
45741	38	22	38	22	Please clarify if all parameter settings are also the same. [Twan van Noije, Netherlands]	Noted. Sentence clearly states that this is a goal, does not say this goal has yet been achieved.
115719	38	23	38	23	Do other chapters provide an assessment of insights from weather forecast on the evaluation of atmospheric models? (please check also the use of "validation") [Valerie Masson-Delmotte, France]	Taken into account. Changed "validated" to "evaluated." Added ref to Ch 10, sec 10.1.2
28691	38	25			suggest shortening "validated as a weather model." to "evaluated." as it is clear this relates to the weather models already stated and their physics are evaluated rather than validated as right or wrong [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Changed to "evaluated."
32491	38	27	38	27	What do you mean by 'vary along many dimensions?' Make this more explicit (I assume you mean a multitude of complex factors factors such as resolution ,parametrisations ,...)? [Robert Colman, Australia]	Accepted. Revised to read: "Since climate models vary along many dimensions, such as grid type, resolution, and parameterizations..."
101469	38	27	38	28	I think this isn't very clear - is it "Since climate models are complex, ..." ? Since there are many influencing factors on climate? Since the outputs are high dimensional? [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Revised to read: "Since climate models vary along many dimensions, such as grid type, resolution, and parameterizations..."
36663	38	32	38	32	This sentence is deceitful because you fail to inform the reader that climate models are calibrated against historical weather data at either a macro (global, hemisphere etc) level or a regional level. [John McLean, Australia]	Rejected. No scientific support.
13201	38	32	38	33	It's suggests to mention the results of CMIP6. [Maria Amparo Martinez Arroyo, Mexico]	Rejected. This is a historical overview section. CMIP6 is addressed elsewhere.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
19153	38	32	38	34	I am not sure about CMIP3 models, but several individual CMIP5 models would hardly be considered successful, by any means, in reproducing the 20th Century global trends, e.g. Hourdin et al. (2017) their Figure 3, Flynn and Mauritsen (https://www.atmos-chem-phys-discuss.net/acp-2019-1175/), their section 5. [Thorsten Mauritsen, Sweden]	Accepted. Correct, but sentence refers to climate model *ensembles* not individual models. Revised to read: Both CMIP3 and CMIP5 included experiments testing the ability of models to reproduce 20th century global trends both with and without anthropogenic forcings. Although some individual model runs failed to achieve this (Hourdin et al., 2017, Figure 3), multi-model ensemble means were successful (Meehl et al., 2007a; Taylor et al., 2012). When only natural forcings were included (creating the equivalent of a “control Earth” without human influences), a multi-model ensemble mean could not reproduce the observed post-1970 warming at either global or regional scales (Edwards, 2010; Jones et al., 2013). "
36665	38	34	38	37	How dare you make such a claim! AR5 explained the failure of models to accurately predict the trend in global average temperature for the previous 15 years, saying firstly "There may also be a contribution from forcing inadequacies and, in some models, an overestimate of the response to increasing greenhouse gas and other anthropogenic forcing (dominated by the effects of aerosols)." [WG I SPM, section D.1, page 15, bullet point 2, and in full Synthesis Report on page SYR-8] and then "This difference between simulated [i.e. model output] and observed trends could be caused by some combination of (a) internal climate variability, (b) missing or incorrect radiative forcing and (c) model response error". [WGI contribution, chapter 9, text box 9.2, page 769] If climate models exaggerate the influence of greenhouse gases AND those models are calibrated/tuned/tweaked to match historical temperatures, then logically excluding anthropogenic GHGs will cause the models to produce lower temperatures than they should. [John McLean, Australia]	Rejected. Text refers to the 20th century trend and the post-1970 trend, not to the shorter 15-year period the reviewer mentions, which is thoroughly discussed in Cross-Chapter Box 3.1.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
36669	38	34	38	37	The output of models is never evidence unless you can prove that the models are accurate in all respects (i.e. all relevant factors accurately incorporated into those models.) IPCC AR5 certainly failed to demonstrate that the models were accurate, in fact it showed, text box 9.2, that 97% of them were not. [John McLean, Australia]	Rejected. First, the section is about climate understanding, which involves working out the relations among many variables in a chaotic system; as explained in the section, models are a tool to improve that understanding. Second, the suggested criterion for treating model results as evidence is so extreme that it would rule out nearly all observational data as well. Third, no claim is made that all relationships captured by models are *perfectly* understood. Much of modern science routinely uses mathematical and computer models to help understand complex processes. Evaluation of models is discussed extensively in Chapter 7 as well as Section 1.5 of this chapter. Fourth, AR5 Box 9.2 concerns whether climate models reproduced a short-term (non-climatic) trend, the supposed warming "hiatus," but as that Box discusses, climate models are not expected to exactly reproduce internal variability on a 15-year time scale. AR5 Box 9.2 shows that on the climatic time scale (30+ years, in the Box 9.2 case 1951-2012) nearly all models reproduced observed trends quite accurately. Finally, see Cross-Chapter Box 3.1 of AR6 for a discussion of updated models and observational data in relation to the 1998-2012 period.
105065	38	36	38	36	it is not the "same experiment" if it has a different forcing. The authors meant the "same models" maybe? [Masa KAGEYAMA, France]	Accepted. Changed to: "similar model ensembles could not reproduce..."
36671	38	39	38	39	On page 37, lines 29-32 you said that the transfer of energy from the equatorial regions to the poles was an important factor. This transfer conflicts with the two-dimensional energy budgets shown in IPCC reports. [John McLean, Australia]	Rejected. No revisions proposed. No evidence provided in support of reviewers claims.
32493	38	39	38	39	Why are these budgets 'theoretical'? Aren't they actual -- i.e. based on the laws of physics such as conservation of energy, etc. Of course we don't expect them to exactly balance in practise at any particular time in the Earth system but that does not make them theoretical. [Robert Colman, Australia]	Accepted. Rewritten as: "whether climate system "budgets," such as the balance of incoming and outgoing energy,..."
35451	38	43	38	43	* C repeats [Carlos Antonio Poot Delgado, Mexico]	Accepted. Done.
641	38	43	38	43	"equilibrium climate sensitivity (ECS)" rather than "climate sensitivity" ? [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Done.
80987	38	43	38	44	Perhaps define climate sensitivity here and why the range is large i.e. 1.5 to 4.5oC - or give a section reference to where climate sensitivity is explained in more detail. [Jeffrey Philip OBBARD, Singapore]	Taken into account. Reference to Section 1.3.5 for more details and Glossary added.
36673	38	49	38	51	Your energy budget for the Earth's surface doesn't balance if you don't include poleward transfer of equatorial heat. [John McLean, Australia]	Rejected. No revisions proposed. No evidence provided in support of reviewers claims.
36675	38	52	38	52	Summary of subsection 1.3.4: Paragraphs about models, relying on models, more models, more models and energy budgets determined by using models don't add up to much if you can't prove that the models accurately incorporate all relevant forcings and influences. WGI AR5 certainly didn't provide that proof, ergo none of this section amounts to any "evidence" (of what?). [John McLean, Australia]	Rejected. No revisions proposed. No evidence provided in support of reviewers claims.
21323	39	1			Should this section not also introduce earth system sensitivity? [Peter Thorne, Ireland]	Accepted. Added.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
71413	39	1			Shouldn't also here appear "Lines of evidence" in the title? It is an additional line of evidence. [Douglas Maraun, Austria]	Rejected. Projections are not called a "line of evidence" in previous IPCC. The only way we could argue that projections of the future ARE a line of evidence would be to show that most or all previous projections have now been confirmed, and given their spread (including individual studies, not just assessments) that's too high a bar.
114209	39	3	39	3	Minor: This section starts, in my view, a bit abruptly, by the sudden focus on near term. [Jan Fuglestedt, Norway]	Noted. We think starting the projections part with the "new" focus on the near-term emerging in the AR5 is useful and makes sense.
36681	39	3	39	20	You assert in this paragraph that the output of climate models cited in AR5 were accurate but in fact AR5 showed us clearly that they were not. [John McLean, Australia]	Rejected. No revisions proposed. No evidence provided in support of reviewers claims.
101471	39	3	39	20	I found it confusing to start with near-term. Could the two halves of this paragraph be switched around? [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Yes, they could be swapped. But we prefer to leave the order of the para as is and to start with how near-term received more attention in the AR5.
36677	39	4	39	4	"made a specific assessment"? Is that different to other types of assessment? And I think you'll find that it didn't do any assessing at all, it simply presented a few predictions. [John McLean, Australia]	Rejected. No science content. In the context of a broad science assessment, a "specific assessment" refers to assessment of a particular issue or point.
89989	39	4	39	4	projected, not predicted. [Jochem Marotzke, Germany]	Accepted.
6433	39	4	39	5	Should the two occurrences of "GMST" on these lines be changed to "GSAT"? I believe GSAT was the variable used in reporting projections in AR5. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Noted. GMST was used in AR5. GSAT does not appear anywhere in the report.
52139	39	4			Please clarify what "this issue" is in "To address this issue". [Mohammad Rahimi, United States of America]	Accepted. Changed to "In response"
125245	39	7	39	7	It's not clear what is meant by "secular changes" in total solar irradiance. Please use a different term. [Trigg Talley, United States of America]	Rejected. Direct quotation from AR5. This term is widely used in meteorology and astronomy to refer to relatively slow changes.
36679	39	11	39	12	AR5 assumed that the output of climate models was accurate but text box 9.2 showed that to be untrue. Your sentence here therefore describes material with implicit flaws. [John McLean, Australia]	Rejected. No revisions proposed. No evidence provided in support of reviewers claims.
19497	39	15	39	17	,assessed in WGI AR5 result in continued warming over the 21st century in all scenarios, and beyond 2100 under all RCP scenarios except a strong climate change mitigation scenario (RCP2.6) ,why this part was ommited?? [Hamideh Dalaei, Iran]	Rejected. This exact sentence follows few paragraphs further down.
114211	39	17	39	18	add "emssion" before "scenario" [Jan Fuglestedt, Norway]	Accepted. Done.
83925	39	19	39	20	(...) aerosol emissions, land use, energy, and other human activitis [Marco Tulio Cabral, Brazil]	Accepted. Done.
125247	39	22	39	22	Insert: "... steadily increaseing ATMOSPHERIC CO2 concentrations..." [Trigg Talley, United States of America]	Noted. This detail does not need to be spelled out every time; it's clear from context and basic knowledge.
36683	39	22	39	33	I'm surprised that you have the chutzpah! to imply that early climate models produced accurate temperature predictions when figure 3.3 of IPCC AR5 shows that early models failed to include many factors that influence temperature. [John McLean, Australia]	Noted. No change.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
87511	39	24	39	25	The Recommendation forms part of the Stockholm Action Plan for the Human Environment -- this may be a better source (the citation is to the Report published by the United Nations, with the reference A/CONF.48/14/Rev.1). So the sentence might read as follows: '... were already addressed in Recommendation 70 of the Stockholm Action Plan, resulting from the 1972 UN Conference on the Human Environment (United Nations, 1973).' However, it's possibly worth mentioning that, for whatever reason, this Action Plan has been largely forgotten, unlike the accompanying Stockholm Declaration from the same Conference, which is of historic importance (but does not mention climate change). [Stephen Humphreys, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Added the recommended phrase.
29687	39	24	39	25	Consider shortening as follows: "...of the 1972 UN Conference on the Human Environment (1973)." [Hernan Edgardo Sala, Argentina]	Noted. Good idea, but publication date is 1973 though conf. held in 1972, so shortening like this would be confusing.
101473	39	27	39	27	Suggest concern or interest might be better than alarm? [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Accepted.
35453	39	29	39	29	remove " [Carlos Antonio Poot Delgado, Mexico]	Noted. Typographical error.
89991	39	29	39	30	The ECS discussion appears out of the blue; better to move that sentence down to after ECS has been introduced. [Jochem Marotzke, Germany]	Accepted.
87513	39	29	39	36	This is the first explanation of ECS and TCR (other than obliquely on page 21, the utility of which I would question) -- so they need to be crystal clear. As it is, the order of relevant sentences is a little confusing -- ECS is only explained after an estimate has already been given. Might the order of these sentences be reconsidered and adjusted? [Stephen Humphreys, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Glossary definitions provided.
41363	39	29	39	51	Given the complexity of the ECS issue and the fact that it is in the spotlight together with CMIP6, this historical ECS overview should be more closely coordinated with the authors of chapter 7.5 (one reference to Box 7.1 is not sufficient). Due to the lack of background on ECS provided here, it should be considered to move the ECS discussion (including the useful table) to Chapter 7 in its entirety. [Alexander Nauels, Germany]	Taken into account. We have carefully cross-checked our statements against Ch 7 and the Glossary, and added a number of more specific references.
21321	39	30	39	30	2-4.5 ... [Peter Thorne, Ireland]	Accepted.
29689	39	30	39	30	Use "NCR" instead of "National Research Council" (the acronym has been previously defined). [Hernan Edgardo Sala, Argentina]	Accepted.
643	39	35	39	35	Table 1.1: Check that this table is consistent with what is in Chapter 7. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. We have carefully cross-checked our statements against Ch 7 and added a number of more specific references. We will monitor changes in Chapter 7 to ensure that any changes there are reflected in this section.
647	39	35	39	35	Table 1.1: The fact that in AR6 the CMIP6 models' ECS is not used in the assessment does not preclude the CMIP6 range being included in the table. The statement that is currently given could instead be given as a footnote to the CMIP6 values. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Ch 7 is very clear that ESM results are only one component of its assessment. Table cell now reads: "CMIP6 range: 1.8-5.6°C. In AR6, GCM and ESM results are assessed in combination with other lines of evidence (Ch 7, Section 7.5)."
649	39	35	39	35	Table 1.1: The AR6 value of ECS should also have a footnote to say that the definition of ECS has changed sine AR5, in that it now includes all feedbacks except those associated with ice sheets. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Added a sentence to body text and to Figure caption.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
645	39	35	39	36	"ECS is a scientific benchmark that compares the radiative forcing of pre-industrial CO2 levels (~275 ppm) with doubled CO2 (~550 ppm)". I don't think that this is an accurate definition. Liaise with Chapter 7 to provide a correct and concise definition. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Replaced with glossary/ Ch 7 definition. Glossary definitions in IPCC have consistently defined ECS relative to pre-industrial.
66645	39	35	39	45	I'm not sure that TCR really is a "more complex" variable than ECS. Observationally, the TCR is simpler under a ramp forcing because TCR is more or less linear in attributable warming. ECS is simpler in the sense that we ignore the thermal inertia of the ocean, but observationally it is more challenging because we do not directly observe it. I think there's probably a better way to put it than as it is currently expressed. [Dave Frame, New Zealand]	Accepted. Phrase no longer appears.
101475	39	35	39	51	A few things. Please fully define ECS - acronym, and warming not just forcing - and isn't it doubling from any level (hence attempts to use palaeo)? For "has recently been questioned" - is it possible to say whether this means they are similarly useful, or TCR is less useful than ECS? And can you nod to the wider CMIP6 ECS range being one reason for the wider evidence base? (maybe too complex). [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Glossary definitions in IPCC have consistently defined ECS relative to pre-industrial. Table cell now reads: "CMIP6 range: 1.8-5.6°C. In AR6, GCM and ESM results are assessed in combination with other lines of evidence (Ch 7, Section 7.5)."
70069	39	35	39	51	It would be useful to contrast the literature on global climate sensitivity (ECS and TCRglob) with more recent results introducing the regional climate sensitivity (RCS) as a new metric relating regional climate changes in e.g. extremes to changes in global mean temperature (Seneviratne and Hauser, in press, Earth's Future: https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2019EF001474). Analysis of CMIP6 projections reveals that inter-model uncertainties in projections of changes in temperature extremes are more strongly related to the representation of RCS than GCS in the models. [Sonia Seneviratne, Switzerland]	Noted. This issue is best addressed in Ch 7.
90041	39	35	40	7	Include CMIP6 ECS values spanning 1.8–5.6 K across 27 GCMs and exceeding 4.5 K in 10 of the models reported by Zelinka et al. (2020) Causes of higher climate sensitivity in CMIP6 models. Geophysical Research Letters, 47, e2019GL085782. https://doi.org/10.1029/2019GL085782 [Govindarajulu Srinivasan, Thailand]	Accepted.
16681	39	36	39	36	This needs to say that ECS compares the temperature response, not the radiative forcing. [William Collins, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Corrected using glossary definition.
89993	39	36	39	36	This is incorrect. ECS measures not the radiative forcing but the equilibrium global-mean surface temperature response to that forcing. [Jochem Marotzke, Germany]	Accepted. Corrected using glossary definition.
70521	39	36			ECS is not a measure of radiative forcing, but of the response to radiative forcing. Also 'radiative forcing' describes a change in radiative balance in response to a change in atmospheric composition. So it doesn't make sense to refer to 'the radiative forcing of pre-industrial CO2 levels'. (How would this be defined? Relative to a CO2 concentration of zero?). I suggest 'is defined as the equilibrium global mean temperature response to a doubling of CO2 concentration from pre-industrial levels'. [Gillett Nathan, Canada]	Accepted. Corrected using glossary definition and Ch 7.
35455	39	39	39	39	Use published sources [Carlos Antonio Poot Delgado, Mexico]	Taken into account. "Submitted" sources have now been published. Dates corrected.
36685	39	39	39	41	Equilibrium sensitivity applied to all climate subsystem is an unrealistic concept because the time taken to reach equilibrium in every subsystem varies. By the time one subsystem has reached equilibrium other subsystems might have reached new equilibriums multiple times (e.g. ocean heat compared to the atmosphere). [John McLean, Australia]	Noted.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
70523	39	41			I would not describe TCR as 'more complex quantity'. It is easier to calculate than ECS - it's just the 20-yr mean warming in a 1pctCO2 simulations centred on year 70. [Gillett Nathan, Canada]	Accepted.
70525	39	44		46	If assessing new literature on ECS/TCR and its relevance to projections, also check for consistency with and cite Chapter 7. [Gillett Nathan, Canada]	Noted. No change.
114213	39	45	39	45	You may consider changing "realistic" to "adequate" [Jan Fuglestedt, Norway]	Accepted. Changed to "appropriate."
107817	39	45	39	46	Questioned how? A little more detail, please. [Linda Mearns, United States of America]	Accepted. Phrase now reads: "however, recent studies have raised new questions about how accurately both quantities are estimated by GCMs and ESMs (Grose et al., 2018; Meehl et al., 2020)."
3637	39	46	39	46	You might want considering adding something like. Recently, the exact mathematical relationship between ECS and TCR has been elucidated in Ragone et al. (2016). [See https://link.springer.com/article/10.1007/s00382-015-2657-3] [Valerio Lucarini, United Kingdom (of Great Britain and Northern Ireland)]	Noted. No change.
74311	39	46	39	46	Missing period (.) [Christopher Hollis, New Zealand]	Accepted.
11339	39	46	39	46	(Meehl et al., submitted) update or remove [Michael Schmitt, Germany]	Accepted. Refs updated.
35457	39	46	39	46	Use published sources [Carlos Antonio Poot Delgado, Mexico]	Noted. "Submitted" papers have now been published; dates corrected.
87517	39	46	39	46	Missing full stop after 'missing' [Stephen Humphreys, United Kingdom (of Great Britain and Northern Ireland)]	Accepted.
29691	39	46	39	46	Add a point "." before "The table shows...". [Hernan Edgardo Sala, Argentina]	Accepted.
36687	39	46	39	48	You are not being comprehensive and open. As you well know, there have been multiple studies that conclude ECS to be in the order of 1.0 to 2.0C. These include Alexander Otto, Friederike E. L. Otto, Olivier Boucher, John Church, Gabi Hegerl, Piers M. Forster, Nathan P. Gillett, Jonathan Gregory, Gregory C. Johnson, Reto Knutti, Nicholas Lewis, Ulrike Lohmann, Jochem Marotzke, Gunnar Myhre, Drew Shindell, Bjorn Stevens & Myles R. Allen (2013) in Nature Geoscience, which concluded 2.0 °C, with a 5–95% confidence interval of 1.2– 3.9 °C. Are you saying that these regular IPCC authors were wrong? Or how about Lewis and Curry (2015) that said 1.67 (17-83% range 1.25-2.6) c.f. IPCC AR5 chapter 12 which gave no average but claimed 17-83% range 1.5 to 4.5. Also Lindzen and Choi 2001 concluded an ECS of about 1.0C. Aldrin et al (2012), Ring et al (2012), Lewis (2013), Otto et al (2013), Masters (2013), Loehle (2014), Skeie et al (2013), Lewis and Curry (2015), Bates (2016), Christy & McNider (2017), and Lewis and Curry (2018) all estimated ECS as being between 1.0 and 2.0C, and recently Happer and van Wijngaarden have used quantum physics and found 1.5 to 1.9C. [John McLean, Australia]	Rejected. Context clearly states that "expert assessments" of the full range of literature - not all individual studies - have broadly agreed on the range of ECS.
36689	39	46	39	48	ECS is often derived from the historical temperature record. My audit of the HadCRUT4 temperature record ("An Audit of the Creation and Content of the HadCRUT4 Temperature dataset", published 2018) showed more than 70 issues, some impacting a single datum but others impacting the entire record or at least enough to distort the often-used global average temperature anomaly. When the historical temperature record is flawed it stands to reason that the ECS derived using that data will very likely be incorrect. Further, an ECS calculated from the more-reliable lower tropospheric temperatures is going to show a different value to an ECS calculated from near surfacetemperatures. [John McLean, Australia]	Taken into account. Added a sentence about ECS derived from historical observations or observations + simple models, which is assessed in Ch 7. Contrary to reviewer's assertion, ECS estimates from these studies are both lower and higher than IPCC assessment range, with the median of these studies at 3-4°C, consistent with IPCC estimates. See Ch. 7. Cited document is self-citation to non-peer-reviewed literature; we can't use that.
28693	39	46			missing full stop. Also lots of submitted references [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Refs updated.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
70527	39	49		50	Since this is the first place that TCRE is mentioned in the report, it should be defined here - explain that it is the ratio of warming to cumulative CO2 emissions in a CO2-only simulation. [Gillett Nathan, Canada]	Accepted. Def added.
19155	39	50	39	50	Paleoclimate reconstructions are not of ECS. Perhaps 'paleoclimate-based estimates of ECS' [Thorsten Mauritsen, Sweden]	Accepted.
87519	39	50	39	50	Missing close bracket after 7.1. [Stephen Humphreys, United Kingdom (of Great Britain and Northern Ireland)]	Accepted.
34827	40	1	40	4	The SOD indicates that most aspects of climate change will persist for many centuries even if CO2 emissions were stopped immediately. Please see general comment #14 above. [Jim O'Brien, Ireland]	Noted. We do not have your numbering for comments, so we can't tell which is your "general comment #14."
19159	40	1	40	7	The table could include the upcoming WCRP report on ECS [Thorsten Mauritsen, Sweden]	Accepted. Good idea - thanks!
114215	40	1	40	8	This table is very useful [Jan Fuglestedt, Norway]	Noted. Thanks.
89995	40	1	40	8	The account of ECS since the TAR is incorrect. The TAR, AR4, and AR5 ranges were the likely ranges, not the very likely ranges. By contrast, it's indeed the very likely range for the AR6; likely range is 2.5--4°C, half of the previous reports and marking a substantial advance. This advance is lost here. [Jochem Marotzke, Germany]	Accept. Added correct statements and noted advance.
11337	40	3	40	5	Repeat definition of GCM and ESM in Table caption [Michael Schmitt, Germany]	Accepted. Done
99925	40	3	40	8	Despite this sentence from the description on page 39, "The table shows that despite some variation in the range of GCM and (for the later assessments) ESM results, expert assessment of the range of ECS has changed very little since 1979," I'm not quite sure what this table is telling the reader? A table that shows that there is no or little change?? [Dan Helman, United States of America]	Noted. Yes, it shows that there has been little change in overall estimates of ECS, i.e., a broad and enduring consensus.
19157	40	4	40	4	Reports up until AR5 reported 'likely' ranges, whereas AR6 will provide both a 'likely' (SOD: 2.5-4.0) and 'very likely' (SOD: 2.0-5.0) [Thorsten Mauritsen, Sweden]	Accepted. Added both ranges and will monitor Ch 7 for further changes in the FGD.
112001	40	6	40	6	In a table footnote, please provide more information for why "Raw GCM and ESM sensitivity results not used in ECS and TCR assessment " [Cynthia Randles, United States of America]	Taken into account. Now discussed in body text and table caption.
71845	40	6	40	6	The ar5 gives the ECR likely range as 1.5C to 4.5 C (not the very likely range). [John Church, Australia]	Accepted. Corrected.
125249	40	6	40	7	In Table 1.1, it's not clear what the difference between the "Range of GCM and ESM results" column and "Assessed range of ECS" column is. Please clarify in the caption text. [Trigg Talley, United States of America]	Accepted. Added to caption: "The assessed range of ECS differs from range of GCM results because other evidence, other models, and expert judgment are taken into account in assessing ECS."
36701	40	6	40	7	Repeating multiple false claims doesn't somehow make them correct. [John McLean, Australia]	Noted. The same is true of false critiques.
36691	40	11	40	12	AR5 was mendacious. The relationship between CO2 and temperature has long known to be logarithmic and previous IPCC reports have said this and the shown the formula by which the increase in temperature is calculated. AR5 implied that past IPC reports were incorrect, which makes one wonder if this current report will also be incorrect. [John McLean, Australia]	Noted. No suggestion for revisions given.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
115029	40	11		20	[pt 2 of 3] That's the unscientific "carbon budget" nonsense. "In the absence of a large net removal of CO2 from the atmosphere" means on some planet other than Earth. The important major negative feedbacks (greening, uptake by oceans) are ALREADY removing about 20 Gt CO2 (5.5 PgC) from the atmosphere, per year, and as the CO2 level climbs so does that removal rate. That's at least half the rate of anthropogenic emissions. So if CO2 emissions were merely halved, atmospheric CO2 levels would be DECLINING rather than rising (with an e-folding time of about fifty years, and a half-life of the anthropogenic fraction of about 35 years). So it is obviously untrue that "stabilizing warming thus requires that CO2 emissions descend to zero." [cont'd] [David Burton, United States of America]	Rejected. Reviewer is confusing the science and seems to not have understood the term "net removal".
107183	40	11		20	[pt 1 of 3] It says, "WGI AR5 assessed that the relationship of cumulative total emissions of CO2 and global mean surface temperature response is close and approximately linear. This finding implies that continued emissions of carbon dioxide will cause further warming and changes in all components of the climate system, independent of any specific scenario or pathway... Further increase in atmospheric CO2 will also lead to further uptake of carbon by the ocean, thus increasing ocean acidification. ... From the close link between cumulative emissions and warming it follows that any given level of warming is associated with a total budget of CO2 emissions. To stay within the budget, higher emissions in earlier decades imply lower emissions later on. In the absence of a large net removal of CO2 from the atmosphere, stabilizing warming thus requires that CO2 emissions descend to zero once the remaining carbon budget is exhausted..." [cont'd] [David Burton, United States of America]	Rejected. Reviewer is confusing the science and seems to not have understood the term "net removal".
107185	40	11		20	[pt 2 of 3] That's the unscientific "carbon budget" nonsense. "In the absence of a large net removal of CO2 from the atmosphere" means on some planet other than Earth. The important major negative feedbacks (greening, uptake by oceans) are ALREADY removing about 20 Gt CO2 (5.5 PgC) from the atmosphere, per year, and as the CO2 level climbs so does that removal rate. That's at least half the rate of anthropogenic emissions. So if CO2 emissions were merely halved, atmospheric CO2 levels would be DECLINING rather than rising (with an e-folding time of about fifty years, and a half-life of the anthropogenic fraction of about 35 years). So it is obviously untrue that "stabilizing warming thus requires that CO2 emissions descend to zero." [cont'd] [David Burton, United States of America]	Rejected. Reviewer is confusing the science and seems to not have understood the term "net removal".
107187	40	11		20	[pt 3 of 3] The fact that the paragraph even mentions one of the major mechanisms for that removal (ocean uptake), makes the concluding claim even more obviously absurd. If you want serious scientists to take this report seriously, the unscientific "carbon budget" nonsense needs to be purged entirely from the Report, and replaced with a mea culpa. Here're some references for the other major mechanism (greening, a/k/a transfer of carbon from atmosphere to terrestrial biosphere): https://www.nature.com/articles/ncomms13428 https://www.nasa.gov/feature/goddard/2016/carbon-dioxide-fertilization-greening-earth https://www.nature.com/articles/nclimate3004 ### [David Burton, United States of America]	Rejected. Reviewer is confusing the science and seems to not have understood the term "net removal".
125251	40	17	40	17	Clarify what the timestamp is for this statement: "... the rate of SLR [in 2100?] will very likely..." [Trigg Talley, United States of America]	Accepted. Added "over the 21st century"
101477	40	17	40	18	For the avoidance of doubt, it would be good to flag this SLR statement is AR5 because it sounds like a present tense assessment. [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Clarified AR5 context.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
114219	40	17	40	21	Sounds as if this is only valid for RCPs in AR5 [Jan Fuglested, Norway]	Accepted. Clarified AR5 context.
36693	40	23	40	24	You have NOT proved that there is a close link between cumulative emissions and temperature, and even if you had proved it you have nothing more than a correlation. Surely you are aware that correlation doesn't prove cause. But how do you explain the findings of AR5 that over the 15 years prior to drafting that report, atmospheric CO2 had definitely increased but there was no statistical certainty that any warming had occurred? [John McLean, Australia]	Rejected. Reviewer confuses annual CO2 and temperature changes and variability with long-term temperature change and its link to cumulative emissions.
36695	40	24	40	25	The statement is false. The annual increase in atmospheric CO2 is approximately 50% of the estimated anthropogenic emissions of CO2, often slightly less in El Nino years and slightly more in La Nina years. This situation has held true since CO2 started being monitored at Muana Loa (or at least as soon afterwards as the calculations could be made). This indicates that the capacity for the biosphere to absorb CO2 is increasing over time., quite possibly via a feedback mechanism (e.g. CO2 encourages the growth of vegetation and that vegetation absorbs more CO2). It cannot therefore be blandly assumed that higher emissions need to be followed by lower emissions. [John McLean, Australia]	Rejected. Reviewer seems to have overlooked the "To stay within the budget", referring to the previous sentence.
28695	40	24			perhaps add in a reference for link between total CO2 budget and warming level [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Added references to Allen et al., 2009 and Collins et al., 2013.
36697	40	25	41	2	Your statement is false because you haven't proved that CO2 causes dangerous warming or even enough warming to be concerned about. I remind you that every IPCC climate assessment report since the first one tries to argue with different "evidence" than the report before it. You are therefore making assertions for which you have no credible and sustained evidence. [John McLean, Australia]	Rejected. The paragraph does not try to classify the warming as "dangerous" or "to be concerned about". It simply summarizes the established knowledge about the close link between cumulative carbon emissions and long-term warming.
68023	40	25	41	4	This paragraph needs support from the literature, in particular from the corresponding sections of WG1 AR5. [Michael Evans, United States of America]	Taken into account. Added references to relevant WGI AR5 Chapters, TS, SPM.
114217	40	26	40	26	Add "net" before "zero" [Jan Fuglested, Norway]	Accepted. Done
19163	40	26	40	26	Perhaps replace 'descend' with 'reduce' [Thorsten Mauritsen, Sweden]	Accepted. Done
115721	40		40		Table 1.1 : it would be very useful of reasons for changes in assessed ranges were explicitly reported (from TAR to AR4, from AR5 to AR6). Even if the raw range of sensitivity is not used, why not report it? [Valerie Masson-Delmotte, France]	Taken into account. CMIP6 range is listed. Caption now indicates that GCM/ESM range not used directly, and this is also mentioned in body text.
70529	40				Table 1.1. For all assessments up to AR5, this table gives a range of GCM/ESM ECS, and then gives an assessed range. For AR6 the table does not give a range for GCM and ESMs with the comment 'Raw GCM and ESM sensitivity results not used in ECS and TCR assessment (Ch 7.5)'. Even though the models' ECS/TCR distribution is not used directly to derive the assessed range, I still think it would be useful to include the range of ECS/TCR for the CMIP6 models in this table, since these models are used throughout this report. The caption could indicate that the model range was not used directly to derive the assessed range in AR6. [Gillett Nathan, Canada]	Accepted. CMIP6 range is listed. Caption now indicates that GCM/ESM range not used directly, and this is also mentioned in body text.
115031	41	1		4	[pt 4 of 5] There are several other ways of counting "CO2 residence time," too. One is the "residence time" decay constant seen in the decay of the 14C "bomb spike" after the atmospheric test ban. It is 16.6 years (half-life 11.5 years). It is shorter than the 50 year "adjustment time" because many of the things which remove 14C from the atmosphere actually just swap it for 12C, and don't reduce the amount of CO2 in the atmosphere. This time constant is very precisely determined, and easiest to see in a log-scale graph: http://2.bp.blogspot.com/-G79oXdgIZC4/UnteTCVaGGI/AAAAAAAAA0/AbSzY3s5ZP0/s1600/logc14.jpg [cont'd] [David Burton, United States of America]	Rejected. The reviewer is wrong. Please review the carbon cycle chapter in e.g. the TAR with regard to the "residence time" of CO2.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
107189	41	1		4	[pt 1 of 5] It says, "most aspects of climate change will persist for many centuries even if emissions of CO2 were stopped immediately. According to the WGI AR5 assessment, a large fraction of this change is essentially irreversible on a multi-century to millennial time scale, except in the case of a large net removal of CO2 from the atmosphere over a sustained period through as yet unavailable technological means." That's nonsense. Most anthropogenic CO2 has a effective residence time ("adjustment time") of about fifty years. The rate of removal of CO2 from the atmosphere is (very closely) a function of the CO2 level in the atmosphere, and we have >60 years of very good records of both CO2 levels & emissions, from which removal rates can be very closely calculated. [cont'd] [David Burton, United States of America]	Rejected. The reviewer is wrong. Please review the carbon cycle chapter in e.g. the TAR with regard to the "residence time" of CO2.
107191	41	1		4	[pt 2 of 5] So we know what would happen to CO2 levels if CO2 emissions were stopped: CO2 levels would decline immediately, on an approximately exponential decay curve toward slightly less than 300 ppmv, with a time constant (adjustment time) of about fifty years. The level would be below 350 ppmv in about 32 years, and below 320 ppmv in about 58 years. Refs: http://www.drrroyspencer.com/2019/04/a-simple-model-of-the-atmospheric-co2-budget/ https://edberry.com/blog/climate-physics/agw-hypothesis/contradictions-to-ipccs-climate-change-theory/#comment-50170 https://sealevel.info/CO2_Residence_Times/Email_about_residence_time00.html https://sealevel.info/CO2_Residence_Times/Email_about_residence_time01.html [cont'd] [David Burton, United States of America]	Rejected. The reviewer is wrong. Please review the carbon cycle chapter in e.g. the TAR with regard to the "residence time" of CO2.
107193	41	1		4	[pt 3 of 5] The very long estimates of CO2 residence time (David Archer, Ken Caldeira, etc.) are based in integrating a very, very "long fat tail" in the decay curve, as CO2 slowly comes out of the oceans and soil. But that tail represents what happens when atmospheric CO2 levels are down near 300 ppmv, which everyone acknowledges is a harmless level. So the "long fat tail" is irrelevant. It only matters how long it takes for CO2 levels to fall below about 350 ppmv, and for the purpose of that calculation the effective half-life is about 35 years. [cont'd] [David Burton, United States of America]	Rejected. The reviewer is wrong. Please review the carbon cycle chapter in e.g. the TAR with regard to the "residence time" of CO2.
107195	41	1		4	[pt 4 of 5] There are several other ways of counting "CO2 residence time," too. One is the "residence time" decay constant seen in the decay of the 14C "bomb spike" after the atmospheric test ban. It is 16.6 years (half-life 11.5 years). It is shorter than the 50 year "adjustment time" because many of the things which remove 14C from the atmosphere actually just swap it for 12C, and don't reduce the the amount of CO2 in the atmosphere. This time constant is very precisely determined, and easiest to see in a log-scale graph: http://2.bp.blogspot.com/-G79oXdglZC4/UnteTCVaGGI/AAAAAAAAA0/AbSzY3s5ZP0/s1600/logc14.jpg [cont'd] [David Burton, United States of America]	Rejected. The reviewer is wrong. Please review the carbon cycle chapter in e.g. the TAR with regard to the "residence time" of CO2.
107197	41	1		4	[pt 5 of 5] Some people also discuss the average "residence time" of a molecule of CO2 in the air, before it is taken up by water or the biosphere, even transiently. This includes CO2 absorbed by raindrops and puddles, which is released back into the atmosphere within hours or days. It also includes CO2 absorbed by short-lived plants, which is released back into the atmosphere by decay, within a year or so. It is typically estimated to be less than five years, but it is completely irrelevant. The residence time that matters is the "adjustment time," which governs how fast nature lowers the atmospheric CO2 level. If mankind's CO2 emissions went to zero, the "adjustment time" is the decay time-constant ("e-folding time") governing the slope of the initial decay curve. It is about fifty years (half-life 35 years). ### [David Burton, United States of America]	Rejected. The reviewer is wrong. Please review the carbon cycle chapter in e.g. the TAR with regard to the "residence time" of CO2.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
24231	41	1			"many centuries" is inconsistent with Ch. 4 [Bryan Weare, United States of America]	Noted. Ch4 confirms the long-term effects of earlier emissions and the persistence of many aspects of climate change for centuries. Not sure why the reviewer thinks "many centuries" is inconsistent with Ch4.
125253	41	2	41	2	Consider clarifying the text by inserting the following phrase: "... were stopped immediately DUE TO THE LONG ATMOSPHERIC LIFETIME OF CO2 COUPLED WITH THE NATURE OF MANY IMPACTS." [Trigg Talley, United States of America]	Taken into account. Text clarified and reference added to Chapters 4 and 5. We do note that there is no single atmospheric lifetime of CO2.
36699	41	2	41	4	If AR5 had managed to substantiate its claims then this sentence might be meaningful. As things stand it is merely an assertion. [John McLean, Australia]	Noted.
111929	41	2		4	Is there any new supporting literature on this? [Tomas Halenka, Czech Republic]	Noted. Yes, but the new, post-AR5 literature is assessed in the subsequent chapters, in particular Chapters 4 and 5.
19165	41	4	41	4	I am not sure why the removal has to occur over a sustained period. The whole idea with carbon budgets is that it doesn't matter much when emissions, or removal for that part, exactly happens in time. Also, there are technological means in existence, so I would avoid being categorical in the end [Thorsten Mauritsen, Sweden]	Rejected. First, we are summarizing a conclusion of AR5 here, as the sentence makes clear. Second, the "sustained period of time" is required because CDR could not be done all at once and, further, would compete with ongoing positive emissions. Technological means "exist," yes, but none so far are proven at scale and at a manageable cost -- hence our conclusion that the means for large net CO2 removal are "as yet unavailable." Sentence now reads: "According to AR5, a large fraction of this change is essentially irreversible on a multi-century to millennial time scale, barring large net removal ("negative emissions") of CO2 from the atmosphere over a sustained period through as yet unavailable technological means (IPCC, 2013, IPCC, 2018; see Chapters 4 and 5)." See Chapter 4 Section 4.3.6.2.
77171	41	7	42	29	While this is technically interesting, it is not clear how useful it is in framing the report? [Emer Griffin, Ireland]	Noted. The fact that past projections match subsequent observations helps build confidence in the projections.
112875	41	7	42	40	Section 1.3.6 deals with the topic "How do previous climate projections compare with subsequent observations". However, the first issue should address the following problem: "How do previous climate model reconstructions compare with past climate changes in the last 1000 years, 2000 years, the Holocene?" Figure 1.5 should show non only the NASA GISTEMP but also the other ones as done in Figure 1.6. Figure 1.6 at page 170 is not convincing because it shows temperature records against computer simulations arbitrarily starting in 1990. What happens if the starting point is changed to 1950, or 1900, or 1850? [Nicola Scafetta, Italy]	Noted. Other Chapters and IPCC assessment reports show the historical model simulations and the observations together back to 1850. That is not repeated here. Other Chapters discuss the longer term simulations.
10341	41	7			Need to describe difference between "prediction" and "projection" here (e.g., 1.4.3). The text is using 'projections' as if they are 'predictions'. [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Text revised.
13203	41	8	41	8	It's suggested to address the issue of lack of data, in validating simulations with models. [Maria Amparo Martinez Arroyo, Mexico]	Noted. Not enough space for those details here.
101479	41	9	41	48	This is all great and really helpful. Can you please give the actual CO2 ppm in 2017 at the end to compare? [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Noted. We chose not to go into this level of detail as multiple GHGs are important to assessing these projections.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
132625	41	11	41	14	This statement needs to be sharpened considerably. The commentary by Stouffer and Manabe (2017) is not a very careful analysis. It shows general consistency between models and observations in features like more warming over land than oceans and more warming in the northern hemisphere than the southern hemisphere. But their choice of colorbar and choice not to plot the Southern Ocean hides substantial model - observational mismatching in warming rates in the Pacific Ocean and Southern Ocean since about 1980, as has been pointed out by many papers (e.g., doi: 10.1038/NGEO2828, 10.1002/2017GL074964). This model -- observations mismatch in warming patterns is a major theme in Chapter 7 because it affects radiative feedbacks and thus estimates of ECS and TCR over the historical record, and is discussed in Chapter 9 as well. We should make sure that our assessments of model -- observations comparisons in warming patterns is consistent. [Kyle Armour, United States of America]	Noted. There is a lack of space to go into the details here, so the papers assessed are only briefly mentioned.
6435	41	14	41	14	Should "GMST" be "GSAT"? [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Text revised.
14497	41	15	41	15	why isn't the third assessment report referred to as AR3 rather than TAR? A consistent format would help readers follow the many acronyms used in this report. [Amy East, United States of America]	Noted. This is the standard acronym.
102467	41	16	41	16	"pre-industrial" - the word "times" should be appended. [Philippe Tulkens, Belgium]	Taken into account. Text revised.
6437	41	17	41	17	Should "GMST" be "GSAT"? [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Text revised.
125255	41	20	41	26	It seems like this paragraph should come at the beginning of this section (1.3.6) OR begin the section with a paragraph about whether GCM runs were meant for sub-30yr evaluation. It used to be common practice to say "GCMs aren't intended to capture interannual variations. Rather, they're intended to capture, long-term trends over climatological timescales." Of course, there's a middle ground between interannual and multi-decadal, which is where this text strikes at, but more context should be provided about the strengths and limitations of using GCMs for sub 30-yr evaluation. [Trigg Talley, United States of America]	Noted. Text edited, but limited space.
89997	41	20	41	26	This account ignores the contribution of internal variability to the uncertainty. [Jochem Marotzke, Germany]	Noted. Regional variability is discussed.
70531	41	23		24	I would phrase as 'to differences between radiative forcings prescribed in models and those which actually occurred, including differences in aerosol emissions, greenhouse gas concentrations or volcanic forcing.'. [Gillett Nathan, Canada]	Taken into account. Text revised.
10343	41	23			Do not use the word "incorrectly" here. The climate model projections should have forcing inputs that follow given scenarios or pathways. That these may subsequently differ from what actually happens is NOT an error. Projections are not predictions (1.4.3). [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Text revised.
10345	41	28	41	34	Should mention that the observed record itself has changed over the period being assessed. e.g., NASA GISSTEMP, like all obs datasets, has evolved slightly over the years (e.g., changes in warming trends over the end of the 20th Century due to dataset improvements) which will effect past and future assessments. [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Noted. No space to go into these details.
28697	41	29			Not clear what the Hausfather method is or is this what is described next? [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Text revised.
6439	41	30	41	30	Should "GMST" be "GSAT"? The caption of Figure 1.5 states that the projections are of GSAT. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Text revised.
102469	41	36	41	36	"pre-industrial" - the word "times" should be appended. [Philippe Tulkens, Belgium]	Taken into account. Text revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
28699	41	36			"quite successful" is vague (also p.42 L24) [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Text revised.
19167	41	37	41	37	Forcings are not observed [Thorsten Mauritsen, Sweden]	Taken into account. Text revised.
107207	41	37		40	[pt 1 of 3] The text says, "For example, the Scenario B presented in Hansen et al. (1988) projected around 50 percent more warming than has been observed during the 1988-2017 period, but this is largely due to an over-estimation of subsequent radiative forcings." That's wrong, because scenario B is the wrong scenario. In his congressional testimony http://sealevel.info/1988_Hansen_Senate_Testimony.html Hansen told Congress that scenario A was "business as usual," and the paper described it as "assumed annual growth [which] averages about 1.5% of current emissions." Scenario B envisioned emissions cuts that didn't happen (except for CFCs, but the decline in CFC emissions was just "business as usual," because of the existing Montreal Protocol of 1987 and the Vienna Convention For The Protection Of The Ozone Layer of 1985.) [cont'd] [David Burton, United States of America]	Rejected. This section discusses the projections presented in the Hansen et al paper not his testimony. We have used the radiative forcings in those projections to make the assessment.
107209	41	37		40	[pt 2 of 3] CO2 emissions actually increased even faster than their 1.5% per year "scenario A" assumption, averaging +1.97% per year, and totaling 66% in 26 years. https://cdiac.ess-dive.lbl.gov/ftp/ndp030/global.1751_2014.ems For scenario A, the projection in their accompanying graph showed a temperature increase of 0.37°C per decade, and the text of the paper discussed a "warming of 0.5°C per decade." Depending on which temperature index you use, https://sealevel.info/GISS_vs_UAH_and_HadCRUT_1960-2014_woodfortrees_annot2.png the actual rate of warming was 0.8°C per decade (UAH6) to at most 0.16°C per decade (GISS), and even the higher of those rates is less than half of the 0.37°C/decade shown in their graph, and just 1/3 of the 0.5 °C they discussed in the paper. [cont'd] [David Burton, United States of America]	Rejected. This section discusses the projections presented in the Hansen et al paper not his testimony. We have used the radiative forcings in those projections to make the assessment.
107211	41	37		40	[pt 3 of 3] The most consequential mistake Hansen et al made was not anticipating that negative feedbacks would remove at least much of the CO2 emitted by mankind, and reduce the rate of increase in CO2 levels. In their paper, they conflated emissions with changes in GHG levels, because they didn't expect them to be different. So, even though CO2 emissions increased exponentially at nearly +2% per year, CO2 levels increased much more slowly, which Hansen et al obviously did not expect, which is the main reason they overstated the warming. (It also appears that they modeled CFCs as increasing, rather than decreasing, despite the existing Montreal Protocol of 1987 and the Vienna Convention For The Protection Of The Ozone Layer of 1985 that ensured CFC levels would decline.) ### [David Burton, United States of America]	Rejected. This section discusses the projections presented in the Hansen et al paper not his testimony. We have used the radiative forcings in those projections to make the assessment.
14499	41	42	41	43	fix the superscript notation ("^-2" should be superscripted) [Amy East, United States of America]	Taken into account. Text revised.
19169	41	43	41	43	Delete 'observational' [Thorsten Mauritsen, Sweden]	Taken into account. Text revised.
10347	41	44			Shouldn't use "aligns" here. Might give impression that one would expect a projection to perfectly match the actual observed trends over a few decades (e.g. fig 1.8 shows the role internal variability can have on decadal trends) [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Noted but aligns has been retained.
125257	41	45	41	46	It's not clear this statement is true. Old projections are still scenario-dependent, right? So, how could a blanket statement about "past climate model projections" having overestimated actual [CO2] be completely true without caveats? [Trigg Talley, United States of America]	Noted. The results for FAR are from the BAU scenario as discussed by Hausfather et al. 2020.
90039	41	45	41	46	Is it climate model projections or the scenarios used ? [Govindarajalu Srinivasan, Thailand]	Taken into account. Text revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
70533	41	45		48	Suggest including the explanation for why past climate model projections had too high CO2 concentration and radiative forcing. Was it too high emissions, or too weak sinks? This is important for the interpretation. [Gillett Nathan, Canada]	Noted. No space to go into these details.
89999	41	47	4	47	assuming, not forecasting. CO2 concentration was input, not result. [Jochem Marotzke, Germany]	Taken into account. Text revised.
651	41	51	41	51	The GIS TEMP line should be in the legend and clearly labelled as observations. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Figure revised.
19171	41	53	41	53	The figure could be visually more compelling [Thorsten Mauritsen, Sweden]	Taken into account. Figure revised.
36703	41	53	42	8	The caption to Figure 1.5 is meaningless waffle because it doesn't have an explanation of the method. (I also notice that you provide no reason for the inclusion of the method and it looks like it might be only because it supports your argument, If it didn't support your argument would you have mentioned it?) [John McLean, Australia]	Rejected. The paper on which the figure is based is clearly cited.
10349	41	53	42	8	Uncertainties must be shown, where available, in the graph, projections and observed. They should be discussed somewhere in the text. [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The original paper on which this figure is based did not include this information.
37625	41	53	42	8	It may be better to show uncertainty range of the most recent estimate to avoid giving an impression that all the projections are deterministic. [Masahide Kimoto, Japan]	Noted. The original paper on which this figure is based did not include this information.
29693	41	53	42	8	This figure caption differs from the one in page 169. [Hernan Edgardo Sala, Argentina]	Taken into account. Caption revised.
13155	41	55	41	55	Missing () [Maria Amparo Martinez Arroyo, Mexico]	Taken into account. Figure revised.
115723	41		41		vague expressions "quite successful", "have tended to"... This section would benefit from a more rigorous approach + use of confidence language + cautiousness about insights from model fit for recent trends (how to interpret this). Reformulation is needed to reflect on prescribed forcing(or CO2 concentration) vs actual ones (validity of scenarios) (especially the last lines 45 to 48. [Valerie Masson-Delmotte, France]	Taken into account. Text revised.
85971	42	0	42	0	Fig 1.6 is extremely useful for messaging: it explains how North Americans, by looking at their own regional data only, can still doubt that climate change is real. This needs to be discussed somewhere. – Please add a Southern African box (a climate change hotspot), and South American box (for balance). [Debra Roberts and the Durban WGII TSU, South Africa]	Noted. Unfortunately the FAR did not include regions in southern Africa or South America so there are no regional projections to assess.
36707	42	14	42	14	Please report the total surface area covered by the five regional temperature projections. It looks very unlikely for them to even amount to 10% of the earth's land area. [John McLean, Australia]	Rejected. These are all the regions assessed in the FAR so are the only places that can be included.
13157	42	14	42	14	(IPCC (1990)) change to (IPCC, 1990) due to stlye [Maria Amparo Martinez Arroyo, Mexico]	Taken into account. Text revised.
36705	42	16	42	16	Wrong. You do not know, and it is impossible to know, what the pre-industrial temperatures were, so it logically follows that you cannot discuss warming from some imaginary baseline. (FWIW, the FAR took 1765 to be the end of pre-industrial times and AR6 is using 1750.) [John McLean, Australia]	Rejected. No science basis.
14501	42	16	42	16	add a noun to make the phrase grammatically correct: "pre-industrial time" [Amy East, United States of America]	Taken into account. Text revised.
19173	42	17	42	18	Does this statement refer to FAR? I find it confusing to repeat statements from earlier reports [Thorsten Mauritsen, Sweden]	Taken into account. Text revised.
19499	42	19	42	19	is better add after climate change "impact" [Hamideh Dalaei, Iran]	Noted. Text edited.
68029	42	23	42	25	"However, temperature change has tracked at or below this range for Central North America and Australia boxes, but within the range reduced by 30% lower for a more realistic lower global warming estimate." Please clarify this statement? [Michael Evans, United States of America]	Taken into account. Text revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
112543	42	23	42	39	more policy and nationally relevant are analysis at the national level that include precipitation such as: Dessai S, Hulme M (2008) How do UK climate scenarios compare with recent observations? Atmos Sci Lett 9: 189–195. this should referenced/mentioned in this section [Suraje Dessai, United Kingdom (of Great Britain and Northern Ireland)]	Noted. For space reasons we have chosen to focus on the large scale projections from IPCC reports.
113033	42	27	42	29	This statement has already been repeated multiple times in this section. [Diego Miralles, Belgium]	Taken into account. Text revised.
125259	42	47	45	25	[PROGRESS] Key findings from the three AR6 Special Reports come here on page 42. After so much unnecessary material, it is a relief to see them. Note this summary of the Special Reports was supposed to be the first section according to the approved outline for Chapter 1. [Trigg Talley, United States of America]	Noted.
41365	42	47			This is a very valuable box, thanks! [Alexander Nauels, Germany]	Noted. Thank you.
70071	42	47			Very useful box! [Sonia Seneviratne, Switzerland]	Noted. Thank you.
70073	42	47			Note that the box text on the IPCC SR15 will need to be revised based on the decisions that will be reached within the report on the definition of global average temperature. In the SR15, GMST was used for global warming up to present, and GSAT for model-based analyses. It is possible that other definitions for global average temperature will be used in the context of the AR6 WG1 report, in which case differences resulting alone from definitional aspects in the present report should be clearly highlighted in this box. [Sonia Seneviratne, Switzerland]	Taken into account. Box 1.2 reproduces the temperature metrics as they appeared in the respective SPMs of the SRs. In AR6 long-term changes of GMST and GSAT are considered to be equivalent, differing in uncertainty estimates only. This is made clear in a footnote in Box 1.2.
37729	42	49	42	56	warming rates should be stated for rural sites and also for urban sites so corrections for the urban heat island effect are made [Howard Brady, Australia]	Rejected. This level of detail is beyond the scope of the box.
36709	42	51	42	51	You don't know what the temperatures were in pre-industrial times - is that 1750 or earlier? - so how can you claim to know how much the temperature has risen since then? The small amount of European temperature data available at that time cannot be taken as a global average; Europe was in the Little Ice Age at the time. Nor can data for 1850-1900 be averaged and form an indicative pre-industrial temperature because until 1904 data was available from less than half of the Earth's surface (and a lot less than that in the period 1850-1875). [John McLean, Australia]	Rejected. The claims are not supported by the available literature.
29697	42	52	42	53	Unbalanced parentheses in "(SRCCL, (IPCC, 2019a)". [Hernan Edgardo Sala, Argentina]	Editorial. Done.
125261	42	52	42	65	The SROCC sentence is described as assessing 'new literature' but the SRCCL sentence does not have the same language. Is there a reason for this difference, or were the special reports conducted with the same directives? [Trigg Talley, United States of America]	Noted. It is clear from the context that both SROCC and SRCCL addressed the current state based on new literature.
29699	42	55	42	56	Unbalanced parentheses in "(SROCC, (IPCC, 2019b)". [Hernan Edgardo Sala, Argentina]	Editorial. Done.
85973	43	9	43	9	This CCB is probably an important vehicle to convey some high level powerful messages. Mention hotspots of warming. [Debra Roberts and the Durban WGII TSU, South Africa]	Rejected. Space limitations do not allow for this level of detail.
36711	43	9	43	11	We're back again to a (presumably) reasonably accurate statement of false claims made in previous IPCC reports. I cannot claim that what you say about the content of those reports is inaccurate because it's those earlier reports that contain the errors and they can't be corrected. That said, what you quote and discuss from those earlier reports is utterly useless given that those reports had significant errors and made unsubstantiated claims. [John McLean, Australia]	Noted.
39909	43	9			"The SR1.5 estimated with very high confidence that human activities caused a global warming of approximately 1°C between the pre-industrial period and 2017." However the text is only high confidence in SR1.5 SPM and TS. [TSU WGI, France]	Accepted. Changed as suggested.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
110743	43	10	43	10	is the year 2017 correct? [Bruno Korgo, Burkina Faso]	Noted. The statement is correct (footnote 5 for A1 in SR1.5 SPM).
6441	43	10	43	11	As GMST is not something that is observed, but rather something that is derived from observations, I suggest deleting "observed" and replacing "was" by "is estimated from observations to be". It is important to convey that the figure of 0.87°C is an estimate, as it is in effect a little over 0.1°C larger than the value implied by SR1.5, as noted in comment 42 on the Technical Summary. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Noted. No change. The statement on GMST is taken directly from A1.1. of the SR1.5 SPM.
113035	43	18	43	18	Please add confidence in brackets after 'drought in some regions'. [Diego Miralles, Belgium]	Accepted. Added (medium confidence).
125263	43	24	43	25	SROCC SPM includes (high confidence) at the end of this sentence, but that is not shown here. Would be best to make the language here exactly match the SPM since much of the wording is verbatim. [Trigg Talley, United States of America]	Accepted. Added (very high confidence) at the end of the sentence as in the SROCC SPM (not high confidence).
28701	43	26			"oxygen was lost" - not clear what this means: totally or just a significant decline? [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Changed 'oxygen was lost' into 'loss of oxygen occurred' as this is literally the sentence taken from the SROCC SPM. Worded this way does not imply total loss.
125265	43	30	43	30	It might be helpful to the general reader to say "...all components including ice sheets and glaciers, snow cover, Arctic sea ice, and permafrost" to be more specific. There are some parts of the cryosphere, such as Antarctic sea ice for example, where there is not documented shrinking (the quote here is from the SROCC SPM). [Trigg Talley, United States of America]	Taken into account. See comments #101481 and #115725.
101481	43	30	43	30	"nearly" all components - no trend in Antarctic sea ice (and presumably some local glaciers) [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Added 'nearly'.
74023	43	30	43	38	The noted changes in cryosphere refer up to 2016. Updated change rates were published after fall 2019, which I believe should have been used to update the rates: 1. https://www.nasa.gov/feature/jpl/greenland-antarctica-melting-six-times-faster-than-in-the-1990s 2. https://www.pnas.org/content/116/19/9239#:~:text=In%201972%E2%80%932000%2C%20D%20averaged,%C2%B1%20%25%20decrease%20in%20SMB . 3. https://www.nature.com/articles/s41612-020-0121-5#:~:text=Under%20Representative%20Concentration%20Pathway%20(RCP,1.67%E2%80%935.61%20m%20by%202300 . 4. https://www.nature.com/articles/s41586-019-1855-2 [Sergiu Dov ROSEN, Israel]	Rejected. The box reproduces the findings of the Special Reports. Updates are discussed in the present AR6 report in chapters 2 and 9.
73945	43	30	43	38	Time periods for estimation of cryosphere trends mentioned in this text are too short, and it is difficult to judge whether such statements as 'very likely' are really based on strong experimental evidence. [Elena Kozlovskaya, Finland]	Noted. No change as qualifiers are taken literally from the respective SPMs.
125267	43	37	43	38	This last sentence combines two findings from SROCC, but the resulting sentence is not quite accurate. From SROCC: "Feedbacks from the loss of summer sea ice and spring snow cover on land have contributed to amplified warming in the Arctic (high confidence) where surface air temperature likely increased by more than double the global average over the last two decades. " Arctic air temperatures are 2x the global average, but this is only in part due to the feedbacks (there are also other mechanisms) so that the combined sentence is no longer accurate. [Trigg Talley, United States of America]	Accepted. Wording changed.
16297	43	37	43	38	There were other reasons for doubling [Cunde Xiao, China]	Taken into account. See comment #125267.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
46583	43	38	43	38	The primary driver of Arctic amplification are temperature-related feedbacks (Planck and lapse rate) which should be reflected here. The current statement does erroneously quote SROCC: SROCC sazs that the ice loss has "contributed" to the doubling of warming [Dirk Notz, Germany]	Taken into account. See comment #125267.
37819	43	42	43	43	Box 1.2 addresses the key findings in Special Reports during AR6 cycle. In this respect, the increase of Category 4 and 5 cyclones with "low confidence" seems to be not quite relevant to Box 1.2. [Junhee Lee, Republic of Korea]	Rejected. Sentence kept as the preceding sentence dealt with the increased effects of tropical cyclones.
114221	43	47	43	47	Sounds as if this was new knowledge. Needs reformulation. [Jan Fuglestedt, Norway]	Accepted. Changed 'found' in 'stated'.
113037	43	48	43	50	This statement is ill-phrased: 'It estimates with medium confidence that AFOLU activities accounted for 23% of the total net anthropogenic emissions of GHGs, and 13% of CO2 emissions'. Please add error bars or a range to those percentages; you certainly do not mean that you have medium confidence that this amounts to exactly and precisely 23.0%. Same for the 29% a few lines below. [Diego Miralles, Belgium]	Accepted. Sentences rephrased to reflect uncertainties.
114223	43	49	43	49	The number 23% of total GHG is probably based on GWP100 - which could be stated in parenthesis [Jan Fuglestedt, Norway]	Noted. In fact the number was given in CO2 equivalents, which is now mentioned.
45745	43	49	43	49	"total net anthropogenic emissions of GHGs". It's unclear how the emissions of GHGs can be lumped into a single total amount, as the concept of CO2 equivalence hasn't been introduced yet. [Twan van Noije, Netherlands]	Accepted. The number in CO2 equivalents is given.
16683	43	49	43	51	I would strongly suggest that the sentences on AFOLU do not try to aggregate the different GHGs. I know that SRCL did do that, but there is no need to make that mistake here. The statement that combined AFOLU activities contribute 21-37% of total GHG emissions is extremely provocative and is only true for one CO-eq metric that doesn't relate to any of the Paris goals. It would be much safer to focus on the CO2-only contribution of AFOLU and refer to the CH4 and N2O contribution seperately if needed. [William Collins, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Sentence cut.
83927	43	50	43	52	omit, or include the information eslwere. If the focus is land use, the additional emissions of pre and post activities of the food system should not be included. Transportation and energy, for instance, are important part of those activites, and unlesse all the economic systems, and product chains are considered in the same detail, this targetting should not be exclusive. [Marco Tulio Cabral, Brazil]	Accepted. Sentence cut.
115725	43		44		Missing error bars on reporting warming levels. Wrong reference to SROCC "widespread shriking of all elements", incorrect / lack of trend / Antarctic sea ice. Missing reference to urban climate addressed in SRCL. [Valerie Masson-Delmotte, France]	Accepted. Error bars and a sentence on urban climate have been added. The summarizing sentence for the SROCC was modified to include Antarctic sea ice.
113039	44	7	44	7	Sentence reads gramatically wrong. [Diego Miralles, Belgium]	Accepted. See also comment #70537.
125269	44	7	44	9	'Net' appears in front of 'methane' in SROCC and is required for the sentence to be correct. [Trigg Talley, United States of America]	Accepted. Added 'net'.
107819	44	8	44	9	Why is there medium confidence and low agreement on this? A later statement (need to find it) seems to contradict this, p. 45 ll. 10-11. [Linda Mearns, United States of America]	Noted. The language is taken directly from the SROCC. No contradiction. The sentence on ll 8-9 refers to today, the statements on p. 45 ll. 10-11 to the future.
70537	44	8		9	It doesn't make sense to write 'there is medium evidence... whether northern permafrost regions are currently releasing additional methane and CO2'. Replace 'whether' with 'that'? (but ensure consistency with SROCC). [Gillett Nathan, Canada]	Accepted. Revised as suggested.
112003	44	13	44	16	This sentence: "The SR1.5 concluded that global warming is likely to reach 1.5°C between 2030 and 2052 if it continues to increase at the current rate (high confidence)" needs rewording. What is "it"? You mean "if emissions continue to increase at the current rate." [Cynthia Randles, United States of America]	Rejected. The 'it' refers to global warming, the wording was taken literally from SR1.5 SPM.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
83929	44	14	44	16	while past emisisions alone will not raise GMST, current emissions alone also have limited influence. The accumulation of emissions, that have started earlier added to new ones, are the cause and impact observed. Historical emissions are a concern, and cannot be reversed. the focus is in what can be done to avoid new emissions currently, so as not to add additional burden to the historically accumulated emissions. [Marco Tulio Cabral, Brazil]	Noted. The comment is well taken, but is not backed up by a relevant statement in the SR1.5 that could have been reproduced in this overview of key findings. No change.
110745	44	18	44	22	this is especially remarkable in west africa monsson region [Bruno Korgo, Burkina Faso]	Noted.
114225	44	19	44	19	I think "centered around 2017" could need some explanation. My experience is that it is not always fully uderstood what this means [Jan Fuglestvedt, Norway]	Taken into account. 'Centered around 2017' cut from the sentence not to cause any additional confusion.
35459	44	20	44	20	* C repeats [Carlos Antonio Poot Delgado, Mexico]	Editorial. No change as this is taken literally from the SPM.
125271	44	24	44	29	[SCOPE] Delete this paragraph. It is WGII content and does not belong in the WGI report. [Trigg Talley, United States of America]	Accepted. Paragraph cut.
112545	44	28	44	28	add "some" before "regional climate characteristics" since it doesn't apply to precipitation, wind and many other ECVs [Suraje Dessai, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. 'Some' was not in the SR1.5 SPM wording. The reviewer meant line 18.
125273	44	31	44	34	Quotes are likely not needed here since much of the box already takes findings from the special reports verbatim. [Trigg Talley, United States of America]	Editorial. Accepted.
114227	44	36	44	36	I think you could say that this was for RCP8.5 [Jan Fuglestvedt, Norway]	Accepted. Replaced 'high emission scenario' by 'RCP8.5 scenario'.
71847	44	36	44	36	It is incorrect to state that the SROCC projected increasing rates of sea level rise for all scenarios. I believe that for RCP2.6 that the rate stabilises during the 21st century (and even decreases late in the 21st century). [John Church, Australia]	Rejected. I agree with the reviewer, however this sentence is taken directly from the SROCC SPM, B3. The statement does not specify the time period and for sure it applies for the coming decades for all scenarios.
125275	44	36	44	48	How is there no quantified projection of SLR in 2100 in this entire paragraph? Authors miss several opportunities throughout this chapter to provide clear, concise quantified findings, opting instead to provide gobs of qualitative "context." [Trigg Talley, United States of America]	Accepted. A sentence is included for sea level projections: 'For the period 2081-2100 with respect to 1986-2005, the likely ranges of GMSL rise are projected to be 0.26-0.53 m for RCP2.6 and 0.51-0.92 m for RCP8.5.'
125277	44	37	44	37	SROCC includes global 'mean' sea level rise. [Trigg Talley, United States of America]	Accepted. Added 'mean'.
86183	44	37			Provide the AR5 sea level rise figures to enable understanding. [Debra Roberts and the Durban WGII TSU, South Africa]	Accepted. A sentence is included for sea level projections: 'For the period 2081-2100 with respect to 1986-2005, the likely ranges of GMSL rise are projected to be 0.26-0.53 m for RCP2.6 and 0.51-0.92 m for RCP8.5.'
88159	44	38	44	40	Should some explanation be provided for "extreme sea level event" - Some might interpret this as a rapid and short-term increase in global mean sea level when I assume you mean local increases due to things like storm surges etc. [Sharon Smith, Canada]	Rejected. An 'event' is understood as a single occurrence of a process.
107199	44	41		43	[pt 1 of 3] It says, "According to SR1.5, by 2100, sea level rise would be around 0.1 m lower with 1.5°C global warming compared to 2°C (medium confidence). Even though sea level will continue to rise well beyond 2100, it will do so at a slower rate and a lower magnitude for a lower warming..." But SR1.5 is wrong. That claim is in defiance of the fact that there's been no significant, sustained, detectable acceleration in coastal sea-level rise since the 1920s, despite a global temperature increase of between 0.5°C and 1.0°C (depending on which temperature index you use). https://tinyurl.com/wft1920-2014 [cont'd] [David Burton, United States of America]	Rejected. Claim not supported by the available literature.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
107201	44	41		43	[pt 2 of 3] Note that what the IPCC calls "1.5°C" really means only 0.5°C (and 2°C means 1°C, etc.) relative to CURRENT temperatures, so those increases are very similar to the temperature increase we've already seen since the 1920s, which caused no detectable increase in the rate of sea-level rise. https://sealevel.info/1612340_Honolulu_Wismar_Stockholm_vs_CO2_annot3.png [cont'd] [David Burton, United States of America]	Rejected. Claim not supported by the available literature.
107203	44	41		43	[pt 3 of 3] So, how can that be? This report does not say (and doesn't even admit the fact). AR6 needs to explain that in a warming climate some processes increase sea-level rise (glacial meltwater, etc.), but other processes DECREASE sea-level rise (increased snowfall accumulation on ice sheets, because warmer air carries more moisture, and because reduced sea ice coverage increases evaporation and Lake/Ocean-Effect Snowfall), and there's no fundamental reason to suppose that either of those changes will dominate the other. If the processes that increase sea-level exceed the processes that decrease sea-level, then sea-level rise will accelerate. But if the processes that decrease sea-level exceed the processes that increase it, then sea-level rise will decelerate. The fact that sea-level trends have done neither over the last nine decades tells us that the two kinds of process are very closely matched. ### [David Burton, United States of America]	Rejected. Claim not supported by the available literature.
111933	44	45		48	This looks a bit in a contradiction. Supposing the 2 degrees will be adequate to the RCP2.6 scenarios around the 2100, triggering multimetres sea level rise in next centuries vs. limitation at 1 m in 2300 [Tomas Halenka, Czech Republic]	Noted. No contradiction. The time scale is of importance here: 'hundreds to thousands of years' vs. '2300'.
35461	44	46	44	46	* C repeats [Carlos Antonio Poot Delgado, Mexico]	Editorial. Not done. Stick to SPM formulation.
114229	44	47	44	47	This was for an extension of RCP2.6. Please mention assumption about post 2100 emissions. [Jan Fuglestad, Norway]	Accepted. Added 'extended'.
41367	44	47	44	48	Please add the quantitative information for 2300 under RC8.5 as provided in SROCC, e.g. "... while multi-meter sea-level rise is projected under RCP8.5 (likely range: 2.3-5.4 m)." [Alexander Nauels, Germany]	Accepted. Revised as suggested.
125279	44	55	44	55	SROCC includes a (medium confidence) at the end of this sentence. Best to be exactly consistent with SROCC SPM since much of this box is verbatim. [Trigg Talley, United States of America]	Accepted. Revised as suggested.
125281	45	2	45	25	[SCOPE] This whole section should be deleted. It is WGIII content and does not belong in the WGI report. [Trigg Talley, United States of America]	Accepted in part. The sentences starting at line 18 of this paragraph were deleted.
15905	45	4	45	12	While the temperature rise may correspond approximately linearly with the cumulative CO2 emissions, this belies the fact that the radiative forcing follows a logarithmic relationship with CO2 concentration, and thus the linear relationship would indicate that the amplifying factors have already been initiated and are having an effect. [Kevin Lister, United Kingdom (of Great Britain and Northern Ireland)]	Noted.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
107205	45	4		18	It says, "The SR1.5... concluded that all emission pathways with no or limited overshoot of 1.5°C imply that global net anthropogenic CO2 emissions decline by about 45% from 2010 levels by 2030, reaching net zero around 2050, together with deep reductions in other anthropogenic emissions such as methane and black carbon. To limit global warming to below 2°C, CO2 emissions would have to decline by about 25% by 2030 and reach net zero around 2070." This is more "carbon budget" nonsense that should be deleted, because it is spectacularly wrong. If anthropogenic CO2 emissions declined by about 45% from 2010 levels by 2030, and then dropped to net zero around 2050, CO2 levels and forcing would be no longer be increasing at all by 2030, and would be dropping rapidly by 2050. Those falling CO2 levels would be expected to cause temperatures to FALL, not level off at 0.5 °C above current temperatures. [David Burton, United States of America]	Rejected. Claim not supported by the available literature.
102471	45	6	45	7	While the use of percentage change with respect to specific climate variables, e.g. precipitation, is frequently used, in some cases the use of a percentage change can be misleading. For example the change in precipitation in a desert area may appear to be dramatic, but since - in absolute terms - the baseline precipitation is very low, let's say, 1 mm, a 25% change practically amounts to nothing in absolute terms (i.e. it will till be a desert area in the future). [Philippe Tulkens, Belgium]	Not applicable. This comment seems to be misplaced.
35463	45	7	45	7	* C repeats [Carlos Antonio Poot Delgado, Mexico]	Editorial - no change.
70855	45	8	45	10	Perhaps this isn't the best place for it, but somewhere it needs to be pointed out that phrases like "a one-in-two chance" in this context are very contingent, as they are based on current estimates of median ECS, and could change quickly with further research. [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. The statement follows the wording of the SR1.5. Speculations on how insights could change in subsequent assessments are not part of this overview of key findings of the AR6 Special Reports.
114231	45	9	45	9	This is for GSAT. In my view, you should also give the numbers for GMST [Jan Fuglestedt, Norway]	Accepted. The numbers for GMST have been included.
85975	45	9	45	9	What are the budgets for a 3 in 4 and a 4 in 5 chance? [Debra Roberts and the Durban WGI TSU, South Africa]	Rejected. These numbers are not provided in the SPM.
111935	45	9		10	GtCO2 [Tomas Halenka, Czech Republic]	Not applicable. Comment unclear.
106251	45	10	45	11	Maybe useful to clarify that the 100 GtCO2 adjustment applies to this century only. [Rogel] Joeri, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Revised as suggested.
66647	45	14	45	14	and throughout the report - I think "limited or no overshoot" should be caveated a bit - folks who use simple models tend to neglect natural variability, but it matters for statements such as this. It's really that the anthropogenic contribution to global mean temperatures shows limited or no overshoot over the period in question. The 30-year climatological mean should show (more or less) the same thing - but it is possible that a bunch of ENSOs and some solar forcing if phased appropriately over the peak could nudge temperatures over 1.5 (or any other threshold) for a fair while. Could it say something like "limited or no overshoot excluding natural variability" or "limited or no overshoot in the climatological mean"? [Dave Frame, New Zealand]	Noted - no action taken.
70075	45	15	45	16	An essential point is missing here. The IPCC SR15 highlighted that reaching net-zero CO2 emissions in 2050 would only give 50% chances of still reaching the 1.5°C limit with no or limited overshoot. It was highlighted in the SR15 SPM that reaching net-zero CO2 emissions in 2040 would lead to a much higher probability (close to 100% based on simulations at the time) of limiting global warming to 1.5 with no or limited overshoot - See figures SPM.1 and SPM.3a in the IPCC SR15. It would seem important to mention here both the implications of net-zero CO2 emissions in 2050 and 2040. [Sonia Seneviratne, Switzerland]	Noted. Whereas the reviewer is correct, there is no SPM key statement that could be quoted to back this up.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
114235	45	18	45	18	Timing of Net zero CO2 received most attention but SR1.5 also gave timing of net zero GHG - which is what Art 4 in PA focuses on. This is given in SR1.5 table. The time for net zero GHG is later than net zero CO2, and you may give both [Jan Fuglestedt, Norway]	Rejected. It is difficult to extract the exact corresponding numbers for GHG from the SR1.5 table. There is no key statement that could be quoted to back this up.
40895	45	18	45	18	the *hypothetical* use of CDR -- as this technology does not exist at scale. [TSU WGI, France]	Not applicable. Sentence was cut.
114237	45	18	45	22	You can explain more clearly that while SR1.5 highlighted the need for large negative emissions, the SRLCC looked more into this and assessed the issues and potential challenges related to negative emissions at large scale [Jan Fuglestedt, Norway]	Not applicable. Sentence was cut.
114233	45	20	45	20	This was also shown in SR1.5 [Jan Fuglestedt, Norway]	Not applicable. Sentence was cut.
86669	45	20	45	22	Regarding response options in the SRCCL, the report warns that many response options increase demand for land and competition with other societal needs. Encouragingly, many response options remain that can be implemented within existing land use and that may rather alleviate pressure on land. One challenge is that such response options, including improved productivity in agriculture, improved grassland management and improved soil management, must always be implemented on the micro-level and the improvements are not always easy to measure or upscale. Likewise, such response options are not always easy to take into account in projections/models. Therefore they tend to be overlooked. Please consider to mention this in your chapter. [Oyvind Christophersen, Norway]	Not applicable. Sentence was cut.
83931	45	20	45	22	the SRCCL concluded (...) well below 2oC required included land-based mitigation.... while LUC is an important part of pathways to limit warming, it will be impossible to achieve the expected goals without drastic reduction of CO2 emissions from energy and other sectors. [Marco Tulio Cabral, Brazil]	Not applicable. Sentence was cut.
86667	45	20	45	23	We appreciate the current formulation from the SRCCL. However, we believe that it is slightly too generic in its current form. The paragraph could gain additional value with a sentence that follows with more information, especially regarding the timeperspectives of different land based response options. From SRCCL SPM page 20 "While some response options have immediate impacts, others take decades to deliver measurable results. Examples of response options with immediate impacts include the conservation of high-carbon ecosystems such as peatlands, wetlands, rangelands, mangroves and forests. Examples that provide multiple ecosystem services and functions, but take more time to deliver, include afforestation and reforestation as well as the restoration of high-carbon ecosystems, agroforestry, and the reclamation of degraded soils (high confidence) ". Since we are presumably entering the decade of restoration we believe that this is especially important in AR6. You should also reflect some information regarding restoration of high-carbon ecosystems and reclamation of degraded soils in the SPM and TS. [Oyvind Christophersen, Norway]	Not applicable. Sentence was cut.
39571	45	20	45	31	Figure 1.7 illustrates that, independent on baseline choice, the projections of climate models are ALL above observations in 2014. [François Gervais, France]	Noted.
28703	45	25			this seems a weak concluding statement since it appears obvious that any emissions reduction will reduce negative impacts from climate change so is there something more quantifiable (e.g. reduce below threshold X or significant;y reduce by Y, ???) [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. Sentence was cut.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
28705	45	32			The first sentence can be removed without loss of information: "AR6 WGI builds on previous assessments using well established foundations and concepts." . The rest of the paragraph is signposting that can be gleaned from the contents page so could also easily be lost I think [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The text has been largely retained as a signposting.
114239	45	38	45	38	Is the storyline approach really used, or is it more presented as a possibility? [Jan Fuglestad, Norway]	Noted. We have pointed to the relevant sections from other Chapters.
85977	45	44	45	44	Re baselines, does setting different baselines in climate models produce different outputs? If yes, then the term 'baseline' is ambiguous, as it can mean the reporting baseline or some mathematical model input. In this case a different term for 'baseline' should be used when speaking about the model input. If choosing a different baseline does not produce different model projections, then it is only a matter of reporting. The only baseline (and the warming measure that goes with it, i.e. GMST or GSAT) that makes sense from a policy perspective in reporting on climate change is the one SR15 is based on, the baseline that involves a 1°C warming by 2017, and the baseline against which the Paris Agreement is worded. [Debra Roberts and the Durban WGII TSU, South Africa]	Noted. Baselines are only used for reporting. But pre-industrial is not the only useful baseline as for many climate variables we lack observations back that far, and we also need a baseline for the projections that is for a recent period.
107821	45	46	45	48	It is excellent that this issue is discussed explicitly [Linda Mearns, United States of America]	Noted - thanks.
36719	45	46	46	17	The significant omission from this discussion about anomalies and absolute values is that the HadCRUT4/CRUTEM4 station data shows that standard deviations, calculated across the common period 1941-1990, vary in inverse relationship with the monthly mean temperature (see section 2.8 of "An Audit of the Creation and Contents of the HadCRUT4 Temperature Dataset"). This indicates that a variation in absolute temperature of 1.0C near the equator is of a greater number of standard deviations than a 1.0C variation is in higher latitudes. On this basis, an anomaly of 1.0C at one location is NOT equivalent to an anomaly of 1.0C at another location and yet that is what deriving such things as the average global, hemispheric or regional anomalies assumes. Further, the standard deviations in SST and land-based temperatures are also inconsistent (see reference given here). [John McLean, Australia]	Rejected and unclear. Section 1.4.2 discusses the well known feature that the tropical regions, where mean temperatures are higher, generally have smaller variations from year to year. Anomalies are expressed in degrees C to be equivalent.
107213	45	49		51	Your job is to accurately convey the range of expert opinion. When you have a contentious scientific issue like coral reefs, and you cite only the work of the most extreme alarmist (Hughes), and ignore the compelling work of more moderate voices (Peter Ridd), you are practicing politics, not science. [David Burton, United States of America]	Rejected. There is no discussion of coral reefs in this section.
79863	45	52	45	52	I may have missed this earlier, but have you explained yet how a "long-term trend" is not "variability"? [Dáithí Stone, New Zealand]	Noted. These two terms are not explicitly defined as they are used in a variety of contexts.
79865	45	52	46	1	This point comes across as "climate models are all over the place and so we need to add a fudge". [Dáithí Stone, New Zealand]	Noted. Text has been edited.
26019	45	55	45	55	This is particularly true when comparing climate simulations with each other, or when comparing simulations with observations, as simulated climate variables are also affected by model bias that can be removed when they are presented as anomalies. It can also occur when comparing observational ... [Don Alfonso Pino Maeso, Spain]	Noted. Text has been edited.
102473	46	1	46	1	"pre-industrial" - the word "times" should be appended. [Philippe Tulkens, Belgium]	Noted. Box has been substantially revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
125283	46	1	46	1	The concept of "reanalysis" is introduced in this paragraph about the foundational concepts in this WGI report. But nowhere in the prior sections is there a good description of the concept of reanalysis. Need to add a very short text box about the "reanalysis" -- what it is and its purpose. Consider changing the title of 1.4.1 to "Baselines, reference periods, and reanalyses". Figure 1.7 presents a "reanalysis" of GMST. Lines 51-54 on page 69 provide a definition of "reanalyses" as model output constrained by observations using data assimilation techniques. That definition needs to come on page 46 or earlier in the chapter. [Trigg Talley, United States of America]	Noted. We have pointed to the relevant section in 1.5 from here in 1.4.
70091	46	3	46	10	Note that analyses from L. Beusch (ETH Zurich) show that the GSAT/GMST scaling is also dependent on whether GMST is computed from the blending of anomalies or absolute temperature across different surface types (land, ocean, sea ice). It would be useful to mention this point, to be documented in a paper likely to be accepted before the cutoff deadline. [Sonia Seneviratne, Switzerland]	Rejected. CCBBox2.3 discusses these issues in depth.
79867	46	3	46	10	I have not followed the point of this paragraph, e.g. what climate sensitivity has to do with it. [Dáithí Stone, New Zealand]	Noted. Additional sentence added to explain.
653	46	4	46	6	"For example, there is not a strong relationship between climate sensitivity and absolute global temperature (Mauritsen et al., 2012; Hawkins and Sutton, 2016)". This needs a bit more explanation. Presumably this is talking about model results, and the "absolute global temperature" refers to a preindustrial simulation? [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The text has been edited.
36715	46	5	46	5	The IPCC author is in dreamland. There is no such thing as "absolute global temperature". [John McLean, Australia]	Rejected. Models very clearly have an absolute global temperature.
36717	46	7	46	10	I suggest that you take a look at section 3.4.4 of "An Audit of the Creation and Content of the HadCRUT4 Temperature Dataset". In that section I show that the absolute value calculated from HadSST3 data sometimes has sea surface temperatures below the lowest ever recorded temperature of sea water (-2.6C). Some absolute sea surface temperatures derived from the 100 variants of HadSST3 are as low as -4.88C, which is simple impossible. [John McLean, Australia]	Noted. HadSST3 is not used in any of the global temperature datasets used in this Section.
46585	46	9	46	9	Please change "sea-ice extent" to "sea-ice area" for consistency with the primary metric in chapters 2, 4 and 9 [Dirk Notz, Germany]	Rejected, but only because the data that was made available was sea ice extent. This figure is an illustration and so the precise metric chosen is less important than elsewhere.
37667	46	12	46	17	Some more words may be necessary for the difference between lower two panels of Fig 1.7, in which scatter among the ensemble members seems to be larger outside the baseline periods. [Masahide Kimoto, Japan]	Noted. Figure revised and text updated.
114241	46	15	46	15	I suggest adding more refs on this quite fundamental issue [Jan Fuglestedt, Norway]	Noted, but no further references suggested or known.
70083	46	20	46	31	Figure 1.7: Very useful figure! [Sonia Seneviratne, Switzerland]	Noted - thanks.
24233	46	20			There are no specific comments related to the complex Fig. 1.7 [Bryan Weare, United States of America]	Noted and fixed.
29701	46	22	46	29	Two suggestions about Figure 1.7 and its corresponding legend: 1) Please, try to use more contrasting colors for the plotted variables. 2) Evaluate including also in the legend the selected periods used as baselines in the two bottom panels (1995-2014 left, 1981-2000 right). Also consider noting that these two panels have different scales on the vertical axis. [Hernan Edgardo Sala, Argentina]	Noted. Figure and colour choices improved and y-axis scales noted in caption.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
6443	46	28	46	29	The caption is incorrect. Jones et al. (1999) estimated the absolute value of GSAT (not GMST) to be 14.0±0.5°C. This is an important distinction, as although GMST and GSAT differ by only a few percent when expressed as anomalies, their absolute values differ more, due to differences in magnitude between marine air temperature and sea-surface temperature. [I can add, off the record, that Jones et al were probably being a bit cautious with their ±0.5°C, as the ERA5 and JRA-55 analyses are quite a bit closer than this to their estimate of 14°C. The calculation has yet to be published, however.] [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Fixed.
90001	46	34	48	40	Since the discussion came up during pre-LAM4: I think CC-Box 1.2 works well as is and sits comfortably alongside CC-Box 2.3. As long as they reference each other, a certain amount of overlap is perfectly acceptable, since the two boxes serve quite different purposes. [Jochem Marotzke, Germany]	Noted - thanks.
87523	46	36	48	4	I welcome this discussion, which goes some considerable way to overcoming any slight doubt potentially sown by the choice of 1850-1900 in SR1.5 [Stephen Humphreys, United Kingdom (of Great Britain and Northern Ireland)]	Noted - thanks.
80989	46	36	48	40	Please check that the information provided in Box 1.2 tallies with statements elsewhere in the text regarding pre-1850 temperature increases. [Jeffrey Philip OBBARD, Singapore]	Noted, but unclear about where other statements might be.
125285	46	36	48	40	Cross-Chapter Box 1.2 serves as an interesting academic discussion, but it's an exceedingly weedy detail. The whole box can be deleted to save space and the authors could just state what the reference or baseline choices are with BRIEF explanations for those choices. [Trigg Talley, United States of America]	Rejected. This material has been welcomed by other reviewers.
19175	46	36	48	40	Although I appreciate the work being done here, perhaps it is worth a thought how this might be perceived by policymakers, and to consider that the focus on the Paris Agreement could be reduced? It may be perceived as scientists moving the goal posts of the Paris Agreement, supposedly the targets were originally set based on the information about global temperature that existed at the time. Anyway, mostly a reflection on my side that the authors may want to keep in mind. [Thorsten Mauritsen, Sweden]	Noted - the emphasis on the PA has been slightly reduced in the revised version.
76793	46	36	48	40	Using a 1995-2014 modern reference period will create apparent discrepancies with previous report, including the recent special reports. I think that it would be much better to retain the established 1986-2005 reference period so that assessment findings can be easily and directly compared between reports. [Nerilie Abram, Australia]	Noted, but the 1995-2014 baseline has been retained as it is the appropriate period for the future projections to use.
41369	46	36			The comparison of observed warming estimates across IPCC assessment reports is a central aspect of the presentation of the new AR6 reference periods, readers of WGI AR6 will be looking for this information. At the moment, however, the box fails to provide a comprehensive and transparent line of sight to other assessments. The figure, for example, should also include HadCRUT4 GMST estimates that would allow to actually re-discover the observed warming presented in AR5. At the moment, the reader is left with 0.7 degC warming for 1986-2005 based on HadCRUT5 and has to do the math of what has changed and why, with the clear danger that the interpretation will be very different from what the authors are envisioning. Please provide a more comprehensive picture, as clear communication on this matter is so important. [Alexander Nauels, Germany]	Noted - the material has been moved around and a figure included to enable readers to translate between reference periods used in previous IPCC reports.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
100003	46	36			We wish to thank the authors for their hard work. This box is very important as it should facilitate the comparison of observed warming estimates across IPCC assessment reports. But the temperature metric has been changed in the AR6 and it does not seem to be addressed here. For justified comparison this information needs to be provided as without it, it will be impossible to compare warming levels provided for different reference periods of older Assessment Reports. Currently, the reader will try to compare (without success) 0.7 degC warming for 1986-2005 with AR5 numbers. In addition to the different reference periods, the figure and box have to provide estimates based on the 'old' metrics in order to allow for comparison. [Caroline Eugene, Saint Lucia]	Noted. The material has been moved around, and the temperature metric assessment changed since the SOD.
84145	46	36			This box is very important as it should facilitate the comparison of observed warming estimates across IPCC assessment reports. It should also include the issue of the AR6 temperature metric change. Without this information, it will be impossible to compare warming levels provided for different reference periods of older Assessment Reports. [Jeffers Cheryl, Saint Kitts and Nevis]	Noted. The material has been moved around, and the temperature metric assessment changed since the SOD.
114243	46	42	46	42	It is not clear whether you mean across the full set of AR6 reports or across WGI chapters. Please clarify. The three WGs have different needs here, but I see a strong need for a clear terminology. I suggest Ch1 gives an overview here - to the extent possible. [Jan Fuglestedt, Norway]	Noted, and text edited.
131365	46	42	46	44	Here you seem to distinguish between baseline and reference period while according to the Glossary baseline/reference seems to be synonym. There might be some clarification required, either here or in the glossary. I suggest to also refer to the glossary here. [Hans Poertner and WGI TSU, Germany]	Noted, and edits made to Glossary.
10363	46	48	47	51	The "Pre-industrial baseline" section is important, but one issue needs discussing. The impression from this discussion is that pre-industrial climate was somehow constant up to 1750s. This of course is not the case. Elsewhere in the report the misleading term "Little Ice Age" is used to describe the period 1450 to 1850 CE. Figure 2.11a shows that climate was slightly warmer in the centuries before 1750, and figure 2.4c shows CO2 concentration was decreasing before 1750. I wouldn't normally make a big deal of such small changes, but if the authors of this section are talking the significance of a tiny 0.05C difference between 1720-1800 and 1850-1900 (Hawkins, 2017) then it needs to also discuss the context of forcing and climate changes before 1750 as well! It might be 1850-1900 is not that bad a choice for PI in the end. [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Text has been edited.
4493	46	48	47	51	The reasoning here does not make sense. In most case studies and many regional and global temperature reconstructions, the year 1750 marks the coldest phase of the Little Ice Age (LIA). The period 1850-1900 lies at the end of the LIA and is already slightly warmer. A meaningful approximation for „pre-industrial global temperatures“ has to represent an average temperature over a longer (late) Holocene time span, e.g. the last 2000 or 10,000 years (until 1850). The choice 1850-1900 does clearly not fulfil this criterion. See Lüning & Vahrenholt 2017 (doi: 10.3389/feart.2017.00104) for details. Why do you not mention this issue in your report? Everybody will understand “pre-industrial temperature” as a long-term average. In the interest of transparency you should at least mention the average pre-industrial temperatures for the last 2000 and 10,000 years and explain how much your baselines deviate from these values. No absolute temperature values re needed, just deviations / anomaly scale. [Sebastian Luening, Switzerland]	Noted. Chapter 2 presents the long-term context (e.g. from PAGES2k) and this Box focuses on the period over which humans have influenced the climate and this is the appropriate relevant choice.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
36721	46	49	47	4	If news can be "fake news" then the text here makes "fake claims". There is no pre-industrial global average temperature and none can be derived because there is very little data available from back then, most (all?) of it coming from Europe which was in the Little Ice Age. [John McLean, Australia]	Rejected. There was a pre-industrial global temperature and the Box discusses various ways that changes since that period can be estimated.
115273	46	54	47	2	I doubt this is correct. The SED (Fischlin et al. 2015) rather emphasized for the reference period 1986-2005 a global mean warming of 0.61 [0.55 to 0.67] °C (GMST) above pre-industrial proxy 1850-1900. This 0.61 is enshrined in key findings as shown in the key figures of AR5 SYR Figure SPM.10 and AR5 SYR Box 2.4, Figure 1, page 73 and AR5 WGII Assessment Box SPM.1 Figure 1, p. 13 (difference between present (associated with all risks, see e.g. AR5 SYR Table 2.3 risks for present) or message 2 (SED Figure 4, p. 9). Also footnotes 9 and 30 of AR5 SYR are worth mentioning here. Of course the picture is more complex with 2003-2012 period being 0.78 [0.72 to 0.85] °C (AR5 WGI SPM, p. 3) above pre-industrial proxy 1850-1900, being closer to the present (2013) than 1986-2005 and therefore also used in aforementioned key figures. The 0.85 [0.65 to 1.06] °C result from linear trend over the period 1880 to 2012 (AR5 WGI SPM, p. 3) and is not used in the key findings of WGII in terms of risks, which the PA intends to reduce by limiting global warming. Cited References: ----- Fischlin, A., Ji, Z., Vladu, F. & Bisiaux, A., 2015. Report on the Structured Expert Dialogue on the 2013–2015 Review of the United Nations Framework Convention on Climate Change (UNFCCC). UNFCCC, Subsidiary Body for Implementation (SBI) and Subsidiary Body for Scientific and Technological Advice (SBSTA), Bonn, Germany. Final Report FCCC/SB/2015/INF.1, 182pp. http://unfccc.int/resource/docs/2015/sb/eng/inf01.pdf Fi215 [Andreas Fischlin, Switzerland]	Noted. The SED discussion has been removed.
50601	47	2	47	3	"this same metric" please clarify, is the GSAT 0.95°C for the period 1880-2012, as per the previous sentence? [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Text deleted.
45747	47	2	47	3	"This same metric is now". Please clarify if the revised estimate applies to the same period 1880-2012, or if the period has been extended to a more recent year. [Twan van Noije, Netherlands]	Noted. Text deleted.
36723	47	9	47	12	The whole artifact of 185-1900 temperatures being indicative of pre-industrial temperature is unprofessional, unscientific nonsense. Based on HadCRUT4 data, the period 1850-1900 is one of variable global coverage, never reaching 50% (not until 1904). For the entire period, western Europe, the eastern seaboard of the USA and the Atlantic Ocean shipping routes that linked them account for a disproportionate amount of the northern Hemisphere coverage. The area is just 12.1% of the NH but accounted for as much as 77.1% of the hemisphere's coverage (in Dec 1862). Europe was coming out of the Little Ice Age and temperature can be expected to have risen over that time. In the Southern Hemisphere it was no better. The shipping route from the South Atlantic Ocean to south-east Asia (eg. Indonesia) is 14% of the hemisphere but accounted for more than 70% of the HadCRUT4 SH coverage in 45 of the 96 months from 1861 to 1868 and the annual average contribution exceeded 60% in six of those seven years. (See section 4.5 of "An Audit of the Creation and Contents of the HadCRUT4 Temperature Dataset") [John McLean, Australia]	Rejected. No suggestion made. HadCRUT5 is now used in AR6.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
125287	47	9	47	38	The two statements bookending this section of text appear to be inconsistent at worst, or just confusing at best. Line 10 says 1850-1900 is pre-industrial. Line 37-38 says pre-industrial is defined as the period around 1750. Authors need to clarify the seeming inconsistency. [Trigg Talley, United States of America]	Noted. Text revised.
21325	47	11	47	11	Can a different word than accurate be used here such as sufficiently sampled? Accurate is a retired term in metrology [Peter Thorne, Ireland]	Accepted. Accurate is no longer used.
36725	47	14	47	51	These paragraphs do nothing more than citing wild speculation and assertion (i.e. statement unsupported by evidence). Any findings derived by using climate models need to first show that the climate models were accurate, but that flies in the face of evidence that they are not. Are we to assume that the IPCC will cite any unsubstantiated claims at all if they seem to endorse the IPCC's pre-conceived but unproven belief? [John McLean, Australia]	Rejected. See response to same reviewer's comment 36669.
114245	47	16	47	17	Minor: "...which is equivalent to.... In the atmosphere" is not needed. You have already said 7 ppm. [Jan Fuglestedt, Norway]	Noted, but we wanted to clarify that it wasn't emissions but amount retained in the atmosphere.
111937	47	16		17	GtC [Tomas Halenka, Czech Republic]	Noted. The text has been edited.
10351	47	16			Should put an estimate of the uncertainty on "7 ppm". From Table 2.2 I estimate > +/- 2ppm. This has a bearing on the significance of the following "15 GtC". [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Text has been rephrased to be less precise.
72137	47	16			"...15 GtC of increased carbon" is redundant, could preplace with "an increase of 15 GtC". [Alexander Wall, Australia]	Noted. The text has been edited.
107823	47	17	47	19	Interesting phrasing here: implicated but not confirmed as the source? Why only implicated? [Linda Mearns, United States of America]	Noted. There is no assessment of the land use emissions in this period to consider.
10353	47	21	47	24	0.3Wm-2 - 0.15 Wm-2 is a bit different to the assessed "Anthropogenic ERF from 1750 to the 1850-1900 period ... 0.22(0.11-0.32)Wm-2" in 7.3.5.2 [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Noted. These are now consistent.
10355	47	24	47	25	" +/- 0.05Wm-2"? I don't think this can be right. Both solar and volcanic ERF are negative during 1850-1900 relative to 1750, Figure 2.10. This statement also brushes under the carpet the high number of large volcanic eruptions between 1750 and 1850 that will have impacted on the temperature trends between 1750 and 1850, and thus has a bearing on discussion of pre-industrial baseline. [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The values used are now from the AR6 emulator and slightly wider than in the SOD. The forcing time series is shown, including the series of large eruptions between 1750 and 1850.
88955	47	24	47	25	Is the volcanic radiative forcing given relative to 1750? Or is it relative to an average volcanic forcing? [Schurer Andrew, United Arab Emirates]	Noted. The forcing time series is now shown and highlights it is relative to an average volcanic forcing.
10357	47	27	47	35	Don't use "attribute" in first sentence. None of the studies referenced in this paragraph attributed the climate changes before 1850. e.g., they don't rule out internal variability or other factors are the cause of the changes. [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Attribute is not used.
10365	47	27	47	35	Another relevant reference that estimates contributions to temperature changes in 17-19th centuries is Owen et al, The Maunder minimum and the Little Ice Age: an update from recent reconstructions and climate simulations, J. Space Weather Space Clim. 2017. They found that the CO2 concentration reduction may have contributed to slightly cooler temperatures during 17 and 18th centuries. [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Owens et al. is now cited.
82575	47	27	47	35	Another issue potentially worth considering is that of what period might best represent a nominal "1750" for temperature, given internal variability on decadal timescales and non-anthropogenic forcings. Hawkins et al 2017 discuss this (as background to their choice of 1720-1800 as a baseline period). [Blair Trewin, Australia]	Noted. The discussion has been kept brief and so this topic has not been discussed in depth, but the choice of Hawkins et al. is mentioned.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
10359	47	28	47	30	The assessed range in Hawkins (2017), is a "likely" range. It is also important to note that they found that the temperature change between 1720-1800 and 1850-1900 was not statistically significant, which undermines somewhat the argument that 1720-1800 should be used as a pre-industrial baseline. [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The text does been edited and does not imply that 1720-1800 is the pre-industrial baseline.
70541	47	29		30	The text here states that 'a range of 0.55-0.80C, which is slightly larger than ... 0.6-0.7C.' The 0.55-0.80 C range has a lower lower bound and a higher upper bound than 0.6-0.7C - I would write is 'a slightly broader range' rather than 'is slightly larger than'. Based on the information given here, you can't assess that the mean is higher, because no information on the mean or the shape of the distribution is given. [Gillett Nathan, Canada]	Noted, and text edited.
10361	47	33	47	34	Haustein (2017) did not analyse data before 1850, so this statement can't be made. [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. It was not discussed in the main text but the Supplementary Material of Haustein et al. included a spreadsheet which did consider pre-1850 temperatures.
40949	47	37	47	37	The glossary defines it as the 'multi-century period prior to' 1750. [TSU WGI, France]	Noted. It is not how the phrase is actually used but it was not possible to revise the Glossary.
29573	47	40	47	40	As per comment above, this statement ", but this warming influence was at least partially offset by increases in anthropogenic aerosol emissions" needs to be modified, as we do not know this with certainty (e.g., the words "was at least partially offset" imply more certainty than exists.) [Steven Smith, United States of America]	Noted. The assessed forcing timeseries are now included and they do show an offset in warming due to aerosols.
28707	47	41			what about natural forcings, particularly volcanic? [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Noted. These are discussed.
28273	47	45	47	46	Suggestion to expand why differences between GMST and GSAT for this assessment over this period are expected to be negligible. Make sure this is in agreement with Cross-Chapter Box 2.3. [Ryan Padrón, Switzerland]	Noted. CCB0x2.3 assessment has been revised since the SOD so this is no longer relevant.
86185	47	46			Have not explained what the difference is between GMST and GSAT by this point in the text so the reader is going to be confused. [Debra Roberts and the Durban WGII TSU, South Africa]	Noted. This difference is now briefly mentioned with citations to CCB0x2.3.
70543	47	48		51	This is research recommendation. Research recommendations are not allowed in IPCC reports. [Gillett Nathan, Canada]	Noted. Text revised.
111939	47	49			probably Brönnimann et al. (2019a) [Tomas Halenka, Czech Republic]	Noted. That paper is no longer cited in this section.
70085	47	53			Note that analyses from L. Beusch (ETH Zurich) show that the GSAT/GMST scaling is also dependent on the considered baselines (among others, because of the role of changes in temperature over sea ice points when one switches from air temperature to SST when ice melts). It might be useful to mention this point here. [Sonia Seneviratne, Switzerland]	Rejected. Cross-Chapter Box 2.3 covers this point and is cited.
115727	47		47		What about issues related to frequency of volcanic eruptions prior to a reference period, and implications for the initial ocean state? [Valerie Masson-Delmotte, France]	Noted. This has not been assessed.
12411	48	1	48	7	This paper is highly relevant here, by directly quantifying and comparing signal and noise in sea level, ocean heat and GMST. Cheng L., K. E. Trenberth, J. T. Fasullo, J. Abraham, T. P. Boyer, K. von Schuckmann, and J. Zhu 2018: Taking the pulse of the planet, Earth and Space Science News, Eos, 99, 14-16. https://doi.org/10.1029/2017EO081839 [Lijing Cheng, China]	Noted. This is labelled as an 'Opinion' piece, so we have not included it as a citation.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
112877	48	9	42	22	This paragraph refers to figure "Cross Chapter Box 1.2, Figure 1". The figure uses HadCRUT5.0 record (Morice et al., submitted). Yet, HadCRUT5.0 should not be used anywhere in the AR6 report because it is not published nor discussed, analyzed or studied by the scientific community yet. HadCRUT5.0 record varies significantly from HadCRUT4.6 for the period from 2000 to 2020 by showing a significant warming that is not seen in several other climatic records including in the HadCRUT4.6. The adoption of the unchecked HadCRUT5.0 record in AR6 questions the credibility of the IPCC. In fact, this record appears to have been chosen because it contradicts the HadCRUT4.6 during the last 20 years by not showing the temperature standstill from 2000 to 2015. Yet, the scientific community has not checked this record. Substitute the HadCRUT5.0 record with the HadCRUT4.6. Moreover, the intervals used to calculate the mean temperature levels in this figure must have the same length. In fact, it was used arbitrarily an interval of 10 years from 2009 to 2018 while the previous three intervals are 20 years long (1980-1999, 1986-2005 and 1995-2014). Moreover these intervals must be taken at constant periods, for example, 1979-1998, 1989-2008 and 1999-2018. On the contrary, the adopted varying segment length (with the last one from 2009 to 2018 that stresses the 2015-2016 strong El Niño event) and the uneven spacing among the periods appear to have been carefully chosen to give an illusion of a progressive warming. The figure is very badly drawn. [Nicola Scafetta, Italy]	Rejected. HadCRUT5 has been published and is assessed in Chapter 2.
35465	48	9	48	10	Use published sources [Carlos Antonio Poot Delgado, Mexico]	Rejected. HadCRUT5 has been published and is assessed in Chapter 2.
114247	48	9	48	22	Wouldn't it be better if the time scale started at 1750 in Cross Chapter Box 1.2, Figure 1? Even if the data series are limited. Just to show visually what it may mean since that is a point in the CCB 1.2. [Jan Fuglestad, Norway]	Noted. The forcings are now shown back to 1750 in the Box figure, with the observations back to 1850 in the text figure.
44087	48	9			At the moment, it is impossible to relate warming estimates for the individual reference periods to the actual warming levels that were presented in the corresponding assessment reports, e.g. 0.61 degC 1986-2005 rel to 1859-1900 in AR5. This has to be changed as the current figure adds to the confusion generated by the AR6 temperature metric switch. Please include time series based on the temperature metrics used in past assessment reports to solve this issue! [Lamin Mai Touray, Gambia]	Noted. Figure now included to enable a translation between baselines.
98775	48	16	48	21	This description of the different baseline periods used in the different assessment reports is baffling when read in isolation (which as a figure caption it might well be). [Elizabeth Kent, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Caption has been revised.
42057	48	18	48	19	1981-2010 is nowhere mentioned as a distinguished reference period (however as "WMO" climate normal period in I.37) [Julia Nabel, Germany]	Noted. The caption now mentions the significance of the 1981-2010 period.
106281	48	25	48	40	A note of caution that the here presented definitions of modern and other reference periods are inconsistent with the IPCC Glossary's "Global Warming" entry which highlights that this is assessed with 30-year averages. Referring to the global mean temperature increase between the 1850-1900 period and the modern period would thus not be "global warming" following the IPCC's own current glossary definition. [Rogel] Joeri, United Kingdom (of Great Britain and Northern Ireland)]	Noted. These reference periods have been retained.
28709	48	26			The 1995-2014 period is unusual for the volcanic quiescent period at the beginning and the negative phase of PDO [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Noted but this period has been retained as the reference period for the future projections.
42055	48	27	48	27	"present" might be confusing here in the context (past and future) -- indicate/show/represent? [Julia Nabel, Germany]	Noted. Text has been revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
125289	48	31	48	33	Explain why 20-year periods are OK (sufficiently long) when common knowledge is that a climatological time period is 30 years. [Trigg Talley, United States of America]	Noted. Text has been added on this issue.
6445	48	32	48	33	The sentence that spans these lines should be reconsidered. This is because WMO uses 30 years not 20 years for its climatological reference periods. 20 years may be sufficient to remove much of the natural variability for some variables and for large-area averages (such as global means in the case of surface air temperature), but it will not be sufficient in other cases. 30 years is also not a magic number, but it is long-established and considered appropriate by WMO. It should be explained in the text why CMIP6 and this IPCC assessment chose 20 years not 30 years. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Noted, this point is discussed more in the revised text.
37731	48	35	48	36	there is no period for 2061-2080 //seems an error [Howard Brady, Australia]	Rejected. These are the periods chosen as relevant for policymakers.
12413	48	35	48	40	The "signal" and "noise" should be better defined here. Physically speaking, fluctuations are not necessarily "natural", could also be part of the "forced changes by human-caused GHGs and aerosols".. And long-term trend is a combination of human forced and natural forced signals. So there are always some confusions here for how "signal" and "noise" are referred to in the context of "emergence". My comment is to provide a clear definition in this chapter of AR6 and then make sure this is used consistently throughout chapters. To me, it is easier to define it as a purely statistical problem: is long-term upward trend significant given the short-term fluctuations in a time series? Time scale is relevant here. Not including "natural" or similar descriptions helps avoiding attribution of both S and N. [Lijing Cheng, China]	Noted. Text has been revised.
112879	48	45	49	28	Section 1.4.2.1 shows that GCM are not able to resolve the decadal time-scale of the climatic signals. However this is a serious problem for the models that need to be properly validated. For example, Scafetta (2013) showed that the decadal scale is characterized by both a near 9-year harmonic related to a tidal forcing and to a 10-11 year harmonic related to the solar cycle. Because the models are not able to resolve this temporal scale they cannot be validated at these same scales. However, the main mechanisms acting at these time-scales are important also for properly interpreting longer scales because the generating mechanisms (tides and solar cycles) can generate longer cycles by just beating. For example the two above cycles beats at about 60-70 year period, which is also observed in several climate records. Thus, by not reproducing the decadal scales the models would not be able to reproduce other longer oscillations too and consequently mistake the interpretation of climate change attributions. Ref.: Scafetta, N., 2013. Discussion on climate oscillations: CMIP5 general circulation models versus a semi-empirical harmonic model based on astronomical cycles. Earth-Science Reviews 126, 321-357. [Nicola Scafetta, Italy]	Rejected. Section 1.4.2.1 discusses in detail how models do simulate decadal scale fluctuations. This section is not about model evaluation.
70545	48	45	50	29	This section on variability and emergence of the climate change signal contains only one reference to subsequent chapters in the report, yet it appears in Section 1.4 - AR6 Foundations and Concepts. Also, this section is not referenced in Chapters 3 or 4 (chapter 4 contains a reference to 1.4.2, but I believe I think this should be a reference to 1.4.3), which might appear to be the most relevant chapters. Does this section really describe a foundation of the AR6? If retained this section should be shortened and better integrated with the rest of the report. [Gillett Nathan, Canada]	Noted. Emergence has now emerged as a more popular concept across Chapters than in the SOD.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
18329	48	45	52	26	<p>Please note that Dai and Bloecker (2019, first published online on 20/02/2018) specifically quantified how internal climate variability can influence the estimated temperature and precipitation trends over different time periods starting in 1979 using two large ensembles of simulations by the CESM1 and CanESM2. These pages here also ignored many important studies by Clara Deser on how internal variability may influence the estimated trends, including the ones listed below. Relevant refs.: Dai, A., and C.E. Bloecker, 2019: Impacts of internal variability on temperature and precipitation trends in large ensemble simulations by two climate models. <i>Climate Dynamics</i>, 52, 289–306. https://doi.org/10.1007/s00382-018-4132-4. Deser C, Phillips AS, Bourdette V, Teng H (2012b) Uncertainty in climate change projections: the role of internal variability. <i>Clim Dyn</i> 38:527–546. https://doi.org/10.1007/s00382-010-0977-x</p> <p>Deser C, Phillips AS, Alexander MA, Smoliak BV (2014) Projecting North American climate over the next 50 years: uncertainty due to internal variability. <i>J Clim</i> 27:2271–2296. https://doi.org/10.1175/JCLI-D-13-00451.1</p> <p>Deser C, Terray L, Phillips AS (2016) Forced and internal components of winter air temperature trends over North America during the past 50 years: mechanisms and implications. <i>J Clim</i> 29:2237–2258. https://doi.org/10.1175/JCLI-D-15-0304.1 [Aiguo Dai, United States of America]</p>	Noted. There are huge numbers of papers on this topic, but we have added additional citations. Also note Section 1.5.4 also discusses the role of large ensembles, as do many other Chapters.
74341	48	49	49	13	In the context of climate variability, the occurrence of unusual events should also be considered (see Yulizar and Bardossy (2020), Study of changes in the multivariate precipitation series, https://doi.org/10.1007/s40808-019-00709-5) [Yulizar Yulizar, Indonesia]	Noted. Section 1.4.4 discusses 'surprises' and storylines and these are used more throughout AR6.
36727	48	53	48	53	What a laugh! You use model simulations and yet you haven't shown them to be accurate and trustworthy. If they are as bad as the models discussed in WGI AR5 then their output has no credibility whatsoever. [John McLean, Australia]	Rejected. See response to same reviewer's comment 36669.
36729	48	53	48	53	Why are you using an ensemble of models when surely only one model can be correct? Creating an ensemble means mixing the output of one good model (if it exists) with other models whose processing and output are incorrect. [John McLean, Australia]	Rejected. We have an ensemble of models to sample the range of possibilities consistent with our knowledge.
36731	48	53	49	7	You seem to be trying to claim that the wide variety of output in individual models should be ignored if their output fits within an absurdly wide range of arbitrary limits. [John McLean, Australia]	Rejected. No suggestion made.
26585	49	2	49	2	Silvy et al. 2020 could be referred to as cited in Chap 9. [Eric Brun, France]	Noted. No space to cite all the relevant papers, but section in Chapter 9 is given.
36733	49	9	49	9	Observations are NOT analogous to realisations. Observations are factual; simulations with unvalidated models are not. If you don't know the difference then maybe you should quit science. [John McLean, Australia]	Rejected.
85979	49	9	49	9	Please add observed changes as a line on the graph, and extend x-axis to start at 1980. Or, since the next section discusses warming in 1938, consider extending the axis even further back. This will illustrate the point better than saying observed changes are 'analogous to' one of the member projections. This figure should clearly illustrate how the observed signal 'emerges' from the natural variability. [Debra Roberts and the Durban WGII TSU, South Africa]	Noted. The point of this figure is to highlight how model simulations show decadal scale variations. The emergence figure shows the emergence in the observations.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
90003	49	10	49	10	The context here is internal variability, which we can hence assume is the noise model against which significance is measured -- and then of course two realisations never differ significantly. It would be significant only if the noise model was based on measurement uncertainty. Need to use "substantial" or the like. [Jochem Marotzke, Germany]	Noted. Substantially is used.
17393	49	16	49	30	Fig. 1.8 main text and caption lack an explanation of the dashed lines shown at approximately 90 degrees to the 2011-2021 trends. [Graham Weedon, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Figure has been improved.
107825	49	17	49	48	Really good examples in this figure. [Linda Mearns, United States of America]	Noted - thanks.
36735	49	18	49	18	Please make it clear whether these plots are based on fake (illustrative) or genuine data. If they are based on genuine data then please state why models that produce such a variety of outputs are considered suitable for creating an ensemble. [John McLean, Australia]	Rejected. The caption is clear as to what is shown.
29703	49	18	49	28	Two considerations about Figure 1.8: 1) The lower right panel of Figure 1.8 has the title "September Arctic sea ice extent", but in the corresponding figure caption says "September sea-ice area". Strictly speaking the sea ice "extent" and the sea ice "area" are two closely linked but different variables. According to the NSIDC, "Area and extent are different measures and give scientists slightly different information" (http://nsidc.org/arcticseaicenews/faq/). So, I suggest to check consistency between the aforementioned title and the corresponding text in the legend. 2) Please, consider using "Global temperature change" instead of solely "Global temperature" in the title of the first top row panel, and also in the correspondingly text in the legend. [Hernan Edgardo Sala, Argentina]	Noted. Figure caption has been corrected to use extent. 'Change' has been added.
10367	49	26	49	27	"observations - which can be considered as a single realisation of the real world" - this should be rephrased. There is only one "real world". What I think is being attempted to be said is that the real world could be considered as one realisation out of many alternative worlds, where climate has taken different paths with different weather. I am sure you can do better than I in expressing this. [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Text has been rephrased.
125291	49	27	49	28	Figure 1.8 is very interesting and helpful here. The last line in the caption is important. The section that follows (emergence of a climate change signal) is well done. [Trigg Talley, United States of America]	Noted - thanks.
19643	49	33	49	33	The concept of signal to noise ratio is of course important. One would like to know how it is used in AR6 to pronounce likelihood figures. Specifically, it may not be easy to estimate the noise, particularly when considering natural variations. In case this issue is dealt with in depth in later chapters, references would be welcome. [philippe waldteufel, France]	Noted. Citations to other Chapters to other uses of emergence are given.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
29955	49	33	50	15	<p>section 1.4.2.2. Explaining emergence using examples is fine but a conceptual definition is lacking.</p> <p>How is natural variability defined? What period and time scales are relevant here? In the context of a climate change projected at 2100, the anthropogenic signal could be mixed with the decadal to centennial variability. The period of reference generally considered as natural in this context is the pre-industrial period. Paleoclimate reconstruction of the last millennium that extend the instrumental record are therefore required to evaluate the emergence of the climate change signal. This is the fundamental contribution the PAGES 2k studies.</p> <p>If no reconstruction of past variability is available for a variable or a region, model simulations are used. [Matthieu Carré, France]</p>	Noted. Emergence is defined in multiple ways dependent on the metric and we cite numerous examples. The glossary exists for a more formal definition.
78407	49	33	50	15	<p>I wonder if it would be good to also mention the recent research by Marvel et al. 2019 (Twentieth-century hydroclimate changes consistent with human influence; https://doi.org/10.1038/s41586-019-1149-8) demonstrating the detection of an anthropogenic signal in global drought in the twentieth century. Just to get some balance (not only temperature)? [Hans W Linderholm, Sweden]</p>	Taken into account. Typically many more publications are considered than end up being cited in the report (e.g., exclusion of similar research to that already cited for brevity)
112883	49	33	50	30	<p>Section 1.4.2.2 and figure 1.9 at page 174 (the same issue is present in Faq 1.2 Figure 1 at page 198) claim that the climate records could be divided between a "noise" component and a "signal" component, and claims that there is a climate change signal that emerges out of the "noise" variability range. This operation is unphysical. What was done was to compare the short time-scale variability of the signal against its long time-scale variability and it was found that the long-scale variability has an amplitude larger than the variability of the short time-scale variability. This does not imply that the short time-scale is "noise" while the longer scale is "signal". Both scales can be driven by specific dynamical signals acting at different time scales. The argument presented in the section and the figure is misleading because it implicitly suggests that in the past the temperature, even in restricted areas, has always remained within the depicted red-pink region range and that since the last decades the data (black curve) came out of such a range and, therefore, it is necessarily anomalous. But this claim is not proven. Again, many papers suggest a warm medieval period comparable or even warmer than today temperatures, and the Holocene Optimum even had larger temperatures than today in many places: in Greenland, in the European Alps, in China, in North America, etc... [Nicola Scafetta, Italy]</p>	Noted. This figure is illustrating emergence over the instrumental period and makes no claim about earlier periods.
70093	49	38	50	5	<p>Note that new publications have also now defined a "global temperature of emergence" in analogy to the "time of emergence" (e.g. Kirchmeier-Young et al. 2019, Seneviratne and Hauser 2020): a) Kirchmeier-Young, M. C., Wan, H., Zhang, X., & Seneviratne, S. I. (2019). Importance of framing for extreme event attribution: The role of spatial and temporal scales. <i>Earth's Future</i>, 7, 1192–1204. https://doi.org/10.1029/2019EF001253; b) Seneviratne, S.I., and M. Hauser, in press: https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2019EF001474 [Sonia Seneviratne, Switzerland]</p>	Noted. Citation added.
35467	49	39	49	40	<p>Bibliographic citations in chronological order [Carlos Antonio Poot Delgado, Mexico]</p>	Noted. Fixed.
10369	49	42	49	43	<p>Be careful about the language here. Did the 3rd assessment report say "observed signal of climate change has been unequivocally detected at the global scale"? I could not find such a statement or similar in the TAR. "Detection" is a specific term in climate studies, e.g., a change is detected when it is outside range of natural variability. [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]</p>	Noted. Fixed.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
10377	49	42	49	43	This section gives impression only signals at global, or local scales have been looked at. But global spatial patterns have also been examined. Important to note the use of the SNR of spatial fingerprints to detect observed changes over estimates of internal variability has a long history, e.g., Hegerl, JoC, 1996. [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Detection of signals is now discussed and Hegerl et al cited.
36747	49	42	49	54	Figure 1.9 needs to be accompanied by a figure showing the coverage of each set of data. It is very likely that there was low coverage in the early years of all plots, which would mean significant error margins. For example, the plot of northern South America (10N-10S,85W-35W) shows data starting in 1850 but the CRUTEM4 station data for stations in that region don't commence until 1887, the second in 1891, another in 1896 and these four were the only stations operating in year 1900, although to be precise, one of the stations that commenced in 1891 (at an elevation of 2818m compared to altitudes of 1m, 5m and 199m for the others) reported data in only five months of 1898-1900. [John McLean, Australia]	Rejected. Berkeley Earth uses a much larger dataset than CRUTEM, and that is the dataset used here.
36749	49	42	49	54	You mention here that variability in temperatures differs between locations and yet when you discussed temperature anomalies (p45 ln46 to p46 ln17) you implied that anomalies were of similar weighting. It's quite obvious that the weighting given to anomalies should depend on location (or as I said earlier, on mean temperature). [John McLean, Australia]	Rejected. Incorrect.
73947	49	42	49	54	One problem of this report is that climate variability is considered in purely statistic context: main stress is upon long-term trends and variations of climate parameters around mean value are considered as noise (for example, in Fig. 1.9) and not discussed. But for decision making also the range of these variations is important, because it is necessary to consider shorter time periods. Global trends just prove that climate change takes place, but it is necessary to take the step further: what to do? [Elena Kozlovskaya, Finland]	Noted. Chapters 10-12 cover the regional picture in far more detail.
70551	49	42		43	This is incorrect. IPCC TAR assessed that 'The warming over the past 100 years is very unlikely to be due to internal variability alone, as estimated by current models.' in its SPM i.e. it was assessed only as very unlikely that warming could be explained by internal variability. This strengthened in subsequent reports, with AR5 assessing 'It is virtually certain that internal variability alone cannot account for the observed global warming since 1951.' (Bindoff et al., 2013). This is not the same as an assessment that the warming was detected unequivocally. TAR and subsequent reports did state that the globe had warmed as statements of fact, but the text here is focussing on detection of warming against the background of internal variability. [Gillett Nathan, Canada]	Noted. Fixed.
28711	49	42			Should be consistent across report and chapter between referring to e.g. TAR, Third Assessment Report or as a reference (I think TSU told me it should be as a reference) [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Fixed.
35469	49	52	49	52	Use published sources [Carlos Antonio Poot Delgado, Mexico]	Noted. We do.
52141	50	2			The authors can consider adding "alkalinity" for ocean. I suggest: "ocean temperature, salinity, and alkalinity" [Mohammad Rahimi, United States of America]	Rejected. No papers suggested to cite.
9233	50	3	50	3	Giorgi and Bi, 2009 ---> Giorgi and Bi, 2009; Kusunoki et al., 2020 [Shoji Kusunoki, Japan]	Rejected. Only limited space for citations.
9235	50	3	50	3	King et al., 2015; ---> King et al., 2015; Kusunoki et al., 2020 [Shoji Kusunoki, Japan]	Rejected. Only limited space for citations.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
70097	50	3	50	3	For analysis of emergence in extremes (drought indices, warm spell duration index), also refer here to Orłowsky and Seneviratne 2013 (HESS; see figure 10 of that paper). Reference: Orłowsky, B., and S.I. Seneviratne, 2013: Elusive drought: uncertainty in observed trends and short- and long-term CMIP5 projections. <i>Hydrol. Earth Syst. Sci.</i> , 17, 1765–1781, 2013, www.hydrol-earth-syst-sci.net/17/1765/2013/doi:10.5194/hess-17-1765-2013 . [Sonia Seneviratne, Switzerland]	Noted. Citation added.
71415	50	3			I discuss the emergence of extreme precipitation (Maraun, <i>Env. Res. Lett.</i> 2013, doi:10.1088/1748-9326/8/1/014004). A key point I make is that the emergence concept is only of limited value when discussing extremes. In the case of high internal variability, a signal in extremes may not have emerged yet, but still the hazard associated with the extremes will have increased. We are discussing the issue briefly in Chapter 10, but it might be important to raise the point here as well. Happy to discuss this further. In any case, we should avoid the impression that one should wait until a signal in extreme events has emerged, before undertaking adaptation measures. [Douglas Maraun, Austria]	Noted. Citation added. Linked to Chapter 10 for larger discussion of these issues.
28713	50	8		9	The definitions of unusual, unprecedented, etc could be made e.g. $S/N > 2$, etc [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Noted. These definitions are not yet widely adopted.
6447	50	11	50	13	The sentence needs attention: "due to large populations and vulnerable, increasing the risk" is incorrect use of language. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Fixed.
19645	50	11	50	15	Strictly speaking, this remark is not really relevant in the present subsection. Moreover, in case the signal of change is smaller, then the climate change is smaller too by definition [philippe waldteufel, France]	Noted. Text edited.
82577	50	12	50	13	The word "populations" is misplaced here - would be best after the Russo et al 2019 reference. [Blair Trewin, Australia]	Noted. Fixed.
72141	50	12			"...large populations (e.g. Lehner and Stocker, 2015) and vulnerable..." should be "large (e.g. Lehner and Stocker, 2015) and vulnerable populations..." [Alexander Wall, Australia]	Noted. Fixed.
125293	50	13	50	13	"... increasing the risk [OF WHAT?]?" [Trigg Talley, United States of America]	Noted. Linked to Risk Framing box which discusses how risk depends on vulnerability and exposure.
66649	50	13	50	14	It would also be worthwhile pointing out that the pattern of emergence is quite similar across models and across scenarios - so that the (vulnerable) tropical countries experience stronger emergence irrespective of the scenario. At the same time, mitigation buys down more emergence units in these countries. (Frame et al., 2017) [Dave Frame, New Zealand]	Noted. Text edited.
125295	50	13	50	15	[SCOPE] Delete this statement. It's WGII content. [Trigg Talley, United States of America]	Rejected. It is important context for the concept.
125297	50	14	50	14	The structure of this sentence is a little confusing: "These tropical countries are often amongst the most exposed due to large populations (e.g., Lehner and Stocker, 2015) and vulnerable (e.g., Harrington et al., 2016; Harrington and Otto, 2018; Russo et al., 2019), increasing the risk." For clarity the authors would need to move or eliminate one of these phrases "due to large populations" or "increasing the risk". But it is best to delete the sentence, as it is not needed in this WGI report. [Trigg Talley, United States of America]	Rejected. The sentence has been reworded but retained for important context.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
36751	50	16	50	16	Summary of 1.4.2.2: The section heading is "The emergence of the climate change signal" but you fail make clear whether you are talking about natural climate change or man-made climate change, and if the former, anything that is abnormal about them. You seem to think that the available data shows typical climate no matter how little data is available. The final paragraph (p50 lines 7-15) say nothing about emergence but are mere speculation about risk. [John McLean, Australia]	Rejected. Context makes entirely clear that the "climate change signal" in question is anthropogenic. Remainder of comment: No scientific basis. No peer-reviewed literature cited.
70095	50	18	50	31	It would be useful to add an indication of global warming on the x axis (e.g. when is +0.25°C, +0.5°C or +1°C of global warming reached in 30-year averages), or add a time series of global mean temperature in the figures to show how the emergence is also tied to the global-scale mean warming. [On this point see also recent publications that have defined a "global temperature of emergence" in analogy to the "time of emergence" (e.g. Kirchmeier-Young et al. 2019, Seneviratne and Hauser 2020): a) Kirchmeier-Young, M. C., Wan, H., Zhang, X., & Seneviratne, S. I. (2019). Importance of framing for extreme event attribution: The role of spatial and temporal scales. Earth's Future, 7, 1192–1204. https://doi.org/10.1029/2019EF001253 ; b) Seneviratne, S.I., and M. Hauser, in press: https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2019EF001474] [Sonia Seneviratne, Switzerland]	Noted. We have kept the figure simpler, but added citations on global temperature of emergence.
10373	50	20	50	21	Is the change deduced from linear regression, difference between two periods, or last year minus 1850-1900 period? [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Linear regression - see the cited Hawkins et al. 2020 paper.
113615	50	26	50	26	"Australasia (50S-10S," instead of "Australasia (10S-50S," [Agnieszka Kowalczyk, Poland]	Noted. Regions have been changed.
10375	50	27			What is the source of the estimate of "internal variability"? Is it just interannual variability or includes estimates of multi-decadal variability? [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The method is described in the cited paper.
114249	50	34	50	34	A new paper by Lehner et al in ESD may be cited here here. https://www.earth-syst-dynam.net/11/491/2020/esd-11-491-2020.html [Jan Fuglestedt, Norway]	Noted. Citation added.
68031	50	34	50	45	Section 1.4.3: there is also structural uncertainty: do the models include all processes, especially those that integrate within grid resolution, or that operate slowly on long time scales? Note the balance between high resolution models of finescale processes (e.g. the COAGCMs) and coarse resolution models of long-term coupled processes that become important over decades to millennia (e.g. the EMICs). See also: section 1.7. Cite also: Fig 1.14. [Michael Evans, United States of America]	Noted. Brief discussion has been included.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
70553	50	34	52	13	This section is poorly organised and the list of subtitles makes it look like 'Uncertainty types' and 'Uncertainty quantification in ensembles of climate model simulations' are sources of uncertainty like 'Internal climate variability' and 'Historical radiative forcing uncertainty'. I suggest that, consistent with the underlying literature cited here, such as Hawkins and Sutton (2009), that the bold subheadings are reduced to three 'Radiative forcing uncertainty' (omit 'historical', because the text text deals with past and future), 'Climate response uncertainty', and 'Internal climate variability'. 'Natural climate variability' describes uncertainties in natural radiative forcings, and this text should be merged into the subsection on radiative forcing uncertainty. The text currently in 'uncertainty types' and 'uncertainty quantification in ensembles of climate model simulations' should have the subheadings removed, and follow the list of the main uncertainty contributions. Also the subheading 'Interactions between variability and radiative forcings' should be removed, and this text should follow after 'uncertainty quantification in ensembles of climate model simulations'. If variability changes with forcing, this represents a limit to the approach described under 'Uncertainty quantification in ensembles of climate model simulations'. [Gillett Nathan, Canada]	Noted. Section substantially revised.
38569	50	34			I found this section confusing because of the way the uncertainties had been split up. For example, many people will consider natural variations as affecting the climate system via their radiative forcing, and this will have uncertainty. For instance, there is uncertainty in the radiative forcing of a volcanic eruption. So my confusion is this seems like a historical radiative forcing uncertainty that is due to Natural Climate Variability. But the Natural Climate Variability section is just about the presence of these natural factors, not that their forcing is uncertain. I think this could be resolved by (i) saying Historical Radiative Forcing Uncertainty is explicitly about anthropogenic forcings; (ii) saying in Natural Climate Variability section that there is uncertainty from the radiative forcing associated with natural variations. Mentioning volcanoes in Historical Radiative Forcing does not seem best way to do this as that section comes before volcanoes are mentioned. [David Sexton, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Section has been substantially revised.
73949	50	36	50	40	One well-known source of uncertainty in physical modeling is uncertainty due to model parameterisation, but it is not considered. [Elena Kozlovskaya, Finland]	Noted. This is part of model response uncertainty.
69159	50	36	50	45	It would make things clear if noted that "scenario uncertainty." will be discussed in 1.6.1.2. [Kaoru Magosaki, Japan]	Noted. Reference to 1.6 has been added.
36739	50	36	50	45	It should be noted in this section that no climate model has been validated and to draw a distinction between validation and evaluation. [John McLean, Australia]	Rejected. This is largely a semantic issue; evaluation and assessment of climate models occurs continuously, against various sets of observational data. In the AR6 WGI report, both activities are discussed where relevant throughout the chapters, however we here wish to point specifically to section 1.5, where we discuss both developments in climate modelling and the concept of "fit-for-purpose" in a general sense.
29705	50	37	50	37	There is an orphan parentheses in "(e.g. (Hawkins and Sutton, 2009)". [Hernan Edgardo Sala, Argentina]	Noted - fixed.
13159	50	37	50	37	Missing () [Maria Amparo Martinez Arroyo, Mexico]	Noted - fixed.
37821	50	37	50	37	(e.g. (Hawkins and Sutton, 2009): delete parenthesis [Junhee Lee, Republic of Korea]	Noted - fixed.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
114251	50	40	50	40	This word is used a lot in the chapter, but this is, as far as I can see, the first time it is explained. Consider having this in the Box on scenarios. And a ref to the glossary could be inserted early in the chapter [Jan Fuglestedt, Norway]	Noted. As this term is in the Glossary we didn't see a need to explain it further.
125299	50	43	50	43	"Projections" can also be based on initial conditions at some temporal scale. This distinction between projections and predictions is confusing. Either delete or rewrite lines 40-45. [Trigg Talley, United States of America]	Unclear.
125301	50	43	50	43	Consider inserting the following to provide more clarity/context: "... initial conditions of the climate system (I.E., MORE LIKE A WEATHER FORECAST)." [Trigg Talley, United States of America]	Noted - added.
90005	50	43	50	45	This is worth checking once more. A global search on AR5 Ch11 suggests there are a few incorrect usages of "predicted" instead of "projected", but I do not remember nor find support for this particular use of prediction alluded to here. [Jochem Marotzke, Germany]	Noted - text edited.
112885	50	47	50	54	There is a need to add uncertainty regarding solar forcing. Not only the total solar irradiance models are quite different from each other (see references in Scafetta et al, 2019), but there is the possibility that the sun drives the climate also via alternative forcing (cosmic ray, etc.). This point is important because several studies have shown a strong correlation between several climate records and solar records, and, therefore, there is the serious possibility that the climate models are severely underestimating the solar contribution to climate change. Probably, the uncertainty in the solar effect on climate change is the greatest among the one that are listed in section 1.4.3. This uncertainty is not limited, as claimed at line 17 of page 51, to "past and future climate", but also to undersand contemporary climate change such as that occurred since 1950 to 2020. Scafetta, N., Willson, R.C., Lee, J.N., Wu, D.L., 2019. Modeling Quiet Solar Luminosity Variability from TSI Satellite Measurements and Proxy Models from 1980–2018. Remote Sensing, 11, 2569. Egorova, T.; Schmutz, W.; Rozanov, E.; Shapiro, A.I.; Usoskin, I.; Beer, J.; Tagirov, R.V.; Pete, T. Revised historical solar irradiance forcing Revised historical solar irradiance forcing. A&A 2018, 615, A85. Hoyt, D.V.; Schatten, K.H. A discussion of plausible solar irradiance variations, 1700–1992. J. Geophys. Res. 1993, 98, 895–906. Soon, W.; Connolly, R.; Connolly, M. Re-evaluating the role of solar variability on Northern Hemisphere temperature trends since the 19th century. Earth-Sci. Rev. 2015, 150, 409–452. Scafetta, N., Milani, F., Bianchini, A., Ortolani, S.: 2016, On the astronomical origin of the Hallstatt oscillation found in radiocarbon and climate records throughout the Holocene. Earth-Sci. Rev. 162, 24. Steinhilber F., Abreu J.A., Beer J., Brunner I., Christl M., Fischer H., Heikkilä U., Kubik P.W., Mann M., McCracken K.G., Miller H., Miyahara H., Oerter H. & Wilhelms F. (2012) - 9,400 years of cosmic radiation and solar activity from ice cores and tree rings. PNAS, 109,	Noted. Uncertainties in natural forcings are discussed.
655	50	50	50	50	Could add the early Eocene or Pliocene to this list because the CO2 uncertainties there are particularly large (which is not the case for the last glacial or the last millenium) [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Noted - added.
90007	50	52	50	52	Exploration of forcing uncertainty pre-dates the references here. See Forster et al. (JGR-A, 2013). [Jochem Marotzke, Germany]	Noted - references added.
36741	50	52	50	54	How these models "consider" uncertainty needs to be explained. [John McLean, Australia]	Noted. It is explained.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
10379	50	52	50	54	This sentence gives impression simulations are only now being done that explore forcing uncertainty. That is incorrect. E.g., Knutti et al, Constraints on radiative forcing and future climate change from observations and climate model ensembles, Nature, 2002 [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Noted - references added.
35471	50	53	50	54	Use published sources [Carlos Antonio Poot Delgado, Mexico]	Rejected. We do.
90009	50	56	51	3	This account lumps different uncertainties too quickly (see page 1-96, lines 33-43). Uncertainty in future ERF comes from three sources. Emissions result from human behaviour and are presumably unpredictable. The conversion of emission scenarios to concentration scenarios is mostly done thorough IAMs and has its uncertainty but is predictable, as is the conversion of atmospheric composition to ERF done in ESMS, again with its around 25% uncertainty in CMIP5 (Vial et al., Clim. Dyn. 2013). The text here only addresses the first of these steps. [Jochem Marotzke, Germany]	Noted. Due to a lack of space we do not break this down further, especially as the RCPs are the source of uncertainty that is explored in the rest of the report.
125303	51	3	51	3	Change the phrasing of this sentence to read: "... future pathways (see Section 1.6) AND the real world MAY OR MAY NOT differ from ANY ONE OF these example pathways." [Trigg Talley, United States of America]	Noted - text edited.
42065	51	6	51	6	Climate response uncertainty" --> maybe "Climate response uncertainty and model (response) uncertainty"? Particularly since "model uncertainty" is a key uncertainty and "model response uncertainty" is referred to later (e.g. I. 44-45) [Julia Nabel, Germany]	Noted. Text has been edited.
45749	51	6	51	13	"this range does not necessarily represent the full uncertainty". On the other hand, there is also the possibility that the range derived from climate models overestimates the actual uncertainty, as is for instance the case for the upper end of the ECS range derived from CMIP6 models. This possibility should also be mentioned. [Twan van Noije, Netherlands]	Noted - this has been added.
38601	51	6	51	13	A key source of Climate Response Uncertainty is structural uncertainty, certainly errors that are common to all models, but each model will have its own structural uncertainty. Structural uncertainty is mentioned on p.91 l47 in chapter 1 about PPEs so it should be discussed here too. It is also relevant to why ensembles do not represent full uncertainty. The text alludes to one source of structural uncertainty but this is not enough - the text needs to explicitly mention structural uncertainty. It's probably our biggest issue in modelling the climate, right? [David Sexton, United Kingdom (of Great Britain and Northern Ireland)]	Noted. This has been added.
70099	51	6	51	13	Under this paragraph ("Climate response uncertainty") it would be useful to distinguish between the global mean warming response ("global climate sensitivity" or "global transient climate response") and the "regional climate sensitivity" (i.e. the response of regional climate signals as function of global warming; see Seneviratne and Hauser, 2020, in press: https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2019EF001474) [Sonia Seneviratne, Switzerland]	Rejected. Lack of space to discuss this issue.
36745	51	7	51	13	This paragraph is just weasel words that try to explain the poor performance of models. Perhaps you can explain why you seem to think a range of models is necessary and yet earlier in this chapter tried to imply that models accurately determine the amount of man-made warming. [John McLean, Australia]	Rejected. See Chapter 3.
36743	51	8	51	8	Why are "a range of climate models" used (even though you should say "a number of climate models)? Surely if the science is settled then one accurate model is not only all that you need but only one can ever be correct.. [John McLean, Australia]	Rejected. This is a fundamental misunderstanding of the science.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
38577	51	10	51	13	I think it would be helpful to add that small sample sizes of interdependent models is another reason for not capturing the full uncertainty. Carlsaw et al (2018; https://eos.org/opinions/climate-models-are-uncertain-but-we-can-do-something-about-it) make this point nicely so we need PPEs about each climate centre's model. Carlsaw et al (2017; https://link.springer.com/article/10.1007/s40641-017-0061-2) also discusses this in context of how pre-industrial aerosol levels may be a structural error across models. [David Sexton, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Carlsaw et al 2018 is labelled as an opinion piece and is not included but the general point is made in the text with other citations. Carlsaw et al. 2017 is cited in CCBox1.2.
114253	51	11	51	11	I suggest inserting a ref to ch7 here. [Jan Fuglestedt, Norway]	Noted. Text has been edited.
68091	51	11	51	12	change "may be small-scale features which cannot ..." -> "there always are ..." [Lev Tarasov, Canada]	Noted - text edited.
107827	51	11	51	13	But does this include high res RCMs? Or only global models? [Linda Mearns, United States of America]	Noted. Lack of space for a full discussion of RCMs also.
14503	51	12	51	12	add a comma after "climate models", to clarify the meaning [Amy East, United States of America]	Noted - text edited.
90011	51	15	51	15	Heading incorrect: Text is only about externally forced natural variability [Jochem Marotzke, Germany]	Noted - text edited.
28715	51	15			Natural climate variability also includes internal variability so this could be entitled "Naturally forced climate variability" or combine both bullets [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Noted - text edited.
11347	51	24	51	24	replace "from days to decades" by "from months to decades" [Michael Schmitt, Germany]	Reject. Days to decades is considered appropriate.
36753	51	24	51	27	You just don't get it, do you?. These are not "internal" variations; they must have got their energy from some source external to the normal climate system. The key is that they store that energy and release it at some point. By the way, doesn't this storage and release of energy make the "energy budget" referred to earlier incorrect? [John McLean, Australia]	Rejected. Internal variability of the climate system, without changes in radiative forcing external to the Earth system, is well established. No scientific basis. No peer-reviewed literature cited.
100781	51	24	51	29	Climate Modes of variability should be properly introduced and/or referred to citing Annex VI. Also the acronyms should be consistent across all WG1 chapters (or at least the difference should be mentioned). Unless strictly necessary, in general IPO should become PDV and AMO AMV [Corti Susanna, Italy]	Noted - text edited.
36755	51	27	51	28	Poppycock! The ENSO, IPO and AMV will cause shifts in global average temperature anomaly, ergo they will influence global trends. This is even more so when these are in one state for a decade or more and then switch to their other state, as the ENSO did in 1976. (I use the term "state" to mean on that state's side of absolutely neutral.) As I said earlier, previous IPCC reports have explicitly commented on changes to climate factors "since the mid 1970s" or "since the laste 1970s"). The change from the La Nina side of neutral to the El Nino side of neutral can not only account for the warming in the 1980s but also for the temperature trends that started prior to 1976 and ended after. Figures 1.7 and 1.8 show that the IPCC ignores the influence that the ENSO has on trends of global average temperature anomaly. [John McLean, Australia]	Part noted, part rejected. Text edited.
90013	51	27	51	28	Not true in the generality stated here. Marotzke & Forster (Nature 2015) showed internal variability is very substantial even in GMST multi-decadal trends. [Jochem Marotzke, Germany]	Noted - text edited.
67549	51	27	51	29	I do not believe that the decadal variability has little influence on multi-decadal global trends. [Baijun Tian, United States of America]	Noted - text edited.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
125305	51	30	51	30	Somewhere in this list, the authors definitely need to include a paragraph on scenario/socioeconomic uncertainty -- a la the key figure in Hawkins and Sutton, 2009. [Trigg Talley, United States of America]	Noted - text edited.
33201	51	33	51	35	Zuo et al. (2019) also revealed a significant impact of volcanic eruptions on ENSO. I suggest adding this reference here. References:Zuo, M., W. Man, T. Zhou, and Z. Guo, 2018: Different Impacts of Northern, Tropical, and Southern Volcanic Eruptions on the Tropical Pacific SST in the Last Millennium. Journal of Climate, 31, 6729–6744.doi:10.1175/JCLI-D-17-0571.1 [Meng Zuo, China]	Noted - citation added.
100783	51	33	51	37	Same as for lines 24-29 [Corti Susanna, Italy]	Noted - text edited.
35473	51	35	51	35	Bibliographic citations in chronological order [Carlos Antonio Poot Delgado, Mexico]	Editorial. The report will undergo professional copy-editing prior to publication. This kind of issues will be fixed then.
82579	51	36	51	37	The results from the cited paper are specific to an environment (Iceland) where many volcanoes are below glaciers or ice caps; is there evidence that this generalises to other glaciated volcanoes? [Blair Trewin, Australia]	Noted. Is it a specific example.
10381	51	40	51	41	it is incorrect to say further research definitely won't reduce uncertainty from internal variability in projections. We pretty much require coupled atmosphere and ocean climate models to estimate variability, so improvements in models and assessments of their suitability could, in theory, help us better constrain uncertainty from internal variability. It could of course increase the magnitude of the uncertainty as well. [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. This sentence has been rephrased.
38571	51	40	51	52	I disagree with this sentence " the intrinsic uncertainty due to internal climate variability can be estimated probabilistically and cannot be reduced in long-term projections by further research". I think the solution might be to be more explicit about what is meant here. If this sentence said it about a given single simulation, or a LARGE initial-condition ensemble, I would agree. But this chapter later mentions different ensembles such as multi-model as well as LARGE ensembles (section 1.5.4.1). Then each different model or LARGE ensemble would have different estimates of internal variability and then there is uncertainty about the magnitude of internal variability. This is something that future research might be able to constrain by ruling out models that poorly represent internal variability. Or processes that affect internal variability such as ENSO are projected to change in a diverse number of ways, so maybe future research (better models/understanding or constraints) can reduce the uncertainty in how internal variability changes in that respect.So I think either delete this clause in bold, or better explain this is conditional on a single projection/LARGE ensemble, but if so there seems a need to suggest across ensembles, may be able to reduce internal variability uncertainty. In this response, I am presuming that this is not about empirical estimates of internal variability, which could be considered probabilistically but would be hard to estimate and separate from climate change signal. [David Sexton, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. This sentence has been rephrased.
73951	51	44	51	45	Even if model response uncertainty is considered as non-probabilistic, it is not the reason to ignore it, as it can have large impact on modelling results. [Elena Kozlovskaya, Finland]	Rejected. It is not ignored but discussed explicitly.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
68093	51	44	55	45	Model response uncertainty can and needs to be considered probabilistically. There is an extensive literature on uncertainty quantification within a Bayesian framework that includes assessing structural uncertainty. For an accessible intro to the topic, consider Rougier, 2007 , DOI 10.1007/s10584-006-9156-9. This gets into issues of what exactly is meant by probability. [Lev Tarasov, Canada]	Taken into account. This sentence has been rephrased and Rougier (2007) is cited.
38573	51	45	51	45	"but cannot be treated probabilistically" is an opinion. There's a whole body of work in the literature in Climate Science that uses probability to quantify uncertainty in model response and an IPCC report needs to present a neutral assessment of the research out there. There's a whole field in Statistics that quantifies uncertainty in model response in a probabilistic framework e.g. http://www.mucm.ac.uk/ . There are examples of probabilistic projections used in National Climate Projections. Also, later on in this section, there is discussion of ensemble weighting - weighted histograms where weight can take a value in continuous interval between 0 and 1 e.g. Knutti and Sanderson papers, are tantamount to a probabilistic treatment of the ensemble without saying the word probability - even the $\exp(-1/2x^2)$ they use is clearly a likelihood. Other studies in this IPCC report often fit distributions to quantities like climate feedback from multi-model ensemble. This IPCC report needs to reflect that there is a range of ways to quantify uncertainty. What is true is that this type of uncertainty (epistemic) does not have a probabilistic parallel in the real world - so that could be said. Given there are two subsections relevant here - Uncertainty Types and Uncertainty Quantification below, I suggest the following. In this section, delete "but cannot be treated probabilistically" and replace it by "There are Bayesian frameworks that treat this kind of uncertainty probabilistically e.g. Rougier (2007; (https://link.springer.com/article/10.1007/s10584-006-9156-9) but the resulting probability cannot be interpreted as a real world probability". Then see next comment on list of work to cite to get a better balance in next subsection. [David Sexton, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. This sentence has been rephrased and Rougier (2007) is cited.
106077	51	45	51	49	It is unfortunate that this part of Chapter 1 and Figure 1.11 try to put storylines into a probabilistic context. The great contribution of Shepherd et al. (2018) was promoting (physical) storylines as a means that allows one to explore and communicate events or sequences of events in the future that are physically plausible and potentially high impact, and (especially) without tying them to probabilities. From that perspective, Shepherd (2019) went backward from Shepherd et al. (2018) by trying to put storylines in a probabilistic framework, which reduces them to being simply a portion of a probabilistic space and thus diminishes their importance. [William Gutowski, United States of America]	Taken into account. Both Shepherd papers are discussed, and the text has been heavily edited since the SOD. The figure has been removed.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
38575	51	50	52	13	Following on from previous comment#4, this section needs to mention that probabilistic projections are produced to quantify uncertainty. As explained above, Uncertainty Quantification in most science fields use some sort of probabilistic model. It's done because it provides the most rigorous framework in which to handle observational weighting accounting for internal variability, observational error and structural uncertainty whilst sampling a number of uncertainties. Where the use of probability becomes difficult is its interpretation for the real world and how it is used in decision-making (for instance, I personally would use it qualitatively on relative likelihood and as context for storylines, not quantitatively) - here there is relevance to the storylines work in section 1.4.4. But the section cannot muddle up these two uses of probability: a) it is the de rigeur framework for Uncertainty Qualification; b) it's use for representing epistemic uncertainty in decision making needs care and storylines are useful. But usage b) is not the purpose of this subsection on Uncertainty Quantification. There are plenty of examples where probabilities are estimated from multimodel data or perturbed parameter ensembles e.g. Tebaldi et al (2004; doi:10.1029/2004GL021276) and Rougier et al (2013; https://doi.org/10.1080/01621459.2013.802963) for multimodel and for perturbed parameter ensembles, Sexton et al (2012; https://link.springer.com/article/10.1007%2Fs00382-011-1208-9) which is an implementation of Rougier 2007 (see comment#4). Given that storylines gets a whole section, a balance needs to be restored here by including references on this work. [David Sexton, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Part of the reason for the length of the storylines section is that it is new to AR6. Additional citations have been added.
36757	51	51	52	1	You need to mention the inherent uncertainties in the historical temperature data to which models are calibrated. Be aware that the uncertainty of that data CANNOT be calculated mathematically because there are issues outside the scope of a shortfall of data possibly causing a mean value that differs from what would be calculated if 100% of the required data was present. For example, the flawed adjustment of temperature data will potentially cause skewing that a simple calculation of error margin cannot take into account. [John McLean, Australia]	Rejected. Chapter 2 discusses the temperature datasets at length.
35475	51	52	51	52	Use published sources [Carlos Antonio Poot Delgado, Mexico]	Noted. We do.
70101	51	52	51	52	Suggest to also cite here Orłowsky and Seneviratne (2013) which looked into this question for drought projections at regional scale and also compared the breakdown of uncertainty for different indices (e.g. drought indices vs warm spell duration index). The breakdown is very different depending on the spatial scale and index considered. For drought indices, it was found that model uncertainty is the dominant contributor to uncertainty (see Figure 10 of that paper). Reference: Orłowsky, B., and S.I. Seneviratne, 2013: Elusive drought: uncertainty in observed trends and short- and long-term CMIP5 projections. Hydrol. Earth Syst. Sci., 17, 1765–1781, 2013, www.hydrol-earth-syst-sci.net/17/1765/2013/ doi:10.5194/hess-17-1765-2013. [Sonia Seneviratne, Switzerland]	Rejected. Paper has been cited in emergence section, and this section is being brief.
68095	51	52	55	54	using a few different climate models alone will only allow a PARTIAL estimate of moel response uncertainty [Lev Tarasov, Canada]	Taken into account. This section has been revised.
6449	51	54	51	54	"can" should be changed to "are used to". [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Noted - fixed.
10383	51	54	51	55	Only complex models, like atmosphere-ocean coupled models, could be used to estimate internal variability. Energy balance models or simpler expressions can't be used for this purpose. [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Added.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
115729	51		51		What about uncertainty related to processes not implemented in models? (as discussed in SRCL chapter 2 for instance)? [Valerie Masson-Delmotte, France]	Noted - some text has been added.
70103	52	3	52	26	On this topic, consider also the recent results of our paper (Seneviratne and Hauser, Earth's Future, in press) which provides a breakdown of the inter-model uncertainty in the spread in global mean warming (global climate sensitivity) vs regional climate sensitivity [see figures 1 and 6 of that paper]. Reference: https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2019EF001474 [Sonia Seneviratne, Switzerland]	Noted. Typically many more publications are considered than end up being cited in the report.
111941	52	3			choice of the scenarios is not uncertainty by the definition above (which I agree with) [Tomas Halenka, Czech Republic]	Noted. text has been edited.
28717	52	8		9	ambiguous since it could imply increasing uncertainty over time whereas what is meant is increasing uncertainty at progressively smaller spatial scales [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Noted.
35477	52	12	52	12	Change & for "and" in bibliographic citations [Carlos Antonio Poot Delgado, Mexico]	Editorial. The report will undergo professional copy-editing prior to publication. This kind of issues will be fixed then.
114255	52	16	52	26	Good figure. I wonder if you could make it easier to read by highlighting GLOBAL TEMP, SOUTH AMERICA TEMP and RAINFALL, and separate the three parts a bit by some boxes or vertical lines. [Jan Fuglestedt, Norway]	Noted - figure has been improved.
81125	52	17	53	57	This section is good, but it gets tangled up again in overly academic verbiage, and alphabet soup of acronyms, and too many citations. The storyline on storylines gets lost to the readers. Recommend shortening to a more accessible discussion with specific examples and put the academic analysis into an annex, possibly with Box1.1 on uncertainty. [Mary Matthews, Azerbaijan]	Noted - the text has been edited.
41371	52	18			Please improve Fig 1.10 by more clearly separating the cascades for the two time periods and including RCP labels also for the near-term time frame. [Alexander Nauels, Germany]	Noted. The figure has been edited and improved.
11349	52	20	52	22	replace "The multi-model mean for each scenario is indicated at the top of each cascade" by "The SSP scenario number in CMIP6 for each scenario is indicated at the top of each cascade" [Michael Schmitt, Germany]	Noted. The caption has been edited.
80991	52	29	52	29	Please carefully consider the use of the word 'Storyline'. Non-scientific readers may literally assume that climate change is fictitious i.e. a story rather than non-fictitious science. I understand the reasoning of the use of the word, but there is a large segment of the public and the media that confuses science fiction with science fact. [Jeffrey Philip OBBARD, Singapore]	Noted. We have revised text for clarification on how the term is used in climate science. (new section 1.4.4)
57447	52	29	52	56	This storylines section is a better section than the section on page 25. The contents of this section should be thought of in relation to that section as well to ensure coherence and consistency. [Margot Hurlbert, Canada]	Noted. We have restructured some sections of the chapter, including section 1.2.2.1 (page 25). It does no longer exist, and storylines are only addressed in section 1.4.4
28295	52	29	53	34	The storyline concept (including Fig. 1.11 which basically shows the same network 4 times with slightly different highlights) is much harder to understand, more abstract, and less convincing than what comes before or after. I wonder if it is really needed to introduce the (important) concept of low-likelihood, high-impact events that follows? I don't quite see why... [Alexander Graf, Germany]	Noted. The figure has been removed.
114257	52	29	53	56	Nice presentation of storylines. But, is this used later? Consistently across chapters? And across WGs? [Jan Fuglestedt, Norway]	Taken into account. We have rewritten this section and included list of chapters where storylines are used

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70107	52	29	54	20	This is a useful and informative section. Note that it is however missing the dimension of varying "regional climate sensitivity" for the development of storylines (see also comment to Figure 1.11 and suggested changes). As an example, an emulator for regional responses has been developed which allows to "crossbreed" global and regional responses based on selection criteria (Beusch et al., in press). This study was focusing on choosing the best performing models on both global scale (i.e. for GCS or TCRglob) and regional scale (regional climate sensitivity), but the same tool could be used to further explore the phase space reached by combining the most extreme global warming responses with the most extremes regional climate sensitivity responses. Reference: Beusch et al., in press, GRL: https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2019GL086812) [Sonia Seneviratne, Switzerland]	Noted. The text has been shortened rather than expanded so the reference is not included. Figure 1.11 has been dropped
28719	52	29			Section 1.4.4 would benefit from a clear, regional example to illustrate the the text which I found somewhat difficult to follow [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Text has been shortened and references to where the concept is used are given.
41373	52	29			Unfortunately, there is a real danger here of adding to the scenario/pathway confusion by introducing yet another storyline term. Using the storyline term outside of the scenario space will be confusing for the reader. In addition, what are physical climate storylines that WGI is apparently covering? Frankly, this term does not make much sense at all. Please find a different way to establish a link to cross-WG risk language. [Alexander Nauels, Germany]	Noted. the concept of storyline is also used outside the scenario literature, so we introduce the different usages in this section. Hopefully clearly enough so to not increase confusion
36759	52	32	52	32	Solicited by whom? If it's the UNFCCC then say so. If it's some other body doing the soliciting then say so. [John McLean, Australia]	Taken account. rephrased
35479	52	36	52	36	Change & for "and" in bibliographic citations and bibliographic citations in chronological order [Carlos Antonio Poot Delgado, Mexico]	Editorial. Corrected
13205	52	39	52	39	It's suggested to mention the type of models used to elaborate the "Storylines". [Maria Amparo Martinez Arroyo, Mexico]	Noted. There is a reference to the section 1.6 which gives details about scenario storylines
125307	52	45	53	28	The lengthy, theoretical discussion of storyline theory is academic and not very helpful. Probably best delete most of lines 45-56 and delete Figure 1.11. [Trigg Talley, United States of America]	Noted. Figure 1.11 has been deleted.
841	52	47	#REF!	#REF!	"Climate response or internal variability" does not clearly link to "dynamical storyline" shown in fig 11d [Bart van den Hurk, Netherlands]	Not applicable- Figure 1.11 no longer considered
4773	52	47	52	47	"Climate response or internal variability" does not clearly link to "dynamical storyline" shown in fig 11d [Bart van den Hurk, Netherlands]	Not applicable. Figure 11.1 has been deleted.
125309	52	49	52	56	Delete this text. It makes the issue more confusing. [Trigg Talley, United States of America]	Rejected. The text has been revised, but examples on how the storyline approach is used in the literature and the report is kept.
70857	52	53	52	54	Mindlin et al. is now published: doi: 10.1007/s00382-020-05234-1 [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	Noted. reference added
70859	52	54	52	54	2017a -> 2017 [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	Editorial. Corrected
35481	52	56	52	56	Use published sources [Carlos Antonio Poot Delgado, Mexico]	Taken into account. Literature cut-off time (January 2021)- All "submitted" will be checked
4775	52	56	52	56	Could use a reference to De Bruijn et al (2016, Nat. Hazards 81, 99–121. doi:10.1007/s11069-015-2074-2.) and to Atlas.6.1.5 [Bart van den Hurk, Netherlands]	Taken into account. References added

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42855	52				Despite this long explanation, what you mean by "storylines" is completely opaque. Give an actual example. The use of this phrase "storylines" invites observers to think that what you are discussing is unscientific so I anyway think the terminology is poor. But at least explain it instead of skirting round it in incomprehensible jargon. On page 94, you actually give a succinct explanation of storylines that is much clearer than what is written here. [Eric Wolff, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The text has been substantially edited.
70105	53	1	53	21	Figure 1.11 would need to be updated to encompass the dimension of "regional climate sensitivity". The ellipse "regional warming" should be replaced with "regional climate sensitivity" (see Seneviratne and Hauser, EF, in press; RCS is dX_{reg}/dT_{glob} ; https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2019EF001474). An additional option for storylines should be included that mentions a "regional climate sensitivity storyline" in which extreme RCS responses are considered. Note that the models showing most extremes RCS responses are not the same as those showing most extremes GCS (or ECS) responses. (On this point, see also Beusch et al., in press, GRL: https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2019GL086812) [Sonia Seneviratne, Switzerland]	Not applicable. Figure 1.11 dropped
41375	53	3			Figure 1.11.: This figure is very confusing, vague, of very limited use and should hence be removed! Panel b, in particular, interferes with the internally consistent terminology of the SSP storylines and SSP/RCP scenario architecture. Even though O'Neill 2016 is cited, it is impossible to identify underlying the RCP/SSP rationale. This figure doesn't add anything to the introductory chapter of WGI apart from confusion. Removing this figure and associated text would also help to shorten the chapter which is way too long atm. [Alexander Nauels, Germany]	Not applicable. Figure 1.11 dropped
67007	53	8	53	8	change "storyline" to "scenario storyline" to differentiate from physical climate storylines [Liese Coulter, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable Figure 1.11 not considered anymore
113041	53	13	53	13	Does Weitzman (2011) use the terminology 'storyline'? It may not work as reference otherwise. If the meaning of 'storilyne' is within the context of 'scenario storyline', then I would suggest making this more clear, because the use of the word 'storyline' to refer to various concepts is already a bit confusing at the moment. [Diego Miralles, Belgium]	Indeed Weitzman does not use the term storyline, but text has been changed to cite correctly in the context of low likelihood high impact events.
70565	53	15			Replace 'includes' with 'applies to'. [Gillett Nathan, Canada]	Not applicable. figure 1.11 dropped
107829	53	24	53	26	While this statement is true it might be appropriate to note that WGII and many researchers therein made the shift from prediction space to decision making space well in advance of the storyline phenomenon. In other words this sentence could suggest that storylines make this shift more feasible, whereas the shift can be made in many ways: see Brown and Wilby or Rob Lempert's work. [Linda Mearns, United States of America]	Not applicable. This text has been dropped
125311	53	24	53	47	So much of this section is painfully wordy and unclear. In these three paragraphs, the reader is left wondering "Are they just trying to say how important tail events are?" If so, just say that. [Trigg Talley, United States of America]	Noted. The text has been substantially revised and shortened

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70555	53	24			The 'storylines' referred to in Stevens et al. (2016) are essentially testable hypotheses, or sets of feedbacks which would give rise to very low or very high climate sensitivities. Although both use the label 'storyline', this is not the same as the scenario storylines introduced in the previous paragraph, which are self-consistent possible futures. If the Stevens et al. (2016) reference and assessment about narrowing the bounds of climate sensitivity is retained, the authors should explain more what Stevens et al. do, and what in what ways this is different and what this has in common with the definition of storylines considered elsewhere in the section. [Gillett Nathan, Canada]	Accepted. Reference to Climate Sensitivity not kept in the revised version
67009	53	30	53	30	change "Storylines" to "Physical climate storylines" to differentiate from scenario storylines [Liese Coulter, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Changed
112547	53	30	53	34	the first sentence is wrong; storylines don't by themselves narrow the bounds of climate sensitivity. They enable the characterisation of the bounds. Also, storylines don't necessarily always reframe the risk question from the prediction space to the decision making space (see for example Stevens et al. 2016 or Zappa and Shepherd) [Suraje Dessai, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Text dropped
67011	53	31	53	31	change 'it' to 'they' before 'can consider' for Subject-Verb Agreement. [Liese Coulter, United Kingdom (of Great Britain and Northern Ireland)]	Editorial; Corrected
36761	53	36	53	47	This is a very poor example given that multiple papers estimate the ECS at values from about 1.0C to 2.0C, to wit Aldrin et al (2012), Ring et al (2012), Lewis (2013), Otto et al (2013), Masters (2013), Loehle (2014), Skeie et al (2013), Lewis and Curry (2015), Bates (2016), Christy & McNider (2017), and Lewis and Curry (2018). [John McLean, Australia]	Rejected. The figure uses the assessed ECS range from AR6.
114259	53	41	53	41	This is GSAT - not GMST - as far as I know. [Jan Fuglestedt, Norway]	Noted. Fixed, anyway text moved in another place
45751	53	41	53	41	"GMST levels" should rather be "global surface warming levels". [Twan van Noije, Netherlands]	Noted. Fixed, anyway text moved in another place
66651	53	50	53	50	Suggest "illustrates" rather than "motivates". Motivates might read as politically normative. [Dave Frame, New Zealand]	Taken into account . Removed. anyway text moved in another place
101483	53	51	53	53	I first read this as the "difficulty in [...] using a storyline approach; i.e. that we couldn't - could it be rephrased? (Will need to cross-check for consistency as currently we use the term pathway and will likely be substantially revising the box too) [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. The text has been revised and adjusted to the term used in Chapter 9
107831	53	56	53	56	The Atlas uses narratives? The Atlas discusses narratives, but it doesn't really use them. [Linda Mearns, United States of America]	Taken into account. Text revised
44343	53	56	53	56	Chapter 12 also includes an example of the use of storylines in the context of climate services (i.e. Cross-chapter Box 12.2) [Jana Sillmann, Norway]	Taken into account. Text revised to add assessment of storyline in Chapter 12
14505	53	56	53	56	add "the" before "Atlas" [Amy East, United States of America]	Editorial. Corrected
71417	53	56			In Chapter 10, we also discuss storylines as a means of representing uncertainty. [Douglas Maraun, Austria]	Taken into account. Text revised to add assessment of storylines as a means of representing uncertainty in in Chapter 10
19647	54	1	54	20	I do not understand this legend of figure 1.12. Even allowing for the "bottom left" on line 7 being probably "top left", the sentence line 7-9 is challenging. [philippe waldeufel, France]	Taken into account. Figure revised.
70109	54	1	54	20	As discussed in other comments, an additional dimension for potential storylines is the spread in the regional climate sensitivity response (Seneviratne and Hauser, 2020, Earth's Future: https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2019EF001474). I would be happy to provide more inputs to the chapter 1 authors on this topic. [Sonia Seneviratne, Switzerland]	Noted. Citation is added in 1.6.2.

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37823	54	3	54	18	The caption of Figure 1.12 is very difficult to understand. [Junhee Lee, Republic of Korea]	Taken into account. Figure and caption revised.
29709	54	4	54	4	Please include the meaning of "pdf" (probability density function). [Hernan Edgardo Sala, Argentina]	Noted. Text deleted.
114261	54	11	54	11	Please consider if this should be changed to GSAT. [Jan Fuglestedt, Norway]	Taken into account. GSAT is used.
125313	54	23	56	12	[SCOPE] Need to delete this cross-chapter box on risk framing and send it to WGII where the subject of climate risks is more appropriately addressed. [Trigg Talley, United States of America]	Reject. The risk framing is a critical aspect of how WGI is considering hazards as climatic impact-drivers.
102475	54	24	54	24	"los of like" should be "loss of life" [Philippe Tulkens, Belgium]	Accepted. Fixed
81127	54	24	56	9	WOW!! YES!! This is beautifully written, clear, to the point and informative. Other sections (box 1.1, 1.1.4, 1.2.3.3, 1.2.3.2) should read like this. Thank you! [Mary Matthews, Azerbaijan]	Thanks
125315	54	25	55	52	[SCOPE] This entire box is a very long-winded way of saying what is concisely written in p. 54, lines 38-39 (i.e., "hazards" = "climate impact drivers" in AR6). But, it's worth questioning why this is even needed at all. This box is WGII content. This figure is literally from AR5 WGII. Save space. Cut this box and move it to WGII. [Trigg Talley, United States of America]	rejected. The new risk definition is an integral part of AR6 and needs to be introduced in WG1
132015	54	25	56	8	repeating criticism on Box SPM.3, Figure 1: Use of the term CID could be misleading as discussed for p. 3, lines 8 to 10: The term climate impact driver is constraining the view on climate and I am wondering whether that is useful. A holistic view of the climate system has its own value and the term climate variable would be more appropriate here. While impacts can be positive or negative, the risk concept focuses on negative consequences and has thus successfully worked with the term hazard. The benefit of using CID is thus rather limited as its use is only fully justified if impacts assessment and detection and attribution have been carried out successfully by WGII. A vague "may" does not eliminate potential misunderstanding if the term is starting to be used routinely and in passing. Suggest dropping this term as constraining its use to verified cases will be challenging. The risk concept is already starting to be confused by this. The term CID being in the WGI glossary only does indicate the need for better coordination between WGs including leadership. If maintained it needs a qualifier such as "Potential CID". And it should not replace the term hazard in the WGII risk framing or in the propeller diagram. [Hans Poertner and WGII TSU, Germany]	Accepted. Included now the original propeller diagram in box
131367	54	25	56	10	The use of the term 'climatic impact driver' doesn't make sense in the context of 'risk'. You say you are using 'climatic impact driver' for changes in physical systems as more neutral term than 'hazards', however 'risk' is per definition the potential for adverse consequences. We strongly recommend to stick with the term 'hazard', at least in the risk framework. [Hans Poertner and WGII TSU, Germany]	Accepted. We have clarified the relationship between CID and Hazard.
131369	54	25	56	10	consider referring to cross-chapter box 2 'Key Concepts of Risk, Adaptation, Resilience and Transformation' in SROCC (Garschagen et al) [Hans Poertner and WGII TSU, Germany]	Accepted. Box from SROCC is referenced now
114807	54	25			Overall I think this box works very well. It would be useful for the box to point out where and to what extent WGI addresses climatic impact drivers that arise from response options such as SRM or CDR, since the risk definition highlights that risks can arise from such responses. [Brian O'Neill, United States of America]	accepted. included reference to table 1.1 where this information can be found
44347	54	27	54	30	shouldn't the authors of cross-chapter boxes be listed alphabetically? [Jana Sillmann, Norway]	yes, after the main contributor

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23623	54	32	54	49	The structure of those two paras seems somewhat duplicative. It would make more sense for me to bring the second para (with the explicit core definition) first, and then use the second para to explain the elements of the definition. Right now, the first para gives the explanation (but based on only parts of the relevant wording around the definition), and then the second para repeats this by giving the full definition (again). It's not wrong but somewhat confusing and duplicative. [Andy Reisinger, New Zealand]	Taken into account. We have restricted the text in this box.
70559	54	34			The phrase 'WGI has traditionally only focussed on the hazard component of the risk' seems to suggest that this is an oversight, and that WGI should also consider exposure and vulnerability. But the mandate of IPCC WGI is to assess physical climate science, not impacts. [Gillett Nathan, Canada]	Noted. Have changed slightly the wording
23619	54	36			add "potential for adverse consequences FOR HUMAN OR ECOLOGICAL SYSTEMS". Need to make clear up-front that risk does not apply to physical systems (since this is an on-going source of misunderstanding, and some of the WGI literature does apply the terminology of 'risk' to physical systems). I know this is stated 2 lines later, but I consider it important to embed this notion within the core definition that is provided in this line. The text two lines later can then emphasise and explain this element of the definition. In fact it might help to add a sentence or short para in this box that makes explicit that the concept of risk, as used by IPCC in the AR6, does NOT apply to physical systems, e.g. that we do (should) NOT talk about an increase in peak river flows as increasing 'flood risk' since this is only the physical dimension, and assessment of flood RISK relies on an assessment of the interactions of this physical quantity with the human and ecological systems that are affected by such physical changes (all of which are mutable over time). Which means that WGI provides a core input for assessment of (climate-related; not so much response-related) risks but in most cannot do the full risk assessment. [Andy Reisinger, New Zealand]	Accepted- reworded as suggested
70561	54	37			Is a positive effect from climate changes really sometimes described as a 'potential co-benefit' in this report? (As in something like 'increased crop yields at high latitudes are a potential co-benefit of climate change'?). This would seem to suggest that climate change is in itself a good thing, and the effect described is an additional benefit. Usually the term 'co-benefit' is used to mean an additional benefit of action taken to mitigate climate change, as in 'reducing coal burning results in co-benefits for air quality'. I suggest deleting 'co-benefits' here. [Gillett Nathan, Canada]	Accepted-'co-benefits deleted'
18607	54	38	54	39	First mention of Climatic Impacts Drivers may benefit from a bit more detail: "In AR6, WGI will use the term 'climatic impact drivers' as a more neutral term than 'hazards' encompassing changes that have the potential for beneficial or detrimental effects on human and natural systems." It could also be useful to include a phrase such as "there are many types of impact drivers (including social, political, economic, ecological) however WGI focuses on climatic impact drivers with origins in the climate system." This definition is expanded upon later in the box, but this initial context may help readers understand this important new term. [Alexander Ruane, United States of America]	Accepted- reworded as suggested

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112825	54	38	56	10	The term "climate impact driver" is confusing. In WGII the word "impact" is reserved for observed/realised impacts, whereas the term "risk" would be used for potential impacts (also future). I would strongly suggest reconsidering this -- even "climate impact/risk driver" would already be much better. Alternatively, you could consider "climate driver" (I realise this may cause confusion with the drivers of climate change itself, but I think it will generally be clear in the context -- whereas the confusion between impacts and risks will really complicate the flow to WGII (and also hamper user perspectives in general, where climate is often handled in terms of risk assessments). Something more explicitly including the word risk also makes a more natural flow to the rest of this text on risk framing (which was developed by the three working groups together). [Maarten van Aalst, Netherlands]	Rejected. Chapter 12 has introduced this new term to refer to "climatic impact-drivers", as: physical climate system conditions (e.g., means, extremes, events) that affect an element of society or ecosystems. Depending on system tolerance, CIDs and their changes can be detrimental, beneficial, neutral, or a mixture of each across interacting system elements and regions. However we have deleted the figure because in indeed for the risk framework it is hazard that is important.
23621	54	39			You could add here the explanation that this terminology is chosen because it is not clear from a WGI perspective whether e.g. a change in rainfall frequency has an adverse consequence or a beneficial one (this is the job of WGII, and ultimately application of the information by stakeholders), and hence WGI doesn't want to pre-judge whether any given climatic change is presenting a cause of risk or cause for an opportunity. [Andy Reisinger, New Zealand]	We haven't included an example in the final text, but rephrased it, so that hopefully it is clearer now. This includes using the term as "climatic impact-drivers" (with hyphen to make sure that these refer to physical variables that can produce an "impact")
112549	54	43	54	44	the sentence about terminology is odd; it seems to suggest that the risk of thermohaline circulation collapse or the risk of crossing physical tipping points or the risk of a bridge collapsing due to climate change are not included. Surely that is not the case? [Suraje Dessai, United Kingdom (of Great Britain and Northern Ireland)]	Indeed with the new terminology risk is only used when referring to human or ecological system .i.e., when there is exposure and vulnerability. Not just a hazard.
131371	54	44	54	49	consider referring to the Glossary when providing the full risk definition [Hans Poertner and WGII TSU, Germany]	Accepted. Glossary is referred to in the box in the revised text
40799	54	44	54	49	Slight wording difference with agreed cross-WG definition: "risks can arise not only from impacts of climate change, but also from potential human responses" -> "risks can arise from potential impacts of climate change as well as human responses" [TSU WGI, France]	Accepted. We have now updated the text to include the exact glossary definition of relevant terms.
125317	54	44	54	55	Where did the quote come from? It doesn't make sense: risk is the description of a possible future condition that could lead to adverse impacts (probability times consequence). Risk doesn't arise from impacts. Depending on proactive actions taken, impacts can arise from risk -- as shown in the WGII propeller diagram. The subsequent paragraph is equally unclear. The thinking is muddled about what is an impact, a risk, and the relationship between them. [Trigg Talley, United States of America]	Accepted. Text has been changed to reflect the exact definition of risk, also available in the glossary now.
70563	54	44		49	There is no reference here - where is the quoted text taken from? [Gillett Nathan, Canada]	in quotes is the glossary definition of risk. In the new version of this box this is made clearer
26135	54	45	54	47	It is important to note that some of the most important risks and uncertainties in the context of climate mitigation are those associated with future economic, social, and policy conditions. For example, investments into renewable energy sources is highly sensitive to expectations of future prices of fossil fuels, which is in turn influenced by future economic growth. In the AR5, WG3 had a framing chapter highlighting these issues (Chapter 2) and the importance of background socio-economic uncertainties. In AR6 there is no such chapter. So it might be worthwhile simply citing the AR5 chapter. [Anthony Patt, Switzerland]	This part of the text has been rewritten, and now reflects the exact definition of risk, as found in the glossary as well. In the meantime IPCC published a guidance note that is cited in the box.

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23625	54	51	54	55	The authors are changing the wording of the definition here in a way that is neither helpful nor correct, by replacing 'hazard' with 'climatic impact driver'. The word 'hazard' is the correct one here - it is tied to the potential for an adverse consequence. Using the term 'climatic impact driver' is not correct here, since it implies that you are agnostic regarding a negative or beneficial outcome - but that is not the case when you are already applying the risk definition. So I would urge the authors to be faithful to the agreed risk definition - use the word 'climatic impact driver' only in a '-re-risk' context, i.e. WGI assesses climatic impact drivers, and this information is then used to assess the contribution of those drivers to outcomes - and if the outcome is negative, this constitutes a 'risk' and the driver is called a hazard; and if the outcome is beneficial, it is not called a 'hazard' but then the risk framework also is no longer applicable. [Andy Reisinger, New Zealand]	Accepted. Text has been changed to reflect the exact definition of risk, also available in the glossary now.
87525	55	1	55	55	Given the importance of the concept of equity to the Paris Agreement, would it make sense to mention 'equity' specifically in the course of this enlightening discussion of risk? For example at line 3 or within the paragraphs on 'exposure', 'vulnerability' and (perhaps especially) 'impacts'. [Stephen Humphreys, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. This part of the text is the exact definition of risk in the IPCC, so we cannot include concepts outside the definition.
39693	55	3	55	3	"(see also risk trade-off)": You don't provide a definition for risk trade-off [TSU WGI, France]	Its in the glossary.
131373	55	3	55	3	(see also risk trade-offs) - I guess you are referring to the Glossary? Please clarify [Hans Poertner and WGII TSU, Germany]	Yes, clarified
125319	55	7	55	7	What is meant by "included within the definition of risk"? [Trigg Talley, United States of America]	Noted. We have change the text. Now is refers to: "The following concepts are also relevant for the definition of risk "
96075	55	7	55	33	Please provide a definition for "risk" as well. [Nicole Wilke, Germany]	Accepted. The new definition of risk is included in the box.
40797	55	9	55	11	Slight difference from cross-WG glossary definition: "The presence of people; livelihoods; species or ecosystems; environmental functions, services, and resources; infrastructure; or economic, social, or cultural assets in places and settings that could be adversely affected." [TSU WGI, France]	Accepted. Text has been edited to include the exact same definition as in glossary
131375	55	9	55	33	the description of key concepts (exposure, vulnerability, hazards, impacts) here should be identical with the descriptions provided in the Glossary. 'Physical impacts' is not at all mentioned in the glossary. [Hans Poertner and WGII TSU, Germany]	Accepted. The key concepts are the same as in glossary and Climatic Impact-drivers as well.
19649	55	9	55	33	Definitions of key concepts introduced here should be added to the glossary [philippe waldteufel, France]	Accepted. They have been included in the glossary
114809	55	15	55	17	The sentence beginning "It also includes..." appears to repeat part of the definition of exposure, and indeed seems like it belongs to exposure, not to vulnerability. The next sentence on "A broad set of factors...." says it applies to both vulneability and exposure but to my mind only applies to vulnerability, not exposure. [Brian O'Neill, United States of America]	Accepted. In the revised text we use the exact glossary definitions
26587	55	19	55	19	Reference to that article is right, but the authors are wrongly listed. It should read Lenton et al., 2008, and the order of authors in the reference list should be modified. [Eric Brun, France]	There seems to be a mistake in page and line number. There is no reference on page 55, line 19

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52215	55	19	55	21	Is it possible to make clear that a Climatic impact driver is often referred to as a hazard when it has a detrimental effect? This could be confusing to people who are used to the risk framework defining hazard, exposure and vulnerability. It is clear in figure, so probably just needs to be clear in the text. [Helene Hewitt, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. included in revised text
50603	55	19	55	40	The shift to climate impact driver is generally helpful and reduces confusion a bit - because some regions will see opportunities through climate change. However I find this definition of climatic impact driver is a little confusing within this framework. By limiting it to the hazard (or physical change that drives an impact), it is then a bit confusing to consider the definition of impacts (which is effects on human/ecosystems) when exposure and vulnerability are also drivers of those impacts. I think there's a risk of that getting lost with the new term. It would be very helpful if the definition of these different terms could be made a little clearer to ensure that a non-expert reader doesn't come away with the idea that it's only physical change that drives climate impacts. [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	The definition of climatic impact driver has been updated and its relationship to Hazard clarified in the text.
40679	55	23	55	23	Remove "or physical impact" from the definition to make it consistent with the SR definitions. [TSU WGI, France]	Accepted. Text is now the exact definition as in the glossary
18609	55	23	55	25	Definition of 'hazard' is confusing. "loss of like, injury...", Please consider rephrasing or clarifying [Alexander Ruane, United States of America]	using correct glossary definition now
106497	55	24	55	24	correct "los of like" to "loss of life" [camille parmesan, France]	thanks. corrected
29711	55	24	55	24	Check line, please [Hernan Edgardo Sala, Argentina]	not a comment
44349	55	24	55	24	typo: "los of like" should be "loss of life" [Jana Sillmann, Norway]	thanks. corrected
42067	55	24	55	24	"los of like" -> "loss of life"? [Julia Nabel, Germany]	thanks. corrected
88161	55	24	55	24	Revise to "loss of life" [Sharon Smith, Canada]	thanks. corrected
13161	55	24	55	24	should say loss of life not los of like [Maria Amparo Martinez Arroyo, Mexico]	thanks. corrected
67699	55	24	55	24	like -> life? [Hiroaki Kondo, Japan]	thanks. corrected
26237	55	24	55	24	I guess this is a typo and instead of "los of like" should be "loss of life" [Tania Guillén Bolaños, Germany]	thanks. corrected
113043	55	24	55	24	Correct 'los of like...' [Diego Miralles, Belgium]	thanks. corrected
110747	55	24	55	24	loss [Bruno Korgo, Burkina Faso]	thanks. corrected
37825	55	24	55	24	los of like -> loss of like ? [Junhee Lee, Republic of Korea]	thanks. corrected
82159	55	24	55	24	"los of like"? Did you mean loss of life? [Borbála Gálos, Hungary]	thanks. corrected
36763	55	27	55	30	It takes 14 people to write just over two pages of text? You have to be kidding! [John McLean, Australia]	Noted
26239	55	27	55	33	The term "impact" is mostly used in a negative sense, but there can also be positive impacts. I would suggest this addition: "... Impacts are also referred to as consequences and outcomes (they can be either positive or negative)". [Tania Guillén Bolaños, Germany]	Rejected. The text used is the exact definition of impact from the glossary.
125321	55	27	55	33	Impacts are observed, which means they are historic or current -- not future. Earlier, risks were appropriately described as occurring in the future. Please work on clarifying the mental model for risk and impact. [Trigg Talley, United States of America]	Noted. Text has been revised and the exact glossary definition of risk and impact have been included
40643	55	27	55	33	Please for impacts the definition in the glossary, which was used by SROCC. It doesn't mention 'physical impacts'. It also makes clear that impacts can be positive or negative. [TSU WGI, France]	Noted. Implemented

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106499	55	29	55	29	please add "species" to this list. An impact on a species is not the same as an impact on an ecosystem. Re common definition of "ecosystem": "An ecosystem is a community of living organisms in conjunction with the nonliving components of their environment, interacting as a system." You can have a species go extinct without substantially affecting the ecosystem it lived in, and you can have a particular ecosystem disappear without necessarily causing every species that ecosystem contained to go extinct. Species often have larger ranges than a single ecosystem. [camille parmesan, France]	Accepted. We have now included the exact glossary definition of impact, that included species.
112551	55	29	55	29	somewhere opportunity needs to be inserted as a key concept [Suraje Dessai, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Opportunity is introduced in the box, when explaining CIDs
3639	55	31	55	32	I would recommend using "smooth dependence" instead of quasi-linear [Valerio Lucarini, United Kingdom (of Great Britain and Northern Ireland)]	Comment probably refers to another part of the chapter. There is no reference to "quasi-linear" in the text of this box.
50605	55	32	55	55	Pg 54 lines 51-55 discuss that the components of risk maybe subject to likelihood of occurrence, however, further down in the Box 1.3 it is less clear, especially that risk of impact is related to the likelihood of impact. WMO booklet 1150 'Guidelines on multi-hazard impact based forecasting and warning services' pg 5 has a clear definition of 'risk of impact' which might be useful to clarify how the key concepts (pg 55 lines 9-33) interact with respect to risk. [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The final text of this box has been revised and now reflects the exact definition of the new risk definition, as stated in the glossary as well.
23627	55	34			Given the broad, explanatory ambition of this box (which I consider useful), it would be helpful to add a short para here that emphasises the evolution/innovation in the risk concept in AR6 that recognises that risks can arise not just from climate change impacts (what the climate does to us) but also from climate change responses. And use this to clarify that inputs from WGI are relevant mainly to the first category (risks related to climate change impacts), but generally less so to risks arising from adaptation and mitigation responses to climate change, although depending on the specific risk, WGI information may of course still be relevant. But get people to understand that risk is a much broader concept that, in the case of risks related to responses, may have nothing to do with climate-related hazards - this is important and would help set up this broader understanding across the AR6 as a whole. [Andy Reisinger, New Zealand]	Accepted. We have rewritten the intro paragraph that now refers to new guidance note among others.
70567	55	35		38	I think this text is contrasting the term 'climatic impact driver' with 'hazard', but this isn't said explicitly. The authors should state this explicitly, otherwise it is not clear to what the comparison is being made. [Gillett Nathan, Canada]	Accepted. The exact definition of CID is now included and its relationship to hazard included.
39711	55	40	55	40	"... or their physical impacts": Suggest to keep "hazard" and "impacts" as distinct. Impacts are the realised risks when a hazard occurs - see SROCC definition. [TSU WGI, France]	Accepted. We have included the exact definition as in glossary
131377	55	42	55	52	All these examples of the risk framework terminology (risk to food security etc) seems a bit misplaced here in a WGI report [Hans Poertner and WGII TSU, Germany]	Noted. We have kept the examples, but added a new paragraph that includes further clarification for WG1 specifically
28721	55	42			Cross Chapter Box 1.3 is excellent. I think it would further benefit from a simple definition of Risk (as a bold title) that builds upon the definitions above and which is illustrated with the flooding example [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	In the revised box we have included clearly the new IPCC risk definition, as in the glossary

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114811	55	46	55	52	The example of risk to food security is pretty confusing. "Climate impact" does not seem to be used correctly, unless something subtle is meant. An impact is a manifestation of a risk (risk of food insecurity is the potential for food insecurity, an impact is the food insecurity actually occurring, in the real world or in a model simulation). It appears to be used here in the sense of what you are calling a climatic impact driver. Or maybe you mean that another climate impact, eg on water security, can also act as a contributor to food security risks. If so you need to spell that out, and I wouldn't start with it as the first determinant of food insecurity in a simple example meant to clarify. Also I would not say pest outbreaks are an impact. The consequence of that pest outbreak for humans or ecosystems is an impact (although maybe that's a grey area, overlapping with an ecological impact). You also introduce "adaptability" (maybe better said as adaptive capacity) without defining it. [Brian O'Neill, United States of America]	Accepted. Example has been kept, but the concept of "climatic impact-driver" with hyphen is used now to clarify that it refers to physical variables that can drive an impact. Hopefully this has clarified the example.
44351	55	48	55	49	The examples listed for climate hazards are actually climatic impact drivers as described and assessed in Chapter 12. Increases in CO2 levels is likewise a climatic impact driver. The CO2 fertilisation of crops could be an example for a (beneficial) biophysical impact of climate change, but is per se not a climatic impact driver. The sentence needs to be changed accordingly. [Jana Sillmann, Norway]	not implemented. This is a mistake
44977	55	48	55	49	In addition to CO2 fertilisation probably increasing yield, research has also been highlighting the possible decline in micronutrients as CO2 levels increase globally (eg Myers et al 2014, Dietterich et al 2015, Medek et al 2017, Zhu et al 2018). This would be relevant to the discussion on climate related risk to food security. [Maysoun Mustafa, Malaysia]	Noted. These are interesting other examples, but due to space limitations not included
70569	56	13	57	38	This section on 'Abrupt change, tipping points and surprises' is written more in an academic review style than as an assessment. The section describes various mechanisms proposed in the literature with no assessment of how likely or unlikely they are. No calibrated uncertainty language is used in this assessment. This topic is very high profile, and will be of interest to governments and other readers, and the authors should recognise that whatever is written here will become the IPCC assessment on this topic. I suggest more careful framing, and assesment of the mechanisms discussed is needed. Also, the starting point for this assessment should be the assessment of abrupt change in AR5 (Section 12.5.5.1, and Table 12.4), which is considerably more conservative than the assessment made here. In which areas do we have new evidence and how and why has this changed compared to the AR5 assessment? If the authors really won't add uncertainty qualification, an alternative less good approach would be to re-write to ensure that the text makes very clear where the authors are reporting an idea proposed in a particular study or studies. And then refer readers to Section 4.7.3 and Table 4.10 for an assessment of the confidence likelihood associated with abrupt change across a range of large-scale indicators. [Gillett Nathan, Canada]	Noted, however this section serves to introduce concepts. The assessment of abrupt changes ad tipping points takes place elsewhere in the report (e.g. in the sections the reviewer refers to).
40023	56	13			Clear and short definition of abrupt change, tipping points and irreversibility is provided in SROCC Chapter 6 Section 6.1.1. Suggest authors to make it more clear and keep consistent for those identification across different Reports. [TSU WGI, France]	Accepted. Definitions are now consistent with the glossary

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107161	56	13			[pt 1 of 2] Re: "1.4.5 Abrupt climate change, tipping points, and surprises" -- any discussion of this topic should include the fact that the CO2 levels of the last few million years are extraordinarily low, in the Earth's history. I suggest inserting a paragraph something like this: "Through >99% of the Earth's history CO2 levels were far higher than their current level (413 ppmv). During the lush Cretaceous (66 to 145 million years ago), it is believed that CO2 levels averaged about 1500 ppmv, and during the Jurassic levels were even higher. Yet those high CO2 levels apparently did not trigger any "tipping point" catastrophes. ..." [cont'd] [David Burton, United States of America]	Rejected. Chapter 1 focusses on Earth's recent history, but already refers back to the Palaeocene when CO2 levels were much higher. It is incorrect to say 1500 ppmv CO2 is optimal for plants, much more likely to be around 600 ppmv
107163	56	13			[pt 2 of 2] "... Coincidentally, 1500 ppmv CO2 is near optimum for most crops, so it is the approximate typical target daytime CO2 concentration used in commercial greenhouses (achieved by means of CO2 generators). Most plants are much healthier, faster-growing and more productive with CO2 near 1500 ppmv. However, that level would represent an increase more than 8 times the 130 ppmv increase which has resulted from mankind's use of fossil fuels, thus far. Resource constraints and natural negative feedbacks make it impossible that mankind could ever drive outdoor CO2 levels that high, by using fossil fuels. In fact, it is unlikely that outdoor CO2 levels will ever reach even half that level." ### [David Burton, United States of America]	Rejected. Chapter 1 focusses on Earth's recent history, but already refers back to the Palaeocene when CO2 levels were much higher. It is incorrect to say 1500 ppmv CO2 is optimal for plants, much more likely to be around 600 ppmv
52217	56	13			Should the AMOC and Ice sheets in chapter 9 be referred to in this section? [Helene Hewitt, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Text has been re-written
40957	56	15	56	16	The glossary definition says "that occurs faster than the rate of change of forcing". Here it says "much faster". Consistency needed. [TSU WGI, France]	Accepted. Definitions are now consistent with the glossary
8615	56	15	56	21	See critique of 'tipping points' language in Kopp et al 2016, 10.1002/2016EF000362. "abrupt change" and "rapid change" can be confused, yet many abrupt changes involve rapid commitment but not realization of change. 'tipping points' in common vernacular implies rapidity, but likewise many climate tipping points result in slow-ish change (eg ice sheet collapse), so should be clear about this [Robert Kopp, United States of America]	Noted. Definitions are now consistent with glossary
70571	56	15		16	This definition of abrupt change appears to be different from that used in AR5. I suggest briefly describing the reasons for the change from AR5. AR5 WGI, 12.5.5.1: We define abrupt climate change as a large-scale change in the climate system that takes place over a few decades or less, persists (or is anticipated to persist) for at least a few decades, and causes substantial disruptions in human and natural systems (see Glossary). Other definitions of abrupt climate change exist. For example, in the AR4 climate change was defined as abrupt if it occurred faster than the typical time scale of the responsible forcing.' [Gillett Nathan, Canada]	Accepted. Definitions are now consistent with the glossary
70573	56	17		19	The assessment 'In some cases, abrupt change occurs because the current state actually becomes unstable, such that the subsequent rate of change is independent of the forcing' does not cite any references and does not include any uncertainty qualifier. This is a very strong statement, and in revision the authors should consider the balance of evidence for and against when assessing the confidence associated with this statement. [Gillett Nathan, Canada]	Noted. Reference Lenton, 2011 has now been added
36765	56	18	56	18	Don't make me laugh!. When has the climate ever been stable? [John McLean, Australia]	Rejected. The point of this section is indeed to discuss abrupt changes in climate.

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36767	56	18	56	19	This is not a tipping point at all. There is no reason to believe that responses to climate forcings are linear. A simple example: Rain on dry ground will largely soak into the ground. The same amount of rain on wet ground might cause flooding because the ground can't absorb any more. It's the capacity of the physical environment to handle the situation that determined what you are trying to call a "tipping point". Another example is coral bleaching. If the ocean is warmed by hot sunshine and there's no cooling breezes, then coral will bleach, but if either one is not present then it won't bleach. [John McLean, Australia]	Rejected. Tipping points are non-linear responses to linear forcing
83401	56	19	56	19	Wrong order of authors for tipping element reference! The correct reference is: Lenton, T.M., Held, H., Kriegler, E., Hall, J.W., Lucht, W., Rahmstorf, S., Schellnhuber, H.J., 2008. Tipping elements in the Earth's climate system. Proceedings of the National Academy of Sciences 105, 1786-1793, doi: 10.1073/pnas.0705414105. [Antje H. L. Voelker, Portugal]	Accepted. Reference amended
70579	56	20			The reference to 4.7.2 should be to 4.7.3. Also, the section should actually link better with the assessment made in 4.7.3. [Gillett Nathan, Canada]	Accepted. Section has been corrected
11351	56	21	56	21	add "and are mostly irreversible" at the end [Michael Schmitt, Germany]	Noted, but we prefer not to talk of irreversibility until it is defined later in this section
28227	56	23	56	24	<p>"There is good evidence of abrupt change and even of tipping points in the paleoclimate record (Dakos et al., 2008)."</p> <p>I disagree with this statement. Dakos et al. looked for changes in autocorrelation prior to abrupt shifts, and found increases in some cases. However:</p> <ul style="list-style-type: none"> - Autocorrelation (and other statistical properties) can always increase or decrease by chance. - The timeseries in the Dakos study represent very different events in Earth's history. Because we have only one realisation from each event, the possibility of statistical assessments is limited. - Increasing autocorrelation is not a sufficient condition for a tipping point. It also increases when the effective inertia of a system changes, or when there is a destabilisation that is not sufficient to cause a tipping point. - There is an unsettled debate whether Dakos et al's findings are consistent with the dynamical systems theory of bifurcation-induced tipping points which would require both autocorrelation and variance to increase (see Ditlevsen and Johnsen, 2010, doi: 10.1029/2010GL044486) - There is no compelling or widely accepted mechanistic evidence that Dansgaard-Oeschger events, or the deglaciations after ice ages, or the end of the green Sahara, were actual tipping points. For example, the paper by Clement and Peterson cited in the next sentence does not provide or discuss such evidence. The most compelling case (mechanistically) is probably the glaciation of Antarctica ~34 million years ago (but I am no expert for that), and the Snowball Earth glaciation and deglaciation around 600 million years ago. <p>I hence suggest to alter the statement as follows:</p> <ul style="list-style-type: none"> - There is evidence of abrupt change in Earth's history. - There is a debate whether some of these events can be understood as tipping points. <p>[Sebastian Bathiany, Germany]</p>	Noted, but we disagree to some extent. There is good evidence of abrupt shifts, such as the Dansgaard-Oeschger events. We have modified the text to say that some of these abrupt shifts have been interpreted as tipping points, which there is no denying.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
70575	56	23		24	This assessment that 'There is good evidence of abrupt change and even of tipping points in the paleoclimate record' only cites a single study. This is a strong statement, and should be based on more than a single study. Also 'good evidence' is not part of the IPCC calibrate uncertainty language. As shown in Box 1.1, Figure 1 in this chapter, the correct terms are 'limited evidence', 'medium evidence' and 'robust evidence'. Also, what is the level of agreement between these different lines of evidence (Box 1.1., Figure 1.1)? And based on this, why do the authors decide not to assess confidence? This is a very important assessment, so the authors should provide a full traceable account of the associated uncertainty assessment. [Gillett Nathan, Canada]	Noted. Text re-written and now uses correct terminology
657	56	25	56	25	Give approximate dates for Quaternary and Paleocene, because most readers will not know what these are. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Dates have been added
21177	56	25	56	26	Rapid warming occurred at start of the Eocene during the PETM not at the end of the Paleocene (see also other chapters). There are signs of local warming prior to the PETM, but this is subordinate to the main warming event. A key and up-to date reference for this is Hollis et al. 2019: The DeepMIP contribution to PMIP4: methodologies for selection, compilation and analysis of latest Paleocene and early Eocene climate proxy data, incorporating version 0.1 of the DeepMIP database. Geoscientific Model Development, 12, 3149-3206. It is frequently used in some other chapters dealing with PETM and EECO [Robert Speijer, Belgium]	Accepted. Text changed to refer to PETM and reference has been added
108003	56	26	56	27	The "much slower" than projected anthro changes line suggests that paleoclimate changes might not be relevant, decreasing risk. Instead, the slower changes seen in paleoclimate records are an upper bound for how slowly tipping points can occur. Rapid warming in comparison to the paleoclimate record increases risk of tipping points, not vice versa. Reflecting that sentiment in this sentence will also improve flow into next paragraph. [Kelly Wanser, United States of America]	Noted. This is a statement on the risk of abrupt change occurring relative to the background climate. Some text has been added to reduce ambiguity.
107165	56	26		27	It says, "Such events changed the planetary climate for tens to hundreds of thousands of years, but at a rate that is actually much slower than projected anthropogenic climate change over this century." That's nonsense. Anthropogenic climate change is known to be MUCH slower than many past natural climate changes. For instance, we know from ice core isotope analyses that over the last 100,000 years the Earth has experienced dozens of natural "Dansgaard-Oeschger events" in which temperatures changed at rates as rapid as several degrees per decade. Those much larger & more rapid natural temperature changes are known to have been globally synchronous, though less abrupt in the southern hemisphere, and they persisted for hundreds or (more typically) thousands of years. Here are some references: https://www.nature.com/scitable/knowledge/library/abrupt-climate-change-during-the-last-ice-24288097/ http://archive.is/aUi9R#selection-415.0-419.271 http://archive.is/x6EWS#selection-285.385-293.48 https://judithcurry.com/2017/02/17/nature-unbound-ii-the-dansgaard-oeschger-cycle/ [David Burton, United States of America]	Noted, but our point holds - abrupt changes seen in the paleoclimate record (with the possible exception of D-O events) are typically slower than anthropogenically forced climate change.
36769	56	29	56	29	You talk about anthropogenic warming but you still haven't proved that it exists and is of a magnitude that is any cause for alarm. The claim by Steffen is his usual fantasy that ignores the temperatures and CO2 levels of the last 500 million years (see Ruddiman, 2001). [John McLean, Australia]	Rejected. We aren't supporting the Steffen hypothesis here, and have rewritten this sentence to make that even clearer. However, the evidence of anthropogenic warming is overwhelming as you will see from the rest of this report.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
15907	56	29	56	38	<p>The statement:</p> <p>"However, there is no evidence of such non-linear responses at the global scale in climate projections for the next century," is misleading.</p> <p>All critical climate change variables are now proceeding non-linearly, such as ocean heat content and sea ice decline and the interactions between these are likely to be critical and not fully understood. Importantly, the high ocean heat content in the upper layers of the ocean and its flow into the Arctic, where it connects directly with the subsea permafrost in the shallow regions is already leading to large and non linear releases of methane, see https://www.mdpi.com/2076-3263/9/6/251/htm. Thus a more correct statement would be:</p> <p>"Non-linear responses at the global scale in climate projections for the next century cannot be ruled out," [Kevin Lister, United Kingdom (of Great Britain and Northern Ireland)]</p>	Rejected. The linearity between cumulative emissions and global warming is very clear even in extreme scenarios like SSP585.
66653	56	29	56	38	<p>I think you could do with another sentence between the point about the linear response to cumulative emissions at the global level and the possibility of variations to this at the regional scale. In particular, readers may get the mistaken impression that "hot-house states" are plausible regionally, when they are not. It might be useful to say something about the climate response being a function of the localisation of forcings by feedbacks, and that none of the main feedbacks show much evidence for tipping, under present conditions and 21st century forcing. (Though maybe this misses the fact that dynamics responses are often indirect responses to thermodynamic change...) Also, the critical-slowng down point is a thing in dynamical systems, but is there any observational evidence in the earth's climate system, or in GCMs/ESMs other than EMICs? If there is evidence, it should be referenced, but if there isn't evidence, then I think the sentence should probably be cut because it's not really something that's wll supported by multiple lines of evidence. [Dave Frame, New Zealand]</p>	Noted, and we have reworded the text around here. Dakos et al., 2008 is already cited and shows critical slowing down before some abrupt transitions in paleoclimate record. Not sure what is meant by the localisation of forcings by feedbacks....
70577	56	29		38	<p>This paragraph discusses tipping points and abrupt change in paleo data and earth system models, but lacks proper assessment. [Gillett Nathan, Canada]</p>	Noted, however this section serves to introduce concepts. The assessment of abrupt changes ad tipping points takes place elsewhere in the report (e.g. in the sections the reviewer refers to).
125323	56	30	56	30	<p>"a permanent hot-house state" is casual. Explain more clearly: Is this the same as run-away greenhouse effect? [Trigg Talley, United States of America]</p>	Accepted. Text re-written
36771	56	30	56	32	<p>How dare you ignore the logarithmic relationship between CO2 and temperature! [John McLean, Australia]</p>	Rejected. We do not ignore the logarithmic dependence of CO2 forcing on CO2 concentration. These emergent phenomena occur despite that.
108001	56	30	56	32	<p>The assessment that there are no evidence of tipping points directly is incorrect, because tipping points are not represented in the models, as discussed later in AR6 WG1 pg. 51, 11-13, and Ch. 3 pg. 56, lines 20-25 [Kelly Wanser, United States of America]</p>	Rejected. It is not true to say that CMIP6 models do not include the processes that can lead to tipping points. Indeed there is evidence that some regional TPs occur in these models (e.g. Drijfout et al., 2015), as we already say in the text.
12415	56	31	56	35	<p>Volcanic eruptions can not be predicted as well. The two classification of surprises defined in line-31 are not independent to each other. This need a revision. Moreover, it should be timely to add some unexpected social global pandemics such as COVID#19 (already cause reduction of GHGs emission in first three months of 2020) [Lijing Cheng, China]</p>	Accepted. Text has been re-written and COVID19 has been referred to

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
28229	56	33	56	34	Besides Drijfhout et al. 2015, there is now a more comprehensive scan for abrupt shifts in CMIP5: Bathiany, Hidding and Scheffer, 2020: Edge Detection Reveals Abrupt and Extreme Climate Events (doi: 10.1175/JCLI-D-19-0449.1) [Sebastian Bathiany, Germany]	Accepted. Reference added
36773	56	33	56	34	Tipping points from models who accuracy has never been proven? You are stooping very low with this claim. [John McLean, Australia]	Rejected. We merely say that regional tipping points can be seen on ESMs, which is true.
36775	56	34	56	35	You have no evidence for this statement. There are just two tipping points in meteorology - the point at which rain starts to fall and the point at which snow starts to fall. [John McLean, Australia]	Rejected. We explain in this section that tipping points are possible in many components of the Earth System.
36777	56	40	56	40	Replace "proposed" with "speculative" because that's what they are. Nothing derived from an unvalidated climate model is, at most, anything more than speculative (and usually even less than that). [John McLean, Australia]	Rejected. There is good evidence of abrupt change and tipping points in models and climate records. We believe "proposed" remains appropriate here.
40953	56	40	56	42	The glossary definition for irreversibility is more explicit about the recovery timescale: "A perturbed state of a dynamical system is defined as irreversible on a given timescale if the recovery timescale from this state due to natural processes is significantly longer than the time it takes for the system to reach this perturbed state. In the context of WGI, the timescale of interest is centennial to millennial." [TSU WGI, France]	Accepted. Definitions are now consistent with the glossary
24243	56	40	56	48	Fig. 1.13 is too abstract without concrete examples and discussion. Even the discussion of freshwater input fails to mention the North American ice dam. [Bryan Weare, United States of America]	Rejected. Concrete examples are given (i.e. Dansgaard-Oeschger events and collapse of the thermohaline circulation in the North Atlantic)
70581	56	41		42	This definition of irreversibility, as corresponding to a move to a new stable state is inconsistent with the AR6 glossary definition of irreversibility 'A perturbed state of a dynamical system is defined as irreversible on a given timescale if the recovery timescale from this state due to natural processes is significantly longer than the time it takes for the system to reach this perturbed state. In the context of WGI, the timescale of interest is centennial to millennial.' The glossary definition does not require that the system moves to a new stable state. By the glossary definition, global warming in response to CO2 emissions is irreversible, but by the definition given here it is not. [Gillett Nathan, Canada]	Accepted. Definitions are now consistent with the glossary
73899	56	42	56	46	The types of tipping are introduced in a different order than they are presented in Figure 1.13, meaning that panels c and d are referred to before panels a and b. [Paul Ritchie, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Text has been re-ordered
101485	56	43	56	43	Suggest "in response to North Atlantic changes such as..." or similar (because also SST increase and sea ice meltwater) [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Change in text has been made
35483	56	44	56	44	Bibliographic citations in chronological order [Carlos Antonio Poot Delgado, Mexico]	Accepted. Ordering has been changed
28231	56	46			To be precise, the state does not leave the stability landscape - it leaves the current well of attraction in the stability landscape. [Sebastian Bathiany, Germany]	Accepted. Text has been re-written
38605	56	50	56	55	"The formulation sounds like tipping point are not an applicable concept in clima change. This is considered to be false. " [Aribert Peters, Germany]	Noted, but the section as a whole aims to give a balanced view.
70583	56	50		55	This discussion is very theoretical, and is lacking uncertainty assessment. [Gillett Nathan, Canada]	See response to 70569.
871	56	52	#REF!	53	Not sure I understand the argument that large inertia lead to the failure of early warning systems. [Bart van den Hurk, Netherlands]	Noted. Early warning systems require a separation of timescales between forcing and response. This is not always the case for systems with large inertia
4777	56	52	56	53	Not sure I understand the argument that large inertia lead to the failure of early warning systems. [Bart van den Hurk, Netherlands]	Noted. Early warning systems require a separation of timescales between forcing and response. This is not always the case for systems with large inertia

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
113045	56	55	56	55	n-dash for hyphen [Diego Miralles, Belgium]	Accepted. Change made
115731	56		57		Please check the consistency between the introduction to abrupt change and tipping points here, and their use in WGI chapters. Pandemic may be added as surprises beyond biological infestations. [Valerie Masson-Delmotte, France]	Accepted. Definitions are now consistent with the glossary
42069	57	1	62	1	would it be possible to introduce more structure to increase clarity (see also following suggestions) [Julia Nabel, Germany]	Accepted. A figure has also been added to guide the reader.
42071	57	1	62	1	Maybe use numbered sub-captions as in Box 1.2 and introduce more sub-captions / structure elements? Re-order content? [Julia Nabel, Germany]	Taken into account. Numbering has not been included, but the box has been shortened, with more structure and a figure.
42073	57	1	62	1	Maybe sub-captions could be clarified - e.g. "Methods, and what different approaches tell us" -> "areas of application"? [Julia Nabel, Germany]	Taken into account. The box has been rewritten, with clear titles and a figure.
42075	57	1	62	1	Maybe try to unify the sub-captions: e.g. "Attribution of impacts and adaptation" vs "Attribution in WGIII" -> "Attribution of impacts and adaptation" seems to be about "Attribution in WGII" or "Attribution in WGIII" about "attribution of changes in emission trends to drivers" ? And the section termed "Methods, and what different approaches tell us" seem to contain information about "Attribution in WGI"? [Julia Nabel, Germany]	Accepted. The use of WG in the headings has been removed.
42077	57	1	62	1	Maybe collect, describe and distinguish the different attribution techniques in a listing / figure? [Julia Nabel, Germany]	Rejected. A list of methods would be far too long for a 2-page box. The aim of this box is to highlight similarities and differences in the methods. But more importantly the uses of attribution studies and aspects to consider when assessing results of those studies.
21327	57	6	57	6	All of chapters 6 through 9 had attribution in their scoped charge so why of these is only chapter 9 cited here? [Peter Thorne, Ireland]	Noted, but the sections listed here are specifically concerned with abrupt changes rather than attribution.
104695	57	11	57	11	shouldn't "dependent on the type of tipping" be between commas? [Marco Tulio Cabral, Brazil]	Accepted. Commas added
125325	57	31	57	32	The structure of this sentence introduces confusion. Suggest revising to read: "Surprises are a class of risks THAT CAN BE DEFINED AS EITHER low-likelihood but well-understood..." [Trigg Talley, United States of America]	Accepted. Text re-written
41131	57	31	57	34	Update the glossary definition for surprises to match this one? [TSU WGI, France]	Accepted. Definitions are now consistent with the glossary
80993	57	31	57	38	In terms of 'surprises'- maybe consider mentioning the unexpected and significant impact of COVID-19 on greenhouse gas emissions - as these were substantial, if only temporary. [Jeffrey Philip OBBARD, Singapore]	Accepted. COVID19 has been added as an example of a surprise
111787	57	31	57	38	The ongoing global health crisis caused by COVID-19 is certainly a "surprise" kind of the climate tipping points. Especially, COVID-19 has resulted in an unprecedented drop in global greenhouse gas emissions. Although it is an extremely recent phenomenon and its effect could be insignificant from climate (30-year interval) perspectives, its unprecedentedness must be interpreted with serious scientific reassessment of the knowns. I suggest the authors mention its important at least briefly. [HUN PARK, Republic of Korea]	Accepted. COVID19 has been added as an example of a surprise
17391	57	31	57	38	Is it appropriate to include mention of the profound economic/emissions impact of COVID19 here? A multi-year slow down in economic activity could generate an emissions pathway outside the range of scenarios considered or assessed. [Graham Weedon, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. COVID19 has been added as an example of a surprise

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
70585	57	31		36	The events discussed here do not belong in this section on abrupt change, since all the examples given are processes or occurrences which could rapidly change the forcing, whereas an abrupt change is defined here as a global scale change that occurs much faster than the forcing. This text should be integrated with the text on radiative forcing uncertainty in 1.4.3, and indeed major volcanic eruptions are already discussed there. Moreover, I don't see any fundamental difference between a future major volcanic eruption, a nuclear war and a large-scale biological epidemic (which the authors presciently included in their list), which are potential events that are understood/known to some extent and have the potential to alter future forcing, but cannot be predicted well. It might be helpful to include with this discussion something about how such events are dealt with in the report - for example, the report gives projections of future climate change conditional on particular forcing scenarios, structural uncertainties are considered when assessing confidence and likelihood etc. Without this the reader may be left wondering how much trust to put in the projections included in this report. A mention of the glossary definition of 'surprises' could be included with the text in 1.4.3. [Gillett Nathan, Canada]	Taken into account. Surprises classifications have been combined
36779	57	32	57	34	You should include " a series of frequent el Nino events after a period when El Nino events occurred rarely", after all that is what happened in the laste 1970s and into the 1980s. Various IPCC reports have even mentioned shifts in climate forcings that date from the mid (or late) 1970s and are known to be linked to such changes (e.g. temperature, rainfall, Hadley circulation and Walker circulation) [John McLean, Australia]	Rejected. Not relevant to this topic.
113047	57	34	57	34	At 'unexpected biological epidemics', may be the right point to mention pandemics (e.g., COVID19) as an example of 'surprise'. [Diego Miralles, Belgium]	Accepted. COVID19 has been added as an example of a surprise
36781	57	34	57	36	If you have evidence that the beetle infestation was due to climate then say so, and if not then remove this sentence. I remind you that the scare about bees dying was quickly blamed on climate change but has since been proven to be due to a virus. [John McLean, Australia]	Noted. This section has been edited. We list here surprises that affect climate in various ways. For example, we now cite the COVID19 pandemic because this has had an unexpected (but not unwelcome) effect on climate change by reducing emissions through the lockdown.
70587	57	34		35	The text here gives biological epidemics as an example of a surprise, whereas the glossary gives these as an example of an unknown unknown. Ensure consistency. I suggest merging the definitions of 'surprises' and 'unknown unknowns'. If retained, the text needs to say something about how these are dealt with in the report - structural uncertainties are a factor that needs to be accounted for when assessing confidence, projections are conditional on particular future forcings etc. [Gillett Nathan, Canada]	Noted. Text has been revised in this section. We now refer to unexpected biological epidemics among humans or other species, such as the COVID-19 pandemic; we have deleted other biological examples. Note that the term "unknown unknowns" was removed from the Glossary in the revisions for the FGD.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
107167	57	34		36	It says, "An example of the latter is unexpected biological epidemics, such as the infestation of pine bark beetles currently devastating North American conifer forests, which may cause large-scale, irreversible changes in ecological regimes with feedback effects on climate (Bentz et al., 2010)." Do you think that's funny? I'm the one who suggested mentioning pine bark beetles, but what you wrote inverts the lesson. Please replace it with the following: "Pine bark beetles illustrate the fact that anthropogenic climate change does not necessarily exacerbate such 'surprises.' It can also help mitigate them. For example, Novick, et al 2012 found that elevated CO2 levels help protect pine trees from bark beetle attacks." https://academic.oup.com/treephys/article/32/6/752/1663608 This is exactly the sort of scientific cherry-picking which discredits the IPCC reports. When the best scientific evidence shows a BENEFIT of climate change, you ignore it, and, if you can find it, you instead report a contrary result, even if it is older and lower-quality. In this case, you found an older study based on speculative modeling, to substitute for a newer, much stronger, measurement-based study. That's not science, that's political spin. [David Burton, United States of America]	Noted. Text has been revised in this section. We now refer to unexpected biological epidemics among humans or other species, such as the COVID-19 pandemic; we have deleted other biological examples.
90015	57	37	57	37	Example is of doubtful validity. The Nobel-prize-winning work on ozone-depletion precursors was done in the early 1970s. [Jochem Marotzke, Germany]	Accepted. The text has been reworded to "The discovery of the ozone hole was also a surprise even though some of the relevant atmospheric chemistry was known at the time."
90955	57	38	57	38	Parker and Risbey (2015), in the Philosophical Transactions of Royal Society A, discuss risk factors for surprises, relating this explicitly to the climate case (see Section 4 of the paper). This might be worth considering in this part of the text. Paper is available at: https://royalsocietypublishing.org/doi/full/10.1098/rsta.2014.0453 [Wendy Parker, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Reference added.
11355	57	38	57	38	At this point a few words in the possible impact of Covid-19 on human emission due to change of habits might be appropriate. [Michael Schmitt, Germany]	Accepted. COVID19 has been added as an example of a surprise
132011	57	41	62	53	In the attribution box, the writing is rather abstract, generic and not very illustrative to aid understanding. It appears advisable to work with one or two illustrative examples for each working group and describe the processes in more specific words, step by step. Otherwise, specifics, similarities and differences are not fully becoming clear. [Hans Poertner and WGII TSU, Germany]	Taken into account. This is a good suggestion. There are too many variations to use the approach fully, however, we have used sea-level rise and 'fingerprints' in species' responses that are uniquely expected from climate change as illustrative examples.
114263	57	41	62	54	This is a useful Box, but in my view, too long. I encourage the authors to try to shorten it. [Jan Fuglestedt, Norway]	Accepted. The box has been shortened.
131379	57	41	62	55	provide proper citation (chapter level) when referring to information or statements in AR5, SROCC and other reports [Hans Poertner and WGII TSU, Germany]	Accepted. This has been corrected, except in the very broad introduction where IPCC is referred to generally.
131381	57	41	62	55	This CCB 1.4 seems quite long and is written rather as a review, in text-book style; I think it can be condensed [Hans Poertner and WGII TSU, Germany]	Accepted. The box has been shortened.
131383	57	41	62	55	There are many self-citations of drafting authors in this CCB 1.4; please make sure that also publications of others are considered [Hans Poertner and WGII TSU, Germany]	Taken into account. More use has been made of references to the underlying chapters in WGI and WGII to provide access to the full range of references.
111943	57	43	62	53	To lengthy for a box, despite of cross-chapter and cross WGs one [Tomas Halenka, Czech Republic]	Accepted. The box has been shortened.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
125327	57	43	62	53	[SCOPE] This 5-page long text box should be cut in half. Let WGII and WGIII write their own material about how they address the topic of attribution in their reports. [Trigg Talley, United States of America]	Taken into account. The box has been shortened. However, given that attribution is a cross-cutting theme, the box remains a cross-WG box across WGI and WGII.
125329	57	43	62	53	[SCOPE] The detailed information on D&A is interesting but not needed for the WGI contribution to the AR6. [Trigg Talley, United States of America]	Rejected. Chapter 1 introduces many of the concepts and techniques used in AR6, and particularly new developments of these. Whilst attribution techniques have been used in previous assessments, there have been a number of new developments, particularly with regards to event attribution. The box has been shortened to remove some of the detailed information; and reference has been made to the relevant chapters to find out more.
40873	57	43	62	53	Suggest to have a separate glossary definition for attribution (separate from detection and attribution) and one that captures the use/meaning across all WGs. Current definition is "Attribution is defined as the process of evaluating the relative contributions of multiple causal factors to a change or event with a formal assessment of confidence." [TSU WGI, France]	Accepted. This has been the decision.
87527	57	43	62	53	Very interesting cross-chapter box on attribution. I did wonder whether the various examples of 'attribution' are so broad -- ranging from the physical sciences in WGI to the social sciences in WGIII -- as to render the discussion a little baggy. 'Attribution' as a term of art is not really more precise than terms like 'analysis' or 'causation' -- and I wondered if the appearance of the word alone in any given domain really justifies juxtaposition alongside so many other barely related, or unrelated, matters. That said, I found the discussion of impacts and adaptation (from page 61 line 28 to 62, 21) fascinating. Indeed everything in the box is interesting -- the only question for me being whether it all fits together usefully. [Stephen Humphreys, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The aim is to draw out the parallels, and highlight the importance of each of the steps and the assessment of the quality of data, models etc. The addition of the figure should help provide clarity of the steps required for attribution relevant to IPCC.
21329	57	43			This box is very long. I suspect it will be impossible to distill to two-pages without losing essential content though and would thus support it being able to exceed this length stipulation in final form. [Peter Thorne, Ireland]	Taken into account. The box has been shortened, and a figure added for clarity.
10385	57	43			It would be helpful in Box 1.4 (or point to elsewhere) to define "Attribution". For instance in IPCC 2013, Chapter 1 it is explicitly stated that "single extreme events cannot generally be directly attributed to anthropogenic influence". I think this is generally still the case, so it should be stated what attribution means in the different areas described here. [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. The second sentence is now a broad definition of attribution. There is literature emerging that shows that single extreme events can be attributed to anthropogenic influence, and this has been included, and some examples cited, as well as reference to the chapter in the report.
71423	57	43			This box does not contain any hint to the fact that all attribution studies rely on the models realistically simulating the underlying processes. This is an issue in particular when changes in large-scale atmospheric dynamics are relevant. I would suggest to include such a statement. We are discussing the representation of the large-scale atmospheric circulation in 10.3.3.4 in different types of models from a regional perspective. It would be useful adding a link here. [Douglas Maraun, Austria]	Noted. A line has been added to mention that greater confidence is gained if the model is evaluated as fit-for-purpose.
44353	57	45	57	49	shouldn't the authors of cross-chapter boxes be listed alphabetically? [Jana Sillmann, Norway]	Noted. The co-ordinating authors for this box were Hope and Cramer, so they are listed before the alphabetical list.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
36783	57	51	57	55	The AR5 claim that you quote was inconsistent with other parts of the report. Text box 9.2 clearly showed that climate models exaggerated warming but what you quote relied on the output of models (and possibly undocumented expert opinion). Quoting that AR5 statement here does not make it true. [John McLean, Australia]	Not applicable. This text has been removed.
131385	57	51	58	1	appropriate references should be provided for the citations from AR5 [Hans Poertner and WGII TSU, Germany]	Accepted. These have been updated
70611	57	51	58	2	This Box should cite and summarise the IPCC Good Practise Guidance Paper on attribution at the outset. Many of the topics addressed in this box are addressed there. [Gillett Nathan, Canada]	Taken into account. Hegerl et al. 2010 is referenced. And more recent references have been added to the steps needed to make an attribution assessment.
19651	57	51	58	32	P57 L51 -P58-32: You begin by writing that the attributions form the basis of likelihood statements; this obviously is their main purpose. When, however, you list ways of using the results of attribution studies, this purpose does not even figure on the list. Perhaps the intermediate title on line 16 should begin with "other uses of the results..." [philippe waldteufel, France]	Accepted. This section has been folded into the introduction and the IPCC purpose is listed in the first paragraph.
36785	57	56	58	1	Same problem as previous sentence. You quote something that is bogus and unsupported by evidence, the output of dodgy climate models and "expert opinion" not being evidence. [John McLean, Australia]	Not applicable. This text has been removed.
131387	58	6	58	7	In the WGII report not only Chapter 16 is focusing on understanding the drivers of observed outcomes in natural and human systems [Hans Poertner and WGII TSU, Germany]	Taken into account. In the revised writing, Chapter 16 is noted as where these results are summarised, but that there are other chapters also with this focus.
70591	58	9			Do the authors mean 'attribute emissions changes to changes in policy'? Aren't 'mitigation efforts' and 'changes in policy' the same thing? [Gillett Nathan, Canada]	Not applicable. This text has been removed.
29713	58	20	58	20	Please, check the accents in "Jezequel et al." [Hernan Edgardo Sala, Argentina]	Editorial.
67013	58	21	58	21	change 'or' to 'and' because narratives and storylines are not mutually exclusive [Liese Coulter, United Kingdom (of Great Britain and Northern Ireland)]	Not Applicable. The topic has been described thus: 'Another approach examines facets of the weather and thermodynamic status of an event through process-based attribution'
114265	58	24	58	29	You may consider mentioning informing discussions on Loss and Damage . [Jan Fuglestvedt, Norway]	Accepted. This has been added.
66655	58	28	58	29	Could revise this to add new items: "The knowledge gained from attribution studies can inform the identification of climate risks, the benchmarking of climate damages functions, policy development, insurance, litigation, and divestment (Marjanac et al., 2017, Frame et al., 2020 (https://doi.org/10.1007/s10584-020-02729-y))." [Dave Frame, New Zealand]	Taken into account. Some items have been added, and Frame has been added
77629	58	30	58	32	The Grant et al. (2013) and Low et al. studies cited here both relate to actions taken after one specific event (the same event, and the two articles are from the same research group). Their relationship to climate science and attribution studies is unclear. [Emer Griffin, Ireland]	Accepted. Grant reference has been removed.
112553	58	30	58	32	if attribution studies guide management decisions - which I doubt - then insert supporting references; writing WGII is insufficient [Suraje Dessai, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. A new reference has been added: Climate and Development Knowledge Network, 2017
125331	58	37	58	40	This text box and text elsewhere in the chapter should not endorse the concept of "climate services" or any other governance or program structure at the country level. That would be more than "policy-relevant". And the reference to "the media" should be removed. [Trigg Talley, United States of America]	Not applicable. These have been removed in this Box.
125333	58	39	58	40	This is not just in response to demand from the media. Rephrase to read something like: "This has partly been in response to demand FOR INCREASED UNDERSTANDING OF THE SCIENCE as climate records continue..." [Trigg Talley, United States of America]	Taken into account. Now phrased: 'Attribution studies serve to evaluate and communicate linkages associated with climate change,...'

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
845	58	46	#REF!	#REF!	sentence doesn't run well [Bart van den Hurk, Netherlands]	Accepted. Rephrased as 'The unambiguous framing of what is being attributed to what is a crucial first step for an assessment...'
131389	58	46	58	46	some word seems missing in this sentence. [Hans Poertner and WGII TSU, Germany]	Accepted. Rephrased as 'The unambiguous framing of what is being attributed to what is a crucial first step for an assessment...'
4779	58	46	58	46	sentence doesn't run well [Bart van den Hurk, Netherlands]	Accepted. Rephrased as 'The unambiguous framing of what is being attributed to what is a crucial first step for an assessment...'
36787	59	10	59	12	The use a null hypothesis is not "relatively conservative" (subjective evaluation!) but in fact proper scientific practice. [John McLean, Australia]	Not applicable. This text has been removed.
70613	59	14		23	This section should define 'detection' and 'attribution' as applied here. The definitions used are those from the IPCC Good Practise Guidance Paper. [Gillett Nathan, Canada]	Taken into account. Attribution has been defined. Detection is not discussed in this box.
10387	59	15	59	16	Detection' and 'attribution' should be defined, or a reference to a definition given. [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Attribution has been defined. Detection is not discussed in this box.
90017	59	17	59	17	It's good practice to cite IPCC chapters by authors' names (here, Bindoff et al. 2013). [Jochem Marotzke, Germany]	Accepted.
70593	59	17		19	I suggest moving this to the end of the paragraph. Also the text doesn't need to cite this single study - it could just cite Chapter 3. And say 'assessed in Chapter 3' rather than 'used in Chapter 3'. [Gillett Nathan, Canada]	Taken into account. WGI, Chapter 3 Section 3.2 is cited, but the single reference is also cited as an example of the fingerprint technique.
36789	59	19	59	23	Looking for fingerprints does nothing more than reveal that some change is consistent with some change in forcing; it is not evidence that the forcing did cause the change. Further, flawed climate models will cause false fingerprints, so first you have to validate the climate models that are used. [John McLean, Australia]	Taken into account. A line has been added to mention that greater confidence is gained if the model is evaluated as fit-for-purpose.
125335	59	21	59	21	For clarity, eliminate "forcing" in this line and insert the words "driver of change": "estimated from coupled climate model simulations forced with a single forcing (e.g. greenhouse gases only)". Otherwise it reads "forced with forcing". [Trigg Talley, United States of America]	Taken into account. 'Forced' has been replaced, and 'forcing agent' has been left as it is used in subsequent sentences. i.e. "This technique disentangles the contribution of individual forcing agents to an observed change"
36791	59	25	59	25	As I said above, looking for fingerprints does nothing more than reveal that some change is consistent with some change in forcing; it is not evidence that the forcing did cause the change. Further, flawed climate models will cause false fingerprints, so first you have to validate the climate models that are used. Using statistical approaches is nothing more than using statistics to try to identify fingerprints. [John McLean, Australia]	Taken into account. A line has been added to mention that greater confidence is gained if the model is evaluated as fit-for-purpose.
70595	59	26		28	Chapter 3 does not conclude that improved understanding of the physical associations between temperature and humidity/precipitation are important in leading to more confidence attribution of observed global temperature change. Of the three studies cited, only Paeth et al. is an attribution study, and while they consider multivariate attribution including hydrological variables, they do not claim that their results lead to more confident attribution of global temperature change to anthropogenic forcing than other studies. I suggest deleting this. [Gillett Nathan, Canada]	Accepted. This has been removed.
113049	59	30	59	30	Correct both '.' in this line. [Diego Miralles, Belgium]	Editorial.
90019	59	31	59	50	By just saying "WGI Chapter X" it's unclear which AR is meant. [Jochem Marotzke, Germany]	Taken into account. All such references are to AR6. Chapters from previous reports are referred to by their first author, et al. and year.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
73953	59	33	59	38	At regional scale, information that is treated as "noise" can be more important for decision-making bodies planning activities for climate change mitigation and adaptation. See also comment to Page 49. [Elena Kozlovskaya, Finland]	Noted.
71849	59	42	59	44	I think this is an overconfident assessment. My understanding of these papers is that there is a residual after the known climate variations are estimated. It is by no means clear that this is an anthropogenic signal. [John Church, Australia]	Taken into account. This section has been rewritten to highlight that some aspects of the decomposition have a more confident assessment of the anthropogenic influences, and these are specifically mentioned - i.e. the thermal expansion. "global mean sea-level change has been attributed to anthropogenic climate forcing by attributing the individual contributions from, for example, glacier melt or thermal expansion, while also examining which aspects of the observed change are inconsistent with internal variability (WGI Chapter 3, Section 3.5.2.12 and WGI Chapter 9, Section 9.6.1.4)."
70597	59	50	60	7	Too much detail is given of this example of process-based attribution of Southern Hemisphere rainfall changes. [Gillett Nathan, Canada]	Taken into account. This has been significantly reduced.
70861	59	53	59	54	Mindlin et al. is now published: doi: 10.1007/s00382-020-05234-1 [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Reference to discussion in WGI Ch10 on process-based attribution has been included instead.
23839	59	54	59	54	It is not wise to cite in this Report sci. papers that have been only submitted; these should be at least tentatively accepted, i.e., that these passed their first review round. [Branko Grisogono, Croatia]	Noted. All papers will be accepted before the final version or the citations will be removed from the report.
70599	60	1		4	Is there really sufficient evidence in the literature to make a quantified probabilistic statement (i.e. that is likely) that greenhouse gas concentrations contributed to the strengthening of the SH polar vortex? Ceppi and Shepherd show changes in RCP 8.5, but do not appear to attribute change in vortex strength over the historical period. The other studies cited also appeared not to carry out attribution of changes in vortex strength to greenhouse gas changes. Section 10.4.2.2.4, cited in support of this assessment, does not exist. [Gillett Nathan, Canada]	Taken into account. This discussion has been removed. We have ensured that reference to sections is accurate.
125337	60	9	62	53	[SCOPE] This box is interesting and valuable, but is unnecessarily long. Suggest deleting the following sections: (1) p. 60, lines 9-14, (2) p. 60, lines 50-55, (3) p. 61, lines 10-26. The section of "impacts and adaptation" and the section on "WGIII" should be moved to WGII and WGIII, respectively. Alternatively (or in addition), strongly consider a heavily condensed version of the whole box reserved for the SYR. [Trigg Talley, United States of America]	Taken into account. The box has been shortened. Thank you for the suggestion of elevating this to SYR. It now combines information from WGI and WGII, but less from WGIII.
36793	60	10	60	11	Please explain why you make this statement when the IPCC fails to audit either the CRUTEM4 data from weather stations or the ICOADS database of scientific observations at sea. My report, "An Audit of the Creation and Content of the HadCRUT4 temperature dataset", shows more than 70 problems, ranging from those that apply to a single datum through to those that apply to a far greater amount of data. You might also consider whether attribution has any credibility when the data the attribution applies to is flawed. [John McLean, Australia]	Noted. Attribution does rely on reliable observations. The datasets are evaluated in the literature, and that literature assessed in Chapter 2.
10389	60	16			"Attribution" should be defined here. It is being used in a different way than in the preceding text. [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Attribution is now defined in a general sense at the start of the box.
35485	60	18	60	18	Bibliographic citations in chronological order [Carlos Antonio Poot Delgado, Mexico]	Editorial
36795	60	20	60	23	This sentence is absolute drivel because it falsely assumes that climate models have been validated and proven accurate. [John McLean, Australia]	Taken into account. It is highlighted in the box the importance of evaluating models used.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
125339	60	24	60	24	This extraneous, dangling sentence should be removed from this paragraph about attribution studies: "Climate extremes are assessed in Chapter 11." Or a word inserted to make it relevant to the text box. [Trigg Talley, United States of America]	Accepted. This has been removed.
36797	60	27	60	29	You make the fundamental error here of assuming that any change of climate is man-made. This proposition is false because climate has probably always changed during the last 4.5 billion years. [John McLean, Australia]	Rejected. While it is true that climate has changed in the past, this box is focussed on changes in the instrumental record. During which time there is evidence that climate has been modified by human activities.
71419	60	29	60	30	The sentence "Another approach describes..." does not really help to understand the concept. The approach basically addresses the question "how would a similar event have unfolded in a cooler/counterfactual climate?", which is a very useful question to ask. It might be worth stating somewhere that these concepts can be unified (see the already cited reference Shepherd 2016). [Douglas Maraun, Austria]	Taken into account. These approaches have been described: 'Another approach examines facets of the weather and thermodynamic status of an event through process-based attribution...'
36799	60	33	60	33	Talking about confidence is inappropriate when the basis for that confidence is tenuous (e.g. derived from flawed modelling, based on "expert opinion"), as the AR5 findings were. [John McLean, Australia]	Taken into account. Lines to ensure that these evaluations are assessed are included: '...note the quality of the observations' and '...model is evaluated...'
44559	60	38	60	48	the issue of defining what an event is should also be included in that list, citing Cattiaux and Ribes 2018 (https://doi.org/10.1175/BAMS-D-17-0281.1), and other relevant studies. [Jana Sillmann, Norway]	Accepted. This has been added as the first point.
71421	60	46	60	48	I am wondering whether the reason for the conditioning should be given here. It is often to get rid of internal variability and deficiencies in simulating large-scale atmospheric dynamics. One rephrases the question from "What was the human contribution to this event?" into "How would this event have looked like without climate change?" [Douglas Maraun, Austria]	Not applicable. This discussion has been removed, however it is a very good point. The change in phrasing is captured in the first sentence of 'Attribution of weather and climate events'... 'to attribute the change in likelihood or characteristics of weather or climate events or classes of events to underlying drivers'
36801	60	50	60	55	To be properly comprehensive, this paragraph needs to say that it relies on unproven (i.e. unvalidated) models. [John McLean, Australia]	Taken into account. In 'Steps...' section it states that greater confidence in an attribution assessment can be achieved if the model is evaluated as fit-for-purpose. Models in IPCC are evaluated in Chapter 3 and the process chapters.
35487	60	55	60	55	Bibliographic citations in chronological order [Carlos Antonio Poot Delgado, Mexico]	Editorial.
36803	61	2	61	8	For completeness this paragraph needs to include comments about making explicit ALL assumptions that were used in any stage of the analysis that led to attribution. [John McLean, Australia]	Accepted. In the new text, the 'Steps...' section details the considerations around the quality of the observations, the framing and model evaluation.
70601	61	2		3	No references are cited in support of this assessment. [Gillett Nathan, Canada]	Not applicable. This has been deleted. Reference to Chapter 3 WGI now supports discussion of the methods.
108111	61	3	61	3	Instead of the term "bias-correction" I suggest to use the term "bias adjustment", which is explained in Chapter 10 Section 10.3.1.4.2 and used in Chapter 2, 8, 10 and 12. [Claas Teichmann, Germany]	Not applicable. This section has been rewritten, and bias correction or adjustment is no longer included.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
19653	61	10	61	15	While earlier we learned that attribution studies were the key for likelihood statements, now we learn that likelihood tables are used to produce attribution statements. Both may be true but it wants a bit of explaining; for the time being, what emerges is a feeling of weak consistency. [philippe waldteufel, France]	Taken into account. The points rephrased - firstly the type of question we might ask: 'Have human greenhouse gas emissions increased the likelihood or intensity of an observed heat wave?' And then mention of the tools we might use to find out what the likelihood change might be: 'New methods have emerged since AR5 to attribute the change in likelihood or characteristics of weather or climate events or classes of events to underlying drivers...'
36805	61	10	61	18	This paragraph fails to make clear that natural variations in climate can throw-up seeming shifts, new trends and even extreme circumstances. Further, extreme circumstances can easily distort a trend, e.g. a brief spell of hotter days can make a mean monthly temperature higher than normal even when the average of all other days is at or even below the long term mean for the same calendar month. [John McLean, Australia]	Not applicable. This section has been removed. Event attribution aims to identify the drivers of a particular event, including/accounting for natural variability, and although the box now does not go into detail, further details can be found in Chapter 10.
125341	61	11	61	26	These two paragraphs about the use of climate event attribution tools in climate services should be deleted. They do not add anything important to this long text box. [Trigg Talley, United States of America]	Accepted. These have been deleted.
70603	61	11		18	This paragraph is missing a sentence of introduction on operational event attribution. [Gillett Nathan, Canada]	Not applicable. These have been deleted.
35489	61	14	61	15	Use published sources [Carlos Antonio Poot Delgado, Mexico]	Accepted. The paper has now been published.
70605	61	22			some of the methods applied' - to what? Also, should 'some of the methods applied' be 'some of the methods assessed'? [Gillett Nathan, Canada]	Not applicable. This section has been rewritten.
70607	61	23		25	This description of the Lim et al. approach is unclear. [Gillett Nathan, Canada]	Taken into account. This point has been removed.
14507	61	24	61	24	add the years for these El Nino events: 1982–83, 1997–98, and 2015–16 [Amy East, United States of America]	Taken into account. This point has been removed.
125343	61	28	61	28	Insert "in Working Group II" after " Attribution of impacts and adaptation" as you did for the WGII subheading on the next page. Better yet, delete the descriptions of how Working Groups I and II describe and assess attribution. [Trigg Talley, United States of America]	Taken into account. There is keen interest to make this a cross-working group box. As such, the labels have been removed to allow the overlap between the working groups to be appreciated.
114269	61	28	62	21	A paper by Otto et al., (https://www.nature.com/articles/nclimate3419?proof=true) may be relevant here [Jan Fuglestedt, Norway]	Accepted. This reference has been included.
44355	61	30	61	30	typo: climate change appears twice in "effects of climate change or climate extremes or climate change" [Jana Sillmann, Norway]	Editorial.
37827	61	30	61	30	Effects of climate change or climate extremes or climate change on: perhaps "climate change" appears twice. [Junhee Lee, Republic of Korea]	Editorial.
29715	61	30	61	31	Please consider replacing this sentence: "In the IPCC context, impacts refer to effects of climate change or climate extremes or climate change on natural and human systems.", by the following: "In the IPCC context, impacts refer to effects or consequences of climate change or climate extremes on natural and human systems." [Hernan Edgardo Sala, Argentina]	Taken into account. The meaning of 'impacts' is now illustrated with a list including economic damages due to floods, heat related human mortality etc. As this is a cross-working group box it includes WGII assessments.
131391	61	31	61	31	Attribution of impacts is not only assessed in in WGII Chapter 16, but also in other chapter of the WGII report. Consider rephrasing [Hans Poertner and WGII TSU, Germany]	We now say that Ch 16 synthesises the attribution results across the report, and mention that attribution of impacts appears in Ch2 and other chapters.
35491	61	36	61	36	Bibliographic citations in chronological order [Carlos Antonio Poot Delgado, Mexico]	Editorial.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
44357	61	37	61	37	Please list references that apply to this statement "... some studies now use climate event attribution techniques". [Jana Sillmann, Norway]	Taken into account. This has been rewritten, but the related text now has references: 'Impact attribution does not always involve attribution to anthropogenic climate forcing. However, a growing 18 number of studies include this aspect (e.g., Frame et al., 2020 for the attribution of damages induced by 19 hurricane Harvey; or Diffenbaugh and Burke, 2019 for the attribution of economic inequality between 20 countries; or Schaller et al., 2016 for flood damages).'
14509	61	39	61	41	another good example worth mentioning here is this case of an attributed physical and hydrological response: Shugar et al., 2017, River piracy and drainage basin reorganization led by climate-driven glacier retreat. Nature Geoscience, 10 (5), 370–375. Doi:10.1038/ngeo2932. They determined that the reorganization of river drainage networks observed in 2016 caused by rapid glacier retreat would have had only a 0.5% chance of occurring under stationary climate. [Amy East, United States of America]	This sounds like a fascinating example. However, we have limited space to present new examples.
44359	61	43	61	44	This is actually part of the definition of climate risk (see CC-Box 1.3) the terms climate impacts and climate risk are not interchangeable. Check the definition of climate impacts in CC-Box 1.3 and rephrase this sentence. [Jana Sillmann, Norway]	Not applicable. This section has been re-written.
44361	61	46	61	47	Do you mean "climatic impact drivers" (i.e. as defined in CC-Box 1.3) or something else? In the paragraph below the term "climatic factors" is used. Is this then something else than referred to in this line? [Jana Sillmann, Norway]	Not applicable. This section has been re-written.
70863	61	53	61	55	Examples of such semi-quantitative assessments can be provided through the storyline approach, which is discussed in the context of climate-related extreme ecosystem event attribution by Lloyd and Shepherd (2020, doi 10.1111/nyas.14308) [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Reference is made to the summary in WGII, Ch16 where further literature will be cited.
44363	61	53	62	21	I don't think that material/discussion belongs in the WGI report and it seems very superficial. The 4 paragraphs could be shortened to 1 with reference to much deeper assessment in WGII (there are probably much more references to support the assessment). [Jana Sillmann, Norway]	Taken into account. This has been re-written by WGII authors, with reference made to WGII. This is a cross-working group box.
19655	61	55	62	4	Agreed; noting that the growing exposure of people and buildings is a consequence of the growing number of people (and consequently of buildings). This is only a comment, since if IPCC was brave enough to address the major overpopulation issue (maybe the day will come!) that would be WG2 and WG3's business. [philippe waldteufel, France]	Noted. This is a cross-working group box.
36807	61	55	62	4	The fire was due to someone failing to properly secure a wire carrying electricity and when it broke and hit the ground it triggered a fire. The spread of the fire had an anthropogenic cause - a failure to reduce the amount of fuel available to the fire, sometimes due to edicts from government authorities at various levels. The fire occurred on a day of very hot dry winds, which are nothing new to that part of Australia. In summary, the fire and the damage it caused can be attributed to human incompetence and ideology about retaining dangerous vegetation. (I live in Victoria and know what happened. Friends of mine lost their house in that fire.) [John McLean, Australia]	Noted. Aspects of vulnerability and exposure form part of the assessment in WGII.
115733	61		61		The use of climate event attribution tools in future scenarios : the detectability of reductions in emissions in terms of climate change is a novel aspect from this report (future interplay of the response to a reduced RF with natural variability). Could there be a link to the approach done for the ozone assessment (early signs of recovery etc) and use of a coherent approach? [Valerie Masson-Delmotte, France]	Not applicable. This discussion has been removed. However it is a very good point that should be considered for the next assessment.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
24245	61		62		This is overlong with little substance. [Bryan Weare, United States of America]	Noted. The box has been shortened.
40625	62	1	62	1	Perhaps update for 2019 if the literature exists? [TSU WGI, France]	Noted. The fire example remains around the 2009 event because of the further assessment of loss and damage - relevant in the WGII context.
71851	62	1	62	4	From my understanding this is not the most relevant assessment from the 2019-2020 fires, or is at best a misleading characterisation. [John Church, Australia]	Noted. There was no assessment of 2019-20 fires in this box. The point is referring to exposure, and the influence that has on the resultant impacts from the fires.
8949	62	1	62	4	Attribution of extreme fire seasons to climate warming is not only related to trends of meteorological danger indices (MDI), but also to long-term trends. Regularly MDI only refer to short-term (days-weeks), but extreme fire seasons are commonly associated to long droughts (which are commonly more linked to climate change than short-term weather changes). The recent case of the devastating fires of the Australian SE (2019-20) confirms this. [Chuvieco Emilio, Spain]	Noted. It will be great when there is literature detailing this connection that can be assessed in the next report.
41377	62	23	62	23	Please change subheading to sth more informative, e.g. "Attribution of changes in emission trends" based on the WGIII explanation provided in the second box paragraph. [Alexander Nauels, Germany]	Taken into account. New subheadings have been included.
114267	62	23	62	53	This part could emphasize how different perspectives may affect the results; as discussed in Skeie et al., 2017, ERL; https://iopscience.iop.org/article/10.1088/1748-9326/aa5b0a [Jan Fuglestad, Norway]	Noted.
125345	62	25	62	33	Error - Line 33 is a word for word repeat of line 25. [Trigg Talley, United States of America]	Noted. Re-written.
70609	62	25		26	Shouldn't this refer to the 'attribution of changes in emissions to changes in policy' rather than 'the attribution of changes in policy'? [Gillett Nathan, Canada]	Taken into account. This has been reworded.
29717	62	27	62	28	In order to reach wider audiences consider expanding the sentence: "One example of this is the monitoring following the Montreal Protocol and amendments", in this way: "One example of this is the monitoring following the Montreal Protocol and amendments aimed to reduce production, consumption and emissions of ozone layer depleting substances". [Hernan Edgardo Sala, Argentina]	Not applicable. This example has been removed.
873	62	33	#REF!	#REF!	Same sentence as first sentence of previous paragraph (line 25) [Bart van den Hurk, Netherlands]	Not applicable. Re-written.
4781	62	33	62	33	Same sentence as first sentence of previous paragraph (line 25) [Bart van den Hurk, Netherlands]	Not applicable. Re-written.
29719	62	35	62	35	Please add a comma in "businesses etc." [Hernan Edgardo Sala, Argentina]	Not applicable. Re-written.
40533	62	48	62	48	Missing from the literature or missing in a policy context? [TSU WGI, France]	Not applicable. This is no longer discussed.
73955	62	48	62	49	Climate policy may work as a positive or negative feedback and hence affect significantly projections of future trends in climate parameters. It is a problem that such analysis is still missing. [Elena Kozlovskaya, Finland]	Noted. This section has been re-written, and includes less about WGIII.
29721	62	49	62	49	Replace "Working Group II" by "WGII". [Hernan Edgardo Sala, Argentina]	Accepted.
111331	62	52	62	53	Confusing: "past, present, and future actions and policies"; should be: "past, present or future actions and policies" [Stephan Savarese, France]	Not applicable. This has been removed.
111333	62	52	62	53	The verb "infrom" is used twice in the SAME SENTENCE, WHICH IS CONFUSING. The meaning of this sentence is unclear and may not be understood correctly. Rephrasing or at least using more precise verbs seems necessary [Stephan Savarese, France]	Not applicable. This has been removed.
70615	63	3	64	11	This section seems to be unnecessarily long. I suggest shortening it. [Gillett Nathan, Canada]	Accepted.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
125347	63	9	63	9	[ACCESSIBILITY] The "Atlas" is casually mentioned here and more than a dozen other places in the text and tables, but the updated Atlas is not introduced as a feature of the WGI contribution until page 105. Need to add a paragraph or full sentence much earlier in Chapter 1 about the Atlas, where it can be found, and its intended use. [Trigg Talley, United States of America]	Accepted. The Atlas is now mentioned at the very beginning of the chapter.
36809	63	22	63	28	Figure 1.14 is wrong. Urban forcing is not an issue with time scales of days or weeks but one of decades, and easily cover regions of up to 60km radius (and the spatial scale gives no indication of whether that's radius, diameter or something else). Also High's and Low's (other than extreme Lows in the form of Cyclones) are absent from this figure and yet they are responsible for the distribution of hot or cold air. [John McLean, Australia]	Not applicable: The figure is no longer in the chapter.
19501	63	27	63	32	In this report, regional climate change is primarily addressed through the introduction of four classes of regions, third class is typological class, what is mean of this class at regional climate change study? It is a little imprecise [Hamideh Dalaei, Iran]	Not applicable: The figure is no longer in the chapter.
21331	63	33	63	41	Given their widespread use in the literature I find the omission of Giorgi regions from this discussion somewhat perplexing. [Peter Thorne, Ireland]	Not Applicable - Discussion no longer included in the chapter
125349	63	33	63	46	These two paragraphs can be deleted. They're moderately interesting, but this is a very wordy introductory chapter and places need to be cut. This is a prime place to cut text. [Trigg Talley, United States of America]	Accepted.
19657	63	33	63	54	Line 54 sounds like an echo of lines 33-34. More generally, I find this section 1.4.6.1 chatty [philippe waldteufel, France]	Noted.
70617	63	34		41	This sentence is long, hard to understand and also appears unnecessary in a section whose main purpose is to define a common set of regions for AR6. [Gillett Nathan, Canada]	Not Applicable - Sentence no longer included in the chapter
70619	63	48		50	I think this is too strongly worded. The main features of regional differences in projected climate change have been well-understood and were well predicted as long ago as the FAR (Figure 1.6). Patterns of projected future change in temperature and precipitation are to a good approximation independent of time and robust across models. There is definitely a need from stakeholders for climate information at a regional and local scale, which is hard to meet for various reasons, but I don't think from a scientific perspective this is 'one of the greatest challenges in climate science'. [Gillett Nathan, Canada]	Accepted. Text revised.
19659	63	49	63	52	Reading this paragraph, one gets the feeling that attempting to define climate regions from observations did not interest WG1. No literature? [philippe waldteufel, France]	Not Applicable - Sentence no longer included in the chapter
113051	64	1	64	1	This should acknowledge that are classifications that are neither based on climate nor ecosystems, but on the response of the ecosystems to climate. I would suggest adding after the reference to Koppen: 'Moreover, data-driven approaches have been applied to delineate ecoregions that behave in a coherent manner in response to climate variability (Ivits et al., 2014; Papagiannopoulou et al., 2018).' Ivits, E., Horion, S., Fensholt, R., and Cherlet, M.: Global Ecosys- tem Response Types Derived from the Standardized Precipitation Evapotranspiration Index and FPAR3g Series, Remote Sensing, 6, 4266–4288, https://doi.org/10.3390/rs6054266 , 2014. Papagiannopoulou, C., Miralles, D. G., Demuzere, M., Verhoest, N. E. C. and Waegeman, W.: Global hydro-climatic biomes identified via multitask learning, Geosci. Model Dev., 11(10), 4139–4153, doi:10.5194/gmd-11-4139-2018, 2018. [Diego Miralles, Belgium]	Accepted.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
79869	64	20	64	32	One issue that is not addressed here is that there tends to be a procedural injustice in regional definitions in IPCC reports, which appears to be continued here. In particular, high per capita GDP is a good predictor of small region size. See for instance Stone (2019, 10.1007/s10584-019-02479-6). [Dáithí Stone, New Zealand]	Rejected - beyond the mandate of WGI, as it refers to economic issues. As explained in the text, the WGI Reference Regions are defined in terms of the characteristic climate and environmental features recognised from the literature assessed in the report. Whether or not the regions recognized in the assessed literature have a GDP bias is beyond the scope of WGI.
12419	64	21	64	50	This section is organized as the components of earth system. This might work out, but have caveats (1) Does not follow the structure of AR6 chapters (2) Some cross-cutting issue is less represented and get separated in different subsections. For example, improvement in energy budget observations were less discussed. Recent progress includes satellite observations at top of atmosphere (TOA), and surface flux derived from TOA observations and atmospheric reanalysis, which has much better accuracy than in situ based surface flux data and used in literature. References (just FYI): (1)Trenberth KE, Fasullo JT (2018) Applications of an updated atmospheric energetics formulation. J Climate, 31:6263-6279. doi:10.1175/JCLI-D-17-0838. (2)Trenberth KE., et al (2017) Atlantic meridional heat transports computed from balancing Earth's energy locally. Geophys Res Lett 44:1919 1927 doi:10.1002/2016GL072475 (3) Trenberth KE, Fasullo JT, Kiehl J (2009) Earth's global energy budget. Bull. Am. Meteorol. Soc. 90:311–323 (4) TrenberthKE, Zhang Y, Fasullo JT, Cheng L (2019) Observation-Based Estimates of Global and Basin Ocean Meridional Heat Transport Time Series. J. Climate, 32:4567-4583' https://doi.org/10.1175/JCLI-D-18-0872.1 (5) Mayer M, et al (2019) An improved estimate of the coupled arctic energy budget. J Climate 32:7915-7933. DOI: 10.1175/JCLI-D-19-0233.1 (6) Loeb NG, et al (2018a) Clouds and the Earth's Radiant Energy System (CERES) Energy Balanced and Filled (EBAF) Top-of-Atmosphere (TOA) Edition 4.0 Data Product. J Climate 31(2):895–918. https://doi.org/10.1175/JCLI-D-17-0208.1 (7) Liu C, Allan RP, Berrisford P, Mayer M, Hyder P, Loeb N, Smith D, Vidale P-L, Edwards JM (2015) Combining satellite observations and reanalysis energy transports to estimate global net surface energy fluxes 1985-2012. J Geophys Res Atmospheres. ISSN 2169-8996 doi: 10.1002/2015JD023264 (8) Liu C, Allan RP, Mayer M, Hyder P, Loeb NG, Roberts CD, Edwards JM, Vidale P-L (2017) Evaluation of satellite and reanalysis-based global net surface energy flux and uncertainty estimates. J Geophys Res Atmospheres 122(12):6250-6272. ISSN 2169-8996 doi: 10.1002/2017JD026616 [Lijing Cheng, China]	Noted. The plan of section 1.5.1 has evolved but we have kept the organization in components of the Earth System, which is consistent with the focus of chapter 1 on observing systems. Chapter 1 mentions the energy balance in section 1.5.2 on reanalyses: "The assimilation of sparse or inconsistent observations can introduce mass or energy imbalances 16 (Valdivieso et al., 2017; Trenberth et al., 2019)". Methodologies to assess the components of the energy budget are presented in more detail in Chapter 7, where the reference Loeb et al is cited.
98523	64	27	64	32	An innovation in AR6 WGI is the inclusion of typological regions, which also form the foundation for the Cross-Chapter Papers (CCPs) in WGII that treat these typological regions in more depth. Hence, a clear definition of what a "typological region" is becomes important. While (1) Land, (2) Oceans and (4) Continental Regions are all very clearly defined, a clear definition of (3) Typological Regions is missing. Lines 31 and 32 refer to the Atlas, but the Atlas does not clearly define Typological Regions. Would be good to include a clear definition of "Typological Regions". [Philippus Wester, Nepal]	Taken into account. A definition of "Typological Region" has been proposed to the Glossary.
13207	64	28	64	32	Many atmospheric processes occur in coastal regions and are very different compared to those that occur in the continental region, ocean, etc. It is suggested to delimit these regions from the other regions. [Maria Amparo Martinez Arroyo, Mexico]	Taken into account. Coastal regions are below the resolution of the Continental and Ocean Reference Regions, and are therefore taken into account by higher-resolution, specialized domains called Typological Regions, as explained some paragraphs later in the text (SOD Page 65 Lines 6-7).

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
125351	64	29	64	31	[ACCESSIBILITY] Another casual reference to the Atlas, but the chapter up to this point never states what the Atlas is, where it can be found, and how it advances beyond the Atlas in the WGI AR5 contribution (2013). [Trigg Talley, United States of America]	Accepted. The Atlas is now mentioned at the very beginning of the chapter.
12417	64	29	64	53	Observation systems and observations are only part of the issue. It is a long way to go from raw in situ observations to gridded products. Gridded products are what actually being used in IPCC and most of the climate studies. Techniques used to process raw data and construct gridded products are equally important to in situ observations, so I recommend a separate subsection for this topic. We always see very different time series made by different groups based on essentially the same raw data, which indicates the importance of data process and reconstruction techniques. This aspect is always missed in IPCC reports, but actually many of the improvements from FAR to AR6 was benefited by the technique advances. Take ocean heat content for an example, better understanding of instrumental error in XBT/MBT data and a new community-agreed correction method significantly improve the accuracy of OHC time series (Cheng et al. 2016); better understanding of the bias in traditional gap-filling methods (Durack et al. 2014) and new gap-filling techniques (Cheng et al. 2017) also significantly improve the OHC estimate and lead to better convergence of different time series (Cheng et al. 2019). For SST, this is also the case, many recent developments on understanding the bias in old data (Chan et al. 2019; Karl et al. 2015). Therefore, we suggest this aspect to be included in chapter-1. References: (1) Cheng L.*, John Abraham, Gustavo Goni, Timothy Boyer, Susan Wijffels, Rebecca Cowley, Viktor Gouretski, Franco Reseghetti, Shoichi Kizu, Shenfu Dong, Francis Bringas, Marlos Goes, Loïc Houpert, Janet Sprintall, Jiang Zhu, 2016: XBT Science: Assessment of Instrumental Biases and Errors, Bulletin of the American Meteorological Society, 97(6), 924-933, https://doi.org/10.1175/BAMS-D-15-00031.1 . (2) Cheng L.*, J. Abraham, Z. Hausfather, K. E. Trenberth, 2019: How fast are the oceans warming? Science, 363, 128-129. https://doi.org/10.1126/science.aav7619 . (3) Durack, P.J., P.J. Gleckler, F.W. Landerer, and K.E. Taylor. 2014. Quantifying underestimates of long-term upper-ocean warming. Nature Climate Change 4(11):999–1,005, https://doi.org/10.1038/nclimate2389 . [Lijing Cheng, China]	Noted. This is a valuable point, but it has not been included in Chapter1 due to constraints of length. Chapter 1 focusses on the improvements and losses in observing networks. Improvements in the next steps towards the production of the datasets are detailed where they are used, for instance in Chapter 2, where three publications by Cheng et al. are cited.
44511	64	30	64	30	The classification and terminology "Typological regions" is inconsistent across Chapters 5, 8–12 and Atlas! For instance, in Ch12 "Typological regions" are not used/referred to, but there is a section on Specific zones and Hot spots, which contains some of the regions that are included in CH1 definition of "Typological regions". In the Atlas, they refer to "Typological domains". Careful check of the use of "Typological regions" across all chapters is needed and possibly a readjustment of the definition in Ch1 according to the use in the other chapters, or a harmonization across chapters according to the definition in Ch1. [Jana Sillmann, Norway]	Taken into account. The consistency issue has been solved after discussions with Chapters 5, 8–12 and Atlas. The expressions "domains" and "regions" are used as synonyms (see e.g. SOD Page 64 Line 48 where Reference Land and Ocean Regions are defined as "sub-continental domains").
99929	64	35	64	45	Since this information is used throughout the entire report, Figure 1.15 should only show the Reference Land and Ocean Regions and their associated acronyms that are shown in panel a. The panel should be enlarged to more clearly show the boundaries between regions. Panels b and c should be moved to their respective chapters. [Dan Helman, United States of America]	Rejected. The larger map of reference regions is available in the Atlas and in the Interactive Atlas. The several maps presented in this figure serve to illustrate the types of regions used in the report.
113617	64	38	64	38	"Acronyms are explained next to the map" not "below the map" [Agnieszka Kowalczyk, Poland]	Accepted. Corrected.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
98525	65	6	65	11	This is a good first attempt at defining Typological Regions but needs more work to clearly specify what Typological Regions are (also see previous comment). It should also clearly be flagged that this is the definition (if it is), and also include the definition in the Glossary. [Philippus Wester, Nepal]	Taken into account. The term "Typological Region" has been proposed to be included in the Glossary.
28723	65	8			Could refer to Fig. 1.15(b) where monsoon regions are mentioned. [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted.
111363	65	13	16	65	Needs more regional reference to Middle East, especially Gulf countries where there huge lack on climate information [Neeshad Shafi, Qatar]	Taken into account. There are two AR6 regions referencing the Middle East and the Gulf Countries: one Land Reference Region (Arabian Peninsula) and one Ocean Reference Region (Arabian Sea).
85011	65	19	69	47	No comments [Katrine Husum, Norway]	No action needed.
36811	65	21	65	24	These are not lines of evidence, they are merely focus areas. [John McLean, Australia]	Rejected. The expression "lines of evidence" is the right terminology for scientific assessments and it is used throughout the report.
85981	65	29	65	29	Is there not some overlap here with section 1.3? [Debra Roberts and the Durban WGII TSU, South Africa]	Executed. Overlap has now been minimized, with the removal of Figure 1.16 and accompanying text to Section 1.3.
71425	65	29			Somewhere in this section, reference should be made to Chapter 2 and 10.2, where we discuss challenges in observations for regional information. [Douglas Maraun, Austria]	Accepted. References added in the second paragraph of the section.
41779	65	29			Regarding the observational system, the SOD provides a description of the huge increase in the array of new observations, especially from remote sensing platforms. I acknowledge that this description is necessarily limited for the sake of space. I would nevertheless put a bit more emphasis on the challenges for the observational system in general, namely: continuity of observations (either because ground or satellite missions may be discontinued); ensuring homogeneous time-series either when dealing with a single satellite mission (may be associated to sensor degradation, or shifts in the observation sensing time), or with multiple missions where intercalibration is paramount; further exploit the combination of remote and ground observations, which may largely solve problems in areas where the ground stations are very sparse. [Isabel Trigo, Portugal]	No change made. These issues are in part addressed in the Trewin et al., 2020, and otherwise are beyond the scope of this section.
36813	65	31	65	36	These statements about coverage conflict with what you said or implied earlier about the credibility of the global average temperature anomaly since 1850. [John McLean, Australia]	Not applicable. This paragraph has been removed to avoid overlap with section 1.3.
67551	65	33	65	33	paleoclimatic [Baijun Tian, United States of America]	Fixed.
6451	65	36	65	36	1979 was not the start of the satellite era. Systematic weather imaging began in 1960. As regards climate, operational sounding of temperature began with the first pair of VTPR instruments launched in October 1972. The first Landsat was also launched in this year. BUV ozone data are available from 1970. The VTPR data have been assimilated in the ERA-40, JRA-55 and ERA5 reanalyses, and ERA5 also assimilated the BUV ozone data. The first of the next generation of sounding satellites was launched in October 1978, and its data were assimilated in ERA5 around the beginning of December 1978, i.e. just prior to 1979. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. This paragraph has been removed to avoid overlap with section 1.3.
82581	65	36	65	36	It may be necessary to clarify here what is meant by the 'satellite era', given that the earliest meteorological satellites go back to the early 1960s and some climatic uses of satellite data (e.g. tropical cyclones) go back to the late 1960s. [Blair Trewin, Australia]	Not applicable. This paragraph has been removed to avoid overlap with section 1.3.
36815	65	45	65	47	This is illogical. New interpretations of data cannot increase the amount of observations in earlier times. [John McLean, Australia]	Noted. The sentence has been rephrased.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
125353	65	46	65	47	The final phrase of this sentence "... and the fact that a larger number..." is a tautological construction. Re-phrase to clarify the point; perhaps split into two sentences. [Trigg Talley, United States of America]	Noted. The sentence has been rephrased.
70115	65	47	65	49	It would be useful to add a table of all the identified ECVs and EOVS (if not in the main text, at least in an annex). [Sonia Seneviratne, Switzerland]	No change made. These are readily available in tables within the publications cited in this section, and are further distilled by Trewin et al., 2020 to 7 prime indicators for assessment of anthropogenic climate change.
70117	65	47	65	49	Suggest to elevate the mention of ECVs to the ES. This is an important new development. [Sonia Seneviratne, Switzerland]	The treatment of observational capacity in the ES focused on the expansion of observations, and threats to existing observations, given limited space.
21333	65	51	65	51	Use of the ocean here jars as it implies their primary value is to characterising the oceans and only secondarily are they useful for the climate. I would suggest removing "ocean and" from this sentence to avoid the potential for mis-interpretation by the reader. Even if they were useful for other non-climatic aspects of ocean monitoring it is beyond the scope of AR6 anyway. [Peter Thorne, Ireland]	Taken into account in the new formulation of this sentence.
21335	65	52	65	52	Please do not use accuracy here - the accuracy presupposes the true state of the measurand is known / knowable - which in some limit is never ever satisfied. In metrology the guide to uncertainty in measurements specifically has retired the term. It would be better to talk about uncertainty than accuracy here. [Peter Thorne, Ireland]	Text modified accordingly.
98777	65	52	65	54	The ESA CCI is extremely valuable but specifically excludes in situ observations. So this statement is true, but could be misinterpreted as meaning that everything is OK because we have things like the ESA CCI. This level of investment in processing of newly acquired and digitised data sources would transform the in situ observational record. It should be made clear that resources for reprocessing in situ observational records and the associated activity of constructing gridded climate products, is a key gap that is holding back progress. [Elizabeth Kent, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The sentence has been removed due to constraints of length.
114271	66	1	66	8	Figure 1.16 is useful, but could probably be developed further in order to be easier to read. E.g. using more space, adding some icons as illustrations etc. [Jan Fuglestad, Norway]	Noted. Icons would overload this figure.
102477	66	2	66	2	Citizens science is mentioned here as means of digitizing old data record. But citizens science may also deliver in situ observations of good quality [Philippe Tulkens, Belgium]	Not applicable. No changes made as the figure moved to section 1.3.
29723	66	4	66	4	Add space in "1979CE". [Hernan Edgardo Sala, Argentina]	Not applicable. The x-axis of the figure has changed.
29725	66	13	66	13	Delete "assessment". [Hernan Edgardo Sala, Argentina]	Implemented.
36817	66	15	66	15	The observational coverage is either better (more detailed, greater coverage) or it is not. There should be no 'High confidence' about it. If there is any uncertainty about it then say so. [John McLean, Australia]	Noted. "High confidence" refers to our overall synthesis assessment, based on the analysis of publications documenting different observation networks, each of which has its own coverage. The sentence has been rephrased and moved to the end of 1.5.1.1.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
21341	66	18			I find overall section 1.5.1.1 very hard to follow or make sense of. Part of the issue is that it is highly selective in what aspects of observational improvements it is calling out. There are very many observational advances not being touched upon. Partly its the so-what aspect from a reader's perspective. I think this section would make much more sense if it were recast as new observations informing the assessment and that each new technique outlined were explicitly linked to the section in the later chapters where it is assessed. This would both more directly aid the future chapters but also give a better sense why, in the context of AR6 WG1, this matters. This will require considerable coordination with most other chapters to achieve but I think would give a better sense of purpose and structure to this section and ensure that only advances of direct relevance to the ensuing assessment were highlighted? [Peter Thorne, Ireland]	Taken into account. The section has been reorganized and references to the other chapters have been added.
83933	66	18			This section does not mention the advances in our understanding of Biogeochemical cycles and the carbon cycle.; at the Paleoclimate - missing information on ocean circulation reconstructions advances? [Marco Tulio Cabral, Brazil]	Noted. Chapter 1 is an introduction, and this section is devoted to advances in observational capabilities. New understanding of biogeochemical processes and carbon cycle is assessed in chapter 5. New ocean reanalyses are mentioned in section 1.5.2 and used in chapters 2 and 9.
90043	66	20	66	33	there are several challenges faced by GSRN networks (Report from 1st Meeting of the Task GCOS Surface Reference Network (GSRN) Task Team) 2017 that need to be noted in this section. [Govindarajalu Srinivasan, Thailand]	Noted. Challenges and limitations of observational products are discussed in chapter 2.
13209	66	21	66	24	It's important to mention the limitations of satellite-derived data. [Maria Amparo Martinez Arroyo, Mexico]	Noted. Challenges and limitations of observational products are discussed in chapter 2.
21337	66	21	66	33	Given their use for the first time in chapter 2 both hyperspectral sounders and GNSS Radio Occultation need to be outlined in this paragraph. Looking at other chapters I suspect there are a number of new applications of satellite techniques across much of the report. This section needs to far more clearly and explicitly note such new applications and cross-reference to where they are applied I think to both be useful to the reader but also latter chapters. I would suggest trying to instigate a cross-chapter BOG on this. [Peter Thorne, Ireland]	Taken into account. 4 new references added.
70621	66	22			Too technical, too many acronyms. I suggest not using the acronyms ECV and EOv. [Gillett Nathan, Canada]	Noted. We have strived to eliminate acronyms when possible. However many observing systems are known by their acronym and not their full name, so that it is necessary to introduce both. ECV is introduced once and only used once elsewhere in the text.
23841	66	23	66	23	Please see the comment above. [Branko Grisogono, Croatia]	It is not clear which other comment is referred to here.
35493	66	24	66	24	OCO-2 satellites or OCO2 subcrit? [Carlos Antonio Poot Delgado, Mexico]	Accepted. OCO-2 and OCO-3 spelled correctly.
67553	66	24	66	24	add OCO2 and OCO3 references. [Baijun Tian, United States of America]	Accepted. Reference Eldering et al, 2017 has been added.
54875	66	26	66	26	Joiner et al. (2011) is not an appropriate reference for GOSAT or satellite observations of CO2 in general. [Nancy Hamzawi, Canada]	Accepted. Reference replaced by Yokota et al, 2009 doi:10.2151/sola.2009-041; Inoue et al, 2016 doi:10.5194/amt-9-3491-2016
54877	66	26	66	26	ESA's Sentinel 5P TROPOMI, launched in late 2018, is another example of new satellite observations worthy of inclusion, since the mission greatly increases global CH4 coverage over past satellites with a similar accuracy and precision to GOSAT. [Nancy Hamzawi, Canada]	Noted. This information is not added, because this new dataset has not been used in this report.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
28297	66	28	68	32	The references Rebmann et al. 2018 (p66L28), FLUXNET/Pastorello (p68L20-21), and NEON (p68L32) basically all refer to the same type of flux measurement networks amended by important other ecosystem measurements. While it is good to see they are recognized here and the chosen references are good, and their approach of collecting data at the intersection of land surface / biosphere and atmosphere makes it indeed difficult to completely assign them to one of the 3 subsections atmosphere, Land and Biosphere, it is somewhat confusing/arbitrary that they appear with a different citation in all of them, without uninformed readers really knowing they belong together. Unfortunately I have no straightforward suggestion how to resolve this, maybe they can be described all together in detail in one particularly fitting subsection (land?) and then cross-referred to in the other two? Or introduce another subsection on "cross-/inter-sphere" observations? [Alexander Graf, Germany]	Taken into account. the atmosphere and biosphere sections have been restructured. We keep the Rebmann et al. reference in "atmosphere", in a specific paragraph on atmosphere-land fluxes.
6453	66	29	66	29	Aeolus does not measure "wind speed and direction". It measures the component of the wind along the line-of-sight. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. this sentence has been removed.
113053	66	30	66	30	Heat and momentum', I'd add fluxes of moisture and other chemicals. [Diego Miralles, Belgium]	Not applicable. this sentence has been removed.
41771	66	31	66	31	The multispectral imager onboard Himawari-8 (AHI) is virtually identical to that onboard the GOES-R series (ABI), so it does not make sense to refer one without the other. Furthermore, all these are geostationary platforms, which combined with other European and other agencies' form a geo-ring of high quality, high frequency observations. Suggest adding this information to the paragraph: "Together with the most recent generation of geostationary platforms (e.g., GOES-R launched in 2016, Meteosat series), these platforms form a geo-ring providing unprecedented high frequency, high quality and nearly global observations." [Isabel Trigo, Portugal]	Noted. The section has been reorganized and the Himawari satellite is now cited as an example of retrieving new variables relevant to the biosphere. The proposed sentence does not fit in this context, it is not possible to add it.
70623	66	31		33	This example belongs in the subsection on land. [Gillett Nathan, Canada]	Taken into account. This subsection has been reorganized.
24251	66	33			cloudy not cloud prone; sounds like clouds are a danger [Bryan Weare, United States of America]	Taken into account, cloud-prone replaced by cloudy.
21339	66	35	66	43	This is very much an incomplete survey. Where are NDACC and GRUAN networks for example? [Peter Thorne, Ireland]	Accepted. Recent references to NDACC (de Mazière et al 2018) and GRUAN (Bodecker et al 2016) added.
70625	66	45		46	This is written as though we are only now able apply trend analysis and climate assessment to records of greenhouse gases, but of course surface measurements of GHGs, especially CO2 concentration, have been routinely made for many decades, as described elsewhere in this chapter. [Gillett Nathan, Canada]	Taken into account. Paragraph removed.
21343	66	52	66	52	It feels a bit sudden to go from new satellite observations straight to data rescue. Also, it seems very odd to call out data rescue but not at the same time note the major advances in data repository efforts with many millions of newly available observations via ICOADS, ISTI, IGRAv2, GHCND etc. Surely the improvements in databases, especially those such as the ISTI databank that have directly informed improved estimates of GMST are important to mention if data rescue is? Otherwise the reader is left with the mis-impression that no advances in data provision have accrued? [Peter Thorne, Ireland]	Noted. The first sentence of this paragraph has been rewritten to improve the transition with the paragraph above it. The progress in data repositories has not been documented in more detail due to lack of space.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
36819	66	52	67	9	But given the errors in the digitising of data by Brohan and others at the Hadley Centre, errors that I found in the ICOADS database as part of my audit of the HadCRUT4 dataset (McLean (2018) "An Audit of the Creation and Content of the HadCRUT4 Temperature Dataset"), why should anyone believe that the digitising will be accurate? [John McLean, Australia]	Rejected. The cited papers describe how the citizen science projects listed ensure accuracy.
111949	66	53			probably Brönnimann et al. (2019a) [Tomas Halenka, Czech Republic]	Fixed.
114963	67	1	67	1	A reference to illustrate examples of undigitized ship log books could be: https://doi.org/10.5194/asr-12-57-2015 [Frank Kaspar, Germany]	Noted. Reference added.
113055	67	1	67	1	exist' [Diego Miralles, Belgium]	Fixed.
113057	67	4	67	4	correct ',' [Diego Miralles, Belgium]	Fixed.
70627	67	8		9	This may be read as a research recommendation. [Gillett Nathan, Canada]	Noted and edited.
33261	67	11	67	11	Are satellite altimetry and tide gauge missing ? Both central for sea-level [Jean-Baptiste SALLEE, France]	Taken into account. Text and three references have been added, as well as a pointer to cross chapter box 9.1.
125355	67	11	67	37	An overview of measurements of ocean surface elevation and instruments that monitor sea level change (with gauges at the coastline and via satellite altimetry) should be inserted here. An ocean observations section without any mention of sea level change is an important oversight for WGI. There is much progress to report regarding advancements in satellite altimetry and the sea level time series now available. The very next section covers measurements in ice sheet mass, which would follow logically right after a discussion of sea level measurements. And the importance of sea level reconstructions are mentioned in a subsequent section after that about paleoclimate data on page 69. [Trigg Talley, United States of America]	Taken into account. Text and three references have been added, as well as a pointer to cross chapter box 9.1.
40471	67	17	67	17	It seems that there are <4000 Argo floats. No? http://www.argo.ucsd.edu/About_Argo.html and Roemmich et al 2019. "more than" -> nearly or around [TSU WGI, France]	Corrected, thanks.
29727	67	17	67	17	There is an orphan parenthesis in this line. [Hernan Edgardo Sala, Argentina]	Corrected. Parenthesis removed.
13163	67	17	67	17	Missing () [Maria Amparo Martinez Arroyo, Mexico]	Corrected. Parenthesis removed.
777	67	17	67	18	Parentheses conflicts [Baruch Rinkevich, Israel]	Corrected. Parenthesis removed.
33259	67	23	67	24	Maybe add gliders are mostly upper ocean plateform. [Jean-Baptiste SALLEE, France]	Noted. New developments regarding ocean gliders are no longer covered in this section, due to constraints of length.
70629	67	26		28	Provide references in support of the statement that data from moored ocean instruments are important for detection of climate change signals, and also refer to the relevant parts of Chapter 3. Is this mainly referring to AMOC changes? [Gillett Nathan, Canada]	Taken into account. In the revised sentence, we avoid the word "detection", which may be ambiguous in relation with chapter 3, and provide instead three examples of climate processes observed by moored instruments (ENSO, ocean convection and transport through straits).

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
29729	67	34	67	37	<p>It could also be mentioned the Aquarius/SAC-D mission, developed collaboratively between NASA and Argentina's space agency (CONAE) (1). The full Aquarius dataset record (SSS) spans the period from 8/25/2011 to 6/7/2015 (i.e., a full three years and nine months period) (2, 3).</p> <p>(1) https://salinity.oceansciences.org/overview.cgi (2) Reul, Nicolas, et al. "Sea surface salinity estimates from spaceborne L-band radiometers: An overview of the first decade of observation (2010–2019)." <i>Remote Sensing of Environment</i> 242 (2020): 111769. https://doi.org/10.1016/j.rse.2020.111769. (3) Meissner, Thomas, Frank J. Wentz, and David M. Le Vine. "The salinity retrieval algorithms for the NASA Aquarius version 5 and SMAP version 3 releases." <i>Remote Sensing</i> 10.7 (2018): 1121. https://doi.org/10.3390/rs10071121. [Hernan Edgardo Sala, Argentina]</p>	Taken into account. The Reul et al 2020 reference has been added.
16299	67	39	68	4	Check with other chapters for possible duplicated descriptions of technology advances [Cunde Xiao, China]	Accepted. Wherever appropriate, cross references are made to chapters 2 and 9.
73957	67	40	67	48	As soon as Polar and sub-Polar (Boreal) regions are considered (for example, Northern Europe) it is necessary to remember that even if there is no permafrost in such regions, the climate conditions are different from other regions, resulting in specific upper soil behaviour under freezing and melting conditions. So changes in this behaviour due to climate change may have impact on forestry, agriculture, construction sector etc. But this topic is completely left out from the present report that considers only permafrost regions. It is strange and contradicts the concept of risk presented in this report: population density in permafrost regions is usually small, while in sub-Arctic regions it can be much higher. [Elena Kozlovskaya, Finland]	Noted. Space is too limited to expand on boreal soil freezing conditions.
45605	67	41	67	45	For the glaciological community, the term inventory is mostly used to count and characterize the glaciers (please see GLIMS or WGI, as examples). Meanwhile, fluctuations of glaciers' length or area are described as time series. Also, time series of length or area fluctuations of glaciers are only known for a minimal amount of the most than 215000 glaciers of the world, using the term inventory in this context gives the wrong impression that we have scrutiny all or at least most of the glaciers seeking for the fluctuations through time. [Lucas Ruiz, Argentina]	Accepted. The word 'inventory' has been removed from the sentence.
71151	67	46			please define "permafrost parameters". As such this statement doesn't help the reader to understand what you mean as "parameters" can be anything, including its colour. [Lukas Arenson, Canada]	Accepted. The word 'parameters' has been removed.
26589	68	1	68	1	The Iso2k article was submitted 8th January 2020 in ESSD, with the discussion paper being available online to everyone. This late submission may deserve being mentioned (Konecky, B. L., McKay, N. P., Churakova (Sidorova), O. V., Comas-Bru, L., Dassié, E. P., DeLong, K. L., Falster, G. M., Fischer, M. J., Jones, M. D., Jonkers, L., Kaufman, D. S., Leduc, G., Managave, S. R., Martrat, B., Opel, T., Orsi, A. J., Partin, J. W., Sayani, H. R., Thomas, E. K., Thompson, D. M., Tyler, J. J., Abram, N. J., Atwood, A. R., Conroy, J. L., Kern, Z., Porter, T. J., Stevenson, S. L., von Gunten, L., and the Iso2k Project Members: The Iso2k Database: A global compilation of paleo- $\delta^{18}O$ and δ^2H records to aid understanding of Common Era climate, <i>Earth Syst. Sci. Data Discuss.</i> , https://doi.org/10.5194/essd-2020-5 , in review, 2020.) [Eric Brun, France]	Accepted; this reference has been added.
125357	68	4	68	5	With as much as has happened in WAIS since AR5, the reader is left wanting more detail in this cryosphere section in terms of any new observational capabilities (e.g., recession of grounding line in Thwaites, etc.). [Trigg Talley, United States of America]	Readers are referred to Chapter 2 for an assessment of the observational constraints on the past and present climate state.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
21345	68	6	68	6	Use of land as a title is problematic given that cross-chapter box 2.2 splits topics to atmosphere, cryosphere, ocean and biosphere. It would be problematic to have chapter 1 disagree with this from the viewpoint of narrative continuity. Most of what is presently in this land section is actually indicators of the terrestrial biosphere. [Peter Thorne, Ireland]	Accepted. The structure of this subsection has been changed.
70121	68	6	68	24	It would also be relevant to mention here new datasets for "land surface temperature", e.g.: Duan et al, 2019, Remote Sensing of the Environment, doi: 10.1016/j.rse.2019.02.020 ; Fu and Weng 2016, Remote Sensing of the Environment, doi: 10.1016/j.rse.2015.12.040 . [Sonia Seneviratne, Switzerland]	Noted. The reference to Duan et al, 2019 has been added.
70123	68	6	68	24	Also relevant for this section are recent estimates of changes in lake heat content: Vanderkelen, I., et al., in press: Global heat uptake by inland waters https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2020GL087867 [Sonia Seneviratne, Switzerland]	Accepted, thanks. Reference added in the paragraph on the hydrological cycle.
70125	68	6	68	24	Estimates of land heat storage could also be mentioned here. A recent new analysis is currently in review (Gentine et al., in review). I could provide a copy of the manuscript. Some further evaluations are also provided in the article of Von Schuckmann et al., in review in ESSD. (a copy can be obtained from Karina von Schuckmann) [Sonia Seneviratne, Switzerland]	Accepted, thanks. Reference to vonSchuckmann et al is added in the paragraph on the hydrological cycle.
113059	68	6	68	34	Why is 'biomass' and 'greenness' in 'Land' and not 'Biosphere'? What does 'land' refer to if it excludes the terrestrial biosphere, just 'soil'? I do not think this partitioning works. I would suggest to move ocean biosphere to ocean and land biosphere to land. [Diego Miralles, Belgium]	Noted. The structure of the section has been modified to make is more consistent with chapter2; the biosphere paragraph has been kept and the "land" information is now found in the atmosphere and biosphere paragraphs.
113061	68	6	68	34	There is no reference to the Sentinel constellation or LandSat. There needs to be an effort to make these two sections a bit more extensive. For example mention Sentinel %P TROPOMI when refereing to fluorescence. [Diego Miralles, Belgium]	Noted. This paragraph has been removed to avoid repetitions between the atmosphere and biosphere paragraph. It has not been possible to discuss all satellite missions due to the constraint of space.
70131	68	6	68	49	It absolutely makes sense to separate the "land" and "biosphere" observations here. Similarly, they should be separated in Fig. 1.2 [Sonia Seneviratne, Switzerland]	Noted. Discussions with chapter 2 have led us not to keep the "land" paragraph. The information is now presented in a paragraph entitled "atmosphere, and hydrological cycle", and on the "biosphere" paragraph.
70119	68	15	68	16	The description of the new satellite soil moisture data from SMOS and SMAP are somewhat random and not provided here with any references. The main development in terms of the soil moisture ECV has been the compilation of a 30-year dataset of soil moisture as part of the ESA climate change initiative. A good overview on this product and its various applications, also in climate research, is provided in the following article: Dorigo, W., et al. 2017: ESA CCI Soil Moisture for improved Earth system understanding: State-of-the art and future directions. Remote Sens. Env., 203 (2017) 185–215. [Sonia Seneviratne, Switzerland]	Taken into account. reference added.
113063	68	16	68	16	A reference is missing after 'over land'. I suggest: McCabe, M. F., Rodell, M., Alsdorf, D. E., Miralles, D. G., Uijlenhoet, R., Wagner, W., Lucieer, A., Houborg, R., Verhoest, N. E. C., Franz, T. E., Shi, J., Gao, H. and Wood, E. F.: The future of Earth observation in hydrology, Hydrol. Earth Syst. Sci., 21(7), 3879–3914, doi:10.5194/hess-21-3879-2017, 2017. [Diego Miralles, Belgium]	Taken into account. The reference is interesting but not specific to SMOS and SMAP. It has been added at the beginning of the new paragraph on the hydrological cycle.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
113065	68	18	68	18	Include: 'Terrestrial evaporation can now be derived based on multi-satellite observations (Fisher et al, 2017)'. Fisher, J. B., Melton, F., Middleton, E., Hain, C., Anderson, M., Allen, R., McCabe, M. F., Hook, S., Baldocchi, D., Townsend, P. A., Kilic, A., Tu, K., Miralles, D. D., Perret, J., Lagouarde, J.-P., Waliser, D., Purdy, A. J., French, A., Schimel, D., Famiglietti, J. S., Stephens, G. and Wood, E. F.: The future of evapotranspiration: Global requirements for ecosystem functioning, carbon and climate feedbacks, agricultural management, and water resources, <i>Water Resour. Res.</i> , 53(4), 2618–2626, doi:10.1002/2016WR020175, 2017. [Diego Miralles, Belgium]	Taken into account. Reference added.
70129	68	25	68	48	Informative section. Note that this section is also covering biosphere indices in the ocean, which is absolutely fine. But this shows further that the realms "land" and "biosphere" should be separated in Figure 1.2. [Sonia Seneviratne, Switzerland]	Noted. This discussion is followed up in section 1.2. (The figure retains biosphere but not land, but the text notes the distinction as they're overlapping concepts.)
70127	68	26	68	27	It would also be relevant to refer here to the article of Guanter et al. 2017, PNAS: www.pnas.org/cgi/doi/10.1073/pnas.1320008111 [Sonia Seneviratne, Switzerland]	Accepted. Reference added.
13165	68	27	68	27	GOME must be expanded acronym has not been used [Maria Amparo Martinez Arroyo, Mexico]	Accepted. Acronym replaced by "Global Ozone Monitoring Experiment".
41775	68	28			Add acronym to the text, since many of vegetation indices and variables are commonly known by the respective acronyms. In this case we should have: (...) Leaf Area Index (LAI) ... [Isabel Trigo, Portugal]	Accepted. LAI added.
77621	68	29	68	29	Replace 'photosynthesis activity' with 'photosynthetic activity' [Emer Griffin, Ireland]	Editorial. Text modified as suggested
41777	68	29			As above, but for FAPAR, which is especially relevant since FAPAR is used in chapter 2: (...) and fraction of absorbed photosynthetically active radiation (FAPAR) – an important indicator of photosynthesis activity and plant (...) [Isabel Trigo, Portugal]	Accepted. FAPAR added.
107215	68	38		41	Your job is to accurately convey the range of expert opinion. When you have a contentious scientific issue like coral reefs, and you cite only the work of the most extreme alarmist (Hughes), and ignore the compelling work of more moderate voices (Peter Ridd), you are practicing politics, not science. [David Burton, United States of America]	We rely on recent syntheses of scientific information presented in the Special Report on Oceans & Cryosphere to present this information.
83407	68	47	68	47	The 1st World Ocean Assessment should also be cited here: United Nations, 2017. The first global integrated Marine Assessment. World Ocean Assessment I. Academic University Press. https://www.un.org/regularprocess/content/first-world-ocean-assessment ; The 2nd WOA (WOA II) is currently being reviewed and should be published before the end of the year. [Antje H. L. Voelker, Portugal]	This assessment considers those elements of the ocean most closely related to climate change, which best synthesized in more recent reports such as the Special Report on Oceans and Cryosphere in a Changing Climate.
105067	68	50	68	69	Among new data sets and new approaches to build these data sets, there are two new data sets for the LGM which use data assimilation: Cleator et al 2020 for continental data, based on pollen and PMIP3 results (Cleator, S. F., Harrison, S. P., Nichols, N. K., Prentice, I. C., and Roulstone, I.: A new multivariable benchmark for Last Glacial Maximum climate simulations, <i>Clim. Past</i> , 16, 699–712, https://doi.org/10.5194/cp-16-699-2020 , 2020.) and Tierney et al (10.31223/osf.io/me5uj) for sea surface temperatures [Masa KAGEYAMA, France]	These references have now been included.
21347	68	50	69	17	This feels very light on detail overall and like it is substantially underplaying the major advances in paleo expanded upon in later chapters, but particularly chapter 2. The ability to estimate over the whole holocene at annual resolution is not as far as I could interpret it mentioned at all for example. It feels like considerable additional detail would be useful here to paint a better picture of the advances in paleo records. [Peter Thorne, Ireland]	Accepted; section has been rewritten to include some of the paleoclimate advances that feature in other areas of the assessment, as well as some that do not.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
81283	68	50	69	17	A database of North American long-term ground surface temperatures, from approximately 1300 CE to 1700 CE, was assembled from geothermal data. These temperatures are useful for studying the future stability of permafrost, as well as for evaluating simulations of preindustrial climate that may help to improve estimates of climate models' equilibrium climate sensitivity. The data set was derived solely from measurements and extrapolation of the subsurface temperature gradient at depth to the surface. There is no model or inversion used. These are data derived values. The reference is: uesta-Valero, F. J., García-García, A., Beltrami, H., Zorita, E., and Jaume-Santero, F.: Long-term Surface Temperature (LoST) database as a complement for GCM preindustrial simulations, <i>Clim. Past</i> , 15, 1099–1111, https://doi.org/10.5194/cp-15-1099-2019 , 2019. [Hugo Beltrami, Canada]	Accepted; reference added.
659	68	50	69	17	This paragraph on paleoclimate really focusses on the last millenium, or more recent, but there have also been significant advances in reconstructions of older time periods. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Accepted; references covering older periods now added.
28725	68	50			What time resolution is possible at the end of the main paleoclimate records since one issue sometimes raised is that overlap with the instrumental record does not correctly account for the lack of time resolution in the paleorecord and presents an unfair comparison (e.g. Marcott et al. 2013 http://www.sciencemag.org/content/339/6124/1198.abstract show quite a high time resolution for the recent past) [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	The resolution of paleoclimate records vary widely, ranging from monthly-resolved coral records (which are available back several million years ago; i.e. Watanabe et al., 2011) to varved sediments through the Holocene. Blanket statements of resolution must only be made with respect to a specific application of interest.
70631	68	55			Stable isotopic records from what? Tree rings? Ice cores? [Gillett Nathan, Canada]	Not applicable. Clause in question removed.
70633	69	5		6	Provide references in support of the statement that new reconstructions of past climate extremes are particularly important for the detection and attribution of anthropogenic impacts on present and future climate extremes, including to any relevant parts of Chapter 11, if indeed the statement is supported. [Gillett Nathan, Canada]	Reference added to Chapter 2 discussion of changes in modes of variability, re detection of ENSO changes in observations record.
113067	69	7	69	7	Add reference after 'drought reconstruction'. [Diego Miralles, Belgium]	Accepted; numerous references added.
29731	69	8	69	8	Please, add a comma before "hurricane activity". [Hernan Edgardo Sala, Argentina]	Accepted.
8617	69	11	69	17	Kopp et al. 2016, 10.1073/pnas.1517056113, was the first statistically sophisticated global synthesis of sea-level record for the last 3 kyr. not sure why Cook et al 2015 is cited for sea level, it is a paper on megadroughts. [Robert Kopp, United States of America]	Accepted; reference fixed.
8619	69	11	69	17	not sure what this paragraph is about -- i thought sea level, but the last sentence isn't worth mentioning advances in paleo-CO2 reconstruction somewhere in this section? [Robert Kopp, United States of America]	Accepted; references added.
28299	69	20	69	46	Other than its title seems to suggest, section 1.5.12 is almost exclusively about the loss of past data archives. Unfortunately I'm not an expert but occasionally you hear about e.g. weather or other observation stations with e.g. 20+ years of interesting data, that are threatened by being discontinued, maybe especially (but not exclusively) in developing countries. If none of the authors has access to such information, maybe it would be better to narrow the title of the subsection. [Alexander Graf, Germany]	Noted. New examples of threats to the coverage of present-day observations have been added, for example the potential impact of the pandemic on data collection.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
21349	69	20			I am surprised that this section does not touch at all upon risks to multi-decadal satellite series from upcoming potential mission gaps or even give the several obvious examples that accrued over the AR6 cycle such as the gap between GRACE and GRACE-FO for example. TSI and TOA last I heard were at risk but I would strongly advise soliciting a contribution from the satellite community that highlights upcoming mission continuity risks and highlights these here. [Peter Thorne, Ireland]	Noted. We have found references demonstrating the possibility of using GRACE and GRACE-FO despite the gap, that have been added in the paragraph on the hydrological cycle. No recent publication has been found regarding upcoming mission continuity risks.
23277	69	22	69	24	This statement is probably true but no evidence/reference is given here. Since many of critical components of in-situ ocean observing network are fully or partly based on research funding and thus vulnerability in terms of their sustainability (e.g. Roemmich et al. (2019) for Argo's situation). [Toshio Suga, Japan]	Noted. This sentence has been removed, section 1.5.1.2 has been extensively modified.
14511	69	26	69	29	this sentence does not make sense as written, please reorganize to clarify, and also add mention of temperate, mid-latitude glaciers: "The risks include threats to natural archives such as tropical and temperate glaciers (Cullen et al., 2013), long-lived corals (Hughes et al., 2018), and long-lived trees (Sanchez-Salguero et al., 2017) that are disappearing as a direct consequence of warming temperatures and/or other human disturbances such as logging (Aguilera-Betti et al., 2017) and harvesting of relic timber (Lorrey et al., 2018). [Amy East, United States of America]	Accepted; section rewritten for clarity.
24255	69	26	69	35	Fig. 1.16 is not useful. Even the one example of PAGES2K is not clearly noted. [Bryan Weare, United States of America]	Taken into account. This figure has been moved to section 1.3, where it is more useful to support the text.
41031	69	28	69	45	There are 3 uses of the term "risk" in this paragraph that may be better characterised as "in danger", as the word "risk" as a specific meeting within the IPCC context. [TSU WGI, France]	Accepted; more specific language is used whenever possible.
41033	69	28	69	45	There are 3 uses of the term "risk" in this paragraph that may be better characterised as "in danger", as the word "risk" as a specific meeting within the IPCC context. Also later on p 86 "there are risks"- may be beter phrased as there is the probability that . Also on page 86 To mitigate against this risk -> to address this situation, might be a preferable phrasing [TSU WGI, France]	Accepted; more specific language is used whenever possible.
29733	69	31	69	31	Replace "Pages" by "PAGES". [Hernan Edgardo Sala, Argentina]	Accepted.
14893	69	31	69	31	please replace Pages 2k Consortium with PAGES 2k Consortium [Marie-France Loutre, Switzerland]	Accepted.
24253	69	32			bottom not top panel [Bryan Weare, United States of America]	Accepted; Figure reference removed.
70635	69	33		35	This is a research recommendation, which isn't allowed in IPCC reports. [Gillett Nathan, Canada]	Accepted; Statement removed.
23845	69	34	69	34	...from select ice core..' it should read perhas as '...from selecteced ice core...' [?] [Branko Grisogono, Croatia]	Accepted; section rewritten for clarity.
113069	69	37	67	37	ship's logs' for 'ship logs' [Diego Miralles, Belgium]	Fixed. (in 1.5.1.1)
16279	69	37	69	46	Referencing these archival sources reinforces comment #1 [Sarah Sutton, United States of America]	Ambiguous reference to a previous comment.
82583	69	37	69	46	The decline of some observing networks without automatic replacements could also be mentioned as a concern here, particularly for variables which are difficult to replace by automatic means (e.g. some cloud and evaporation variables), or radiosondes, where observation schedules are being reduced in some countries for cost reasons. A further issue is that in many cases observations are made but not communicated internationally and hence difficult to obtain for global data sets. [Blair Trewin, Australia]	Noted. This paragraph has not been expanded due to constraints of space.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
6455	69	39	69	40	The sentence that spans these lines will be viewed by some as a bit overdramatic. There are indeed issues/risks to be faced in transitioning to automatic observing systems, but automation has increased the temporal frequency of observation and enabled measurements to be made at remote locations (GCOS, 2015). Manual observations carry the risk of human error. It is also not clear what is implied by the sentence starting "Looking ahead ...". Observations from automatic systems are already more numerous than observations from manual stations in the synoptic data routinely transmitted by countries. I have just checked data receipt in 2019 for ECMWF, and there were almost 50% more observations of surface air temperature and humidity that were coded to be from automatic stations than there were observations coded to be from manual stations. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. The sentence has been rephrased.
98779	69	40	69	40	WMO 2017a does not consider any marine observations - the move to automated systems over the ocean (ships -> buoys) has led to a reduction in the coverage of several ECVs, including air temperature and humidity. The increasing use of automated systems on those ships that do still report means that variables requiring manual input such as cloud cover, weather codes and waves have declined dramatically. See reference for comment #1. This comment should be expanded to also include marine surface observations. [Elizabeth Kent, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The paragraph has been modified and the reference to WMO 2017 removed.
82827	69	45	69	46	Traditional knowledge holders have always passed away (like all humans). Actually, due to the environmental crisis, there are strong processes of cultural and spiritual revival, and new wise are emerging. The traditional knowledges regarding climate are at risk due to multiple sociohistorical, political and economic factors, but mainly because traditional knowledge-holders are losing confidence; their knowledge has historically been underestimated and the speed of environmental changes causes traditional knowledge to lose precision. [Rosario Carmona Yost, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account; space constraints prevent a more thorough treatment of indigenous knowledge holders.
125359	69	47	69	47	Authors should strongly consider inserting some text about the risks to the continuity of collection for satellite and long-term observational networks -- i.e., the importance of sustained funding for long-terms observations, as well as gaps -- and maybe include a map of observational density for a given parameter to illustrate spatial gaps. [Trigg Talley, United States of America]	Noted. The need for continuity in funding is discussed in detail in may of the references cited in 1.5.1. Adding text and a figure was not possible due to the constraint of space.
114273	69	49	72	2	The overview in section 1.5.2 is very useful. And I wonder if the section could do a bit more of assessment of the various types of reanalyses. I believe this would be very useful. [Jan Fuglestedt, Norway]	Thanks. Section 1.5.2 has been expanded, with more references and a more in-depth assessment of different reanalyses.
21351	69	51	69	53	Reanalyses are always (not generally) the result of running a frozen configuration of a data assimilation and forecast model retrospectively upon a selected subset of the available historical observations. The second sentence should note that in AR6 the term is specifically reserved for the definition given in the preceding sentence for the avoidance of doubt? This should be checked with remaining chapters for adherence. [Peter Thorne, Ireland]	Accepted. The word 'generally' has been removed, and an additional point has been made in the second sentence that the focus here is on the reanalyses using the model-based method.
125361	69	55	69	55	"within the limitations": the presence or lack of observations can also add to the limitations of reanalyses. [Trigg Talley, United States of America]	Noted. Added 'data availability' to the limitations.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
41773	69		69		Section 1.5.1.2 does not refer at all risk of disruptions/dicontinuity of surface station networks or some satellite missions, that are specifically highlighted in the executive summary (page 7; also mentioned above). For the sake of consistency, at least one or two sentences should also be added in this section about the need to continue such observations. [Isabel Trigo, Portugal]	Noted. References have been added in section 1.5.1.2 and the executive summary statement has been revised.
6457	70	1	70	1	Perhaps a better choice than wind shear can be made for an example of an unobserved variable. Wind shear can be computed from radiosonde measurements of wind, which are increasingly reported with high vertical resolution. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Evaporation is now chosen as an example.
38653	70	3	70	3	The Box 2.3Tab 1 there isn't in the text [Luisa Sturiale, Italy]	Noted. 'Table 1' has been removed to make it clearer the 'Box2.3' refers to AR5 WGI Chapter 2, Hartmann et al.
104547	70	3	70	6	The limitations should include three aspects, i.e., model error, assimilation error and observation error (Thorne and Vose, 2010; Zhou et al., 2018). Zhou et al. (2018) compared regional warming in all the existing twelve atmospheric reanalyses to reveal these errors. As such, 'Their limitations include model biases, ...' would be better revised as 'Their limitations include model biases, assimilation method biases, ...'(Thorne and Vose, 2010; Zhou et al., 2018)'. References: Thorne, P., and R. Vose, 2010: Reanalyses suitable for characterizing long-term trends: Are they really achievable? Bull. Am. Meteorol. Soc., 91, 353-361. Zhou, C., Y. He, and K. Wang, 2018: On the suitability of current atmospheric reanalyses for regional warming studies over China. Atmos. Chem. Phys., 18, 8113-8136 [Chunlüe Zhou, United States of America]	Noted. These errors have been included, along with the references.
32651	70	12	70	40	Add some information about the resolution of the GCMs in the first to sixth assessment reports of ipcc. [sadegh zeyaeyan, Iran]	Noted. This comment seems to refer to section 1.5.3, where the progress in resolution from CMIP5 to CMIP6 is documented and illustrated by a figure. The information about earlier models, given in previous IPCC reports, does not need repeating.
32981	70	12	70	40	Add some information about the resolution of the GCMs in the first to sixth assessment reports of ipcc. [Sahar Tajbakhsh Mosalman, Iran]	Noted. This comment seems to refer to section 1.5.3, where the progress in resolution from CMIP5 to CMIP6 is documented and illustrated by a figure. The information about earlier models, given in previous IPCC reports, does not need repeating.
125363	70	16	70	26	One issue that is not discussed here is the energy imbalance in reanalyses. Presumably, the observations that are assimilated experience the real world imbalance to within their uncertainty. As the data assimilation merges observations with models, they add or subtract atmospheric heat and water so that the reanalyses have a numerical imbalance related to observational analysis. Changing observing systems can affect this. Models do not have this issue and all energy is accounted through some physical process. This places some uncertainty on the energy and water flux terms. This may or may not also affect the state fields time series and modes of variability. [Trigg Talley, United States of America]	Accepted. New sentence added: "The assimilation of sparse or inconsistent observations can introduce mass or energy imbalances"

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
17401	70	16	70	50	The discussion about atmospheric reanalysis does not mention that impact models, especially hydrological models only rarely use raw surface reanalysis meteorological variables for forcing. It would probably be a good idea to mention that, since surface meteorology from reanalyses include residual biases - especially for precipitation, gridded observations (e.g. from CRU) are combined with regridding and elevation corrections to produce adjusted forcing datasets. Examples include the WFDEI (adjusted ERA-Interim, Weedon et al., 2014) and WFDE5 (adjusted ERA5, Cucchi et al., submitted). [Graham Weedon, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. We have included a sentence in the "applications" section: "... they are often bias adjusted first (e.g., Weedon et al., 2014). Copernicus Climate Change Service (C3S) provides a bias adjusted dataset for global land areas based on ERA5 called WFDE5 (Cucchi et al., 2020) ..."
17403	70	16	70	50	Cucchi, M. Weedon, G.P., Amici, A., Bellouin, N., Lange, S., Mueller Schmied, H., Hersbach, H. and Buontempo, C., submitted. WFDE5: bias adjusted ERA5 reanalysis data for impact studies. Earth System Science Data, doi: 10.5194/essd-2020-28. [Graham Weedon, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. This has been included.
17405	70	16	70	50	Weedon, G.P., Balsamo, G., Bellouin, N., Gomes, S., Best, M.J. and Viterbo, P., 2014. The WFDEI meteorological forcing dataset: WATCH Forcing DATA methodology applied to ERA-Interim reanalysis data. Water Resources Research, 50, pp 7505-7514, doi: 10.1002/2014WR015638. [Graham Weedon, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. This has not been included as we are discussing the latest developments.
21357	70	16			This section would greatly benefit from much more directly addressing the improvements in the realism of reanalysis products through time. It should more directly make the distinction in quality between older and newer reanalysis products and the implications for the report. [Peter Thorne, Ireland]	Accepted.
21353	70	19	70	21	This may be true but its now a 20-year old reanalysis system and suffers many issues. It should be noted explicitly here that results from this pioneering reanalysis need to be treated with far greater caution than from more recent reanalyses. [Peter Thorne, Ireland]	Noted. New text has been added: " Older reanalyses have a number of limitations, which have to be accounted for when assessing the results of any study that uses them. ."
104543	70	21	70	22	Zhou and Wang (2017) used in-situ observations to comprehensively assess/reveal large errors in precipitation characteristics (including frequency, intensity and amount) in eight reanalyses at sub-daily to multidecadal timescales. It's better to cite Zhou and Wang (2017) before Sun et al. (2018). References: Zhou, C., and K. Wang, 2017: Contrasting daytime and nighttime precipitation variability between observations and eight reanalysis products from 1979 to 2014 in China. J. Clim., 30, 6443-6464. [Chunlüe Zhou, United States of America]	Accepted. Added.
21355	70	22	70	24	This sentence makes little sense to me but I'm not quite clear what you are trying to say here to make a constructive suggestion. [Peter Thorne, Ireland]	Noted. The trends in these reanalyses match those of observational datasets (but only those that include the polar regions). This has been reworded.
104545	70	22	70	25	It would be better to add 'and China (Zhou et al., 2018)' after '... represented the polar regions (Simmons and Poli, 2015)'. Because Zhou et al. (2018) used a high-density observation network to evaluate regional warming in all the existing (twelve) atmospheric reanalyses and found that ERA-Interim and JRA-55 reanalyses are the best. Reference: Zhou, C., Y. He, and K. Wang, 2018: On the suitability of current atmospheric reanalyses for regional warming studies over China. Atmos. Chem. Phys., 18, 8113-8136. [Chunlüe Zhou, United States of America]	Accepted. Sentence now reads: "reanalyses continue to be consistent over the last 20 years with surface observational data sets that include the polar regions (Simmons and Poli, 2015), although biases in precipitation and radiation can influence temperatures regionally (Zhou et al., 2018)."

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
21359	70	35	70	43	Paragraph needs a complete revision to account for Hersbach et al., 2020 (QJRM) and to cite the increased number of papers describing this product. I can provide a list nearer the time of such papers from a C3S contract I am working on which is contracted to undertake evaluation of many facets of ERA5 and those validation reports themselves should be up on the C3S CDS on the timescale of the chapter receiving these review comments. [Peter Thorne, Ireland]	Accepted. Hersbach et al. 2020 has been added.
28727	70	35			ERA5 also contains better representation of radiative forcings such as Pinatubo which was lacking in earlier versions but still suffers from inhomogeneity in the global water cycle e.g. Allan et al. 2020 NYAS Fig. 4 doi: http://doi.org/10.1111/nyas.14337 [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. This information and reference has been added.
6459	70	36	70	36	Hersbach et al. (2020) is a better reference than Hersbach and Dee (2016). It is referred to elsewhere in the SOD as "submitted", and has now been accepted, so is a bona fide reference for IPCC purposes. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. This has been added.
6461	70	37	70	38	"but is being extended back to 1950" can be changed to "and has recently been extended back to 1950". The back-extension has been completed, but data have to be formatted for public release, which should occur mid-year. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. done.
113071	70	40	70	42	At 'ERA5 also saw improvements [...] reanalyses'. Please refer to Martens, B., Schumacher, D. L., Wouters, H., Muñoz-Sabater, J., Verhoest, N. E. C., and Miralles, D. G.: Evaluating the surface energy partitioning in ERA5, Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2019-315 , 2020. [Diego Miralles, Belgium]	Accepted. Reference added.
125365	70	42	70	42	The primary reference for ERA5 (by Hans Hersbach) is presently accepted to QJRM. This should be cited here. Of particular importance is a list of known issues. Here, it needs to be made known that while ERA5 has many useful qualities, it is still subject to some of the the broad sources of uncertainty in reanalyses mentioned earlier, specifically changes in the observing system and model uncertainty. [Trigg Talley, United States of America]	Accepted. Added "Although ERA5 presents a great improvement in atmospheric reanalyses, the limitations introduced by limited and time-varying observations and model limitations still remain."
6463	70	42	70	43	This statement is true only if the user chooses to work with full-resolution data. The user has the option to work with data at a lower resolution in space and time, similar to the resolution of earlier reanalyses. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. The sentence has been rewritten.
80995	70	43	70	43	Perhaps avoid the word 'manipulate' as it may be used in a negative sense by certain readers. Perhaps instead use the word 'process'. [Jeffrey Philip OBBARD, Singapore]	Accepted.
125367	70	45	70	53	Include "spatial" in both line 45 and line 53 to clarify the type of resolution being described. [Trigg Talley, United States of America]	Accepted. Added.
70637	70	45	80	44	This is a well-written and it provides useful background and context to Chapter 3. [Gillett Nathan, Canada]	Noted. Thank you for this positive comment.
112515	70	49	70	49	There is also evidence for improved quality of other parameters, e.g. wind, see for example: https://doi.org/10.5194/asr-13-151-2016 ; https://doi.org/10.5194/asr-12-187-2015 ; https://doi.org/10.1088/2515-7620/ab2ec3 ; https://doi.org/10.1088/1748-9326/ab702d [Frank Kaspar, Germany]	Noted. The text on regional reanalyses has not been expanded because of the constraint of space. One of these references, Kaiser-Weiss et al, 2015, is cited in the paragraph "applications of reanalyses". Kaiser et al 2019 is cited in Chapter 10.
102479	71	12	71	12	Technically speaking, the core of most ESMs is a coupled AOGCM. [Philippe Tulkens, Belgium]	Noted. We assume this comment is about page 72, not page 71. We use the term GCM, which may include atmosphere, ocean and sea ice.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
21361	71	19	71	19	The reanalysis community term these "sparse input" reanalysis systems to differentiate them from "full-input" reanalyses. For narrative continuity as these are a sub-class of atmospheric reanalyses this section would make a lot more narrative sense to be moved up to immediately follow the description of atmospheric reanalyses products [Peter Thorne, Ireland]	Accepted. The section has been moved.
125369	71	19	71	19	it could also be mentioned that these are also run as ensembles, and the spread of the ensembles provides an estimate of variability. [Trigg Talley, United States of America]	Accepted. This is a good suggestion, and a sentence has been added.
26591	71	27	71	27	"aspect" would be a better word than "measure" [Eric Brun, France]	Accepted. We assumed the comment refers to page 72 line 27, because the word "measure" is not found on page 71.
13211	71	32	71	32	It's suggested to mention the uncertainty resulting from the use of emulators. [Maria Amparo Martinez Arroyo, Mexico]	It is unclear which page this comment refers to. Page 71 line 32 is about Reanalyses of the pre-instrumental era.
38301	71	32	71	32	Paleoclimate records cannot be referred to as observation records. It is suggested to change "paleoclimate observations" to "paleoclimate reconstructions" or "paleoclimate information" and use them uniformly in the report. [Yaming LIU, China]	Accepted. We now use "paleoclimate archives" which is the most often used terminology in chapter 1 and elsewhere in the WG1 report.
130467	71	32			paleoclimate observations should be "paleoclimate information". [Panmao Zhai, China]	Accepted. We now use "paleoclimate archives" which is the most often used terminology in chapter 1 and elsewhere in the WG1 report.
77623	71	34	71	34	Oxygen isotopes are a method of assessment rather than unit - suggest 'oxygen isotope composition' [Emer Griffin, Ireland]	Accepted. 'composition' has been added.
26593	71	35	71	35	colours in Table 1.2 are hard to distinguish [Eric Brun, France]	Not applicable. Table 1.2 has been removed.
9263	71	45	71	55	It must be mentioned that one of important application of reanalyses is post processing the climate models for regional scales. There are several papers which use reanalyses for post processing the climate models for their regions. [Morteza Pakdaman, Iran]	Accepted. This application of reanalyses is now mentioned in the text.
32653	71	45	71	55	It must be mentioned that one of important application of reanalyses is post processing the climate models for regional scales. There are several papers which use reanalyses for post processing the climate models for their regions. [sadeqh zeyaeyan, Iran]	Noted. as comment 9363
32983	71	45	71	55	It must be mentioned that one of important application of reanalyses is post processing the climate models for regional scales. There are several papers which use reanalyses for post processing the climate models for their regions. [Sahar Tajbakhsh Mosalman, Iran]	Noted. as comment 9263.
82585	71	46	72	2	Another important aspect of reanalyses is that they provide globally complete fields for many variables at a range of timescales, including daily and sub-daily timescales relevant to assessment of climate extremes. [Blair Trewin, Australia]	Accepted. added 'sub-daily timescales' to the list of reasons why they complement observations. and also "the exploration of fine-scale extremes in both space and time" in the list of uses at the end.
21363	71	48	71	48	You had said earlier that reanalysis precipitation was questionable and yet here you say they are a potential application. Which is it? It can't be both. [Peter Thorne, Ireland]	Accepted. Precipitation has been removed from the list of new uses.
37829	71	51	71	53	Ocean reanalyses are now being used routinely in the context of climate monitoring, e.g. the Copernicus Marine Environment Monitoring Service Ocean State Report; von Schuckmann et al., 2019): missing parenthesis [Junhee Lee, Republic of Korea]	Accepted. This has been added.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
114275	72	5	80	44	A useful section. While the plan is that the assessment of models fit for purpose will be placed where the models are used - and discussed in light of the application there - I still wonder if the assessment aspect could be strengthened in this section. This needs of course coordination with the chapters using the models. A bit more attention to this would be very useful for the general overview of model performance and development. [Jan Fuglestedt, Norway]	Accepted. The general discussion on fitness for purpose (section 1.5.4.8) has been moved to the beginning of 1.5.4 to give it more visibility, and strengthened in coordination with other chapters.
36837	72	5	80	44	All parts of section 1.5.3. need to explicitly state which models, if any, have been validated and the techniques used for this validation. Validation is very different to evaluation, which you discuss in section 1.5.4. [John McLean, Australia]	Model validation and evaluation for different time scales, processes and regions is presented in the chapters: chapter 3 for global climate over the historical period, chapter 4 for global projections, etc. The scope of chapter 1 is only to present the evolution of methods for evaluation/validation, which is done in section 1.5.4.
14895	72	5			Section 1.5.3.1. discusses the models used for CMIP experiments and how they changed between AR5 and AR6. Section 1.5.3.4 mentions that EMICs were heavily used in previous IPCC assessment, for long-term studies, in particular for paleoclimate. It would be interesting to discuss the progress made with the framework of PMIP, and how the models used within PMIP are similar/different from those used in PMIP. This is really a key issue for the reliability of the paleo simulations. [Marie-France Loutre, Switzerland]	Noted. A discussion about PMIP models has not been added due to constraints of space.
19179	72	8	72	8	I would not state that ESMs are the only tools to do this [Thorsten Mauritsen, Sweden]	Taken into account. "only tools" replaced by "main tools".
125371	72	14	72	14	[ENSEMBLES] State here that 32 different Earth system models (listed in Table 1.2) contributed to CMIP6 and compare this with the number of CMIP projects used in AR5 (also listed in Table 1.2). The table shows 13 new ESMs used in CMIP6, which appears to contradict the statement about 23 modeling centers contributing ESM output for CMIP5 (on page 76, line 2) . [Trigg Talley, United States of America]	Noted. This paragraph is an introduction and we feel that detailed information on number of ESMs or GCMs in CMIP6 is better presented later in the text (section 1.5.4). Table 1.2 is removed in the FGD, because precise information on ESM components fits better in annex III. The removal of the list of ESMs in table 1.2 avoids the confusion with the modelling centres in figure 1.18 and line 76. There was an apparent discrepancy because one centre may contribute more than one model .
19181	72	14	72	14	Past reports have relied on ESMs for projections, not AR6 [Thorsten Mauritsen, Sweden]	Taken into account. Like past reports, AR6 relies on ESMs, but not exclusively: other models have always been needed for, e.g., projections of sea level. "rely on" has been changed to "make use of".
70639	72	15			Avoid referring to CMIP6 results as 'early' results. CMIP6 data have been available on ESGF for more than 18 months (more than 12 months at time of submission of this draft). [Gillett Nathan, Canada]	Taken into account. "Early" has been removed. Thanks.
21365	72	22	72	22	natural laws seems an odd expression do you not mean the physical, chemical and biological processes? [Peter Thorne, Ireland]	Noted. Yes, this is what we mean. We used "natural laws" to avoid confusion with man-made laws. adding more precisions would make the sentence too convoluted.
45753	72	22	72	22	It would be worthwhile to point out that this ESM definition differs from the narrower definition used by CMIP6 (Eyring et al., 2016), where "models that can calculate atmospheric CO2 concentration and account for the fluxes of CO2 between the atmosphere, the ocean, and biosphere are referred to as Earth System Models (ESMs)". [Twan van Noije, Netherlands]	Taken into account. We have added "representation of the carbon cycle" in the definition.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
125373	72	22	72	22	Re-phrase sentence to read: "Earth system models CONTAIN THOUSANDS OF mathematical formulations FOR the natural laws that govern..." [Trigg Talley, United States of America]	Rejected. Regarding the style, we prefer the formulation "ESMs are", because it is a definition, rather than "ESMs contain". Regarding the number of mathematical formulations in an ESM, we cannot define it unambiguously while keeping the paragraph concise: for example, should the Navier-Stokes equations count as a mathematical formulation, should each partial derivative in the Navier-Stokes equation be counted as a separate mathematical formulation, or should each line of code containing an arithmetic operation be counted as a mathematical formulation? Depending on the choice, the number of mathematical formulations in an ESM may be in the tens, the hundreds, or the hundred of thousands.
40013	72	22	72	23	Check consistency with the glossary definition for 'Earth system model'. [TSU WGI, France]	Taken into account. Added "representation of the carbon cycle" for consistency with the glossary.
9261	72	22	72	30	References must be provided for lines 22-30 page 72 [Morteza Pakdaman, Iran]	Accepted. Three references have been added.
114277	72	23	72	23	The language may be improved here (to avoid "laws" twice in a row). May be changed to "This builds on the fundamental laws...." [Jan Fuglestedt, Norway]	Taken into account, thanks.
19183	72	23	72	23	I would not consider empirical relationships as 'laws', this is a too strong word to use here [Thorsten Mauritsen, Sweden]	Taken into account. Formulation changed to "They build on... laws...or empirical relations..."
125375	72	24	72	24	Insert a parenthetical example for "empirical relations established based on observations" as was done for "fundamental laws of physics" with the insertion of "(e.g., Navier-Stokes equations)". [Trigg Talley, United States of America]	Noted. The suggestion is interesting, but an extra example has not been added because the sentence is already long and would lose readability.
70133	72	24	72	24	Add "Clausius-Clapeyron" after "Navier-Stokes". For balance, it would also be important to mention a physical thermodynamic equation (e.g. Clausius-Clapeyron relationship) in addition to the Navier Stokes equations which are more focused on dynamics. [Sonia Seneviratne, Switzerland]	Accepted. Change made.
70641	72	26		27	Provide references in support of the assessment that 'the spatial resolution of these grids is an important measure of the expected skill of the model in reproducing or projection the evolution of the physical phenomena'. This is the assessment in 3.8.2.2: 'Higher resolution improves aspects of the simulation of climate (particularly concerning sea surface temperature) but discrepancies remain and there are some regions where currently attainable resolution produces inferior performance (high confidence). Such model behaviour can indicate deficiencies in model physics that are not simply associated with resolution.' [Gillett Nathan, Canada]	Taken into account. The sentence has been modified. References are provided in the following paragraph.
42079	72	28	72	28	because the spatial (and temporal) resolution determines which processes need to be parameterised or can be explicitly resolved and how well [Julia Nabel, Germany]	Accepted. Thanks for providing this sentence.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
19185	72	35	72	39	I am not sure I understand what the purpose of this table is? Does having strong colors mean a model is better or more suitable? [Thorsten Mauritsen, Sweden]	Taken into account: the table has been removed. Our intention was to build a table similar to table 9.1 in AR5. More ESMs participate in CMIP6 than in CMIP5, but ESMs participating in both CMIP5 and CMIP6 have similar components for both MIPs, in most cases. Therefore, for CMIP6, we have not succeeded in translating the qualitative information about model complexity into a useful quantitative measure with associated colorscale. References documenting the models used in this assessment and all their components are available in annex III.
98659	72	35	73	7	While I realize this is a placeholder, the different intensities of the different colors will need to be distinguishable for this figure to have meaning. [Sonya Legg, United States of America]	Not applicable. Table 1.2 has been removed.
2935	72	35	73	7	The country of Table 1.2 should add country and region, because Taiwan is not a country. [Zong Ci Zhao, China]	Not applicable. Table 1.2 has been removed.
2937	72	35	73	7	Please add a reference for CIESM model, Lin et al., Community Integrated Earth System Model (CIESM): description and evaluation, Journal of Advances in Modeling Earth Systems, submitted. [Zong Ci Zhao, China]	Not applicable. Table 1.2 has been removed. References for the ESMs used in this report are found in Annex III.
38303	72	35	73	7	Taiwan is a province of China, not an independent country. The current statement is politically wrong. It is suggested to change the "country" in the title of Table 1.2 to "country or region", and change the "Taiwan" in the table to "Taiwan, province of China". [Yaming LIU, China]	Not applicable. Table 1.2 has been removed.
125377	72	38	72	38	In Table 1.2, it's unclear what "most intense colour" means because the table contains different colors, not different intensities. [Trigg Talley, United States of America]	Taken into account: the table has been removed. Our intention was to build a table similar to table 9.1 in AR5. More ESMs participate in CMIP6 than in CMIP5, but ESMs participating in both CMIP5 and CMIP6 have similar components for both MIPs, in most cases. Therefore, for CMIP6, we have not succeeded in translating the qualitative information about model complexity into a useful quantitative measure with associated colorscale. References documenting the models used in this assessment and all their components are available in annex III.
85983	73	0	73	0	Colours are quite a subjective ranking. Actual numbers should be included. [Debra Roberts and the Durban WGII TSU, South Africa]	Taken into account: the table has been removed. Our intention was to build a table similar to table 9.1 in AR5. More ESMs participate in CMIP6 than in CMIP5, but ESMs participating in both CMIP5 and CMIP6 have similar components for both MIPs, in most cases. Therefore, for CMIP6, we have not succeeded in translating the qualitative information about model complexity into a useful quantitative measure with associated colorscale. References documenting the models used in this assessment and all their components are available in annex III.

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23847	73	1	73	1	Table 1.2, it is surprising that Sweden did not contribute there, e.g., via SMHI's Rossby Centre. [Branko Grisogono, Croatia]	Not applicable. Table 1.2 has been removed. References for the ESMs used in this report are found in Annex III. SHMI participates in CMIP6 through the EC-Earth consortium.
100785	73	1	73	1	Table 1.2 – In column 1 EC-Earth should be EC-Earth-Consortium [Corti Susanna, Italy]	Not applicable. Table 1.2 has been removed. References for the ESMs used in this report are found in Annex III.
125381	73	1	73	1	In Table 1.2, it's unclear why there are no colors in the CMIP6 columns. [Trigg Talley, United States of America]	Taken into account: the table has been removed. Our intention was to build a table similar to table 9.1 in AR5. More ESMs participate in CMIP6 than in CMIP5, but ESMs participating in both CMIP5 and CMIP6 have similar components for both MIPs, in most cases. Therefore, for CMIP6, we have not succeeded in translating the qualitative information about model complexity into a useful quantitative measure with associated colorscale. References documenting the models used in this assessment and all their components are available in annex III.
113073	73	1	73	18	In the section 'Model grids and resolution' there is no mention of the land. It would be great not just to discuss the resolution of LSMs but to include it in Figure 1.17. [Diego Miralles, Belgium]	Noted. The land models are usually run at the same resolution as the atmosphere. This information is added in the figure caption.
125379	73	1	73	55	Table 1.2 should have been more than half complete for the Government Review. Its hard to review and comment on an incomplete "PLACEHOLDER". The table title does not indicate what the yellow, blue, and orange colors represent, but it appears that all is needed is for the colors to be picked up in the first line of the table (orange for aerosol, green for land carbon, etc.). And what does the gray shading represent? It appears to mean that that particular model was not available for CMIP5 or used in AR5. [Trigg Talley, United States of America]	Taken into account: the table has been removed. Our intention was to build a table similar to table 9.1 in AR5. More ESMs participate in CMIP6 than in CMIP5, but ESMs participating in both CMIP5 and CMIP6 have similar components for both MIPs, in most cases. Therefore, for CMIP6, we have not succeeded in translating the qualitative information about model complexity into a useful quantitative measure with associated colorscale. References documenting the models used in this assessment and all their components are available in annex III.
26595	73	18	73	18	We suggest to add at the end of the sentence "and better resolve the diurnal cycle (Bernie et al. 2008)". Ref Bernie D. J., E. Guilyardi, G. Madec, J. M. Slingo, S. W. Woolnough and J. Cole (2008). Impact of resolving the diurnal cycle in an ocean-atmosphere GCM. Part 2: A diurnally coupled CGCM. Clim. Dyn., 31, 909-925 [Eric Brun, France]	Accepted, reference added.
9093	73		73		Ideally the entries for CMIP6 models would be filled. [Olaf Morgenstern, New Zealand]	Not applicable. Table 1.2 has been removed.
45755	73				In Table 1.2, the CMIP5 version of EC-Earth can be denoted by "EC-Earth2". Please also note that there are several CMIP6 configurations of EC-Earth than one may want to include: EC-Earth3 (AOGCM version), EC-Earth3-Veg (version with dynamic vegetation), EC-Earth3-AerChem (version with interactive aerosols and atmospheric chemistry), EC-Earth3-CC (version with carbon cycle and ocean BGC), ... [Twan van Noije, Netherlands]	Not applicable. Table 1.2 has been removed. References for the ESMs used in this report are found in Annex III.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
24259	73				This table should summarize the models in the multi-model means in Ch. 3 and 4. I am not sure what we have here, especially when many modeling centers have several versions in CMIP6. [Bryan Weare, United States of America]	Not applicable. Table 1.2 has been removed. The models used for the figures in chapters 3 and 4 (and other chapters) are now listed in "end-of-chapter tables". References documenting the models are listed in Annex III.
19661	74	1	74	1	Should this intermediate title be left in italics or modified to bold? [philippe waldteufel, France]	Taken into account. All intermediate titles have been formatted in italics according to the technical guidelines.
28729	74	2			It could be beneficial to quote median horizontal and vertical resolutions of the CMIP6 models in the text [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The median resolutions are displayed in the figure and not repeated in the text.
19187	74	6	74	12	This paragraph mentions that higher resolutions leads to 'much better' circulations and leads to 'important improvements', though is unspecific as to what that means. Based on my personal experience from model development, the improvement one gets from going from say 200 to 50 km are surprisingly modest, and typically limited to certain phenomena. In some instances higher resolution models are less useful because they cannot be tested and tuned to the same extent, and also fewer experiments can be conducted. [Thorsten Mauritsen, Sweden]	Accepted. References have been added to document improvements, and a cautionary paragraph has been added at the end of this subsection in line with the assessment in chapter 3.
70643	74	6		24	This paragraph describes reported benefits of higher horizontal resolution without any critical assessment. This discussion should cite and ensure consistency with the evaluation of high resolution models in 3.8.2.2, which concluded 'Higher resolution improves aspects of the simulation of climate (particularly concerning sea surface temperature) but discrepancies remain and there are some regions where currently attainable resolution produces inferior performance (high confidence). Such model behaviour can indicate deficiencies in model physics that are not simply associated with resolution.' [Gillett Nathan, Canada]	Accepted. The discussion has been modified and references to chapter 3 added.
45757	74	8	74	8	Change "HighResMip" to "HighResMIP". [Twan van Noije, Netherlands]	Accepted.
16099	74	12	74	12	Mc Gregor (2015), Recent developments in variable-resolution global climate modelling. Clim. Change 129, 369–380. doi:10.1007/s10584-013-0866-5 - a relevant paper to cite here, instead or at least in addition to Giorgetta et al. 2018 which is only one example [Gerhard Krinner, France]	Accepted, reference added.
19189	74	12	74	12	The model described in Giorgetta et al. (2018) is not participating in CMIP6 to the extent that I am aware [Thorsten Mauritsen, Sweden]	Noted. New flexible grids are often used for regional applications; the ICON model participates in CORDEX, which justifies the reference here.
52219	74	17			Is it worth noting that there are ocean models with different vertical grids such as MOM6? [Helene Hewitt, United Kingdom (of Great Britain and Northern Ireland)]	Noted. However we do not mention this for the sake of space, considering that different ocean vertical grids are not highlighted in the other chapters.
125383	74	19	74	19	The reader is left yearning for a description of two things here: (1) how we can trust model projections / how is model skill assessed; and (2) downscaling techniques. [Trigg Talley, United States of America]	Noted. Model evaluation is addressed in section 1.5.4 and also in the other chapters. Downscaling is briefly mentioned in 1.5.3.3 and presented in chapter 10.
38655	74	23	74	23	Fig 1.17 - The content of the figure is not very clear. Add some other reading elements (for example the different green or blue colour to what you laugh at). [Luisa Sturiale, Italy]	Accepted. The figure has been redrawn.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
36825	74	31	74	45	Please state clearly whether models incorporate the transfer of heat by ocean currents and by large-scale oscillations and whether correct temporal delays are included. [John McLean, Australia]	Rejected. The scope of this section is to present new developments since AR5. Atmosphere-ocean coupled models (which, by definition, include an active ocean and represent oceanic heat transports) have been developed since 1975 (see section 1.3.4). Thus they are not a new development since AR5. We agree that it is important to assess the capacity of models to represent modes of variability: this is done in chapter 3, section 1.3.7.
114279	74	31	75	9	I hope this is coordinated across the chapters that use models for various purposes. [Jan Fuglestedt, Norway]	Taken into account. Consistency with other chapters has been checked, and more references to these chapters added.
45759	74	31	75	9	The developments mentioned in this section are not representative for the current generation of ESMs. Some of the developments mentioned are specific to a small subset of the models, and developments in the description of chemical processes are not hardly covered. [Twan van Noije, Netherlands]	Taken into account. The text has been improved. We have strived to document the developments that are the most relevant for the other chapters of this report, but an exhaustive review cannot be provided due to limited space.
113075	74	31	75	10	The section 'Representation of physical and chemical processes in ESMs' ignores land again. [Diego Miralles, Belgium]	Noted. Regarding land models, the most important new developments are found in the treatment of vegetation, and are thus included in the biosphere paragraph.
9097	74	32	74	32	I would argue that not all of the processes listed here are "parameterized". I understand a "parameterization" to be a replacement of a physical law with a non-physical alternative (e.g. based on statistics) because the physical process cannot be represented (e.g. in the case of convection occurs on too small a scale). Radiation and in many cases chemistry are not "parameterized" but rather represented explicitly. Suggest to replace "parameterization" with "representation". [Olaf Morgenstern, New Zealand]	Accepted.
69789	74	39	74	40	"...leading to improved understanding of the climate influence of aerosols and short-lived climate forcers,". Aerosols are included in short lived climate forcer definition. Please also see comment regarding the usage of term SLCF and short lived climate forcer versus aerosol in Chapter 1. [Bhupesh Adhikary, Nepal]	Accepted. "aerosols" removed.
19191	74	43	74	45	It seems awkward to highlight a single cloud parameterisation (CLUBB) as the advance made to representing clouds in CMIP6 models. If the authors wish to discuss something overarching, perhaps a better topic to discuss is the increased focus on mixed-phase clouds. This is an example where several studies have identified biases wrt observations, and some modelling centers have taken action to address this. [Thorsten Mauritsen, Sweden]	Accepted.
70645	74	49		53	The inability of CMIP5 models to reproduce the slightly increasing trend in Antarctic sea ice extent has not generally been corrected in CMIP6 as is indicated here. Refer to and cite Section 3.4.1.2 and Figure 3.19. [Gillett Nathan, Canada]	Accepted. Removed the statement on Antarctic sea ice.
45761	74	52	74	52	Change "increasing trend" to "positive trend". [Twan van Noije, Netherlands]	Not applicable. The text on Antarctic sea ice has been removed from the sentence.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
101487	75	2	75	2	I would say that DeConto and Pollard (2016) is too controversial, and MICI has too little evidence for / about it, for this paper to be cited under "improved understanding of processes". The other three papers also seem a bit specific/arbitrary in choice - better to cite review papers or more widely agreed key advances. We are also relatively low key about elevation feedback in Ch 9 (~5% by 2100) - more important for palaeo of course - I would say coupled ice-ocean models for Antarctica were more crucial in the sense of changing understanding (relative to simple basal melt parameterisations). [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. This paragraph has been revised. The references have been replaced by Hanna et al. (2020).
70647	75	2		4	Which CMIP6 models have interactive ice sheets? Could consider adding this information to Table 1.2. [Gillett Nathan, Canada]	Not applicable: table 1.2 has been removed. The information about interactive ice sheets is available in Annex III.
45763	75	4	75	4	Start new paragraph with "Another notable ...". [Twan van Noije, Netherlands]	Accepted.
73959	75	4	75	9	After reading this sentence, the question arises: what happens with the modelling results, if this stochastic approach would be fully implemented? [Elena Kozlovskaya, Finland]	Noted. We mention that the approach reduces systematic biases and a reference to climate sensitivity (Strommen et al, 2019) has been added.
100787	75	9	75	9	The citation Sanchez et al. 2016 should be added (Sanchez, C., Williams, K. D., and Collins, M. (2016). Improved stochastic physics schemes for global weather and climate models. Q. J. R. Meteorol. Soc. 142, 147–159. doi:10.1002/qj.2640.), they showed that Stochastic Physics can correct long standing biases in climate models. Moreover, more recently Strømme et al. 2019 and Meccia et al. 2020 showed that the inclusion of stochastic physics impacts somehow on the model response to global warming (decreasing and increasing the response depending on the rate of warming. (Strommen, K., Watson, P. A. G., and Palmer, T. N. (2019). The Impact of a Stochastic Parameterization Scheme on Climate Sensitivity in EC-Earth. J. Geophys. Res. Atmos. n/a. doi:10.1029/2019JD030732 ^{11 SEP} ; Meccia, V. L., Fabiano, F., Davini P., & Corti S. 2020. Stochastic parameterizations and the climate response to external forcing: An experiment with EC-Earth. Geophysical Research Letters, 47, e2019GL085951. https://doi.org/10.1029/2019GL085951) [Corti Susanna, Italy]	Accepted. Thanks for the suggestions, two of the references have been added.
42081	75	11	75	21	what about first steps to better represent wetlands, permafrost and the like (e.g. Hurk et al., 2016; Burke et al., in review)? van den Hurk, B., Kim, H., Krinner, G., Seneviratne, S. I., Derksen, C., Oki, T., Douville, H., Colin, J., Ducharne, A., Cheruy, F., Viovy, N., Puma, M. J., Wada, Y., Li, W., Jia, B., Alessandri, A., Lawrence, D. M., Weedon, G. P., Ellis, R., Hagemann, S., Mao, J., Flanner, M. G., Zampieri, M., Matera, S., Law, R. M., and Sheffield, J.: LS3MIP (v1.0) contribution to CMIP6: the Land Surface, Snow and Soil moisture Model Intercomparison Project – aims, setup and expected outcome, Geosci. Model Dev., 9, 2809–2832, https://doi.org/10.5194/gmd-9-2809-2016, 2016. Burke, E. J., Zhang, Y., and Krinner, G.: Evaluating permafrost physics in the CMIP6 models and their sensitivity to climate change, The Cryosphere Discuss., https://doi.org/10.5194/tc-2019-309, in review, 2020. [Julia Nabel, Germany]	Taken into account. The reference to Burke et al (2020) has been added.
114281	75	11	75	21	I hope this is coordinated with ch5 [Jan Fuglestedt, Norway]	Taken into account. Consistency with chapter 5 has been verified. A reference to section 5.4 and a reference to Arora et al, 2020: doi.org/10.5194/bg-17-4173-2020 have been added.
16101	75	11	75	21	Permafrost carbon might be mentioned here [Gerhard Krinner, France]	Accepted.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
70809	75	12	75	13	One could add here that still many processes of land management are not ((like wetland drainage, land-use-induced erosion, fire as management-tool) and most only partially (e.g. grazing in forests, irrigation) integrated [for the Eluc flux calculation; Le Quéré et al., 2018 https://doi.org/10.5194/essd-10-2141-2018] which might indtroduce a bias - we discussed this in e.g. Pongratz et al., 2018 10.1111/gcb.13988 and Erb et al., 2016 10.1111/gcb.13443) [Karlheinz Erb, Austria]	Taken into account. A sentence has been added: "although the integration of many processes (e.g., wetland drainage, fire as management-tool) remains a challenge (Pongratz et al 2017)"
80997	75	13	75	16	The impact of soil nitrogen availability on carbon sequestration needs more elaboration. How does soil N status limit C sequestration? Is it a positive or negative relationship? At least provide a sub-section reference where the reader can understand more fully. [Jeffrey Philip OBBARD, Singapore]	Accepted. A reference to section 5.4 in chapter 5 has been added.
70135	75	24	76	26	Would it be possible to add a table showing which aspects of tuning have been focused on in the ESMs assessed in the AR6? For instance some models have been developed with a focus on getting global warming/ECS right. [Sonia Seneviratne, Switzerland]	Noted. Chapter 2 documents the models that are tuned to the warming during the historical period. For ECS, tables are found in the references cited here.
70137	75	24	76	26	It could be useful to mention here that models performing well in the representation of global warming are not the same as those performing well in capturing regional climate sensitivity (Beusch et al., in press, GRL: https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2019GL086812 ; see Fig. 2 of this paper). This might reflect different strategies that have been applied in model tuning in the modeling groups. [Sonia Seneviratne, Switzerland]	Thanks for pointing out this interesting paper. However There is not obvious link between the performance reported in this paper and the tuning strategies. Out of the 6 model families with good performance for historical trends, only 2 models have been tuned for the historical period.
28733	75	24			Implicit tuning is not discussed. For example, if modelling groups encountering very high or low climate sensitivity they may be more likely to look again at their model which might not happen if the climate sensitivity appears less of an outlier. This is also true for comparison with the observational temperature record. [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. Given the definition given here, tuning becomes implicit if it is not documented. In the example provided ("out of range ECS"), the process to "look again at the model" is called tuning and will lead to adjustments of the model. We believe the text should not be changed. It is the culture of documenting tuning that requires change !
114283	75	26	75	35	I miss a couple of point here, which the authors may see a obvious and given, but still: When models are developed, I think the scale, framing and focus are also issues taht are considered. Maybe worth mentioning? [Jan Fuglestedt, Norway]	Noted. Section 1.5.3.2 is about the tuning of coupled model parameters. A general discussion about scale, framing and focus of all modelling choices would require much more space.
24261	75	26	75	35	This paragaph is a gramatical nightmare, randomly combining colons, sem-colons and periods. [Bryan Weare, United States of America]	Accepted. The paragraph has been removed.
45765	75	26	75	35	These sentences read like a general introduction to climate models. Is this the right place for such an introduction? [Twan van Noije, Netherlands]	Accepted. The paragraph has been removed.
36821	75	43	75	54	Thank you for explicitly stating that models are tuned to historical climate patterns. This undermines what was implied earlier in this chapter. [John McLean, Australia]	Noted. No revision seems requested here.
40083	75	46	75	46	Differs from the glossary definition for fitness for purpose, which is "The suitability of a model (or other resource, such as a dataset or method) for a particular task, such as quantifying the contribution of increased greenhouse gas concentrations to recent changes in global mean surface temperature or projecting changes in drought frequency in a region under a given scenario. Assessment of a model's fitness-for-purpose can be informed both by how the model represents relevant physical processes and by how it scores on relevant performance metrics." [TSU WGI, France]	Accepted. The notion of "fit for purpose" is no longer mentioned in this sentence.
36823	75	50	75	50	The energy received from the sun is not 340W/m^2. This figure is an average used in the two-dimensional energy budget diagrams. [John McLean, Australia]	Accepted. No number is needed in this sentence.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
19193	75	50	75	54	The question seems irrelevant here. It is the state of affairs that modelling centers decide how they wish to tune their models based on their needs, and it is not something that the broader community needs to decide on. The only thing one can require is that modelling centers openly document their decisions in this regard. You may also find my recent paper interesting (Mauritsen and Roeckner, 2020 JAMES). [Thorsten Mauritsen, Sweden]	Accepted. The sentence has been modified and "matter of debate in the climate science community" has been replaced by "open question". Thanks for the relevant reference which has been added.
85985	76	0	76	0	Figure 1.18: are there no modelling groups in Africa? [Debra Roberts and the Durban WGII TSU, South Africa]	Noted. No model dataset contributing to CMIP6 has been submitted by a climate centre in Africa.
31483	76	1	76	4	Each modelling group has its own strategy and, after the AR5, a survey was conducted to understand the tuning approach used in 23 CMIP5 modelling centres. The results are discussed in Hourdin et al. (2017) which stresses that the behaviour of ESMs depends on the tuning strategy. An important recommendation is that the calibration steps that lead to particular model tuning should be carefully documented [...] and based on common well-defined protocols and procedures. These have to be objective, transparent, traceable and easy to apply (Tapiador et al., 2017). Comment: Climate models should be considered within quality control (QC) standards. Model documentation is the first step but the public and the decision makers demand that the science behind policies is traceable, transparent and fully auditable. Tapiador et al. (2017) proposes three tiers for Quality Assessments (QA) of climate models (page 15). Reference: Tapiador, F.J., Navarro, A., Levizzani, V., García-Ortega, E., Huffman, G.J., Kidd, C., Kucera, P.A., Kummerow, C.D., Masunaga, H., Petersen, W.A., Roca, R., Sánchez, J.-L., Tao, W.-K., Turk, F.J., 2017. Global precipitation measurements for validating climate models. Atmospheric Research 197, 1–20. https://doi.org/10.1016/j.atmosres.2017.06.021 [Andrés Navarro, Spain]	Noted. The publication by Tapiador et al is focussed on model validation using observed precipitation datasets, not on model tuning "per se". Thus, we have not added this reference in our subsection about model tuning.
24263	76	1	76	26	This section does not give a proper feel for the vast number of degrees of freedom in climate models. It strongly suggests that a few numbers can be twiddled to get a realistic climate. It does not acknowledge that much of the tuning has largely been done and verified in daily forecast models. Overall, this section does a total disservice to modelers. [Bryan Weare, United States of America]	Noted. The sentence "An initial set of such choices is usually made by (often extensive) groups of modellers working on individual components of the earth system ..." acknowledges the work of the teams carrying out atmospheric forecasts. This section focusses on the final tuning of the coupled system.
875	76	6	#REF!	#REF!	separate URL from word "and" [Bart van den Hurk, Netherlands]	Done.
29735	76	6	76	6	Orphan parenthesis. [Hernan Edgardo Sala, Argentina]	Accepted. Parenthesis added.
4783	76	6	76	6	separate URL from word "and" [Bart van den Hurk, Netherlands]	Done.
37831	76	6	76	6	delete parenthesis [Junhee Lee, Republic of Korea]	Taken into account. A parenthesis has been added to match the orphan one.
28731	76	6			Missing "(" [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Parenthesis added.
70649	76	8		10	Near-surface air temperature is not mentioned as a tuning target here. Climatological GSAT was certainly a key tuning target in CCCma. [Gillett Nathan, Canada]	Accepted. "ocean temperature" replaced by "air and ocean temperature" in the list of tuning targets.
45767	76	13	76	13	Is there a particular reason to explicitly mention DMS parameterization here? Some other natural sources of aerosols or precursor gases (e.g. BVOCs, fire emissions, sea spray, mineral dust) are also poorly constrained. [Twan van Noije, Netherlands]	All the parameterizations mentioned here are highlighted in papers documenting the tuning of CMIP6 models. DMS is discussed in Sellar et al, JAMES, 2019, for the MOHC UKESM model.
19195	76	13	76	13	I would not consider ocean albedo as a poorly constrained parameter. Some modelling centers adjust it to compensate for a lack of clouds. [Thorsten Mauritsen, Sweden]	Accepted. "uncertain and poorly constrained processes" replaced by "uncertain or poorly constrained processes"
37833	76	16	16	16	delete colon [Junhee Lee, Republic of Korea]	Accepted. Editorial.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
36827	76	16	76	19	Clarification needed. Explain what these "targets" are. Are these factors that are still to be incorporated in models or are they new current features in models? And why are they regional? Are they already incorporated into global models or not? [John McLean, Australia]	Noted. the notion of "tuning targets" is explained earlier in the text. More information can be found in the individual publications of each modelling group referenced in this section and also in Annex III.
36829	76	23	76	24	Why are models tuned to an "equilibrated pre-industrial balance" when there is no credible substantial volume of data back then and the notion that the climate is ever balanced is risible? Please explain. [John McLean, Australia]	Noted. Preindustrial control runs are useful to ensure the consistency of the representation of physical processes in models, and the correct balance of these processes. For this reason, preindustrial control experiments are included in the "DECK3, the core of CMIP6 (Eyring et al, 2016, geoscientific model development; see also section 1.5.4.2).
19197	76	24	76	25	I don't think that the question as to whether or not a model is tuned to historical warming deserves a yes/no answer. Models are developed over several generations, and it is conceivable that a modeling center will take actions (e.g. introduce aerosol indirect effects) that improve the match to the historical warming record. Is such changes an act of tuning or development? There is a broad gray-zone and I think it would be useful to acknowledge this here rather than being categorical. [Thorsten Mauritsen, Sweden]	Accepted. Our information comes from declarations by the modelling groups, which may have different interpretations for "tuning". This is now made clear in the sentence "The majority of CMIP6 modelling groups report that they do not tune ..."
10391	76	24	76	26	Would it be better to say "The majority of CMIP6 modelling groups do not report that they tune their model...". I am not aware of an independent way of assessing if tuning has taken place or not. [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Thanks for this suggestion.
19199	76	25	76	25	The table referred to does not contain the stated information on CMIP6 models [Thorsten Mauritsen, Sweden]	Accepted. Reference to the table has been removed.
125385	76	27	76	27	[ENSEMBLES] Insert a section on the skill of CMIP6 models (i.e., hindcast results, etc.): "These results give us confidence in the projections from these models because..." A reference to Section 1.5.4 could suffice, but it would be really valuable to have a very explicit conversation about why climate model projections can/should be trusted (with uncertainties, etc.). [Trigg Talley, United States of America]	Noted. Model performance assessment is discussed in section 1.5.4. The subsection "fitness for purpose" has been moved to 1.5.4.1. in order to make this point clearer.
36831	76	31	76	31	State why the need is supposedly increasing [John McLean, Australia]	Noted. The need for regional information is explained in chapter 10, E.G. the first executive summary of the SOD: "The AR5, SR1.5, SROCC and SRCL reports underlined the urgent need for regional climate information that is useful and relevant to the decision scale.". A reference to chapter 10 is added.
73961	76	31	76	35	As soon as regional models are so important, high costs are not the reason to substitute regional-scale modelling by downscaling of global models. Factors important at regional scales may be considered as noise or ignored at global scale. [Elena Kozlovskaya, Finland]	Noted. The point in this sentence is that limited computer resources are the reason why only a handful of scenarios are run with HighResMIP models. "cost" has been replaced by "large computational resources required". The rationale for RCM is presented in more detail in chapter 10.
9095	76	32	76	32	"HighResMIP" -- correct capitalization. [Olaf Morgenstern, New Zealand]	Accepted.
21367	76	33	76	33	Suggest to clarify what you mean by high cost. Presumably its not the monetary cost but the high computational cost? [Peter Thorne, Ireland]	Accepted. cost replaced by "large computational resources required by these models".
45769	76	36	76	36	Please rephrase "RCMs are based on global models run over a limited region". [Twan van Noije, Netherlands]	Accepted. Sentence rephrased "RCMs are dynamical models similar to GCMs that are run over a limited region"

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
36833	76	36	76	38	Why is an "acceptable cost" such an issue? Is this intended as a hint for more funding or just a clumsy way of saying that the limiting of the region means that the resolution can be increased without the data exceeding the available computing resources? [John McLean, Australia]	Accepted. "at an acceptable cost" removed from the sentence.
111951	76	36			RCMs are based on global models run over a limited region - this is not nice formulation - global model can hardly be run over a limited region [Tomas Halenka, Czech Republic]	Accepted. Sentence rephrased "RCMs are dynamical models similar to GCMs that are run over a limited region"
125387	76	39	76	39	Need to describe the differences in statistical and dynamical downscaling here. [Trigg Talley, United States of America]	Noted. A sentence and a reference to Maraun and Widman, 2018, doi 10.1017/9781107588783 have been added to mention statistical downscaling. More detailed information is found in chapter 10.
125389	76	41	76	42	The number cited in this sentence is not the same as the number of rows in Table 1.2 (where there are 32 models listed). How do you reconcile? [Trigg Talley, United States of America]	Noted. Table 1.2 was incomplete, and it is removed in the final version.
125391	76	46	76	46	Insert a section on downscaling techniques: statistical vs dynamical processes; pros and cons; applications; etc. [Trigg Talley, United States of America]	Noted. A sentence and a reference to Maraun and Widman, 2018, doi 10.1017/9781107588783 have been added to mention statistical downscaling. A section cannot be inserted due to constraints of space. More detailed information is found in chapter 10.
107833	76	48	76	53	For North America CORDEX additional centers include: University of Arizona, Ouranos, Quebec, Canada, University of Quebec at Montreal, Iowa State, UK Met Office, Swedish Meteorological and Hydrologic Institute, Danish Meteorological Institute, Helmholtz-Zentrum Geesthacht, National Center for Atmospheric Research. NCAR should be considered the major center in that data from all models have been collected and curated there. [Linda Mearns, United States of America]	Noted. An updated list of CORDEX centres is provided for the FGD by the CORDEX teams.
125393	77	1	79	1	Too much detail here about ESM complexity. Leave it to the later chapters. Table 1.3 should be deleted completely. All of this complex material about emulators, ranging statistical approaches, simple impulse response functions, and multimodel comparisons appear in subsequent chapters (e.g., 4 and 9) where it is needed. It is not needed here. [Trigg Talley, United States of America]	Taken into account. Table 1.3 has been deleted, the surrounding text has been focused on the emulators/SCMs in most prominent use in AR6.
36835	77	3	73	30	State clearly whether these models have been validated. [John McLean, Australia]	Taken into account. We now state that the model evaluation of EMICs is being done in the specific context that these models are being applied. But it is difficult to say much more about model evaluation given space limitations, heterogeneity of EMICs used in the assessment and lack of a coordinated EMICs effort. We refer the reviewer to the cited original literature for more details [NOTE: comment refers to page 77. not 73]
45771	77	4	77	5	AOGCMs and ESMs have already been introduced. [Twan van Noije, Netherlands]	Accepted. Abbreviations used.
40015	77	5	77	7	Check consistency with the glossary definition for 'EMIC' [TSU WGI, France]	Noted. Definitions are consistent. Glossary has a short definition only: "Earth system model of intermediate complexity (EMIC) represent climate processes at a lower resolution or in a simpler, more idealised fashion than an Earth system model (ESM)."

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
64825	77	8	78	1	I believe the "statistical approaches" section of this table should be improved. Currently the emulators are named after the statistical methods which are applied in the studies at hand. In my opinion, this should be changed since neural networks and random forests have no intrinsic association with their applications. They are merely mathematical tools used to approximate a relationship between input and output data (just like a linear regression). Additionally, the assembly of statistical emulators listed here seems rather random. A more comprehensive list of statistical emulators split e.g. by their application area could be included. For ideas of application areas and references which could be included in such a list please see my other comment on this chapter. [Lea Beusch, Switzerland]	Not applicable. Table 1.3 has been deleted.
12421	77	13	77	13	For people who is not working on emulators but eager to learn, the description in this table is not very understandable, too many jargons. It will help a lot to describe the basic ideas of these models, and strengths/limitations of them. [Lijing Cheng, China]	Not applicable. Table 1.3 has been deleted.
70651	77	20			Should 'used' be replaced with 'assessed'? [Gillett Nathan, Canada]	Accepted
29737	77	25	77	25	"MIPs" has not been defined previously (it is defined just in page 82). [Hernan Edgardo Sala, Argentina]	Rejected. Abbreviation used and defined earlier in Ch1, Section 1.2.3.2 and 1.3.4
52145	77	25			Please change "modelling" to "modeling" [Mohammad Rahimi, United States of America]	Accepted.
8621	77	27	77	30	systematically different in what manner? This is too vague a statement to be useful. [Robert Kopp, United States of America]	Taken into account. Text revised and made more specific, accounting for latest results. "Frölicher and Paynter (2015), for example, showed that the EMICs have a higher simulated realized warming fraction (i.e. the TCR/ECS ratio) than CMIP5 ESMs and speculated that this may bias the temperature response to zero carbon emissions. But in a recent comprehensive multi-model analysis of the zero emissions commitment from CO2, MacDougall et al. (2020) did not find any significant differences in committed temperatures 90 years after halting emissions between EMICs and ESMs. The ensemble of reduced complexity models, however, when neglecting one model that showed an exceptionally strong decrease in temperature, tend to show a narrower range of committed temperatures in response to zero emissions.
661	77	32	78	3	This paragraph on emulators could definitely do with some references to papers that have used this approach. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Added a reference to emulators being used to estimate the impact of COVID-19. (There are too many examples to be complete, so going with just one; the text is already long.)

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
64823	77	32	80	10	I think the definition and description of emulators here should be broadened a bit by expanding the section on statistical emulators. While it is true that a main application of emulators is to expand insights from ESMs across different emission scenarios, many other important applications of emulators in climate science exist as well and I think they would deserve to be mentioned too. Many (statistical) emulators have been developed in recent years for e.g., sub-grid-scale parameterizations (e.g., Rougier et al 2009, Williamson et al 2013), the full dynamics of simple general circulation models (Scher 2018, Scher and Messori 2019), and grid-point-level and regional-scale internal climate variability (e.g., Castruccio and Genton, 2016, Alexeeff et al 2018, Link et al 2019, Beusch et al 2020). The full references of the papers listed here as well as additional references on this topic can be found in Beusch et al 2020 (https://doi.org/10.5194/esd-11-139-2020) where we provide an overview on climate model emulation in general as part of our literature review with a specific focus on emulation of ESM initial-condition ensembles. A nice short discussion on the potential of statistical emulators is additionally provided by Deser et al 2020 (https://doi.org/10.1038/s41558-020-0731-2). [Lea Beusch, Switzerland]	Rejected. We appreciate the very helpful input, but due to space constraints we need to condense the treatment of emulators and SCMs to those in broad use across the report. The material here is better suited for a review paper (as indeed is partially done already in Beusch et al. 2020).
70653	77	33			Insert 'GSAT' before 'responses'? Emulators do not reproduce the full response of the climate system as simulated by an ESM, only a small subset of indicators. [Gillett Nathan, Canada]	Taken into account, in the parenthesis following the relevant phrase.
44365	77	36	77	37	In this sentence it is referred to "climate impacts", in CC-Box 1.4 it is written "Climate impacts on an ecological or social system result from the interactions of a climatic impact driver with vulnerability and exposure of the system." What is meant by climate impact here in section 1.5.3.4? It seems that the term "climate impact" is not used consistently (following definition in CC-Box 1.3) throughout Chapter 1. [Jana Sillmann, Norway]	Accepted. Text revised to refer to changes to the physical climate system.
114285	77	43	77	43	It would be good if you could make the difference between emulator and SCM can be more clear. [Jan Fuglestad, Norway]	Accepted. Clarification attempted.
70139	78	6	79	1	Table 1.3: A new approach for the emulation of the ESM initial-conditions ensembles including regional signals (but conditioned on Tglob trajectories) has been implemented in the "MESMER" emulator. It combines physical relationships (regional climate sensitivity of mean temperature at each grid point, approximated from a linear regression) with stochastic noise generation for the interannual variability, and a representation of spatial autocorrelation features. See Beusch et al. 2020, ESD: https://www.earth-syst-dynam.net/11/139/2020/ . Could be listed as a separate category as "Regional climate response emulator combining physical and statistical features". [Sonia Seneviratne, Switzerland]	Taken into account, reference added in revision (though the text is also substantially changed.)
98661	78	8	78	8	Insert "from" after "ranging" [Sonya Legg, United States of America]	Not applicable. Table 1.3 has been deleted.
41379	78	8			Table 1.3: Please improve the presentation of the individual models in the second column and separate the individual entries more clearly. [Alexander Nauels, Germany]	Not applicable. Table 1.3 has been deleted.
37835	78	13	78	13	In Table 1.3, "Rohrschneider et al., 2019)": delete parenthesis [Junhee Lee, Republic of Korea]	Not applicable. Table 1.3 has been deleted.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
44291	78	13	79	1	It is not adequate to label GIR/FaIRv1.0 as an impulse response model, implying they are incapable of modelling the climate system, but then labelling FaIRv1.3 as a full SCM. Both of these models have the same underlying structure in their most important characteristic (CO2). An emulator which models the carbon cycle in a simple way but captures the fundamental physical properties is as valid as the process-based models highlighted in the second part of table 1.3. The wording of the table seems biased towards the MAGICC/FaIRv1.3 models. Further, GIR (to be renamed FaIRv2.0) is identical in its coverage and completeness to the FaIRv1.3 or MAGICC models. [Stuart Jenkins, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. Table 1.3 has been deleted.
115737	78		78		Table 1.3 needs to be coordinated with chapter 7 x chapter box on emulators. It could be relevant to stress the approach used in AR5; SR15; here AR6 and differences. [Valerie Masson-Delmotte, France]	Accepted. Table 1.3 has been deleted, and the text clarified according to the intent of this comment.
70655	78		79		Table 1.3. Indicate which type of simple model is used to make projections of warming in Chapter 4. [Gillett Nathan, Canada]	Accepted. Table 1.3 has been deleted, and the text clarified according to the intent of this comment.
8623	79	1	79	1	FFaIR is a modified impulse response model, and indeed FaIR 1.0 appears in the prior row. Why does FaIR also appear in the second row? [Robert Kopp, United States of America]	Not applicable. Table 1.3 has been deleted.
112567	79	13	79	13	In the table, note that the Held two-layer model is functionally identical to the two-time-constant model used in AR5, as shown by Geoffroy et al, 2013, and the ECS and TCR are simple functions of the AR5 model parameters. We are where we are, but this seems to be change for the sake of change. [Myles Allen, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. Table 1.3 has been deleted.
12423	79	23	79	27	Please explain exactly how GWP and GTP are calculated, these are quite important metrics, so a bit details and make it understandable to broad audience will help. THANKS [Lijing Cheng, China]	Rejected. This is done (to some extent) in Chapter 7. We give better references to that treatment now, however.
13167	80	9	80	9	RCMIP must be expanded acronym has not been used [Maria Amparo Martinez Arroyo, Mexico]	Accepted. Done.
19663	80	13	80	13	Naming emission metrics a climate model can only be understood as a joke. Please imagine, though, how climate sceptics might use it: "stop giving all this money to climate scientists to let them enjoy enormous, useless numerical simulations".... [philippe waldteufel, France]	Noted. This section has been revised, and changed to a short Box. Its main purpose is to introduce the concept of metrics, link to the fuller discussion in Section 7.6, and summarize other usages within AR6 WG1.
66591	80	13	80	21	I don't think this section works very well at all. Emissions metrics are not obviously climate models, especially since the most commonly used emissions metric, GWP100, does not contain a model of the climate system. (If it did, it would not have been anywhere near as controversial.) It does not contain a model of the climate system because it contains the steps from emissions to radiative forcing, but not from forcing to climate response, which is the bit that climate models actually do. The existing text masks this by talking about "building blocks" but not preserving the sense of which steps are part of which systems (lines 17-21). The text is too ambiguous and I don't really think it's a chapter 1 job to do this, because chapter 1 does not go into a similar level of detail of other aspects of climate research. [Dave Frame, New Zealand]	Noted. This section has been revised, and changed to a short Box. Its main purpose is to introduce the concept of metrics, link to the fuller discussion in Section 7.6, and summarize other usages within AR6 WG1.
125395	80	13	80	45	The jargonistic heading "The simplest of all climate models: Emission metrics" and related text in Section 1.5.3.5 seems technically misleading if not inaccurate. Emission metrics alone are not "climate models". Emissions can be measured and modeled as a distance function but they do represent the "climate". They may be used as an indicator, a forcing, or a model variable but, by themselves, they remain simply "emissions". [Trigg Talley, United States of America]	Noted. This section has been revised, and changed to a short Box. Its main purpose is to introduce the concept of metrics, link to the fuller discussion in Section 7.6, and summarize other usages within AR6 WG1.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
112561	80	15	80	21	It is debateable whether emission metrics that get the sign of the warming wrong when emissions are falling should be called climate models at all, but if they are so called, this problem needs to be noted. After line 21 add "Note that, under conditions when methane emissions or other short-lived climate forcers are falling, conventional metrics such as GWP and GTP indicate a contribution to future climate change of the wrong sign." You could cite any number of papers for this point, starting with Wigley (1998) and ending with Lynch et al (2020). [Myles Allen, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Thanks. We refer to the fuller discussion in 7.6 for this particular point.
112563	80	15	80	21	An even simpler climate model is $\Delta T = TCRE \times [E + \Delta F / \alpha]$, where ΔT is the warming over any multi-decade period, E is total emissions of CO2 over that period, ΔF is the change in non-CO2 radiative forcing over that period and α is the normalised AGWP of CO2, or change in RF that results from a steady CO2 emission (AGWP_H/H) also over that period (see Cain et al, 2019, but note that this follows from the definitions of AGWP and TCRE, so it does not depend on any particular paper). This explains human-induced warming to date as well as future warming under a range of ambitious mitigation scenarios at a precision well within the uncertainty due to internal climate variability (Jenkins et al, 2020). It would be really helpful to policymakers to provide this formula and explain it, since lots of other things follow from it and not a lot of people understand that predicting climate change is so astonishingly simple, and based on constants that are already very familiar (TCRE since AR5, and AGWP since AR1). If you want to get a bit more detailed, you could note that α is not exactly constant but declines slightly with longer time-horizons (figure 8.29 in AR5), which is why we need a gently declining non-CO2 RF plus net zero CO2 emissions to halt global warming, as noted in SR1.5. [Myles Allen, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The phrasing of 'simplest of all climate models' has been removed.
114949	80	15	80	44	While this is only a summary of the discussion in 7.6, the near term metrics like GWP20 or GTP20 are not even mentioned. I believe there will be specific comments about this towards Chapter 7, the summary here should, in my view, mention the short term metrics which have been consistently discussed and evaluated in previous ARs along with the justification (if approved) to remove them from the AR6. Some might perceive this is an important change and a message that shall be well documented and highlighted. [Zbigniew Klimont, Austria]	Taken into account; this point is mentioned in the revision.
8625	80	15	80	44	It is really weird to call these summary metrics 'models' -- metrics must be calculated using a model (e.g., AR5-IR for AR5's metrics). I suppose they are models, or at least elements of models, in the sense of 'mental models' -- but this section just reads really oddly. [Robert Kopp, United States of America]	Noted. This section has been revised, and changed to a short Box. Its main purpose is to introduce the concept of metrics, link to the fuller discussion in Section 7.6, and summarize other usages within AR6 WG1.
114289	80	18	80	19	I suggest saying "non-CO2 component" instead of methane. More general. [Jan Fuglestedt, Norway]	Taken into account.
114291	80	21	80	21	"their" may be understood as pointing to the individual gases, but since you write "sum" it should point to the aggregated impact. [Jan Fuglestedt, Norway]	Rejected. Difficult to rephrase, it should be clear as-is.
66593	80	23	80	39	If it is to be retained, this text could be rewritten to explain at the outset that GWP and GTP are pulse emissions - they compare pulses of emissions with no context from the time-series of emissions that are occurring either before or after the emissions being compared, while CGTP and GWP* have been designed to place the comparison in the context of the surrounding years' emissions. A pulse emissions metric will do (in general) a lousy job of differentiating between stock pollution and flow pollution. [Dave Frame, New Zealand]	Taken into account.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
14899	80	23		26	I strongly believe the report should note the growing use of GWP20 (not just GWP100) in the literature, and by governments. For instance, new legislation enacted in 2018 in New York State mandates the use of only GWP20. See Fesenfeld et al. 2018 Nature Climate Change 8: 933-936; Ocko et al. 2017 Science 356: 492-493; Howarth 2014 Energy Science & Engineering 2: 47-60; and Howarth et al. 2011 Climatic Change Letters 106: 679-690. FURTHER, please note that IPCC AR5 said "It has usually been integrated over 20, 100 or 500 years consistent with Houghton et al. (1990). Note, however that Houghton et al. presented these time horizons as 'candidates for discussion [that] should not be considered as having any special significance'. The GWP for a time horizon of 100 years was later adopted as a metric to implement the multi-gas approach embedded in the United Nations Framework Convention on Climate Change (UNFCCC) and made operational in the 1997 Kyoto Protocol. The choice of time horizon has a strong effect on the GWP values — and thus also on the calculated contributions of CO2 equivalent emissions by component, sector or nation. There is no scientific argument for selecting 100 years compared with other choices (Fuglestedt et al., 2003; Shine, 2009)." For the AR6 report to ignore this and simply go back to AR4 logic is beyond disappointing. [Robert Howarth, United States of America]	Rejected. There is widespread use of a range of metrics in the literature, and we have opted not to give special consideration to any one choice (or list of choices). The role of GWP100 in the "Paris Rulebook" is covered in the glossary definition of "net zero GHG emissions", but apart from that we do not consider it the role of WG1 to comment further on metric usage. See also Chapter 7.
114293	80	24	80	24	I dont think "expected" is teh right word here. I suggest delete. (It is calculated) [Jan Fuglestedt, Norway]	Taken into account.
40009	80	24	80	26	Check consistency of GWP definition with glossary definition: "An index measuring the radiative forcing following an emission of a unit mass of a given substance, accumulated over a chosen time horizon, relative to that of the reference substance, carbon dioxide (CO2). The GWP thus represents the combined effect of the differing times these substances remain in the atmosphere and their effectiveness in causing radiative forcing." [TSU WGI, France]	Noted. This should be consistent.
15909	80	25	80	25	The statement: "certain time horizon (usually 100 years)" should be qualified to reflect that a 100 year time period is not relevant when climate change is likely to be irreversible and catastrophic on a much smaller timescale than this. [Kevin Lister, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. This is a value judgement; we present what is usually done in the literature and policy domains.
40029	80	27	80	28	Consider adding a definition for "global temperature change potential" to the glossary [TSU WGI, France]	Rejected. This was considered, but in considered too technical. The GTP is however mentioned in the definition for "greenhouse gas metric".
16685	80	28	80	30	This sentence comparing GTPs and GWPs is slightly misleading - the main difference in the values of the metrics are because GWP measures an *integrated* effect whereas GTP measures an effect at a *instant* in time. The use of temperature rather than radiative forcing makes much less difference - as shown by comparing GWP and the integrated temperature metric (iGTP) which are actually very similar numerically. [William Collins, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account.
114295	80	29	80	29	"on" --> "in" [Jan Fuglestedt, Norway]	Taken into account.
28735	80	29			Also global precipitation-change potential, GPP: Shine et al. (2015) ESD http://www.earth-syst-dynam.net/6/525/2015/esd-6-525-2015.html [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account.
114297	80	30	80	31	regarding "add additional uncertainties": Yes, for teh AGTPs, but much of this cancels out when given relative to CO2; i.e. as GTP. [Jan Fuglestedt, Norway]	Taken into account. The text has been substantially revised, taking into account this and a number of other comments.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
15911	80	30	80	32	<p>The statement:</p> <p>"While this additional step from radiative forcing to the climate response adds additional uncertainties, it can potentially provide a better indication of the temperature contribution to a certain year in the future."</p> <p>Is vague and incorrect. It is not at all demonstrated that the use of GWP rather than radiative forcing provides a better indication of the temperature contribution of a particular type of greenhouse gas in the future. In fact, precisely the opposite is the case; the use of GWP(100) causes the immediate impacts of short lived greenhouse gases such as methane to be greatly underestimated, especially when their concentration is dependent on the rates of emission and the rates of decomposition, and in so doing prevents the mobilisation of short term action. [Kevin Lister, United Kingdom (of Great Britain and Northern Ireland)]</p>	Noted. The detailed discussion of metrics is in section 7.6, and this section only summarizes what is assessed and presented there. We therefore refer to the more detailed assessment of Chapter 7.
114299	80	31	80	31	re "can potentially provide": I think you can be stronger here. It gives a better indication since it calculates temp. [Jan Fuglestvedt, Norway]	Taken into account.
14513	80	34	80	34	delete the comma after "AR5" [Amy East, United States of America]	Taken into account.
86671	80	34	80	37	Quotation: "Yet another approach that has been further developed since the AR5, compares a pulse emission of CO2 to step-changes of emission rates for short-lived components. For example, if methane emissions are reduced by 5% in a certain year or accounting period, it is assumed that this change is sustained and therefore has a continuing impact on radiative forcing." We think this message is a misinterpretation. It is not the metrics that establishes such a parallel, rather it is a physical fact that a pulse emission of CO2 is comparable to a sustained emission of SLCF, and new metrics have been developed that try to unify these different behaviours into a unified metrics. Please rephrase accordingly. [Oyvind Christophersen, Norway]	Taken into account, via some rephrasing.
93633	80	34	80	37	Quotation: "Yet another approach that has been further developed since the AR5, compares a pulse emission of CO2 to step-changes of emission rates for short-lived components. For example, if methane emissions are reduced by 5% in a certain year or accounting period, it is assumed that this change is sustained and therefore has a continuing impact on radiative forcing." This message is a misinterpretation. It is not the metrics that establishes such a parallel, rather it is a physical fact that a pulse emission of CO2 is comparable to a sustained emission of SLCF, and new metrics have been developed that try to unify these different behaviours into a unified metrics. See Ch. 7 p 111 line 44-49, [Jon Magnar Haugen, Norway]	Taken into account.
44293	80	34	80	39	CO2-forcing-equivalent metric is also important here. The justification for not including in SR15 was it was too novel, but this cannot be the case now. CO2-fe provides the most physically representative comparison between two greenhouse gas emissions timeseries. It is the basis for the design of the GWP* metric. CO2-fe was discussed in depth in Jenkins et al. 2018 (GRL; Framing climate goals in terms of cumulative CO2-forcing-equivalent emissions), and is used extensively, including in a policy relevant simplified form in Jenkins et al., 2020 (in press) (PNAS; Quantifying non-CO2 contributions to remaining carbon budgets). [Stuart Jenkins, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The detailed discussion of metrics is in section 7.6, and this section only summarizes what is assessed and presented there. We therefore refer to the more detailed assessment of Chapter 7.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
52007	80	34	80	39	It may be worth discussing here that using a pulse/step metric as outlined in this para allows you to use non-CO2 forcings in a carbon budget framework (unlike if you use a pulse/pulse metric like GWP100. i.e. both Cain et al 2019 and Lynch et al 2020 (in ERL) show that you can multiply cumulative all GHG CO2-e emissions as defined using a step pulse metric such as GWP* by TCRE and get an estimate of the delta-T. i.e. you could add up global mitigation pathways of emissions and estimate if they lead to 2C or warming. As you discuss here that metrics are the simplest models of all, and the Paris Agreement has a temperature goal, you could show how to link the two. [Michelle Cain, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. See Box 1.3 on metrics, and Box 1.4 on net-zero emissions.
15913	80	34	80	39	this metric sounds like it is going to add more confusion. Why not have a simple metric for radiative forcing? [Kevin Lister, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. See Section 7.6.
68251	80	34	80	39	GWP* being used throughout the AR6 Report can be a useful metric, but does not completely negate the need and utility of a metric for a shorter timescale like GWP20. In the IPCC 1.5C Report, GWP* is noted for its ability to describe the impacts from SLCFs, even providing a Figure in Cross-Chapter Box 2 that shows the differences between GWP100, GTP100, and GWP*. This does not help for shorter timescale concerns. In the First Order Draft for WGIII for AR6, GWP* is explained in Chapter 2 as allowing the comparison of a sustained change in emissions for non-CO2 forcings in comparison with CO2, but the chapter also notes that there are limitations to using GWP* for policy applications, including those relevant for the Paris Agreement (see WGIII FOD 2-23–2-24). Further, Chapter 2 does suggest that GWP20 may be useful alongside metrics like GWP100 and GTP100 to compare changes in emissions (WGIII FOD 2-22). In Chapter 6 of WGIII FOD, the authors note that a chosen climate metric and the time horizon for which it covers affect assessing the timing of achieving climate targets like net-zero emissions (WGIII FOD 6-100). In discussing the balance of CO2 and non-CO2 emissions from aviation, Chapter 10 of WGIII's FOD suggests that time horizon is a subjective choice of the whomever is using the information, and that if longer time horizons are chosen, CO2 becomes more important (WGIII FOD 10-51: "Any GWP/GTP type emissions equivalency calculation always involves the user selection of a time horizon, over which the calculation is made, which is a subjective choice (Fuglestedt et al., 2010). In general, the longer the time horizon, the more important CO2 becomes in comparison with a SCLF [sic]."). [Durwood Zaelke, United States of America]	Taken into account. Please see Box 1.3, Box 1.4 and the metrics discussion of Chapter 7 (section 7.6).

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
68253	80	34	80	39	Speed is the metric of concern because of our proximity to 1.5C and aggressive mitigation efforts needed to meet that goal. As a result, policymakers that will rely on the IPCC's scientific expertise would greatly benefit from the access and analysis of climate metrics that consider the shorter timescales like GWP20, which was used in past assessments and throughout policy work. SLCFs are featured in Chapter 6 of this report, but their impact on the climate—especially in the crucial near-term—should not be relegated to only that chapter but instead considered as part of the whole, most importantly short-lived climate pollutants (black carbon, methane, tropospheric ozone, and HFCs). Aggressive mitigation of SLCFs can cut the rate of warming in half, Arctic warming by two-thirds, and avoid up to 0.6C of warming by 2050. UNEP & WMO (2011) Integrated Assessment of Black Carbon and Tropospheric Ozone; Shindell D., et al. (2012) Simultaneously Mitigating Near-Term Climate Change and Improving Human Health and Food Security, Science 335(6065):183–189; Xu and Ramanathan (2017) Well below 2 °C: Mitigation strategies for avoiding dangerous to catastrophic climate changes, Proc. Natl. Acad. Sci. 114(39):10315–10323. [Durwood Zaelke, United States of America]	Taken into account. Please see Box 1.3, Box 1.4 and the metrics discussion of Chapter 7 (section 7.6).
68255	80	34	80	39	For policymakers, changes in the near-term and creating policies that are in line with the lower emissions scenarios would benefit from the ability to emphasize the amount of avoided warming from the SLCFs and the near-immediate impact that they can have, which is aided by having the appropriate metric in GWP20. See Climate and Clean Air Coalition (CCAC) , Mexico , Molina Center for Energy and the Environment (MCE2), & United Nations Environment Programme (UNEP) (2018) Progress and Opportunities for Reducing SLCFs across Latin America and the Caribbean; UNEP & Climate and Clean Air Coalition (2018) Integrated Assessment of Short-lived Climate Pollutants in Latin America and the Caribbean: Improving air quality while contributing to climate change mitigation; Climate and Clean Air Coalition & UNEP (2019) Air Pollution in Asia and the Pacific: Science-based solutions; European Environment Agency (2018) Air quality in Europe — 2018 report, EEA Report No 12/2018. [Durwood Zaelke, United States of America]	Taken into account. Please see Box 1.3, Box 1.4 and the metrics discussion of Chapter 7 (section 7.6).
112565	80	34	80	39	"alternative quantification" implies they are all equally valid, which is not the case for quantification of future global surface warming. I suggest replace second sentence (because the use of the metric does not imply any assumption about whether reductions are sustained) with something like "For example, a permanent increase in methane emission rate by 1 tonne of methane per year would have a similar impact on future radiative forcing and hence temperature change as a one-off pulse emission of approximately 3000 tonnes of CO2. So-called "CO2-warming-equivalent" emissions, which can be calculated in a number of ways including GWP* and CGWP, attempt to capture this relationship, and provide a more accurate quantification of future global surface warming than aggregate CO2-equivalent emissions calculated with conventional metrics. [Myles Allen, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account, through rephrasing.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
66743	80	34	80	39	Speed is the metric of concern because of our proximity to 1.5C and drastic mitigation efforts needed to meet that goal. As a result, policymakers that will rely on the IPCC's scientific expertise would greatly benefit from the access and analysis of climate metrics that consider the shorter timescales like GWP20, which was used in past assessments and throughout policy work. SLCFs are featured in Chapter 6 of this report, but their impact on the climate—especially in the crucial near-term—should not be relegated to only that chapter but instead considered as part of the whole, most importantly short-lived climate pollutants (black carbon, methane, tropospheric ozone, and HFCs). [Kristin Campbell, United States of America]	Taken into account. Please see Box 1.3, Box 1.4 and the metrics discussion of Chapter 7 (section 7.6).
66745	80	34	80	39	GWP* being used throughout the AR6 Report can be a useful metric, but does not completely negate the need and utility of a metric for a shorter timescales like GWP20. In the IPCC 1.5C Report, GWP* is noted for its ability to describe the impacts from SLCFs, even providing a Figure in Cross-Chapter Box 2 that shows the differences between GWP100, GTP100, and GWP*. This does not help for shorter timescale concerns. In the First Order Draft for WGIII for AR6, GWP* is explained in Chapter 2 as allowing the comparison of a sustained change in emissions for non-CO2 forcings in comparison with CO2, but the chapter also notes that there are limitations to using GWP* for policy applications, including those relevant for the Paris Agreement (see WGIII FOD 2-23–2-24). Further, Chapter 2 does suggest that GWP20 may be useful alongside metrics like GWP100 and GTP100 to compare changes in emissions (WGIII FOD 2-22). In Chapter 6 of WGIII FOD, the authors note that a chosen climate metric and the time horizon for which it covers affect assessing the timing of achieving climate targets like net-zero emissions (WGIII FOD 6-100). In discussing the balance of CO2 and non-CO2 emissions from aviation, Chapter 10 of WGIII's FOD suggests that time horizon is a subjective choice of the whomever is using the information, and that if longer time horizons are chosen, CO2 becomes more important (WGIII FOD 10-51: "Any GWP/GTP type emissions equivalency calculation always involves the user selection of a time horizon, over which the calculation is made, which is a subjective choice (Fuglestad et al., 2010). In general, the longer the time horizon, the more important CO2 becomes in comparison with a SCLF [sic]."). [Kristin Campbell, United States of America]	Taken into account. Please see Box 1.3, Box 1.4 and the metrics discussion of Chapter 7 (section 7.6).

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
69863	80	34	80	39	Metrics should be relevant on near term timelines, such as GWP20, to account for mitigation strategies that slow warming and especially reduce extreme climate events in the near term. In the First Order Draft for WGIII for AR6, GWP* is explained in Chapter 2 as allowing the comparison of a sustained change in emissions for non-CO2 forcers in comparison with CO2, but the chapter also notes that there are limitations to using GWP* for policy applications, including those relevant for the Paris Agreement (see WGIII FOD 2-23–2-24). Further, Chapter 2 does suggest that GWP20 may be useful alongside metrics like GWP100 and GTP100 to compare changes in emissions (WGIII FOD 2-22). In Chapter 6 of WGIII FOD, the authors note that a chosen climate metric and the time horizon for which it covers affect assessing the timing of achieving climate targets like net-zero emissions (WGIII FOD 6-100). In discussing the balance of CO2 and non-CO2 emissions from aviation, Chapter 10 of WGIII’s FOD suggests that time horizon is a subjective choice of the whomever is using the information, and that if longer time horizons are chosen, CO2 becomes more important (WGIII FOD 10-51: “Any GWP/GTP type emissions equivalency calculation always involves the user selection of a time horizon, over which the calculation is made, which is a subjective choice (Fuglestedt et al., 2010). In general, the longer the time horizon, the more important CO2 becomes in comparison with a SCLF [sic].”). [Gabrielle Dreyfus, United States of America]	Taken into account. Please see Box 1.3, Box 1.4 and the metrics discussion of Chapter 7 (section 7.6).
16689	80	35	80	37	The point is not that methane emission reductions are assumed to be sustained. The point is that physically the climate responses to a sustained reduction in methane are similar to the responses to a pulse reduction in CO2. I suggest something like: "For example, the temperature response to a sustained methane reduction has a similar behaviour to the temperature response to a pulse CO2 reduction. However, applying such metrics requires making assumptions about the permanence of of the mitigation." [William Collins, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Please see Box 1.3, Box 1.4.
114301	80	36	80	36	Why give "5%" here. Better to be more general. [Jan Fuglestedt, Norway]	Accepted, text revised.
16687	80	37	80	37	"GWP*" is only one example of a pulse-vs-sustained metric. It isn't the generic term for such metrics. It would be better to say "Such a metric (for example GWP*)" [William Collins, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Please see Box 1.3, Box 1.4.
66595	80	37	80	39	This phrasing is odd. GWP* is called GWP*. Other step-pulse metrics include CGTP. If you are retaining this section, you should probably name both. [Dave Frame, New Zealand]	Taken into account. Please see Box 1.3, Box 1.4.
114303	80	41	80	42	I think you may delete "i.e. a weight based... emisisions changes)". Not needed to repeat. [Jan Fuglestedt, Norway]	Not applicable (text removed).
66597	80	41	80	44	This is potentially misleading - emissions metrics are not climate models. GWP does not even contain anything about the climate response; perhaps this was one of the things that attracted early researchers to it, since it did not rely on knowing flavours of climate sensitivity. [Dave Frame, New Zealand]	Taken into account. Please see Box 1.3, Box 1.4.
23629	80	41	80	44	It would be helpful for readers to also point out that WGIII takes up and builds on the WGI assessment of GHG emission metrics - so that people understand that WGI Chapter 7.6 is not the only place where IPCC discusses GHG metrics. (For specific reference, this discussion is in Box 2.2, Chapter 2 in the WGIII report - but it may not be necessary to provide such a specific cross-reference - just point out that GHG metrics are also assessed in WGIII, building on the assessment of their physical dimensions in WGI). [Andy Reisinger, New Zealand]	Taken into account. Please see Box 1.3, Box 1.4.
14515	80	42	80	42	does not make sense as written, edit to “that provides a relative indication” [Amy East, United States of America]	Not applicable (text removed).

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
114305	80	43	80	44	you may add a link to WGIII, Ch2 here. (But we need to clarify how to do this since WGIII is later) [Jan Fuglested, Norway]	Taken into account.
37213	80	47	88	12	Entire section 1.5.4. Stop trying to hide information. You are supposed to be open and transparent. Show the output of models compared to historical temperature data (with its uncertainty) so that readers can understand just how accurate climate models are. IPCC AR5 compared predictions to observations and AR6 should do the same thing or people will wonder if you are trying to avoid admitting how poor climate models are. [John McLean, Australia]	Rejected. Chapter 1 is only an introduction. The information is not "hidden", it is found in chapter 3 where model-observation comparisons are presented at the global scale. Model evaluation is also presented in the other chapters, for specific processes and at the regional scale.
18331	80	47	88	12	Section 1.5 seems to cover model evaluation methods used in the literature. However, it failed to recognize that model evaluation should go beyond comparing the mean of a climate variable (such as temperature and precipitation) and many studies have already made such attempts. For example, Trenberth et al. (2017) and Chen and Dai (2019) compared precipitation frequency, duration and intensity in observations and CESM1 and found the "drizzling bias" seen previous models (Dai 2006) still exist. Furthermore, the estimates of precipitation frequency and intensity are very sensitive to the model or observation data resolution used (Chen and Dai 2018), making the re-gridding method a critical issue for model evaluation. This issue also applies to evaluating temperature variability (Chen et al. 2019). Another critically important issue for model evaluation is the impact of internal variability on regional climatology, which can be large for precipitation, cloudiness, and other variables (Dai and Bloecker 2019). Because of this, one should not expect a model to produce the same 20-50 year averaged precipitation (or trends) as in observations over many regions, such as the Southwest U.S. or eastern Australia, even for a perfect model. Many authors incorrectly concluded that a model has a deficiency in simulating precipitation over a given region because they found substantial differences in the precipitation climatology or trend (over the last 20-60 years) between observations and a model simulation, without realizing that such a difference can exist purely due to internal variability, as shown by large ensemble simulations (e.g., Deser et al. 2012; Dai and Bloecker 2019). This often leads to misleading conclusions regarding models' inability to simulate precipitation climatology or trends, like those made by Wentz et al. (2007, Science). Relevant refs.: Chen, D., and A. Dai, 2018: Dependence of estimated precipitation frequency and intensity on data resolution. <i>Climate Dynamics</i> , 50, 3625–3647. DOI: 10.1007/s00382-017-3830-7. Chen, D. and A. Dai, 2019: Precipitation characteristics in the Community Atmosphere Model and their dependence on model physics and resolution. <i>J. Adv. Model. Earth Syst.</i> , 11, 2352-2374. https://doi.org/10.1029/2018MS001536 . Chen, J., A. Dai, and Y. Zhang, 2019: Projected changes in daily variability and seasonal cycle of near-surface air temperature over the	Noted. Chapter 1 is only an introduction on methods, and it is not within the scope of our chapter to present such detailed information. Chapter 3 discusses some of these issues and quote Dai and Bloecker (2019). Chen and Dai (2019) are referenced in chapter 8 on the water cycle. The comment has been passed on to chapters 3 and 8.
36839	80	49	80	49	It is ignorance or deception at its worst to claim that modelling exercises are evidence for anything unless you can prove that models have been properly validated. The only applicable method of validation is to input a certain scenario and have the model predict what happened after this initial state. [John McLean, Australia]	Rejected. Chapter 1 only presents methods. The statements about climate change are made in the other chapters, and for each assessment the different lines of evidence are presented and weighted. Numerical models are used sometimes but not for every statement, and when it is the case, their use is justified in the corresponding chapter.
71551	80				I believe that a section should be devoted to the inverse analysis, which plays a very important role in the analysis of the greenhouse gas fluxes. [Takashi Maki, Japan]	Rejected. This is too detailed for our section, but could be relevant for Chapter 5.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
37669	81	1	81	54	There is another class of large ensemble using AGCM (given SST/sea ice BCs) to better cover extremes (though the spirit is similar to ICE...): Mizuta, R., A. Murata, M. Ishii, H. Shiogama, K. Hibino, N. Mori, O. Arakawa, Y. Imada, K. Yoshida, T. Aoyagi, H. Kawase, M. Mori, Y. Okada, T. Shimura, T. Nagatomo, M. Ikeda, H. Endo, M. Nosaka, M. Arai, C. Takahashi, K. Tanaka, T. Takemi, Y. Tachikawa, K. Temur, Y. Kamae, M. Watanabe, H. Sasaki, A. Kitoh, I. Takayabu, E. Nakakita, and M. Kimoto, 2017: Over 5000 Years of Ensemble Future Climate Simulations by 60 km Global and 20 km Regional Atmospheric Models. Bull. Amer. Meteor. Soc., 98, 1383-1398, doi:10.1175/BAMS-D-16-0099.1. [Masahide Kimoto, Japan]	Taken into account. Thanks.
36841	81	7	81	9	Don't be ridiculous. Different models cannot all produce the correct result, so any "ensemble" will, at best, mean a mixing of one correct and multiple incorrect outputs. [John McLean, Australia]	Rejected. Please read up on the concept of internal variability.
70657	81	8		9	I think the main advantage of MMEs is that they allow sampling over model uncertainty, rather than they quantify the influence of particular sets of parameterizations. [Gillett Nathan, Canada]	Taken into account. Thanks.
8627	81	11	81	13	Particularly since MME-derived conclusions are used throughout this report, you cannot just leave this hanging without point to solutions. [Robert Kopp, United States of America]	Taken into account. The sentence has been rephrased. It is not the result itself that is the problem, but any further usage if MME-derived conclusions should acknowledge the potential biases in the underlying dataset.
21371	81	15	81	54	The absence of reference to the climateprediction.net experiment technique is somewhat of an omission here given the number of results covered presumably in chapter 11 which make use of this massive ensemble. Maybe some of the references are to it but if so this text, as written is not obvious. Also, there are the NorESM ensemble runs with distinct volcanic futures to explore the episodic forcing that is unknown and it would seem that the approach described in Bethke et al. is new and novel and should also be included here. So, my suggestion would be to expand this section accordingly to cover these two aspects which, as far as I can tell, are not covered presently here and are required to give a comprehensive view of recent advances? [Peter Thorne, Ireland]	Taken into account. Thanks Peter.
125397	81	15	81	55	The authors should consider whether this level of detail on climate models is really warranted in an introductory chapter OR whether it is better placed in a chapter on climate models. After all, most folks interested in climate model details will go to that chapter -- not the introduction. And a 114-page introductory chapter is a turn-off to many readers. [Trigg Talley, United States of America]	Noted. The AR6 scoping meeting decided that there should be no such model evaluation chapter, hence it needs to be treated differently to before. Chapter 1 deals with the developments and techniques related to climate models, and as such no longer purely an introduction (see the scoping documents.)
90533	81	16	81	32	Some additional comments and references about multi-model ensemble approaches allowing for model dependence [Richard Smith, United States of America]	Rejected. Unfortunately the two post-AR5 papers mentioned do not seem to be in the peer-reviewed literature.
90535	81	16	81	32	In recent years, there have been extensions to the Multi-Model Ensemble approach based on Bayesian statistics, that have recognized and corrected for weaknesses in earlier approaches such as the reliability ensemble average, including that models often have common biases or dependencies (e.g. shared code) that may make it inappropriate to treat them as if they were independent stochastic processes. [Richard Smith, United States of America]	Rejected. See the response to comment #2823

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
90537	81	16	81	32	Chandler (2013) and Rougier et al. (2013) independently developed an approach that treats the climate models as statistically exchangeable. In this paradigm, increasing the number of simulators will not necessarily reduce the uncertainty to zero. The approach in effect decomposes the errors in a climate model as the sum of the deviation from some overall average "consensus" model, and the deviation between the consensus model and the true Earth system. [Richard Smith, United States of America]	Rejected. See the response to comment #2823
90539	81	16	81	32	Sansom et al. (2017) proposed a hierarchical Bayesian framework based on a coexchangeable representation of the relationship between climate models and the Earth system. They showed how emergent constraints fit into the coexchangeable representation, and extended it to account for internal variability simulated by the models and natural variability in the Earth system. Their analysis showed that projected warming in some regions of the Arctic may be more than 2C lower and uncertainty reduced by up to 30% when constrained by historical observations. [Richard Smith, United States of America]	Rejected. See the response to comment #2823
90541	81	16	81	32	A further extension by Huang et al. (2020) proposed a model paradigm that also included the spatial structure of a climatic variable, as well as inter-model dependence, the emergent relationship between historical and future periods in climate models, and errors from different sources. In projections of future temperatures in Central North America under RCP 8.5, this approach resulted in lower projected temperature increases than a simple multi-model mean approach. However, in a parallel reconstruction for temperatures in the East Asia region, the deviation between the two approaches was in the opposite direction. [Richard Smith, United States of America]	Rejected. See the response to comment #2823
90543	81	16	81	32	R.E. Chandler (2013), Exploiting strength, discounting weakness: combining information from multiple climate simulators. Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences, 371, pages 20120388 [Richard Smith, United States of America]	Rejected. See the response to comment #2823
90545	81	16	81	32	H. Huang, D.M. Hammerling, B. Li and R.L. Smith (2019), Combining interdependent climate model outputs in CMIP5: A spatial Bayesian approach. Submitted for publication, available on arXiv:2001.00074, current version posted February 26, 2020 (first posted December 2019). [Richard Smith, United States of America]	Rejected. See the response to comment #2823
90547	81	16	81	32	J.C. Rougier, M. Goldstein and L. House (2013), Second-Order Exchangeability Analysis for Multimodel Ensembles, Journal of the American Statistical Association 108 (503), 852-863 [Richard Smith, United States of America]	Rejected. See the response to comment #2823
90549	81	16	81	32	P.G. Sansom, D.B. Stephenson and T.J. Bracegirdle (2020), On constraining projections of future climate using observations and simulations from multiple climate models. Submitted for publication, available on arXiv:1711.04139, current version posted February 5, 2020 (first posted November 2017) [Richard Smith, United States of America]	Rejected. See the response to comment #2823
26021	81	21	81	21	such tiny changes in initial temperatures, winds... [Don Alfonso Pino Maeso, Spain]	Accepted.
70659	81	21			Delete 'may'. [Gillett Nathan, Canada]	Accepted.
111953	81	22			evolutions for the system as a whole. - Maybe better ... evolutions for the individual realization of the system characterizing its internal variability. [Tomas Halenka, Czech Republic]	Accepted.
70661	81	25		26	Replace 'a number of models' with 'most models'. [Gillett Nathan, Canada]	Accepted.
70663	81	28		30	To make sense to readers the authors need to say a bit more to explain the McKinnon and Deser approach, otherwise the reader won't know what an 'observation-based large ensemble' is. [Gillett Nathan, Canada]	Accepted.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
107835	81	29	81	29	LeDuc et al., 2019 should be cited along with Mote and Schaller. [Linda Mearns, United States of America]	Accepted.
107837	81	29	81	29	I don't know if 'often' is still the case here. It was true of Mote et al., but not of Leduc et al. [Linda Mearns, United States of America]	Accepted.
70665	81	29			This paper uses a 35-member large ensemble from CanRCM4 regional model - it could be cited here too: (Fyfe et al. , 2017) https://www.nature.com/articles/ncomms14996 [Gillett Nathan, Canada]	Accepted.
70667	81	38			Replace 'may not' with 'cannot'. This does not require an in press reference to support it - there are many earlier references that could be used to support this. WGI AR5, Chapter 9 would be one. [Gillett Nathan, Canada]	Accepted.
40453	81	42	81	42	Is 'Perturbed physics ensemble' the same thing as 'Perturbed parameter ensemble'? If so, I suggest to update the text in the definition for '(Model) Ensemble to 'Perturbed physics ensemble (also called perturbed parameter ensembles)...' [TSU WGI, France]	Accepted.
38579	81	44	81	45	Using Knutti et al 2010 as first reference makes PPEs look like they've been around for a decade at best. Please cite Murphy et al 2004 and Stainforth et al 2005 rather than this one. As an example of a statistical method, please cite Lee et al (2013; Atmospheric Chemistry and Physics. 13(17), pp. 8879-8914). [David Sexton, United Kingdom (of Great Britain and Northern Ireland)]	Accepted.
70669	81	44			There are earlier references for perturbed physics ensembles. One example is Stainforth et al. (2005): https://www.nature.com/articles/nature03301?draft=collection [Gillett Nathan, Canada]	Accepted.
12425	81	50	81	50	Model numbers to be included/updated [Lijing Cheng, China]	Not applicable - this comment appeared misplaced? We cannot identify what it refers to.
90957	81	52	81	54	Parker (2013) in WIREs Climate Change also provides an overview of the three types of ensemble and their use in gauging uncertainty. The paper is: WIREs Clim Change 2013, 4:213–223. doi: 10.1002/wcc.220 [Wendy Parker, United Kingdom (of Great Britain and Northern Ireland)]	Accepted.
38581	81	52	81	54	This small paragraph could usefully be extended to mention that there are strengths in using more than one of these data sources. The UK land report (Murphy et al 2018; https://www.metoffice.gov.uk/pub/data/weather/uk/ukcp18/science-reports/UKCP18-Land-report.pdf) uses both MME and PPE to give a fuller assessment of modelling uncertainty, as does Sexton et al (2012). Carslaw et al (2018; https://eos.org/opinions/climate-models-are-uncertain-but-we-can-do-something-about-it)'s aerosol PPE states that each model in the MME has a parametric uncertainty about it so without combining we are underestimating the uncertainty. PPEs can test robustness of multimodel emergent constraints e.g. Wagman et al (2018; https://journals.ametsoc.org/doi/full/10.1175/JCLI-D-17-0682.1?af=R&mobileUi=0). Sexton et al (2019; https://link.springer.com/article/10.1007%2F00382-019-04625-3) test robustness of the Williams et al-style ICE approach and use statistical methods to identify the key parameters. Would be a great, more complete message on uncertainty and shows these approaches to be complementary. [David Sexton, United Kingdom (of Great Britain and Northern Ireland)]	Accepted.
115739	81		81		Please check wording here and in the glossary and x chapters for various types of ensembles, and make sure that definitions are in the glossary (large initial condition ensembles, perturbs physics ensembles, multi model ensembles) (to reflect their use x chapters). [Valerie Masson-Delmotte, France]	Accepted, text revised and made consistent.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
10061	82	20	82	26	<p>I recommend to start section 1.5.4.2 with a short introduction to give some precisions about CMIP. For instance, I would suggest the following:</p> <p>“The Coupled Model Intercomparison Project (CMIP) provides an infrastructure to compare the results of different Earth System Models (ESM) under similar conditions. Since its creation in the mid-1990s, it has evolved in different phases, involving all major climate modelling centers in the world. The results of these phases have played a key role in previous IPCC reports, and the present report assesses a range of results from CMIP5 that were not published until after the AR5, as well as the first results of the 6th phase of CMIP (CMIP6). Despite the crucial importance of CMIP for climate science today, its supremacy is a matter of debate in the climate science community due to its cost in human and computational resources and the challenges associated with the interpretation of multi-model ensembles (Palmer and Stevens, 2019; Touzé-Peiffer et al., 2020).</p> <p>The CMIP6 experiment 22 design is somewhat different from previous phases. It now consists of a limited set of DECK...”</p> <p>References:</p> <p>Palmer, T., & Stevens, B. (2019). The scientific challenge of understanding and estimating climate change. <i>Proceedings of the National Academy of Sciences</i>, 116(49), 24,390–24,395. https://doi.org/10.1073/pnas.1906691116</p> <p>Touzé-Peiffer L, Barberousse A, Le Treut H. The Coupled Model Intercomparison Project: History, uses, and structural effects on climate research. <i>WIREs Clim Change</i>. 2020:e648. https://doi.org/10.1002/wcc.648 [Ludovic Touzé-Peiffer, France]</p>	Taken into account. (The comment has however been split across multiple locations.)
125399	82	21	82	21	Insert a reference for CMIP6. [Trigg Talley, United States of America]	Taken into account.
36843	82	29	82	30	1850 is NOT pre-industrial, nor is data from 1850 in any sense global given that even HadCRUT4 data indicates global coverage in that years averaging about 22% (about 35% of which was from Europe in which the Little Ice Age was just ending). [John McLean, Australia]	Rejected. We say 'taken as pre-industrial', which is clearly true for the modelling design described here.
45773	82	34	82	35	"... common CMIP6 forcings are prescribed." In fact these are not only provided for the historical period, but for all simulations. Moreover, it depends on the model which data sets are prescribed. [Twan van Noije, Netherlands]	Rejected. True, but there is a clear separation between historical and future simulations in terms of the requirements for participation.
114951	82	35	82	35	The reference to the gridded CMIP6 pollutants emisisions shall be added along Hoesly et al 2018, i.e. (Gidden et al. 2019: https://www.geosci-model-dev.net/12/1443/2019/) [Zbigniew Klimont, Austria]	Accepted.
45775	82	40	82	41	This is not totally correct. Some models without interactive aerosols apply their own aerosol data sets. For instance, in CNRM-CM6-1 aerosols are prescribed based on earlier simulations with interactive aerosols. [Twan van Noije, Netherlands]	Taken into account. Text revised accordingly.
70671	82	43		44	Add a reference to describe the ozone database e.g. Checa-Garcia et al. (2018) - https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2017GL076770 . [Gillett Nathan, Canada]	Accepted.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
36845	82	46	82	51	You should state here how accurate the models were (and clarify the years that each dealt with and the data coverage at the time). I would also expect a comment that agreement between models does NOT automatically mean that the models are validated. I remind you that 97% of CIMP5 model runs (111 of 114) produced a greater warming trend for the the 15 years prior to the drafting of AR5 than the temperature data over that time indicated (text box 9.2 AR5) [John McLean, Australia]	Rejected. The aim of chapter 1 is to introduce the methods. Model evaluation is presented in chapter 3.
64689	83	0	83	0	table 1.4. For PMIP please add Kageyama et al. 2018 Kageyama, M., Braconnot, P., Harrison, S. P., Haywood, A. M., Jungclaus, J. H., Otto-Bliesner, B. L., Peterschmitt, J. Y., Abe-Ouchi, A., Albani, S., Bartlein, P. J., Brierley, C., Crucifix, M., Dolan, A., Fernandez-Donado, L., Fischer, H., Hopcroft, P. O., Ivanovic, R. F., Lambert, F., Lunt, D. J., Mahowald, N. M., Peltier, W. R., Phipps, S. J., Roche, D. M., Schmidt, G. A., Tarasov, L., Valdes, P. J., Zhang, Q., and Zhou, T.: The PMIP4 contribution to CMIP6 – Part 1: Overview and over-arching analysis plan, Geosci. Model Dev., 11, 1033-1057, 2018.. This is the reference for PMIP in CMIP6 and the paper in the special CMIP6 issue for it. The other paper should be also cited, they are specific to each of the PMIP periods considered in CMIP6. [Pascale Braconnot, France]	Noted. The Kageyama paper was already cited, but with the wrong year (2017 instead of 2018). This is now corrected and the reference is moved to the top of the list.
70141	83	1	84	2	Table 1.4: Indicate that LS3MIP results are also used in Chapter 11. [Sonia Seneviratne, Switzerland]	Accepted, thanks.
70143	83	1	84	2	Table 1.4: It is possible that DAMIP and LUMIP results will be used in Chapter 11 depending on the availability of publications (please check with chapter 11 authors when preparing the FGD). [Sonia Seneviratne, Switzerland]	Noted. No reference has been found to LUMIP nor DAMIP in Chapter 11.
38659	83	3	83	3	Fig 1.20 - For a better understanding it is recommended to indicate in full the acronyms CMIP6 and DECK in the figure. [Luisa Sturiale, Italy]	Accepted. Acronyms are now explained in the legend.
24267	83	10	84	1	Instead of the long name, there needs to be a brief description. More importantly there needs to be an equivalent table for DECK, the CMIP6 runs actually used in nearly all of Ch. 3 and 4. [Bryan Weare, United States of America]	Noted. Detailed descriptions of MIPS are found in the references cited. The DECK simulations are described in the text.
90021	83	10	84	2	SIMIP is referred to in Ch04, too. [Jochem Marotzke, Germany]	Accepted. Thanks.
114307	83	12	84	2	This table is useful [Jan Fuglestedt, Norway]	Thanks for the positive remark.
28737	83	12			An extra column detailing time period may be useful in Table 1.4 [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Noted. This information has not been added in order to keep the table concise. Detailed descriptions of the MIPS are found in the references cited.
35495	83	13	83	13	remove parentheses in the key references [Carlos Antonio Poot Delgado, Mexico]	Noted. The citation style with parentheses seemed consistent in this table, but citation styles may be modified during the final formatting stage.
42103	83	49	83	50	("main science questions they pose, the number of models participating") this is currently not the case [Julia Nabel, Germany]	Accepted, thanks. The sentence has been changed to "Table 1.4 lists the 23 CMIP6-Endorsed MIPS and, key references."
5097	83		84		table 1.4: A reference to a new table in Annex III for the CMIP6 data references should be added. [Martina Stockhause, Germany]	Accepted. Reference added in the text (end of CMIP subsection, 1.5.4.3).

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
66547	84	5	84	20	This section about CORDEX could be complemented by a short paragraph indicating that there is an extensive work going on in developing and evaluating the next generation of convection permitting regional models (these are also referred to in several places of the AR6 report including the atlas). In CORDEX there is a flagship pilot study on this focusing on the European Alps which is being mentioned in Jacob, D., et al. (2020). Regional climate downscaling over Europe: perspectives from the EURO-CORDEX community.. Reg Environ Change . 20: 51; DOI: https://doi.org/10.1007/s10113-020-01606-9 and more specifically in Coppola E., et al. (2019). A first-of-its-kind multi-model convection permitting ensemble for investigating convective phenomena over Europe and the Mediterranean. Climate Dynamics. : 1-32; DOI: https://doi.org/10.1007/s00382-018-4521-8 [Kjellström Erik, Sweden]	Taken into account. The convection resolving models are now mentioned in the "model development" section, 1.5.3.3., and the Coppola et al reference has been added. A more detailed presentation of CORDEX is found in chapter 10 and the Jacob et al reference has been pointed to chapter 10 authors.
66543	84	8	84	8	CORDEX is not just about "regional models" but about "regional downscaling" which includes both RCMs and ESD techniques. [Kjellström Erik, Sweden]	Accepted. "regional models" has been replaced by "regional models and statistical downscaling techniques"
66545	84	11	84	11	Why the word "however" here? It makes the text sounds as if downscaling methods are different compared to other climate projections. Also GCMs need careful evaluation. I would suggest framing this as "As other techniques for providing information about future climate conditions, ..." [Kjellström Erik, Sweden]	Taken into account. For the sake of conciseness, we simply remove "however".
70145	84	11	84	13	Mention the following here: "For instance, while the higher resolution of the CORDEX simulation can be advantageous to resolve small-scale features, other aspects of the CORDEX set-up and models may imply shortcomings in the simulations, e.g. the use of constant aerosol fields in projections (Bartok et al. 2017) or the lack of representation of CO2 effects on photosynthesis (Schwingshackl et al. 2019), which may both affect the representation of temperature extremes (Chapter 11)." References: Bartok, B., et al., 2017, Climate Dynamics: DOI 10.1007/s00382-016-3471-2 ; Schwingshackl, C., et al. 2019, Env. Res. Letters: https://doi.org/10.1088/1748-9326/ab4949 [Sonia Seneviratne, Switzerland]	Noted. The discussion of regional models is done in Chapter 10. The proposed sentence has not been added here, but instead, more references to Chapters 10, 11 and 12 have been included in this paragraph.
14517	84	12	84	12	delete the comma after "performance" [Amy East, United States of America]	Not applicable. The sentence has been rephrased.
36847	84	19	84	19	How can something "represent a new level of validation" when there has been no previous validation? And what is the representing of validation compared to validation itself? It sounds like it's the pretence of validation. [John McLean, Australia]	Noted. Chapter 1 introduces the methods, and validation is presented in the other chapters. A reference has been added for CORDEX-CORE: Remedio et al., 2019.
16103	84	23	85	19	Note that besides ESMValTool, several other open tools exist, such as ILAMB (ilamb.org) designed for land model evaluation, or CLIMAF which is heavily used in France and was operational quite some time before ESMValTool. [Gerhard Krinner, France]	Rejected. True, but we (now explicitly) refer to the tool that sees the broadest usage in this particular report.
125401	84	25	84	26	Explain what the Earth System Grid Federation (ESGF) is. [Trigg Talley, United States of America]	Accepted.
115741	84		88		I suggest to include model evaluation as a cross cutting theme and to better reflect what is done in the various chapters in section 1.5.4 (possibly including with an overview table?) [Valerie Masson-Delmotte, France]	Accepted. Model evaluation is included in table 1.1.
44367	85	2	85	3	Min et al. 2011 is the wrong reference in this context. The routines used in the ESMValTool for evaluating the ETCCDI indices are based on Sillmann, J., V. V. Kharin, X. Zhang, F. W. Zwiers and D. Bronaugh, 2013: Climate extremes indices in the CMIP5 multi-model ensemble. Part 1: Model evaluation in the present climate. J. Geophys. Res. Atmos., 118, 1716-1733, doi: 10.1002/jgrd.50203. [Jana Sillmann, Norway]	Taken into account. The additional reference has been added.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
112065	85	7	85	7	The ATLAS chapter does not use ESMValTool, but Chapters 10 and 11 do. [jose manuel gutierrez, Spain]	Accepted.
105069	85	12	85	19	Is there only ESMValTool? It would be good to be comprehensive here. [Masa KAGEYAMA, France]	Noted. the name refers to one specific piece of software, yes.
90023	85	18	85	18	evaluation, not validation. [Jochem Marotzke, Germany]	Accepted.
4491	85	22	85	22	Hindcast of pre-industrial regional and global climate of the past 2000 and 10,000 years needs to be carried out and results discussed here. Hindcast control runs over just modern data or the Little Ice Age are not enough. The key objective should be to replicate natural warm phases of the past millennia, regardless of whether they are regional or global. Be more transparent about which hindcasts were successful and which once still unsuccessful, rather than just citing various papers without any detail. For a start: has the temperature development or the last 2000 and 10,000 years as published by PAGES 2k (2013) and Marcott et al. (2013) been replicated by the models? Where are the hindcast test results? [Sebastian Luening, Switzerland]	Rejected. This is a question of full model validation, which is not performed here but rather in Chapters 2 and 3. (For this particular question.)
125403	85	22	86	3	The reader is left wanting not just a description of HOW model evaluation is done, but at least a direction to WHERE the RESULTS of those model evaluation experiments are elsewhere in the report. Please include some cross-chapter references in this paragraph (wherever that content may be). [Trigg Talley, United States of America]	Taken into account. In the current report, model validation is performed in the individual chapters, rather than in a separate chapter as was the case for AR5. Please refer to relevant sections of Chapters 3 (attribution), 5 (carbon cycle), 6 (short-lived climate forcers), 8 (water cycle), 9 (oceans, cryosphere and sea level) and 10 (regional models) for further discussion.
36853	85	22	86	3	This section is talks about what was claimed to be done but it fails to demonstrate any improvement in modelling since the farcical failure of 111 of 114 climate model runs discussed in text box 9.2 of IPCC AR5. It also fails to make any reference to the very general reasons suggested in IPCC AR5 for the failure of those models. [John McLean, Australia]	Rejected. In the current report, model validation is performed in the individual chapters, rather than in a separate chapter as was the case for AR5. Please refer to relevant sections of Chapters 3 (attribution), 5 (carbon cycle), 6 (short-lived climate forcers), 8 (water cycle), 9 (oceans, cryosphere and sea level) and 10 (regional models) for further discussion.
112889	85	22	86	3	The section aim to discuss "Evaluation of process-based models against observations". However, the models must be validated versus data different from those used for the internal tuning of the models themselves. Thus, among the various approaches, also testing whether the models are able to properly predict past climate changes both globally and locally needs to be required. [Nicola Scafetta, Italy]	Noted. This is indeed done, please see the discussions of model validation throughout the report (and linked to in the text in Chapter 1, section 1.5.)
70673	85	25		27	I don't think this is true. ESMValTool is publicly available, but it does not run automatically on new CMIP6 output published to the ESGF archive. Scripts have to be updated, and effort needs to be applied to resolve issues with non-standard datasets before the tool will run on newly-published data. [Gillett Nathan, Canada]	Taken into account. It's true that the process is not automatic. The sentence has been rephrased.
36849	85	27	85	27	"taking into account the observational uncertainty" is conceptually correct but surely you mean the uncertainty in the temperature data after it has been subjected to adjustment, averaging and any other processing. McLean (2018) "An Audit of the Creation and Content of the HadCRUT4 Temperature Dataset" showed more than 70 areas of uncertainty, and I very much doubt that these are all taken into account when the output of models is compared, given that the slow increase in global coverage of temperature data is so rarely mentioned in IPCC reports. [John McLean, Australia]	Noted. Yes - but this is all discussed in Chapter 2.
28739	85	28			model --> models? [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
112887	85	32	85	38	In addition to the cited references "(e.g. Bellenger et al., 2014; Covey et al., 2016; Pendergrass and Deser, 2017; 34 Goelzer et al., 2018)" there is a need to add and discuss the references that have found serious problems with the GCM models using metrics based on the empirical findings that the climate system presents long-scale cyclical behaviors from the decadal to the millennial scales, which the models do not reproduce. Scafetta, N., 2013. Discussion on climate oscillations: CMIP5 general circulation models versus a semi-empirical harmonic model based on astronomical cycles. Earth-Science Reviews 126, 321-357. Scafetta, N., 2012. Testing an astronomically based decadal-scale empirical harmonic climate model versus the IPCC (2007) general circulation climate models. Journal of Atmospheric and Solar-Terrestrial Physics 80, 124-137. Neff, U., Burns, S.J., Mangini, A., Mudelsee, M., Fleitmann, D., Matter, A.: 2001, Strong coherence between solar variability and the monsoon in Oman between 9 and 6 kyr ago. Nature 411, 290. And many others.... [Nicola Scafetta, Italy]	Rejected. The comment neglects to mention the critique of the suggested papers also present in the scientific literature (see e.g. Holm 2014 https://doi.org/10.1016/j.jastp.2014.01.014). For further discussion, see the model evaluation sections of the individual chapters, and the forcing/response breakdown presented in Chapter 7.
70147	85	33	85	34	Also cite here Beusch et al. 2020, in press, in GRL: https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2019GL086812 ; (see Fig. 2 of that paper which identifies different sets of best performing models based on regional climate sensitivity signals across IPCC regions, as well as based on the models' performance in capturing mean Tglob warming) [Sonia Seneviratne, Switzerland]	Accepted.
36851	85	36	85	38	You are admitting here that models are "improved" to match observations but earlier in this chapter it was implied that climate models accurately(?) replicated historical climate data without any tweaking. Clearly that earlier section was misleading. [John McLean, Australia]	Rejected. Clearly, a model can be assessed to perform well in one regard, while still improving in others. Model design and development is a continuous process, as is validation against observations.
70675	85	38			The reference to Chapter 3 should be to Section 3.8.2. [Gillett Nathan, Canada]	Accepted.
14519	85	41	85	41	awkward phrasing, suggest instead "and insights can be gained as to whether..." [Amy East, United States of America]	Accepted.
28741	85	43			There is also work that systematically assesses the coupling such as Southern ocean cloud biases e.g. Hyder et al. (2018) Nature Comms https://doi.org/10.1038/s41467-018-05634-2 [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted.
45355	85	50	86	3	The approach of instrument simulators is promising, also in other domains than cloud evaluation. The COSP simulator is the most sophisticated of such instrument simulators. However, I want to point to the sea-ice community, who is currently also working on instrument simulators (e.g. Burgard, C., Notz, D., Pedersen, L. T., and Tonboe, R. T.: The Arctic Ocean Observation Operator for 6.9 GHz (ARC3O) – Part 2: Development and evaluation, The Cryosphere Discuss., https://doi.org/10.5194/tc-2019-318 , in review, 2020.). Adding one or two sentences about the interest of instrument simulators for other climatic phenomena than clouds would highlight how dynamic this area of research is and how much potential there is. [Clara Burgard, Germany]	Accepted.
21373	85	50	86	3	It would seem worth to me making the point that instrument simulators are well-posed (a single geophysical profile yields a single unique instrument equivalent measure) whereas the inverse is not true - multiple geophysical profiles can satisfy a single instrument measure. This is why it makes more sense to convert the ESM output to the instrument equivalent but this is never made explicit here. My feeling is that there would be considerable value in doing so. [Peter Thorne, Ireland]	Rejected. This is a good point, but it is difficult to integrate in the current discussion without adding significant length.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
90959	85	54	85	54	"what a satellite would be" - should that be "what a satellite would see"? [Wendy Parker, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Indeed it should.
114311	86	6	86	42	This is an important element in AR6 WGI and will also be important in the communication of the findings. So it is important to explain this well here in Ch1. I suggest you give a very concrete example [Jan Fuglestedt, Norway]	Taken into account. Two examples drawn from Chapter 7 have been included, instead of a general description.
36855	86	8	86	8	The word "emergent" means "appearing", and "constraint" means "a limit", but what you describe is not a limit that is appearing. [John McLean, Australia]	Rejected. Even so, that is what the technique is being called in the literature. And constraint is not synonymous to 'limit'.
40011	86	8	86	10	Check consistency with glossary definition for emergent constraint "An attempt to reduce the uncertainty in climate projections, using an ensemble of ESMs to relate a specific feedback or future change to an observation of the past or current climate (typically some trend, variability or change in variability)." [TSU WGI, France]	Taken into account. The consistency has been checked.
70149	86	9	86	10	Also cite here Padron et al. 2019, GRL: Observational constraints reduce likelihood of extreme changes in multidecadal land water availability. Geophysical Research Letters, 46. https://doi.org/10.1029/2018GL080521 [Sonia Seneviratne, Switzerland]	Rejected. This is anyway not a complete list, and this reference seems a bit on the side.
16105	86	12	86	13	"Where an ensemble of different ESMs agrees on a relationship..." - This formulation might be a bit misleading. It sounds a bit like "each model has an idea about what the relationship should be, and the nice thing is that they agree". Each model is one data point, and the relationship appears (emerges) when these points are plotted. [Gerhard Krinner, France]	Accepted - text revised.
66405	86	12	86	15	The "can be converted" in this sentence makes it sound like this can always be done. Should be more like "can possibly be converted" or "can in some instances be converted". [Charles Koven, United States of America]	Rejected. The sentence begins with a conditional, so the "can" holds under the given assumptions.
13213	86	18	86	18	It's important to mention in which components the external forcing has been divided. [Maria Amparo Martinez Arroyo, Mexico]	Not applicable - this comment appeared misplaced? We cannot identify what it refers to.
41043	86	22	86	22	there are risks->there is the probability that... [TSU WGI, France]	Accepted - text revised.
38583	86	25	86	25	Wagman et al (2018; https://journals.ametsoc.org/doi/full/10.1175/JCLI-D-17-0682.1?af=R&mobileUi=0) use a PPE to show that the Sherwood index is not robust across their PPE even though it is across the MME. This should be included with Caldwell et al 2018 as an example of an 'out-of-sample' test. [David Sexton, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - text revised.
9099	86	30	86	30	Section 3.8 does not discuss emergent constraints. This is now in Ch4. [Olaf Morgenstern, New Zealand]	Accepted - text revised.
70677	86	37			Emergent constraints often use aspects of the mean climate, not just trends or variability. Also they are not only applied to climate sensitivity or feedbacks - they may also be applied directly to projections. I suggest 'an observable, mean, trend or variations in the climate (x-axis) and an uncertain projection, climate sensitivity or feedback (y-axis).' [Gillett Nathan, Canada]	Accepted - text revised.
24271	86	45	87	32	This only adds confusion and needs shortening. Such metrics are rarely used anywhere else in AR6. [Bryan Weare, United States of America]	Rejected. This discussion has been repeatedly asked for, as an acknowledgement of an ongoing methodological discussion in the literature.
90025	86	45	87	39	This account is consistent with that in Ch04 and worth showing up here. I'm missing an overall assessment of what to do about weighting. [Jochem Marotzke, Germany]	Rejected. We consider it out of the scope of Ch1 to perform this assessment, as different approaches are taken in various places in the report (and underlying literature).

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
36857	86	45	87	39	You try to imply that weighting the output of unvalidated models gives them with credibility. How gullible do you think your audience is? [John McLean, Australia]	Rejected. The premise is false; models are not unvalidated. They have known and quantified strengths and weaknesses, and some share ancestry and hence systematic behaviour. This warrants weighting in relevant analyses; not doing so would be ignoring information.
125405	86	45	87	40	Suggest the authors include reference to one of the biggest, most visible studies since AR5 to use a model weighting strategy: the Fourth U.S. National Climate Assessment. Here is the reference: Sanderson, B.M. and M.F. Wehner, 2017: Model weighting strategy. In: Climate Science Special Report: Fourth National Climate Assessment, Volume I [Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, D.J. Dokken, B.C. Stewart, and T.K. Maycock (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 436-442, doi: 10.7930/J06T0J53. This reference is DIFFERENT from the existing Sanderson et al. 2017 reference already cited in this section. [Trigg Talley, United States of America]	Accepted - text revised.
31485	86	47	86	50	Many results in this report, and in the underlying assessed literature, are based on ensembles of climate model simulations or projections. Such ensemble-based results have commonly assumed that each individual model is of equal value ('model democracy'). In other words, when combining simulations to estimate the mean and variance of quantities of interest, they are typically unweighted (Haughton et al., 2015) [...] This practice diminishes the contribution of comprehensive, fully-fledged models exhibiting a good match with observations, in favor of models that may have notable differences with observations (Tapiador et al., 2020). Comment: The 'one-model one-vote' approach has important drawbacks. For example, it diminished the contribution of comprehensive, fully-fledged models exhibiting a good match with observations, in favor of models that may have notable differences with observations (Tapiador et al. 2020, page 16). Reference: Tapiador, F.J., Navarro, A., Moreno, R., Sánchez, J.L., García-Ortega, E., 2020. Regional climate models: 30 years of dynamical downscaling. Atmospheric Research 235, 104785. https://doi.org/10.1016/j.atmosres.2019.104785 [Andrés Navarro, Spain]	Accepted - text revised.
125407	87	1	87	1	Model weighting was used in practice in the Fourth National Climate Assessment (Volume 1, USGCRP, 2017), which could be cited here. See < https://science2017.globalchange.gov/chapter/appendix-b/ >. [Trigg Talley, United States of America]	Accepted - text revised.
16107	87	1	87	1	"typically time series of global mean properties such as surface temperature" - I'm not sure that the typical weighting exercise uses time series. I personally have more examples in mind where pattern correlations or mean biases are used for model selection/weighting (selection being just an extreme form of weighting) (e.g. Agosta et al., The Cryosphere, 2015) [Gerhard Krinner, France]	Accepted - text revised.
34829	87	1	87	12	The SOD interestingly comments that even if the models are not fit for purpose, it can reach conclusions with high confidence if supported by other lines of evidence – how can that be so? [Jim O'Brien, Ireland]	Rejected. This is not quite what the assessment states. Fitness-for-purpose is a separate discussion, and can be established in various contexts. It needs to be in place for confidence statements, but models need to be fit-for-purpose in all aspects to be a line of evidence in a particular one.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
28275	87	5	87	14	See also methods section in Padrón, R. S., Gudmundsson, L., & Seneviratne, S. I. (2019). Observational constraints reduce likelihood of extreme changes in multidecadal land water availability. <i>Geophysical Research Letters</i> , 46, 736–744. https://doi.org/10.1029/2018GL080521 [Ryan Padrón, Switzerland]	Rejected. Thanks, but we cannot be comprehensive in listing all studies here that employ weighting techniques.
70679	87	7			Liang et al. (2020) apply a similar technique to CMIP6 warming projections and could be cited here (https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2019GL086757). [Gillett Nathan, Canada]	Accepted - citation added.
107839	87	10	87	12	A little more explanation would be desired here. The result described is a bit counterintuitive. [Linda Mearns, United States of America]	Accepted. The sentence has been revised.
70681	87	10		12	This wasn't a general result of Herger et al. (2018a), and whether an ensemble selected based on model performance performs better or worse than a random ensemble will depend on the performance metric used for the weighting, and the approach used to assess the quality of the model ensemble. The corresponding quote from Herger et al. is 'The performance ranking ensemble sometimes even performs worse than the random ensemble in its mean, even though of course the individual models perform better.' Re-phrase or delete the sentence. [Gillett Nathan, Canada]	Accepted. The sentence has been revised.
29739	87	11	87	11	Please, check the proper use of the parentheses. [Hernan Edgardo Sala, Argentina]	Editorial. Will be fixed in copy editing.
37837	87	11	87	11	(Herger et al., 2018a) --> Herger et al. (2018a)? [Junhee Lee, Republic of Korea]	Editorial. Will be fixed in copy editing.
114313	87	16	87	32	This para contains important information. But I miss some reflections or assessment of the implications for this report. Can you try to add that? [Jan Fuglestedt, Norway]	Noted. Some discussion has been added, but not a full assessment. We consider that beyond the scope of CH1, as the choices on weighting need to be made in light of the assessments in each subsequent chapter.
29741	87	29	87	29	Please, check the proper use of the parentheses. [Hernan Edgardo Sala, Argentina]	Editorial. Will be fixed in copy editing.
35497	87	29	87	29	Correct bibliographic citation [Carlos Antonio Poot Delgado, Mexico]	Editorial. Will be fixed in copy editing.
37839	87	29	87	29	(Sunyer et al., 2014) --> Sunyer et al. (2014)? [Junhee Lee, Republic of Korea]	Editorial. Will be fixed in copy editing.
113077	87	29	87	32	Integrate this better. Als '(Sunyer et al., 2014)' without brackets. [Diego Miralles, Belgium]	Editorial. Will be fixed in copy editing.
90027	87	34	87	34	Unfortunately, Ch04 had to scale down its ambition because of lack of literature on quantities other than GSAT and Ch09-derived assessments of Arctic SIA and GMSL. The Ch04 default has thus been the same as the AR5 one, so the language here probably needs to be downgraded, too. [Jochem Marotzke, Germany]	Accepted. The text has been made consistent with the revised Box 4.1
4251	87	34	87	39	As currently written, the paragraph would probably leave many readers interested in the weighting of models hanging in midair. It is not clear whether weighting is used throughout the AR6 (unlike AR5) or just in some parts of the report (e.g. Chapter 7 mentioned here). If weighting is applied for all model ensembles in the report, please state it clearly here. If not, please also clarify that it is only done in specific cases. Box 4.1 does not seem to clarify that either. [Claude-Michel Nzotungicimpaye, Canada]	Taken into account. Both this section and box 4.1 have been revised.
114315	87	42	88	12	Section 1.5.4.8: Well written and important, but it would be useful if you could add more about implications for AR6. [Jan Fuglestedt, Norway]	Accepted. The section has been moved to 1.5.4.1 and expanded,. References to the other chapters have been added.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
19665	87	42	88	12	This subsection is stimulating but somewhat disturbing. One thing is to recognize that no climate numerical model will ever be faultless; another one is to speculate that there is a limit to what can be done to improve the performances of a model in a specific area without deteriorating them in another area. It seems to me that the second proposition can only be understood in the presence of a constraint, typically a limit in the available computing power. But it is known that so far such limits use to go further and further away. It is not clear to me whether this report mentions the "fitness for purpose" concept for the sake of completeness of reporting the work carried out (in the present case at the interface between climate science and philosophy), or because it is believed to be a promising orientation for the improvement of climate modelling. [philippe waldteufel, France]	Noted. This sub-section has now been moved at the beginning of section 1.5.4. We believe that it fits better there and that the purpose is clearer, as an introduction to the other issues discussed in 1.5.4.
36859	87	42	88	12	The "fitness for purpose" is just a weasel notion to try to fudge around the fundamental issue of climate models not being validated. [John McLean, Australia]	Noted. Unclear what revision is requested there.
71427	87	42			I find this section too relevant for it being buried in a second-order subsection. Could this be lifted? It discusses the basis for all our confidence in projections! [Douglas Maraun, Austria]	Accepted. The subsection is now the first in 1.5.4
102481	87	43	87	45	While it is embedded in the current formulation, it might be useful to here make the explicit statement (like in previous reports) that no scenario is more probable than any other. Thus, there are countless examples from the literature - and actual applications - that the different scenarios are being labelled as more or less probably [Philippe Tulken, Belgium]	Noted. Comment seems to refer to Section 1.6.1 on page 88, same lines, where the scenarios are being introduced. We now state explicitly already in the Executive Summary that "The feasibility or likelihood of individual scenarios is not part of this assessment, which focuses on the climate response to possible, prescribed emission futures.". Section 1.6.1. discusses this in more detail, referring to the WGIII report for an assessment of the feasibility of specific scenarios in relation to current trends.
73963	87	44	87	49	This text makes impression that the purpose of the report was only to receive new scientific resultkeholders s, but adaptation of these results for stakeholders (decision makers, general public) was not important. [Elena Kozlovskaya, Finland]	Noted. Unclear what revision is requested there.
90961	87	45	87	45	Suggest changing "i.e." to "that is," for readability and clarity. [Wendy Parker, United Kingdom (of Great Britain and Northern Ireland)]	Accepted
90967	87	47	87	49	I am the author of Parker 2011 and think it is not particularly relevant here; I suggest replacing with Parker 2020. The latter was accepted for publication on 9 September 2019 and will appear in the July 2020 issue of the journal; it has doi: 10.1086/708691 -- you can see the paper here: https://www.journals.uchicago.edu/doi/10.1086/708691 . The relevant material is in Section 4, page 12. [Wendy Parker, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Reference modified.
90963	87	51	87	51	Suggest changing "New model evaluation tools and emergent constraint methodologies also can aid" to "New model evaluation tools, such as ESMValTool (Eyring et al., 2019a; Righi et al., 2019), and emergent constraint methodologies also can aid". Could also insert references to the preceding subsections where these are discussed. [Wendy Parker, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. References to the following subsections, on evaluation tools (1.5.4.5) and on emergent constraints (1.5.4.7). Eyring and Righi references are given in section 1.5.4.5 and not repeated here.
90965	87	53	87	53	Comma needed between "ensembles" and "in" [Wendy Parker, United Kingdom (of Great Britain and Northern Ireland)]	Accepted.
90969	88	9	88	9	I think Parker and Winsberg 2018 can be removed as a reference here, as it doesn't seem to be directly relevant. (I say this as an author on both of the papers cited here.) [Wendy Parker, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Reference removed.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
24273	88	10	88	12	This concluding statement saying "trust me" must be supported by literature. [Bryan Weare, United States of America]	The subsection has been moved to the top of 1.5.4. The sentence does no longer appear as a concluding statement for the section. We do not feel that additional references are needed there.
19667	88	15	88	15	Comments on section 1.6 will be offered when considering figure 1.28 [philippe waldteufel, France]	Noted. Thanks.
7219	88	20			The application of the Representative Concentration Pathways (RCPs, Moss et al., 2010) and the Shared Socioeconomic Pathways framework (SSPs; Riahi et al., 2017) or combination of both of them, need to be clarified. An explanation prior to use or cite the scenario are necessary, including full descriptions on the main component, assumptions and parameter used and scenario setting. This is important for the reader to have a better understanding of the applied projections. In addition, a scientific background is needed to the application of RCPs. Review on the SROCC and SRLCC showed that most research have applied only two RCPs (RCP 2,6 - the lowest emission scenario and RCP 8,5- the highest scenario), as limited data to support the applications of others RCPs (RCP 4,5 and RCP 6). [Asaad Irawan, Indonesia]	Taken into account. We have restructured the section in order to provide an introduction to the SSP upfront. The new Cross-Chapter Box on the SSPs and their use in the WGI report also helps in this regard. We can however not go into all the details of the RCPs here given that the SSPs are the core set of scenarios used and given the length constraints.
67821	88	20			The application of the Representative Concentration Pathways (RCPs, Moss et al., 2010) and the Shared Socioeconomic Pathways framework (SSPs; Riahi et al., 2017) or combination of both of them, need to be clarified. An explanation prior to the use or citing of the scenario are necessary, including full descriptions on the main components, assumptions and parameters used and scenario setting. It is important for readers to have a better understanding of the applied projections. In addition, a scientific background is needed regarding the application of RCPs. Review on the SROCC and SRLCC showed that most research have applied only two RCPs (RCP 2,6 - the lowest emission scenario and RCP 8,5- the highest scenario), as there is more limited data to support the applications of others RCPs (RCP 4,5 and RCP 6). [Ruandha Agung Sugardiman, Indonesia]	Taken into account. We have restructured the section in order to provide an introduction to the SSP upfront. The new Cross-chapter Box on the SSPs and their use in the WGI report also helps in this regard. We can however not go into all the details of the RCPs here given that the SSPs are the core set of scenarios used and given the length constraints.
86673	88	25	88	25	We are finding the choice of words within the parantheses slightly odd. Please consider to be somewhat more precise. Alternatives for you to consider includes including "such as" in both cases, or use e.g. "potential for emission reductions" for WGIII and "impacts associated with climate model projections" for WGII, if appropriate. [Oyvind Christophersen, Norway]	Taken into account. The sentence is rephrased to "Similarly, cumulative carbon emissions and global warming levels (GWL) provide key links between WGI assessments and those of the other WGs."
40777	88	27			Section structure is provided here, but not for the other Sections. [TSU WGI, France]	Rejected. All sections in the chapter start with a brief overview of the content by subsections
24275	88	36	90	23	This section does not properly define the VERY important SSPs used through this report. Fig. 1.22, 1.23 and 1.24 help very little. A major discussion and figure needs to be added expanding on the two left-most boxes of Fig. 1.23. For each of the major SSPs one needs to see the assumed emissions for not only CO2, also the other long-lived GHG and ozone. This could look something like Fig. 1.25, which reasonably describes the secondary forcing. Then one must include plots of the assumed concentrations that most CMIP6 models are actually using. Only with a few detailed specific examples can one comprehend the SSP nomenclature and the scenarios that underlies it. This all is a major failing that needs careful thought. It must be made clear exactly what inputs are passed to the models described in Ch.3 and especially Ch.4. [Bryan Weare, United States of America]	Taken into account. Section has been restructured and the Cross-Chapter Boxes deleted or incorporated into the main text. A new Cross-Chapter Box was added on "The SSP scenarios as used in Working Group I". The main text is now streamlined and the RCP-SSP comparison has been added in different places including many new references to recent literature. A new figure is presented that provides the main timeseries of emissions and concentrations in SSP scenarios.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
111519	88	36	100	4	Section 1.6.1 on Scenarios needs to be much clearer on the difference between CO2 emissions and changes in CO2 concentrations. The discussion here frequently conflates the two, and seems to overlook the fact that the CMIP6 projections used in this report are driven by CO2 concentration rather than being fully coupled climate-carbon cycle models driven by scenarios of emissions. The discussion here, including the text and also Box 1.4 Table 1, needs to recognise that there is no single one-to-one mapping of emissions scenarios and concentration pathways, and any radiative forcing level could be reached from a range of emissions depending on how strong the carbon cycle feedbacks are. [Richard Betts, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Section has been restructured and the Cross-Chapter Boxes deleted or incorporated into the main text. A new Cross-Chapter Box was added on "The SSP scenarios as used in Working Group I". The main text is now streamlined and the RCP-SSP comparison has been added in different places including many new references to recent literature. A discussion of emission- vs concentration-driven runs has been included. We revised the text to make it clear that the majority of WG1-assessed scenarios and CMIP6 experiments is indeed concentration driven and that the carbon cycle and gas cycle steps between emissions and concentrations come with uncertainties.
21385	88	36			I felt that overall across the text and the two boxes there was a lot of repetition and that this led to some potential for within section reader confusion. Does this really need two boxes and do some concepts really need to be present in the text and in both boxes? It feels to me like this whole outline of scenarios could be much cleaner. Also, notably missing, at least explicitly as far as I could tell was any discussion around the RCP and SSP despite nominally having the same forcing in 2100 often having very different pathways to get there and the implications thereof for direct comparison of RCPX.X to SSPY-X.X runs which seems critical in support of latter chapters. If there already it needs to be brought out more explicitly in redrafting. [Peter Thorne, Ireland]	Taken into account. Section has been restructured and the Cross-Chapter Boxes deleted or incorporated into the main text. A new Cross-Chapter Box was added on "The SSP scenarios as used in Working Group I". The main text is now streamlined and the RCP-SSP comparison has been added in different places including many new references to recent literature.
107841	88	38	88	38	But the term 'scenario' in this first line is used in other contexts, e.g., climate scenario. Shouldn't the term scenario here be modified somehow, e.g., socio-economic scenarios? [Linda Mearns, United States of America]	Taken into account. We do not, however, provide an all-encompassing definition of scenarios related to socio-economic characteristics. We do still mention that scenarios can be defined geophysical driving forces only.
125409	88	38	88	38	Suggest changing to "not-improbable"; plausibility over the course of the coming century is hard to gauge. [Trigg Talley, United States of America]	Taken into account. Deleted "plausible" in that particular sentence. Plausibility of 100-year scenarios is judged from today's point of view. The reviewer is correct, that over the long time frame of the century, plausibility will diminish for some of the scenarios. Given the broad basis of research underpinning the scenario development, labelling scenarios in this context as "Not improbable" is not considered to be helpful and we thus refrain from doing so and keep the term "plausible" in a few other places.
18457	88	45	88	46	actually GSAT not GMST..... [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	Noted. We now write "global mean temperature" to avoid the need to get into the technical distinction between GMST and GSAT.
102483	88	48	88	48	There seems to be a ":" missing in this sentence [Philippe Tulkens, Belgium]	Rejected. Not clear what the reviewer is referring to.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
115743	88		90		I suggest to more explicitly highlight land use as a dimension of integration(important for biodiversity and ecosystems, building on SRCLL) [Valerie Masson-Delmotte, France]	Rejected. We limit the dimensions of integration to few overarching key dimensions here and in Section 1.6. Other dimensions would be possible to be included, but we decided against it for practical reasons. Note that land use (change) is considered as part of the scenarios/projections and thus at least implicitly covered.
10393	89	1	80	11	This type of figure does not have a place in a scientific report. It is a gimmick and communicates little in the way of scientific information. Time series plots will provide much clarity and be much more easily understandable. There is no colour bar to give an indication of what is being shown. The dark reds at the right look similarly dark to the dark blues to the left, giving the impression that future warming is similar to past warming. It is almost impossible to gauge what the rates of change are. Have they accelerated or slowed down? No reference period is given. What the spreading outwards of the bars to the right indicates is anyone's guess. What temperature dataset was used for the historical period? How was the simulated future blended with the observations? Any discrepancy between models and observations would be impossible to see in this plot. What does the vertical dimension represent? [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Comments/questions taken into account. Figure has been revised and is better explained.
17395	89	1	89	11	Fig. 1.22 lacks a scale indicating relationship between colour and temperature. [Graham Weedon, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Colour scale added.
38657	89	3	89	3	Fig 1.22 - For a better understanding it's recommended to indicate in full the acronym SSP in the figure. [Luisa Sturiale, Italy]	Rejected. Not considered necessary.
114317	89	3	89	9	Useful fig but from an aesthetic point of view, I wonder if the part up to 2015 could be shrunk to approx the same size of the futures. The the branching and alternative ways would then be given relatively more weight. And the time dimension could probably be made clearer by stronger indication of peak, half and zero. [Jan Fuglestedt, Norway]	Noted. We keep the time axis constant. Indication of peak, half and zero emissions visually more highlighted.
125411	89	3	89	9	Figure 1.22 needs an explanation of the color codes in red and blue. Blue is cool but what was the temperature range of the various shades of blue in the MIROC-6 model output? [Trigg Talley, United States of America]	Taken into account. Colour scale added.
17905	89	3	89	9	Why not use the multi-model mean or median? Why MIROC, particularly if it is an outlier? [Katherine Calvin, United States of America]	Taken into account. We no show assessed GSAT projections under the SSPs from Chapter 4. For the projections, the upper end of each arrow aligns with the 95% percentile of the projected temperatures and the lower end aligns with the colour corresponding to the 5% percentile of the projected temperature range. For illustrative purposes, natural variability has been added from a single CMIP6 ESM model.
28743	89	3			A colour bar could be added to Figure 1.22 - nice plot! [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Colour scale added.
114319	89	17	89	17	I suggest inserting "emission/concentration" before "scenario" [Jan Fuglestedt, Norway]	Accepted. Revised accordingly.
114321	89	17	89	18	It is good that you refer to the box on this in SRLCCL, but what about the box in this chapter? [Jan Fuglestedt, Norway]	Accepted. Revised accordingly.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
50631	89	23	89	23	It is confusing to treat emission and concentration scenarios as if they are the same thing when they are different. There has been widespread surprise, even among scientists, that the reduction in emissions due to the Covid-19-related global lockdown did not result in a reduction in CO2 concentrations, and in fact concentrations continued to rise. This suggests that many people expected that dealing with climate change would be easier than it is, and are not aware of the long-term commitment to climate change that comes from the long lifetime of CO2 in the atmosphere. Promoting the idea that emissions and concentrations are interchangeable risks continuing this confusion. Also, it overlooks the uncertainties in climate-carbon cycle feedbacks that mean that there is no single concentration pathway that would arise from any one emissions scenario or socioeconomic pathway. [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Section has been restructured and the Cross-Chapter Boxes deleted or incorporated into the main text. A new Cross-Chapter Box was added on "The SSP scenarios as used in Working Group I". The main text is now streamlined and the RCP-SSP comparison has been added in different places including many new references to recent literature. A discussion of emission- vs concentration-driven runs has been included. We revised the text to make it clear that the majority of WG1-assessed scenarios and CMIP6 experiments is indeed concentration driven and that the carbon cycle and gas cycle steps between emissions and concentrations come with uncertainties.
45777	89	23	89	23	The scenarios are not only "emissions and concentration scenarios", but also describe land use. [Twan van Noije, Netherlands]	Accepted. Revised accordingly.
125413	89	26	89	26	[PRECISION] SSP stands for shares socioeconomic pathways, not scenarios. Use of pathway and scenario needs to be clarified across this section. [Trigg Talley, United States of America]	Noted. We agree. the terminology-mess is not helpful. The Cross-Chapter Box is deleted and the SSP concept introduced in the main text; the use of the SSPs in the WGI report introduced in a new, dedicated Cross-Chapter Box.
107843	89	26	89	28	It seems unfortunate that the term 'SSP' now can mean different things. The whole description of the RCPs-SSPs from AR5 vs. the SSPs in AR6 is confusing. For the uninitiated, this could be a torturous thing to sort out. There must be a way to summarize the differences more simply. Cross chapter box 1.5 isn't all that helpful in this regard. [Linda Mearns, United States of America]	Noted. We agree. the terminology-mess is not helpful. The Cross-Chapter Box is deleted and the SSP concept introduced in the main text; the use of the SSPs in the WGI report introduced in a new, dedicated Cross-Chapter Box.
50633	89	27	89	27	It is confusing to treat emission and concentration scenarios as if they are the same thing when they are different. There has been widespread surprise, even among scientists, that the reduction in emissions due to the Covid-19-related global lockdown did not result in a reduction in CO2 concentrations, and in fact concentrations continued to rise. This suggests that many people expected that dealing with climate change would be easier than it is, and are not aware of the long-term commitment to climate change that comes from the long lifetime of CO2 in the atmosphere. Promoting the idea that emissions and concentrations are interchangeable risks continuing this confusion. Also, it overlooks the uncertainties in climate-carbon cycle feedbacks that mean that there is no single concentration pathway that would arise from any one emissions scenario or socioeconomic pathway. [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Section has been restructured and the Cross-Chapter Boxes deleted or incorporated into the main text. A new Cross-Chapter Box was added on "The SSP scenarios as used in Working Group I". The main text is now streamlined and the RCP-SSP comparison has been added in different places including many new references to recent literature. A discussion of emission- vs concentration-driven runs has been included. We revised the text to make it clear that the majority of WG1-assessed scenarios and CMIP6 experiments is indeed concentration driven and that the carbon cycle and gas cycle steps between emissions and concentrations come with uncertainties.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
50635	89	33	89	33	It is confusing to treat emission and concentration scenarios as if they are the same thing when they are different. There has been widespread surprise, even among scientists, that the reduction in emissions due to the Covid-19-related global lockdown did not result in a reduction in CO2 concentrations, and in fact concentrations continued to rise. This suggests that many people expected that dealing with climate change would be easier than it is, and are not aware of the long-term commitment to climate change that comes from the long lifetime of CO2 in the atmosphere. Promoting the idea that emissions and concentrations are interchangeable risks continuing this confusion. Also, it overlooks the uncertainties in climate-carbon cycle feedbacks that mean that there is no single concentration pathway that would arise from any one emissions scenario or socioeconomic pathway. [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Section has been restructured and the Cross-Chapter Boxes deleted or incorporated into the main text. A new Cross-Chapter Box was added on "The SSP scenarios as used in Working Group I". The main text is now streamlined and the RCP-SSP comparison has been added in different places including many new references to recent literature. A discussion of emission- vs concentration-driven runs has been included. We revised the text to make it clear that the majority of WG1-assessed scenarios and CMIP6 experiments is indeed concentration driven and that the carbon cycle and gas cycle steps between emissions and concentrations come with uncertainties.
102485	89	41	89	42	While it is embedded in the current formulation, it might be useful to here make the explicit statement (like in previous reports) that no scenario is more probable than any other. Thus, there are countless examples from the literature - and actual applications - that the different scenarios are being labelled as more or less probable [Philippe Tulkens, Belgium]	Taken into account. This is explicitly stated in the new Section 1.6.1.1: Finally, in general no likelihood is attached to the scenarios assessed in this report. However, the likelihood of various high-emission reference scenarios remains a topic of discussion in the scientific literature (Section 1.6.1.4).
18459	89	45	89	45	WG II as well as WG III - O'Neill is a WG II author [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Revised accordingly.
114323	89	45	89	46	Can you also try to indicate a bit more clearly in the figure where the process starts? [Jan Fuglestedt, Norway]	Accepted. Revised accordingly.
67015	89	46	89	46	change "Storylines" to "Scenario storylines" to reinforce difference from physical climate storylines [Liese Coulter, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Revised accordingly.
14523	89	48	89	48	awkward phrasing. Suggest surrounding the phrase "gross domestic product (GDP), population, technology, energy, and land use demand" with either parentheses or em-dashes [Amy East, United States of America]	Accepted. Added "i.e.," before "gross domestic product".
17907	89	48	89	48	I would remove the word "demand". The scenarios also include energy supply, transformation, etc. [Katherine Calvin, United States of America]	Accepted. Revised accordingly.
12427	89	49	89	56	A short discussion on the difference of emission and concentration scenario is helpful. [Lijing Cheng, China]	Accepted. The former Cross-Chapter Box 1.5 has been deleted. The new box 1.4 now focuses on the SSPs and their use in this WGI report. We do agree that this distinction is important. It is thus described in two paragraphs in the revised FGD Box.1.4 text. [Comment does not apply to page 89. Could it be page 90?]

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
50637	89	53	89	54	Please provide details of the extent to which uncertainties in deriving concentration pathways from emissions scenarios have been taken into account in this process. [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Section has been restructured and the Cross-Chapter Boxes deleted or incorporated into the main text. A new Cross-Chapter Box was added on "The SSP scenarios as used in Working Group I". The main text is now streamlined and the RCP-SSP comparison has been added in different places including many new references to recent literature. A discussion of emission- vs concentration-driven runs has been included. We revised the text to make it clear that the majority of WG1-assessed scenarios and CMIP6 experiments is indeed concentration driven and that the carbon cycle and gas cycle steps between emissions and concentrations come with uncertainties.
114325	90	4	90	4	re "feeding back information": not clear to reader if this is results or models. You may say that this will be in the form of simplified models [Jan Fuglestedt, Norway]	Accepted. Revised accordingly.
114327	90	4	90	4	You may add a ref to WGIII Annex C [Jan Fuglestedt, Norway]	Accepted. Revised accordingly.
114329	90	5	90	5	I dont think they use sea level rise. Please check. [Jan Fuglestedt, Norway]	Accepted. Revised accordingly.
114331	90	6	90	9	I am not sure how much of this is used by WGII. We need to check. [Jan Fuglestedt, Norway]	Accepted. Revised accordingly.
24281	90	26	94	2	This section continues the weaknesses in pages 88-90 [Bryan Weare, United States of America]	Noted. No changes requested. The former Cross-Chapter Box 1.5 has been deleted. The new box 1.4 now focuses on the SSPs and their use in this WGI report.
106255	90	28	94	2	Great overview, which might be further strengthened by supporting the descriptions in the main text of the Box with references. [Rogel] Joeri, United Kingdom (of Great Britain and Northern Ireland)]	Noted. No changes requested. The former Cross-Chapter Box 1.5 has been deleted. The new box 1.4 now focuses on the SSPs and their use in this WGI report.
70687	90	28	94	2	I was more confused after reading this table about the relationship between SSPs and RCPs than I was before. The table makes reference to the 'integrative SSP-RCP framework', and implies that RCPs and SSPs are somehow directly related. If I understand correctly, RCPs were concentration pathways developed during the AR5 assessment cycle, and there are five of them. They are labelled based on the approximate radiative forcing in 2100. The SSP scenarios used in AR6 are based on the five SSPs, and each scenario is also labelled based on the approximate radiative forcing in 2100. The only direct relationship between these scenarios and the RCPs is that both are labelled based on the radiative forcing in 2100. The concentrations and emissions in these scenarios are not the same as those in the RCPs. Referring to the two sets of scenarios as an 'integrative SSP-RCP framework' just make things confusing for the reader. If a small number of impacts studies have considered RCP climate changes and other drivers from the SSPs, this still doesn't justify calling this an integrated framework. I suggest describing the SSPs without refernce to the RCPs, except possibly noting that, like the RCPs, the SSP scenarios used in this report are labelled based on their approximate radiative forcing in 2100. And shorten the discussion of the RCPs, to note that these were concentration scenarios used in AR5. Or possibly if I have still misunderstood then the relationship between the SSPs and RCPs needs to be explained more clearly. [Gillett Nathan, Canada]	Taken into account. Section has been restructured and the Cross-Chapter Boxes deleted or incorporated into the main text. A new Cross-Chapter Box was added on "The SSP scenarios as used in Working Group I". The main text is now streamlined and the RCP-SSP comparison has been added in different places including many new references to recent literature. A discussion of emission- vs concentration-driven runs has been included. We revised the text to make it clear that the majority of WG1-assessed scenarios and CMIP6 experiments is indeed concentration driven and that the carbon cycle and gas cycle steps between emissions and concentrations come with uncertainties.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
50607	90	28	94	2	Many of the terms defined here are also defined (more briefly) in the Glossary. We recommend that in such instances, the Glossary definitions have a note saying "see Cross-Chapter Box 1.5 for a more detailed explanation." (We have made a similar comment against the Glossary) [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The former Cross-Chapter Box 1.5 has been deleted. The new box 1.4 now focuses on the SSPs and their use in this WGI report. For definitions, we now refer to the Glossary.
81129	90	28	94	2	Very well written, but needs more clarification on socio-economic scenarios [Mary Matthews, Azerbaijan]	Noted. The former Cross-Chapter Box 1.5 has been deleted. The new box 1.4 now focuses on the SSPs and their use in this WGI report. For definitions, we now refer to the Glossary. Presentation of SSP was restructured to provide more clarity. However, this is the report on the physical science basis. The socioeconomic details on the SSPs will be provided in the WGIII report.
102487	90	36	90	36	"if" should be "of" [Philippe Tulkens, Belgium]	Not applicable. Former Cross-Chapter Box 1.5 has been deleted.
131393	90	36	90	37	Cross-Chapter Box 1.5: Scenarios, Projections, Pathways and temperature-levels: is it really necessary to refer to the three glossaries of the working groups? There will be a joint glossary so that terms and definitions across working groups should be identical and key concepts will appear in all three glossaries. [Hans Poertner and WGII TSU, Germany]	Noted.. Reference should still be to the WGI Glossary here, which will be part of the printed WGI report. The former Cross-Chapter Box 1.5 has been deleted.
114333	90	36	90	37	Please note that we have a common Glossary [Jan Fuglestedt, Norway]	Noted. Former Cross-Chapter Box 1.5 has been deleted.
29743	90	43	90	43	Please, use "AR6" instead of "Sixth Assessment Report". [Hernan Edgardo Sala, Argentina]	Not applicable. Former Cross-Chapter Box 1.5 has been deleted.
70683	90	43			The term 'pathways' is used here before it is defined. I suggest either not using the term here, or putting 'Pathway' before 'Scenario' in the table. [Gillett Nathan, Canada]	Not applicable. Former Cross-Chapter Box 1.5 has been deleted.
13169	90	44	90	44	Missing explanation of the meaning of the SSP1-1.9 etc. There needs to be an introduction before the new scenarios. [Maria Amparo Martinez Arroyo, Mexico]	Taken into account. Reference to the Table made in the main text. Former Cross-Chapter Box 1.5 has been deleted.
114335	90	44	90	44	I suggest changing "comparison" to "applications" [Jan Fuglestedt, Norway]	Accepted. Revised accordingly. Former Cross-Chapter Box 1.5 has been deleted.
18461	90	44	90	45	The plausibility of RCP85 is an open question in WG III. [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	Noted. No changes requested.
131395	90	44	90	45	I suggest introducing/explaining the acronym SSP first before using it in this CCB. CCBs should be seen as stand-alone products that can be understood without reading the entire chapter. [Hans Poertner and WGII TSU, Germany]	Noted. Editorial decision. Former Cross-Chapter Box 1.5 has been deleted.
28745	90	44			It could refer to table for what the RCP numbers mean. [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Reference to the Table made in the main text. Former Cross-Chapter Box 1.5 has been deleted.
114337	90	45	90	45	I suggest adding "societal and climatic" before "futures" [Jan Fuglestedt, Norway]	Accepted. Revised accordingly. Former Cross-Chapter Box 1.5 has been deleted.
9101	90	49	90	50	This is a slightly too narrow definition of a "scenario". Scenarios include emission datasets for ozone precursors that are not "potentially radiatively active" (why "potentially" here -- gases are either active or not). They are chemically active producing ozone, which is then radiatively active. [Olaf Morgenstern, New Zealand]	Not applicable. The former Cross-Chapter Box 1.5 has been deleted. For definitions, we now refer to the Glossary.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
41129	90	49	90	53	Update definition to be consistent with glossary definition (differences in all caps): A plausible representation of the future development of emissions of substances that ARE RADIATIVELY ACTIVE (e.g., greenhouse gases (GHGs) or aerosols), plus human-induced land cover changes that can be radiatively active via albedo changes, based on a coherent and internally consistent set of assumptions about driving forces (such as demographic and socio-economic development, technological change, ENERGY AND LAND USE) and their key relationships. Concentration scenarios, derived from emission scenarios, are often used as input to a climate model to compute climate projections. [TSU WGI, France]	Not applicable. The former Cross-Chapter Box 1.5 has been deleted. For definitions, we now refer to the Glossary.
67701	90	49	91	2	Tropospheric ozone is denoted in 'concentration scenario' but the emission scenario of the precursors of tropospheric ozone is not denoted in 'emission scenario'. This may be odd. [Hiroaki Kondo, Japan]	Not applicable. The former Cross-Chapter Box 1.5 has been deleted. For definitions, we now refer to the Glossary.
50639	90	49	91	2	Please point out that the reason why emissions scenarios and concentrations scenarios are defined separately is because there are uncertainties in relating emissions to concentrations. Eg. for concentrations scenarios that limit warming to a particular level, such as 1.5C or 2C, there is a range of emissions scenarios compatible with this, due to uncertainties in climate-carbon cycle feedbacks. Similarly, a single emissions scenario could result in a range of concentrations scenarios. [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Section has been restructured and the Cross-Chapter Boxes deleted or incorporated into the main text. A new Cross-Chapter Box was added on "The SSP scenarios as used in Working Group I". The main text is now streamlined and the RCP-SSP comparison has been added in different places including many new references to recent literature. A discussion of emission- vs concentration-driven runs has been included. We revised the text to make it clear that the majority of WG1-assessed scenarios and CMIP6 experiments is indeed concentration driven and that the carbon cycle and gas cycle steps between emissions and concentrations come with uncertainties.
70685	90	50			Delete 'potentially'. [Gillett Nathan, Canada]	Not applicable. The former Cross-Chapter Box 1.5 has been deleted. For definitions, we now refer to the Glossary.
41127	90	55	91	2	Update definition to be consistent with glossary definition (differences in all caps): "A plausible representation of the future development of atmospheric concentrations of substances that ARE RADIATIVELY ACTIVE (e.g., greenhouse gases (GHGs), aerosols, tropospheric ozone), plus human-induced land cover changes that can be radiatively active via albedo changes, and OFTEN used as input to a climate model to compute climate projections." [TSU WGI, France]	Not applicable. The former Cross-Chapter Box 1.5 has been deleted. For definitions, we now refer to the Glossary.
9105	90	56	90	56	"Concentrations" are slightly incorrect here. These gases are prescribed in terms of their volume mixing ratios (unit: molecule/molecule). Concentrations would be in terms of mass or molecules/volume. Concentrations of long-lived GHGs would not be nearly uniform in space, VMRs are. [Olaf Morgenstern, New Zealand]	Not applicable. The former Cross-Chapter Box 1.5 has been deleted. For definitions, we now refer to the Glossary.
9103	91	1	91	1	Cut out "tropospheric" -- this also applies to stratospheric and mesospheric ozone which in most CMIP6 models is prescribed. [Olaf Morgenstern, New Zealand]	Not applicable. The former Cross-Chapter Box 1.5 has been deleted. For definitions, we now refer to the Glossary.
125415	91	4	91	5	Consider referencing and describing the Kaya Identity in this definition of "socioeconomic scenario." [Trigg Talley, United States of America]	Not applicable. The former Cross-Chapter Box 1.5 has been deleted. For definitions, we now refer to the Glossary.
81131	91	4	91	5	Please clarify what are "other socioeconomic factors"? As is, it seems very cursory and perhaps not as valid as needed. [Mary Matthews, Azerbaijan]	Not applicable. The former Cross-Chapter Box 1.5 has been deleted. For definitions, we now refer to the Glossary.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
113079	91	7	91	7	It would be good to clarify the difference with the concept 'storylines' used earlier on, or at least mention this difference explicitly. [Diego Miralles, Belgium]	Not applicable. The former Cross-Chapter Box 1.5 has been deleted. For definitions, we now refer to the Glossary.
125417	91	7	91	8	Include the following in the definition of "scenario storyline": "Many different storylines can be consistent with a given scenario. Said another way, a scenario does not necessarily imply any single storyline." This point is captured in the following definitions ("pathway" and "RCPs"), but it's necessary to include it here. In fact, there is very good language on p. 94, lines 43-44, that could be copied here as well. [Trigg Talley, United States of America]	Not applicable. The former Cross-Chapter Box 1.5 has been deleted. For definitions, we now refer to the Glossary.
77625	91	10	91	10	Replace 'and or' with 'and/ or' [Emer Griffin, Ireland]	Not applicable. The former Cross-Chapter Box 1.5 has been deleted. For definitions, we now refer to the Glossary.
131397	91	12	91	14	This sentence is unclear. Are the 2 examples 1.the idealized pathway and 2. the RCP? In that case the term 'idealized pathway' should be also in quotationmarks, and maybe consider briefly explaining the term. CCBs should be seen as stand-alone products that can be understood without reading the entire chapter. [Hans Poertner and WGII TSU, Germany]	Not applicable. The former Cross-Chapter Box 1.5 has been deleted. For definitions, we now refer to the Glossary.
131399	91	14	91	14	when mentioning RCPs refer to paragraph below where RCPs are explained [Hans Poertner and WGII TSU, Germany]	Not applicable. The former Cross-Chapter Box 1.5 has been deleted. For definitions, we now refer to the Glossary.
131401	91	15	91	15	provide full name for SSPs here and refer to paragraph below where SSPs are explained [Hans Poertner and WGII TSU, Germany]	Not applicable. The former Cross-Chapter Box 1.5 has been deleted. For definitions, we now refer to the Glossary.
21377	91	16	91	16	Be explicit which SR. I assume SR1.5? [Peter Thorne, Ireland]	Not applicable. The former Cross-Chapter Box 1.5 has been deleted. For definitions, we now refer to the Glossary.
106253	91	16	91	17	This is an important point, and I'm wondering whether the term "target-oriented scenarios" would benefit from a few more words of explanation, as it might not be clear to the reader what the difference is with other scenarios. My understanding of the use of the "pathway" concept in different communities is that a "pathway" describes a path towards a desirable future - and hence the initial great interdisciplinary confusion that something like "RCP8.5" would exist at all. [Rogel] Joeri, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. The former Cross-Chapter Box 1.5 has been deleted. For definitions, we now refer to the Glossary.
131403	91	16	91	17	Provide title of SR15 and proper citation [Hans Poertner and WGII TSU, Germany]	Not applicable. The former Cross-Chapter Box 1.5 has been deleted. For definitions, we now refer to the Glossary.
98527	91	16	91	17	It is unclear which of the 3 IPCC Special Reports is being referred to in the sentence "In the IPCC Special Report, the term 'pathway'". Is this SR1.5, SROCC or SRCLL? [Philippus Wester, Nepal]	Not applicable. The former Cross-Chapter Box 1.5 has been deleted. For definitions, we now refer to the Glossary.
80999	91	19	91	31	Perhaps a fuller definition and explanation of RCPs in terms of what the numbers mean in terms of radiative forcing and their temperature equivalents is needed, or at least reference to a sub-section so that the reader can get a fuller explanation and level of understanding as to their meaning and significance. [Jeffrey Philip OBBARD, Singapore]	Not applicable. The former Cross-Chapter Box 1.5 has been deleted. For definitions, we now refer to the Glossary.
131405	91	19	93	2	There seems some overlap/redundancy between details given in the text and details given in the table. Maybe try to reduce [Hans Poertner and WGII TSU, Germany]	Not applicable. The former Cross-Chapter Box 1.5 has been deleted. For definitions, we now refer to the Glossary.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
33269	91	24			Erase point. [Guiomar Rotllant, Spain]	Not applicable. The former Cross-Chapter Box 1.5 has been deleted. For definitions, we now refer to the Glossary.
50641	91	25	91	26	Please highlight the fact that although the IAMs produce specific emissions scenarios aligned to the RCPs, Earth System Models driven by RCP concentration pathways produce a number of different pathways of emissions compatible with a single concentration pathway. [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account in the main text in Section 1.6.1.1. The former Cross-Chapter Box 1.5 has been deleted. For definitions, we now refer to the Glossary.
29745	91	29	91	29	Please, use "AR5" instead of "Fifth IPCC Assessment". [Hernan Edgardo Sala, Argentina]	Accepted. Text revised accordingly. The former Cross-Chapter Box 1.5 has been deleted.
14525	91	29	91	29	elsewhere in this report the "Fifth IPCC Assessment" is referred to as the AR5. Consistent terminology will be essential. [Amy East, United States of America]	Accepted. Text revised accordingly. The former Cross-Chapter Box 1.5 has been deleted.
77627	91	30	91	30	approximately below' is confusing [Emer Griffin, Ireland]	Accepted. Text revised to clarify this. The former Cross-Chapter Box 1.5 has been deleted.
113081	91	33	91	33	Revise the capitalization of 'Shared Socioeconomic Pathways' throughout. [Diego Miralles, Belgium]	Accepted. Done where applicable. The former Cross-Chapter Box 1.5 has been deleted.
107845	91	33	91	46	More on the SSPs. So one change that might help make the shift in meaning of the SSPs clearer would be to more cleanly distinguish between how the IAMs were used for developing the RCPs for AR5 and how they were used in AR6. Also, one of the strengths of the initial RCP-SSP matrix was that you could explore different combos of SSPs and RCPs. Why was it worth sacrificing that flexibility in this new context? [Linda Mearns, United States of America]	Noted. We have restructured the scenario and SSP presentation to make this clearer. The former Cross-Chapter Box 1.5 has been deleted.
21379	91	33	91	46	An admittedly not particularly useful comment here but just to note that I found this very challenging to read and I'm pretty sure I didn't get the intended messaging. But I'm not sure why and hence at a loss to make any specific and useful suggestions here, sorry. Also this text is somewhat redundant with section 1.6.1.3 [Peter Thorne, Ireland]	Noted. We have restructured the scenario and SSP presentation to make this clearer. The former Cross-Chapter Box 1.5 has been deleted.
9107	91	36	91	36	replace "if" with "of". [Olaf Morgenstern, New Zealand]	Accepted. Text revised accordingly. The former Cross-Chapter Box 1.5 has been deleted.
28747	91	36			if --> of [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Text revised accordingly. The former Cross-Chapter Box 1.5 has been deleted.
114339	91	38	91	38	A relevant paper by O'Neill et al. may be referred to here: Achievements and needs for the climate change scenario framework, Submitted to Nature Climate Change (In revisions) [Jan Fuglestedt, Norway]	Not applicable. The former Cross-Chapter Box 1.5 has been deleted. Reference added to the main text with the SSPs
114341	91	45	91	45	you may add "...and climate impacts" after "assumption" [Jan Fuglestedt, Norway]	Not applicable. The former Cross-Chapter Box 1.5 has been deleted.
50643	91	45	91	46	It is a very substantial approximation to assume that any particular socioeconomic pathway will lead to a specific radiative forcing by 2100. There are large uncertainties involved in the steps from socioeconomic scenario to emissions to concentrations to radiative forcing, which are downplayed here. [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Uncertainties are being discussed and the approximation in terms of radiative forcing is explicitly discussed in Section 1.6.1.1 on the SSPs

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
106257	91	49	93	2	<p>Cross-Chapter Box 1.5, Table 1: row "The SSP scenario "SSP X-Y"" can have the following literature references:</p> <p>(1) Initial SSPX-Y quantification from 8.5 to 2.6 W/m2: Riahi, K., van Vuuren, D.P., Kriegler, E., Edmonds, J., O'Neill, B.C., Fujimori, S., Bauer, N., Calvin, K., Dellink, R., Fricko, O., Lutz, W., Popp, A., Cuaresma, J.C., Kc, S., Leimbach, M., Jiang, L., Kram, T., Rao, S., Emmerling, J., Ebi, K., Hasegawa, T., Havlik, P., Humpenöder, F., Da Silva, L.A., Smith, S., Stehfest, E., Bosetti, V., Eom, J., Gernaat, D., Masui, T., Rogelj, J., Strefler, J., Drouet, L., Krey, V., Luderer, G., Harmsen, M., Takahashi, K., Baumstark, L., Doelman, J.C., Kainuma, M., Klimont, Z., Marangoni, G., Lotze-Campen, H., Obersteiner, M., Tabeau, A., Tavoni, M., 2017. The Shared Socioeconomic Pathways and their energy, land use, and greenhouse gas emissions implications: An overview. <i>Global Environmental Change</i> 42, 153–168. https://doi.org/10.1016/j.gloenvcha.2016.05.009</p> <p>(2) 1.9 W/m2 quantification: Rogelj, J., Popp, A., Calvin, K.V., Luderer, G., Emmerling, J., Gernaat, D., Fujimori, S., Strefler, J., Hasegawa, T., Marangoni, G., Krey, V., Kriegler, E., Riahi, K., van Vuuren, D.P., Doelman, J., Drouet, L., Edmonds, J., Fricko, O., Harmsen, M., Havlik, P., Humpenöder, F., Stehfest, E., Tavoni, M., 2018. Scenarios towards limiting global mean temperature increase below 1.5 °C. <i>Nature Climate Change</i> 8, 325–332. https://doi.org/10.1038/s41558-018-0091-3</p> <p>(3) ScenarioMIP: O'Neill, B.C., Tebaldi, C., van Vuuren, D., Eyring, V., Friedlingstein, P., Hurt, G., Knutti, R., Kriegler, E., Lamarque, J.F., Lowe, J., Meehl, J., Moss, R., Riahi, K., Sanderson, B.M., 2016. The Scenario Model Intercomparison Project (ScenarioMIP) for CMIP6. <i>Geosci. Model Dev. Discuss.</i> 2016, 1–35. https://doi.org/10.5194/gmd-2016-84 [Rogelj Joeri, United Kingdom (of Great Britain and Northern Ireland)]</p>	Accepted. References added to new Table 1.4 or the main text in Section 1.6.1.1
50645	91	49	93	2	<p>This table does not mention GHG emissions, it correctly describes the RCPs as representing GHG concentrations, which is how they are used in the CMIP6 projections, but the SPM describes the SSP-RCPs as "emission scenarios" (Box SPM-2, page SPM-19 line 14) which seems inconsistent with what is written here in this chapter. Cross-Chapter Box 1.5 Table 1 should clarify the difference between emission scenarios and concentration pathways. [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]</p>	Taken into account. Presentation of SSP has been restructured to provide more clarity. New Cross-Chapter box 1.5 does address the issue of emissions scenario vs concentration pathway.
14527	92	1	92	70	<p>p. 92, middle-right box, meaning of "inter alia-GDP" is not clear [Amy East, United States of America]</p>	Accepted. Replaced with "amongst other things"
125419	92	3	92	5	<p>This statement ("In other words, an SSPX is one of...") is very confusing. Earlier in this table description and in the definitions that precede it, it's stated that there are five SSPs -- i.e., SSP1, SSP2, SSP3... -- all consistent with distinct socioeconomic conditions. But to then say that all SSPs are "absent of climate policy intervention" is impossible. How can you assert that none of the SSPX would be consistent with some sort of climate policy intervention? It would be more accurate to describe the SSPX, then, as not EXPLICITLY articulating any climate policy, but that they could be consistent with an array of policy landscapes. [Trigg Talley, United States of America]</p>	Taken into account. Text deleted. Presentation of SSP has been restructured to provide more clarity. New Cross-Chapter box 1.5 does address the issue of emissions scenario vs concentration pathway.
35499	92	9	92	9	<p>remove parentheses in the key references [Carlos Antonio Poot Delgado, Mexico]</p>	Accepted.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
125421	92	9	92	9	[PRECISION] Nowhere is it defined what the SSPs are and how they differentiate from one another. It leaves the reader guessing. In contrast, it's explicitly described that the numbers associated with the RCPs are end-of-century radiative forcing levels. Somewhere in this table, each SSP should be given a brief description -- e.g., SSP1 = low GDP growth, low pop growth, etc. [Trigg Talley, United States of America]	Taken into account. Presentation of SSP has been restructured in sections 1.6.1.1. and new Cross-Chapter box 1.5 to provide more clarity. It is however outside the remit of the WGI report to introduce the socioeconomic basis of the SSPs.
17909	92	9	92	9	For the last row ("SSP scenario SSPX-Y", you could include Riahi et al. (2017) and Rogelj et al. (2018) as references (or the whole GEC special issue on the SSP-RCP pathways) [Katherine Calvin, United States of America]	Accepted. The Riahi et al. 2017 and Rogelj et al. 2018 references are now included in section 1.6.1.1 where these SSPX-Y scenarios are introduced.
131407	92	9	93	1	CCB 1.5 Table 1: there are some acronyms used in this table that might need an explanation for non-experts, e.g. AOGCM, ICONICS [Hans Poertner and WGII TSU, Germany]	Noted. List of Acronyms to be provided for the overall report. added ICONICS: International Committee On New Integrated Climate change assessment Scenarios
12429	92	12	92	12	Here it is 1750, Table 1.5 is 1850-1900. Which is actually used? [Lijing Cheng, China]	Taken into account. Not applicable. The former Cross-Chapter Box 1.5 has been deleted. For definitions, we now refer to the Glossary. Text revised elsewhere to clarify this point.[Comment applies to page 93, not 92]
29791	93	1	93	1	"NTCF" has not been defined along this chapter (it is in the last cell of the Cross-Chapter Box 1.5, Table 1, and in other parts of the chapter). [Hernan Edgardo Sala, Argentina]	Noted. NTCF is not used as an acronym, it is just part of the name of a particular SSP. Throughout the chapter and the WGI report, we refer to Short-lived climate forcers SLCF instead.
18463	93	10	93	14	Choose GMST v GSAT carefully [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Not applicable. The former Cross-Chapter Box 1.5 has been deleted. For definitions, we now refer to the Glossary.
18465	93	10	93	14	WG III ch 3 has its own warming bands. [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Not applicable. The former Cross-Chapter Box 1.5 has been deleted. For definitions, we now refer to the Glossary.
50647	93	10	93	14	The term "temperature levels" for 1.5C, 2C, 3C, 4C is potentially misleading as it could be taken to refer to the absolute temperature of the Earth when of course it really means temperature change relative to pre-industrial. The SPM uses "Global Warming Levels" (eg. page SPM-19 line 48) which seems clearer, so this term should be considered for use here and elsewhere in this chapter. [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. The former Cross-Chapter Box 1.5 has been deleted. For definitions, we now refer to the Glossary. Discussion on Global Warming levels in Section 1.6.2 has been revised.
21383	93	10	93	28	Another caveat that is very significant here given what is then assessed in chapter 2 is that improvements in our understanding of historical changes in the climate system can affect our estimate of present day warming and thus the impacts at given temperature levels. Changes since AR5 on a like-for-like metric and period increase the warming estimate by 0.1 degrees. This then has knock-on impacts for temperature levels assessments. I think it would be worth noting this here and referencing forward to chapter 2 for the detailed observational assessment? [Peter Thorne, Ireland]	Not applicable. The former Cross-Chapter Box 1.5 has been deleted. For definitions, we now refer to the Glossary.
40089	93	10	93	28	Do you want to add "in half-degree steps to the end of the glossary definition for 'temperature levels' to make it consistent? [TSU WGI, France]	Not applicable. The former Cross-Chapter Box 1.5 has been deleted. For definitions, we now refer to the Glossary.
82587	93	10	93	28	This will need to be linked to the (redeveloped) cross-chapter box in Chapter 2 looking at definitions of temperature and the implications that has for temperature thresholds such as 1.5 C. The link might alternatively be made through section 1.6.2. [Blair Trewin, Australia]	Not applicable. The former Cross-Chapter Box 1.5 has been deleted. For definitions, we now refer to the Glossary. Discussion on Global Warming levels in Section 1.6.2 has been revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
131409	93	11	93	11	Are you sure "temperature-levels" used in this report exclusively refer to GSAT? There seem to be a lot of GMST related information throughout the reports and also in the TS/SPM GSAT as well as GMST occur [Hans Poertner and WGII TSU, Germany]	Not applicable. The former Cross-Chapter Box 1.5 has been deleted. For definitions, we now refer to the Glossary. Discussion on Global Warming levels in Section 1.6.2 has been revised.
21381	93	11	93	12	Use of 1750 here is problematic given that chapter 2 and latter chapters reference everything to 1850-1900. I would suggest changing text here to 1850-1900 for consistency and cross-referencing x-chapter box 1.2 if you wish to allude to the possible delta between that and true PI? [Peter Thorne, Ireland]	Not applicable. The former Cross-Chapter Box 1.5 has been deleted. For definitions, we now refer to the Glossary. Discussion on Global Warming levels in Section 1.6.2 has been revised.
35501	93	13	93	14	* C repeats [Carlos Antonio Poot Delgado, Mexico]	Not applicable. The former Cross-Chapter Box 1.5 has been deleted. For definitions, we now refer to the Glossary. Discussion on Global Warming levels in Section 1.6.2 has been revised.
18467	93	30	93	33	This isn't right. Baseline scenarios for WG III IAMs are characterised by zero carbon prices which do indeed act as counterfactuals. They generally have LESS mitigation than business-as-usual, current policies or stated policies scenarios. Because of the zero carbon price assumption. "No policy" is OK but recognise its a step backwards from the WG III ch 3 has its own warming bands. real world in mitigation terms. It's really important to stress that "baseline" and "business-as-usual" are not the same thing. [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. The clear distinction between 'baseline' and 'business-as-usual' is now provided in section 1.6.1.4.
70689	93	30			Insert 'socioeconomic' or similar before 'change'. In WGI change is generally measured relative to the preindustrial or relative to some other baseline in the historical period, not relative to a reference scenario. [Gillett Nathan, Canada]	Not applicable. The former Cross-Chapter Box 1.5 has been deleted. For definitions, we now refer to the Glossary. Discussion on Global Warming levels in Section 1.6.2 has been revised.
109479	93	32	93	32	Please specify "no climate change mitigation" as all baseline scenario include air pollution mitigation. [Sophie Szopa, France]	Not applicable. The former Cross-Chapter Box 1.5 has been deleted. Applied elsewhere.
109481	93	36	93	36	Please specify "no climate change mitigation" as all baseline scenario include air pollution mitigation. [Sophie Szopa, France]	Not applicable. The former Cross-Chapter Box 1.5 has been deleted. Applied in other parts of the chapter where applicable.
114343	93	37	93	37	Please check if these two words are used interchangeably in WGIII [Jan Fuglestedt, Norway]	Not applicable. The former Cross-Chapter Box 1.5 has been deleted. For definitions, we now refer to the Glossary.
125423	93	38	93	38	This really should be stated as 'no NEW policy scenario' as 'no policy scenario' implies there is no policy existing in that scenario, which is simply not true. [Trigg Talley, United States of America]	Not applicable. The former Cross-Chapter Box 1.5 has been deleted. For definitions, we now refer to the Glossary. Change implemented where applicable in revised Chapter. We now consistently to "no additional climate policy"
28749	94	2			Some further specifics of the problem of BAU would help preempt criticisms, for example that economies would be severely damaged by climate change thereby reducing any semblance of business as usual but this is not factored in with any certainty [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. The former Cross-Chapter Box 1.5 has been deleted. For definitions, we now refer to the Glossary.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
41381	94	7			Please make sure that this section can be even more clearly distinguished from what is presented as storylines in section 1.4.4. In my view, storylines should only be used in the (SSP) scenario sense and another term should be coined for what the authors are trying to present in section 1.4.4. Currently, having both topics covered with "storylines" is very confusing. [Alexander Nauels, Germany]	Taken into account. Storylines still used in different parts of the report, reflecting the use of the term in the underlying literature. However, we have tried to clearly distinguish between the socio-economic scenario storylines and other usages of the term. Glossary also clarifies the different uses: "In climate research, the term storyline is used both in connection to scenarios as related to a future trajectory of the climate and human systems or to a weather or climate event. In this context, storylines can be used to describe plural, conditional possible futures or explanations of a current situation, in contrast to single, definitive futures or explanations."
8629	94	9	94	11	Noun phrases (scenario uncertainty) are not hyphenated in English. "Geophysical" is one word, not hyphenated. [Robert Kopp, United States of America]	Accepted. Revised accordingly where applicable.
44371	94	10	94	12	In this context (i.e. geo-physical uncertainties, with the latter resulting from our limited understanding and unpredictability of the climate system) reference to the physical climate storylines described in section 1.4.4 should be made. [Jana Sillmann, Norway]	Accepted. Revised accordingly. Reference to section 1.4.4 added.
11361	94	11	94	11	"limited understanding" in this context is okay, but I would avoid the term "unpredictability". [Michael Schmitt, Germany]	Accepted. Changed to "predictability"
114345	94	11	94	11	you may change "resulting from our limited understanding" to "due to limitations in the understanding" [Jan Fuglestedt, Norway]	Noted. No change. Unclear how this would improve the sentence.
5017	94	12	94	14	Futures emissions scenarios also depend on the amount of fossil reserves available for production (https://sta.uwi.edu/iir/normangirvanlibrary/sites/default/files/normangirvanlibrary/documents/Views%20on%20Peak%20Oil%20and%20Its%20Relation%20to%20Climate%20Change%20Policy.pdf Verbruggen and Al Marchochi, 2010, in Energy Policy). Furthermore a brand new study (https://advances.sciencemag.org/content/6/17/eaaz5120 , Zhand and al., 2020, in Science Advances) shows that methane emissions from oil and gas production are increasing to a concerning level. So we still have to learn way better which emissions are going to increase or to decrease in the coming years. [Olivier RAGUENES, France]	Noted. No change. We state "to a large extent" and thus don't think a change is needed here. Resource constraints will further be discussed in WG3.
114351	94	13	94	13	you may add "and processes" since I feel "choices" is a bit narrow here [Jan Fuglestedt, Norway]	Accepted. Revised accordingly.
14529	94	13	94	13	"activity's", singular possessive [Amy East, United States of America]	Accepted. Revised accordingly.
109473	94	18	91	18	Both climate change mitigation and air pollution mitigation exist, the term "mitigation" should be replaced by "climate change mitigation" [Sophie Szopa, France]	Taken into account. "Climate change mitigation" clarified throughout the Section where necessary. [Unclear to which part of the section the comment applies. Neither on page 94 nor on page 91 the term "mitigation" is used on line 18]
106259	94	21	94	21	A good reference on different types of uncertainty and the distinct nature of scenario versus other types of uncertainty is: Smith, L.A., Stern, N., 2011. Uncertainty in science and its role in climate policy. Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences 369, 4818–4841. https://doi.org/10.1098/rsta.2011.0149 [Rogelj Joeri, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Reference added.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
67047	94	24	94	24	change (Section 1.4.3) which does not relate to storylines to (Section 1.4.4) which relates to storylines [Liese Coulter, United Kingdom (of Great Britain and Northern Ireland)]	Accepted.
114347	94	27	94	27	sound strange " do not ' seek truth' " [Jan Fuglestedt, Norway]	Accepted. Revised accordingly.
67017	94	27	94	27	change "storylines" to "scenario storylines" to reinforce difference from physical climate storylines [Liese Coulter, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Revised accordingly.
70691	94	32			Delete 'new'. [Gillett Nathan, Canada]	Accepted. Revised accordingly.
114349	94	43	94	43	you may consider changing "almost any" to "several" [Jan Fuglestedt, Norway]	Not applicable. Sentence deleted.
70693	94	43		44	I understood that some emissions levels are not possible under all SSPs - in particular the 1.9W/m ² level in 2100, which I thought is not attainable under all SSPs. [Gillett Nathan, Canada]	Taken into account. Sentence deleted. In the new SSP section 1.6.1.1. and in the new Cross-Chapter Box 1.4, we clarify that IAMs can derive multiple emission futures for each socio-economic development pathway, assuming no new mitigation policies or various levels of additional mitigation action (in the case of reference scenarios and mitigation scenarios, respectively).
18469	94	48	94	48	Somewhere in this section "overshoot" should be introduced. Its used in Box 1.3, Table 1. [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Overshoot introduced in Cross-Chapter Box 1.4
125425	94	48	94	48	Brian O'Neill has a review paper on the SSPs under review; it will hopefully be accepted soon. [Trigg Talley, United States of America]	Noted. Reference included in Section 1.6.
102489	94	48	94	50	"The new illustrative marker SSP scenarios offer unprecedented detail for climate model simulations. They encompass a broad range of future trajectories, allowing for a more comprehensive assessment of the implications of future emission levels than what was possible with the RCP scenarios alone". Based on the content above and in the context of climate model simulations, "unprecedented" seems too strong. While the framing is definitely much improved, as discussed in these sections, from a climate modeller's perspective, carrying out simulations for SSP1-1.9, SSP1-2.6, SSP2-4.5, SSP3-7.0 and SSP5-8.5 is similar to carrying out simulations for RCP-2.6, RCP-4.5 and RCP-8.5 in AR5. Except of course that there is now an explicit link between SSPs and RCPs and associated implications for the forcings serving as boundary conditions for the projections. Previously, the SSP-like assumptions were still there but somewhat hidden. [Philippe Tulkens, Belgium]	Taken into account. Text clarified to state: "offer unprecedented detail of input data for climate model simulations"
67019	94	52	94	52	After "of a possible future" insert "without assuming climate change". This important caveat is often misunderstood or lost. It needs to be briefly reinforced here that SSPs represent a baseline that assumes no global warming. [Liese Coulter, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Text revised: "Each pathway is an internally consistent, plausible and integrated description of a socio-economic future, but these socio-economic futures do not account for the effects of climate change, and no new climate policies are assumed."
70695	95	7			Could this instead be referred to as an SSP-RF matrix? If I understand correctly, RCP in 'SSP-RCP scenario matrix' just stands for the radiative forcing level in 2100, and the actual evolution of the forcings in SSP-X is not the same as RCPX. If so, it would be more straightforward to refer to the SSP-RF matrix. [Gillett Nathan, Canada]	Taken into account. SSP-RCP matrix is commonly used. But we have revised the text to clarify the direct link to RF.
114387	95	8	95	8	fig 1.24: Both panels in this figure are really useful and will be important in the communication of use of scenarios. [Jan Fuglestedt, Norway]	Noted. Thanks.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
125427	95	12	95	14	[PRECISION] SSPs are the "marker scenarios" used in the WGI contribution to AR6, yet this single sentence in lines 12-14 is all there is about the development assumptions that underly the five SSPs used in all three volumes of AR6. The single word "inequality" as the descriptor for SSP4 and the lone colloquialism "middle of the road" for SSP2 are simply insufficient. Figure 1.24 does not add any additional detail. Never is it explained what "regional rivalry" is in SSP3 or how it distinguishes SSP3 from the other four scenarios. The authors should eliminate at least a quarter of the figures and the materials about risks that belong in WGII and add a good table about the assumptions of SSP1-SSP5. Table 1 in Box 1.3 does not provide any assumptions about development under each SSP. This is a serious oversight in Chapter 1, and is not explained with the sentence at the end of the paragraph: "More specific information on the SSPs and the assumptions underlying those will be provided in the IPCC WGIII report (WGIII, 2022)." The narratives for the shared socioeconomic pathways have already been written and can be drawn from O'Neil et al. 2014, 2016 or 2017. No need to wait until 2022. [Trigg Talley, United States of America]	Rejected. After careful consideration, we opted for an approach where the input assumptions and narratives are left o WG3 to describe and contextualise. It is most truthful to the approach that WG1 uses these scenarios, i.e. given "as is" by the community that is close to WG3.
109485	95	12	95	21	This paragraph should present the level of air pollution control assumed in each scenario baseline. (to support TS/SPM) [Sophie Szopa, France]	Rejected. This would be too much detail to provide here given the space constraints. But air pollution control is now mentioned in multiple places in Section 1.6.
70697	95	12		16	Although SSP5 is labelled as 'fossil fuel intensive', this label applies to the baseline scenario, but should not be interpreted as applying to the SSP5 scenarios reaching low levels of radiative forcing by 2100. Kriegler et al. Fig 4, https://www.sciencedirect.com/science/article/pii/S0959378016300711 shows that SSP5-2.5 has coal phased out by around 2050, and almost zero fossil fuel use by 2100. This should be flagged in the text. As it is readers may look at this discussion and Fig 1.24, which show some SSP5 scenarios which limit global warming to 2C by 2100, and conclude that we can follow a fossil fuel intensive development pathway, and still limit global warming to 2C. [Gillett Nathan, Canada]	Taken into account. Sentence deleted. In the new SSP section, we clarify that IAMs can derive multiple emission futures for each socio-economic development pathway, assuming no new mitigation policies or various levels of additional mitigation action (in the case of reference scenarios and mitigation scenarios, respectively). Also we explicitly added to Cross-Chapter Box 1.4: "For example, SSP5 can accommodate strong mitigation scenarios leading to net-zero emissions; these do not match a 'fossil-fuelled development' label"
14531	95	15	95	15	delete the comma after "development" [Amy East, United States of America]	Accepted. Text revised accordingly.
106261	95	16	94	16	This finding is already explicitly discussed and shown in the study presenting the SSPx-1.9 scenarios - see https://doi.org/10.1038/s41558-018-0091-3 , and particularly Supplementary Figure 1 in that publication. [Rogelj Joeri, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. Text deleted. Reference added elsewhere.
109483	95	16	95	17	Please specify high "LL-GHG" emissions. In addition, this sentence (Likewise, sustainability-oriented socioeconomic developments at the global scale are not envisaged to go hand-in-hand with very high emission levels.) is a bit confusing. Actually, the SSP5, based on an high fossil fuel hypothesis and thus high LLGHG assumes a high level of pollution control at the same time (this high CO2 scenario can thus be considered as sustainability-oriented developments from the air pollution point of view). [Sophie Szopa, France]	Not applicable. Text deleted. Reference added elsewhere.
109471	95	18	95	18	Here the paragraph seems to discuss the SSP in general but there is no climate mitigation in the SSP baseline scenarios. The level of climate mitigation is applied in a second step to provide the SSPx-yy scenario. In the case it refers here more specifically to the five core wg1 scenario, it's not true neither since SSP5-8.5 and SSP3-7.0 do not account for climate mitigation, thus it can not lead to "reduced air pollution". [Sophie Szopa, France]	Taken into account. Text revised. Description of SSPs has been substantially revised in Section 1.6.1.1 and Cross-Chapter Box 1.4.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
42107	95	21	95	21	repalce (WGIII,2022) with (see WGIII, Chapter XYZ) or the like [Julia Nabel, Germany]	Accepted. Text revised accordingly.
37841	95	26	95	27	These five scenarios are those in "Tier 1" (SSP1-2.6, SSP2-4.5, SSP3-7.0 and SSP5-8.5): SSP1-1.9 is missing in the "Tier 1" scenarios. [Junhee Lee, Republic of Korea]	Accepted. Text revised accordingly.
70699	95	27			Insert 'participating' before 'climate modelling groups'. Participation in ScenarioMIP is voluntary for CMIP6 modelling groups, as explained elsewhere in the chapter. [Gillett Nathan, Canada]	Accepted. Text revised accordingly.
109487	95	36	95	36	Please replace the term "mitigation" by "climate change mitigation" [Sophie Szopa, France]	Taken into account. Text revised.
114353	95	49	95	49	re "future trajectories": You may add "of emissions" after trajectories [Jan Fuglestedt, Norway]	Not applicable. Text deleted.
45779	95	50	95	50	This limitation of the RCPs is discussed in a paper by Chuwah et al. It would be appropriate to include a reference to that paper here: Chuwah, C., et al., 2013: Implications of alternative assumptions regarding future air pollution control in scenarios similar to the Representative Concentration Pathways, Atmos. Environ., 79, 787-801, https://doi.org/10.1016/j.atmosenv.2013.07.008 . [Twan van Noije, Netherlands]	Accepted. Reference added.
45781	95	50	95	50	Change "VOC" to "NMVOCs", and add "NH3". [Twan van Noije, Netherlands]	Accepted. Revised accordingly. Now part of Cross-Chapter Box 1.4, Table 2.
70701	96	5		7	The text here says that volcanic aerosols 'are provided in a level of detail that was not available for CMIP5'. Volcanic aerosols were not provided at all for CMIP5 - modelling groups were free to choose their own. Clarify this. [Gillett Nathan, Canada]	Taken into account. Text deleted. Now part of Cross-Chapter Box 1.4, Table 2.
70703	96	5		7	The text refers to 'solar forcing... historical time series' being provided in CMIP6. But it is worth also flagging here that CMIP6 includes predicted future variations in solar forcing, including long term multidecadal trends. This is different to CMIP5 which had a repeating solar cycle, but no long-term variations. [Gillett Nathan, Canada]	Taken into account. Text deleted. Now part of Cross-Chapter Box 1.4, Table 2.
37843	96	16	96	16	NTCF has not been spelled out in Chapter 1. [Junhee Lee, Republic of Korea]	Noted. NTCF is not used as an acronym, it is just part of the a name of a particular SSP. Throughout the chapter and the WGI report, we refer to Short-lived climate forcers SLCF instead.
125429	96	16	96	16	In the Figure 1.25 caption -- as well as in the figure legend -- define "NTCF". [Trigg Talley, United States of America]	Noted. NTCF is not used as an acronym, it is just part of the a name of a particular SSP. Throughout the chapter and the WGI report, we refer to Short-lived climate forcers SLCF instead.
113619	96	17	96	17	Please change "SSP370" to "SSP3-7.0". [Agnieszka Kowalczyk, Poland]	Taken into account. Text revised.
35503	96	18	96	18	Use published sources [Carlos Antonio Poot Delgado, Mexico]	Taken into account. References updated.
114355	96	23	96	23	This statement is very general and vague. Can you be more specific? [Jan Fuglestedt, Norway]	Taken into account. Text revised in the new section 1.6.1.4.
70707	96	23		18	This discussion of the limitations of the SSP scenarios should cite and discuss Hausfather and Peters (2020) (https://www.nature.com/articles/d41586-020-00177-3), which argues that SSP5-8.5 is unlikely. Also, in the FGD this discussion should refer to the new cross-chapter box on assessment of the climate effects of COVID-19, for discussion of the influence of COVID-19 on future forcing evolution. [Gillett Nathan, Canada]	Taken into account. Likelihood of SSP scenarios and the effect of COVID-19 are integrated in new section 1.6.1.4.
70705	96	23		25	Provide references for the assessment that the historical aerosol emissions data used in CMIP6 underestimate the decrease in SO2 emissions from East Asia. [Gillett Nathan, Canada]	Not applicable. Text deleted

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
28757	96	23			It could be stated that mean stratospheric volcanic aerosol are prescribed in future projections (if that is indeed the case for all models) and that this does not realistically capture the year to year and decade to decade forced changes due to volcanic eruptions [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Text deleted. Now part of Cross-Chapter Box 1.4, Table 2.
102491	96	25	96	25	Line with SSP4-6.0 - apart from the scenario description entries are identical with those found in the preceding line. This is potentially an error. [Philippe Tulkens, Belgium]	Taken into account. Text revised in new Cross-Chapter Box 1.4, Table 1 [Comment applies to page 98, not 96]
125431	96	31	96	31	Revise text to read: "... possible geophysical futures in the absence OR WITHOUT FULL IMPLEMENTATION of international agreements." This additional text accounts for, say, members of the Montreal Protocol who have not yet implemented the Kigali Amendment -- though the "international agreement" still exists. [Trigg Talley, United States of America]	Not applicable. Text deleted.
50649	96	33	96	35	Please clarify which aspects are defined with concentrations (GHGs) and which with emissions (aerosols) [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Given that the SSP scenarios are sometimes - depending on the experiment - implemented for CO2 as emission or concentration scenario, more detail on the input datasets is now provided in Cross-Chapter Box 1.4.
114357	96	41	96	41	Regarding "summarized into a single number": I think you should explain that while a certain level of RF can consist of many different compositions of individual forcings by components [Jan Fuglestedt, Norway]	Taken into account. Text revised: "Nonetheless, using approximate radiative forcing labels is advantageous because it establishes a clear categorization of scenarios, with multiple climate forcings and different combinations in those scenarios summarized in a single number"
114359	96	48	100	4	very useful box. Gives overview and info that will be asked for. Also supporting the other chapters [Jan Fuglestedt, Norway]	Noted. Thanks.
87141	96	48			We have seen RCPs introduced in earlier reports and now we see SSPs so in order to fully understand they have to be comparable. The text and tables provided are helpful however the figure is not very clear in distinguishing the scenarios. It is important to see how fossil CO2 trajectories compare as well as how resulting mean temperature trajectories compare in a separate column. [Jacqueline Spence, Jamaica]	Taken into account. Figure has been updated, comparison between SSPs and RCPs strengthened in a number of places of Section 1.6, including the Cross-Chapter Box 1.4. Temperature projections are being considered in Ch4, not here.
100005	96	48			The ability to compare RCPs and SSPs is key. While text and table are doing a good job in discussing different scenario generations, the figure fails to provide a clear way to visually distinguish the scenarios. In particular, it will be very important to see not only how the fossil CO2 trajectories compare (which is currently impossible due to the small fonts and high opacity of the top layer) but also how resulting avg temperature trajectories compare (in a separate column), for example supported by simple climate model example runs. [Caroline Eugene, Saint Lucia]	Taken into account. Figure has been updated, comparison between SSPs and RCPs strengthened in a number of places of Section 1.6, including the Cross-Chapter Box 1.4. Temperature projections are being considered in Ch4, not here.
41383	96	48			This is probably the topic people will look out for the most in Chapter 1. While the text and table do a great job in comparing the scenario generations, the current figure draft is not succeeding in providing a clear overview. The multiple overlays and supersmall fonts make it impossible to compare individual pathways from different scenario generations. What is also missing is another column which provides central temperature trajectories based on the emission pathways. These could be taken from previous assessment reports and complemented by runs done with the latest MAGICC version, for example. [Alexander Nauels, Germany]	Taken into account. Figure has been updated, comparison between SSPs and RCPs strengthened in a number of places of Section 1.6, including the Cross-Chapter Box 1.4. Temperature projections are being considered in Ch4, not here.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
84165	96	48			The ability to compare RCPs and SSPs is key. The figure however fails to provide a clear way to visually distinguish the scenarios. In particular, it will be very important to see not only how the fossil CO2 trajectories compare but also how resulting average temperature trajectories compare. [Jeffers Cheryl , Saint Kitts and Nevis]	Taken into account. Figure has been updated, comparison between SSPs and RCPs strengthened in a number of places of Section 1.6, including the Cross-Chapter Box 1.4. Temperature projections are being considered in Ch4, not here.
70709	96	50			Re-write as 'The climate scenarios assessed in IPCC reports have evolved over time...'. The current text just says that climate scenarios evolve over time, which could be interpreted as saying that individual scenarios have emissions which evolve over time through the 21st century. [Gillett Nathan, Canada]	Accepted. Revised accordingly.
35505	96	53	96	54	Bibliographic citations in chronological order [Carlos Antonio Poot Delgado, Mexico]	Noted. Editorial.
90045	97	0	97	0	In row SSP1-1.9, add reason for this additional "low scenario" in AR6, with no linked RCP or even range as in SSP4-3.4 (between RCP 2.6 and RCP 4.5) [Govindarajalu Srinivasan, Thailand]	Taken into account. Main text revised and expanded to also explain this addition of a "low emissions scenario"
125433	97	3	97	3	It would be helpful to add a sentence that there are SSP-RCP combinations reported in the literature that are implausible (SSP1 - RCP8.5), so not covered in the WGI contribution to AR6. [Trigg Talley, United States of America]	Taken into account. Likelihood of SSP scenarios integrated in new section 1.6.1.4.
9109	97	9	97	13	The "historical" part of the plot is not mentioned or explained in the caption. [Olaf Morgenstern, New Zealand]	Accepted. Added.
114361	97	9	97	13	The visual aspects for values <0 could be considered. I think more space below zero would help [Jan Fuglestedt, Norway]	Accepted. Figure revised accordingly.
44089	97	9			The information provided with this figure is crucially important to connect the dots between the scenario generations. However, it is very hard to distinguish the corresponding CO2 emission pathways at the moment. Also, GMT trajectories should be displayed to ensure that projected avg warming levels by the end of the 21st century can be compared. Please revise this figure! [Lamin Mai Touray, Gambia]	Taken into account. Figure has been updated, comparison between SSPs and RCPs strengthened in a number of places of Section 1.6, including the Cross-Chapter Box 1.4. Temperature projections are being considered in Ch4, not here.
877	97	11	#REF!	#REF!	"maker" -> "marker" (also in line 20) [Bart van den Hurk, Netherlands]	Not applicable. The term "marker" is no longer used.
4785	97	11	97	11	"maker" -> "marker" (also in line 20) [Bart van den Hurk, Netherlands]	Not applicable. The term "marker" is no longer used.
125435	97	11	97	20	It's unclear what the phrase "illustrative marker SSP scenarios" means. The "marker" is what is confusing. Can authors clarify in lines 11 and 20 of page 97? [Trigg Talley, United States of America]	Not applicable. The term "marker" is no longer used.
50651	97	18	99	1	Box 1.3 Table 1 needs more clarity on the difference between GHG emissions and concentrations, as several statements in the table give the impression that the RCP concentration pathways are only determined by emissions when in fact they are also affected by carbon cycle feedbacks. AR5 WG1 Chapter 6 showed that there are many emissions scenarios that are compatible with any particular concentration pathway. [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Section has been restructured and the Cross-Chapter Boxes deleted or incorporated into the main text. A new Cross-Chapter Box was added on "The SSP scenarios as used in Working Group I". The main text is now streamlined and the RCP-SSP comparison has been added in different places including many new references to recent literature. A discussion of emission- vs concentration-driven runs has been included. We revised the text to make it clear that the majority of WG1-assessed scenarios and CMIP6 experiments is indeed concentration driven and that the carbon cycle and gas cycle steps between emissions and concentrations come with uncertainties.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
107847	97	20	98	1	In particular Box 1.3, description of SSP5-8.5. It would be useful to explain why the SSP5-8.5 produces higher emissions than the RCP8.5 from AR5. Really, there must be a way to simplify some of this stuff so that it will make sense to those who have NOT been steeped in the SSP-RCP world since 2010. [Linda Mearns, United States of America]	Taken into account. Likelihood of SSP scenarios (and the effect of COVID-19) are integrated in new section 1.6.1.4.
39153	97	20	100	4	Firstly, this effort to explain the various scenarios (whether IS92, SRES, RCPs or SSPs) certainly helps readers in understanding the evolution of how these scenarios evolved, developed and used. However, because constitutin of policymakers changes very fast, it is quite difficult to keep pace wth the evolving scenarios in their use. furthermore, there has been no way we can compare outcomes. Box 3, Table 1 is immensely helpful. [Lourdes Tibig, Philippines]	Noted. Thanks.
114363	97	23	97	23	Yes, coordination with WGIII here is improtant. [Jan Fuglestedt, Norway]	Noted. No change requested.
8631	97	25	98	1	RCP 6 actually had the lowest forcing early in the 21st century, and was systematically below RCP 4.5 through the first half of the century, so statements about in 'being similar to RCP 4.5 in early decades' actually understate this point. [Robert Kopp, United States of America]	Taken into account. This is now explicitly stated in the new the Cross-Chapter Box 1.4, Table 1.
50653	97		97		Box 1.3 Table 1 row on SSP1-26 column 3. The statement on "RCP 2.6 emissions" is an oversimplification. It refers to the emissions scenario routinely associated with the RCP2.6 concentration pathway, but AR6 WG1 Chapter 6 figure 6.25 showed that there is a wide range of emissions scenarios compatible with each RCP, so in the light of this, the statement here is incorrect. [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Wording in Cross-Chapter Box 1.4, Table 1 table has been revised and sharpened based on the actual assessment in Ch4.
115745	97		98		Please sharpen the wording in the table ("a bit cooler", "best case" = from which source of information; "less plausible" = see other remarks on the use of "plausible" in the report, "methane EMISSIONS are also reduced"). [Valerie Masson-Delmotte, France]	Taken into account. Wording has been revised, expanded and sharpened based on the actual assessment in Ch4.
70711	97				Box 1.3, Table 1. SSP1-2.6 row, RCP column 'RCP2.6 might be a bit cooler' is imprecise language. Re-write using calibrated language. Also the sentences 'RCP2.6 emissions were second highest in the RCP set of scenarios before year 2020. Given recent emission increases, the illustrative SSP scenarios are higher in 2020 than the RCP2.6 level.' are unclear and should be clarified. [Gillett Nathan, Canada]	Taken into account. Wording has been revised, expanded and sharpened based on the actual assessment in Ch4.
70713	97				Box 1.3, Table 1. SSP4-3.4 row. Which scenario is most consistent with current NDCs is important information for policymakers and governments. Include a proper assessment with calibrated language on the consistency of this scenario with NDCs (e.g. 'radiative forcing/ GHG-eq emissions are consistent with those corresponding to current NDCs in 2030 to with +/- x% (low/medium/high confidence)'). Report the quantitative results from Ch4 on the probability of staying below 2C under this scenario. [Gillett Nathan, Canada]	Taken into account. Wording has been revised, expanded and sharpened based on the actual assessment in Ch4.
113083	98	1	98	1	Most people are familiar with A1B. It would be important to reflect it on this table. [Diego Miralles, Belgium]	Not applicable. SRES Scenarios dropped from the table since they are not used in the WGI AR6
114365	98	1	98	1	In top left yellow cell you write "best guess wamring around 3.1 C...", which I find a bit sloppy, and could be reworded [Jan Fuglestedt, Norway]	Taken into account. Wording has been revised, expanded and sharpened based on the actual assessment in Ch4.
111811	98	1	98	1	On RCP8.5.: to highlight that "no policy" doesn't mean BAU it would be preferable to add a directional qualifier, like "with no climate policy implemented anymore" or "with climate policy dismantled/abolished etc." [Oliver Geden, Germany]	Taken into account. Wording has been revised.
14533	98	1	98	1	p. 98, top left box, next to SSP2-4.5: add degree sign between "3.1" and "C" [Amy East, United States of America]	Accepted. Editorial.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
17913	98	1	98	1	What does "best guess warming" mean? [Katherine Calvin, United States of America]	Not applicable. Sentence deleted.
41385	98	1			Please spell out NTFs in the description of SSP3-7.0 low-NTFs. [Alexander Nauels, Germany]	Noted. NTCF is not used as an acronym, it is just part of the a name of a particular SSP. Throughout the chapter and the WGI report, we refer to Short-lived climate forcers SLCF instead.
114953	98		98		Row in the Box where SSP-7.0 Low NTCF scenario is addressed. Here term SLCP is used while I think it should be replaced with SLCF. In general this is something that has to be checked across this chapter and the whole assessment, i.e., consistent use of terms like NTCF and SLCF and only if really needed (and explained) the SLCP term that is rather confusing depicting only warming SLCFs - and so consequently not consistent with what is actually reduced in SPP3-7.0 NTCF. [Zbigniew Klimont, Austria]	Noted. NTCF is not used as an acronym, it is just part of the a name of a particular SSP. Throughout the chapter and the WGI report, we refer to Short-lived climate forcers SLCF instead.
50655	98		98		Box 1.3 Table 1 row on SSP5-85 gives the impression that high concentration pathways can arise only from high emissions scenarios, but they could also arise from lower emissions scenarios if climate-carbon cycle feedbacks are strong (AR5 WG1 Chapter 6 and other more recent literature eg. Booth et al (2017) Narrowing the Range of Future Climate Projections Using Historical Observations of Atmospheric CO2, J. Climate 30, 3039-3053 https://doi.org/10.1175/JCLI-D-16-0178.1 [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)])	Taken into account. Sentence deleted. In the new SSP section, we clarify that IAMs can derive multiple emission futures for each socio-economic development pathway, assuming no new mitigation policies or various levels of additional mitigation action (in the case of reference scenarios and mitigation scenarios, respectively). Also we explicitly added to Cross-Chapter Box 1.4: "For example, SSP5 can accommodate strong mitigation scenarios leading to net-zero emissions; these do not match a 'fossil-fuelled development' label"
70715	98				Box 1.3, Table 1: SSP3-7.0. I suggest more strongly flagging the high SO2 emissions and LUC in this scenario. [Gillett Nathan, Canada]	Taken into account. This is now explicitly stated in the new the Cross-Chapter Box 1.4, Table 1.
70717	98				Box 1.3, Table 1: SSP5-8.5. The phrase 'seem less plausible' is imprecise. Can this be replaced with a proper assessment based on the scenario literature? [Gillett Nathan, Canada]	Taken into account. Text deleted from Cross-Chapter Box 1.4, Table 1. Likelihood of SSP scenarios (and the effect of COVID-19) are integrated in new section 1.6.1.4.
70719	98				Box 1.3, Table 1: SSP3-7.0 Low NTCF - What does 'depending on the application' mean in this context? [Gillett Nathan, Canada]	Taken into account. Text deleted from Cross-Chapter Box 1.4, Table 1.
45783	98				Box 1.3, Table 1: Remove "Depending on the application, methane is also reduced". The truth is that methane is reduced in this scenarios but that it depends on the application (i.e. simulations defined in AerChemMIP) whether methane follows the standard SSP3-7.0 or SSP3-7.0-lowNTCF scenario. [Twan van Noije, Netherlands]	Taken into account. Text deleted from Cross-Chapter Box 1.4, Table 1.
125437	99	4	99	6	Clarify at what year those stabilization levels were reached (2100?). [Trigg Talley, United States of America]	Rejected. Not implemented. The stabilisation date is different for the different stabilisation levels. For S-350 and S-550, the stabilisation point is 2150, for S-450, the stabilisation point is 2100, for higher scenarios the stabilisation point is 2200 and 2250. For space reasons, we hence refrain from providing that amount of detail on pathways that are not used any more in the scientific literature - but nevertheless provide an important historical contextualisation.
70721	99	11			It doesn't make sense to write 'SRES Special Report'. The SR in SRES stands for 'Special Report'. Replace 'SRES Special Report' with 'Special Report on Emissions Scenarios (SRES)'. [Gillett Nathan, Canada]	Accepted. Revised accordingly

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
125439	99	12	99	12	It's unclear what the phrase "albeit without mitigation scenarios" means. The SRES represented a range of "socioeconomic storylines" -- some with fairly aggressive mitigation components that were implicit (if not explicit) in them. [Trigg Talley, United States of America]	Taken into account. Text revised to read "...albeit without assuming any climate-policy-induced mitigation..."
125441	99	14	99	14	As on page 97, lines 11 and 20, there is a confusing phrase here. This time it's "illustrative marker scenarios"... previously it was "illustrative marker scenarios." What does this mean and make the occurrences consistent. [Trigg Talley, United States of America]	Not applicable. The term "marker" is no longer used.
50657	99	19	99	21	Please highlight the other new innovation of the RCPs, which was that they were primarily defined in terms of concentrations (hence the C in RCP) and a key aim was to drive Earth System Models to be driven by RCP concentrations and calculate the range of emissions compatible with these concentration pathways. [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Text in new Section 1.6.1.3 covers these aspects suggested by the reviewer.
111521	99	20	99	20	Not all emissions pathways compatible with RCP2.6 require negative emissions. This was clear in the carbon cycle chapter of the AR5 WG1 report. [Richard Betts, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Text in new Section 1.6.1.3 revised to highlight that RCP2.6 was one example, only.
50659	99	20	99	20	Please clarify more precisely the likelihood that RCP2.6 concentrations required negative emissions. AR6 WG1 Chapter 6 Figure 6.25 shows that negative emissions are not required in all emissions scenarios compatible with RCP2.6. [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Text in new Section 1.6.1.3 revised to highlight that RCP2.6 was one example, only.
24283	99	23	99	34	This is a TOTALLY inadequate description of the SSPs. There needs to be a figure which shows the emissions AND concentrations of CO2, other important GHG, and aerosols for all years in the 21st century. At the same time there should be a brief discussion as to these values were arrived at. Only then will the reader have any feel for Ch. 4. This should probably come earlier in Ch. 1 before the SSP results are discussed. [Bryan Weare, United States of America]	Taken into account. Section has been restructured and the Cross-Chapter Boxes deleted or incorporated into the main text. A new Cross-Chapter Box was added on "The SSP scenarios as used in Working Group I". The main text is now streamlined and the RCP-SSP comparison has been added in different places including many new references to recent literature.
50661	99	23	99	34	Please clarify how the distinction between GHG emissions and concentrations is made in the SSP scenarios [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Section has been restructured and the Cross-Chapter Boxes deleted or incorporated into the main text. A new Cross-Chapter Box was added on "The SSP scenarios as used in Working Group I". The main text is now streamlined and the RCP-SSP comparison has been added in different places including many new references to recent literature. A discussion of emission- vs concentration-driven runs has been included. We revised the text to make it clear that the majority of WG1-assessed scenarios and CMIP6 experiments is indeed concentration driven and that the carbon cycle and gas cycle steps between emissions and concentrations come with uncertainties.
70723	99	23		24	Another major difference between the SSPs and RCPs is the inclusion of the SSP3-7.0 scenario which has very high aerosol emissions. [Gillett Nathan, Canada]	Accepted. Text in new Section 1.6.1.3 revised accordingly: "The full set of nine SSP scenarios now includes a high aerosol emission scenario (SSP3-7.0). "
125443	99	24	99	24	It's the addition of a very HIGH mitigation scenario that's different (or very LOW emissions scenario). Text should clarify that this was driven, in part, by the need to inform the SR1.5. [Trigg Talley, United States of America]	Accepted. Text revised to: "of a very low climate change mitigation scenario"

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
14535	99	26	99	26	within blue box text: "a collapsing decline of emissions" is unclear. Does this mean the emissions collapse, or that the decline collapses, i.e., that emissions actually increase? [Amy East, United States of America]	Not applicable. Text deleted.
70725	99	30			Which scenario ranges are being compared to observed emissions here? Is it the RCPs or the SSPs? [Gillett Nathan, Canada]	Taken into account. Text revised: "Historical emissions over 2000 to 2010 approximately track the upper half of SRES and RCP projections (Figure 1.28)"
12431	99	31	99	34	Is this temperature level in the 21st century? Is overshoot allowed? [Lijing Cheng, China]	Taken into account. Table was deleted from FGD: the levels per se are defined independently of a particular time [Comment refers to page 100, not 99]
70727	99	32		34	Saying that the SSPs are 'improved' compared to the RCPs because all the RCPs have a strong reduction in SLCPs is a judgement which is not necessarily supported by the literature. My understanding is that this reduction in SLCP emissions is something that arises in almost all IAMs and is based on developing countries introducing the same kind of pollution controls that have already been introduced in developed countries. My understanding was that the SSP3-7.0 scenario is extreme in this respect and was included specifically to span a broader range in SLCP emissions. I would replace 'are improved' with 'span a broader range'. [Gillett Nathan, Canada]	Taken into account. The new text now specifies that SSPs cover a broader range, but do not explicitly label that as an "improvement". Cross-Chapter Box 1.4, e.g., states "The core set of five SSP scenarios SSP1-1.9, SSP1-2.6, SSP2-4.5, SSP3-7.0 and SSP5-8.5 was selected in this Report to align with the objective that the new generation of SSP scenarios should fill certain gaps identified in the RCPs. For example, a scenario assuming reduced air pollution control and thus higher 4 aerosol emissions was missing from the RCPs."
23849	99	34	99	34	Replace uniformly by uniform. [Branko Grisogono, Croatia]	Accepted. Revised accordingly
125445	99	39	99	32	It's not that such scenario construction would be redundant - it would be WRONG. Emissions have not peaked and, therefore, any scenario that has emissions peaking prior to 2020 would be false. This statement (and the paragraph that follows) is very important. There's a common argument that scenarios are worst case and that the actual path isn't that bad, when in reality trajectory in the "two-third quantile or upper half." [Trigg Talley, United States of America]	Not applicable. Text removed. The point that scenarios are now redundant is not included any more. Historical scenarios that did not project the actual emission evolution correctly, are not false, as scenarios are to some degree the expression of collective choices taken. So, in retrospect they become indications of how the current present state (of emissions, energy use etc) could have been, had other choices been taken.
111523	99	41	99	44	The statement on the ranking of the RCP emissions scenarios is not correct. It is true for the IAM-based emissions that were aligned to the RCP concentration pathways, but actually when ESMs were used to calculate the emissions compatible with each RCP, the ranges of compatible emissions overlap considerably. This can be seen in the carbon cycle chapter of the AR6 Working Group 1 report. [Richard Betts, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. The provided example is now clarified to specifically refer to the IAM emission scenarios.
50663	99	41	99	44	This discussion of the ranking of the RCPs overlooks the uncertainties in the emissions compatible with the RCP concentration pathways (AR5 WG1 Chapter 6 Figure 6.25). According to these previous WG1 conclusions, the emissions scenarios compatible with the RCPs overlap considerably until the 2020 and there is no clear ranking. [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. The statement is now clarified to specifically related to the IAM's total CO2 emission scenarios rather than the inverse emissions that show some overlap.
70729	99	41			This discussion of the limitations of the SSP scenarios should cite and discuss Hausfather and Peters (2020) (https://www.nature.com/articles/d41586-020-00177-3), which argues that SSP5-8.5 is unlikely. Also, this discussion could now refer to the new cross-chapter box on assessment of the climate effects of COVID-19, for discussion of the influence of COVID-19 on future forcing evolution. [Gillett Nathan, Canada]	Accepted. The section 1.6.1.4 now discusses Hausfather and Peters (2020) and related articles. Likelihood of SSP scenarios (and the effect of COVID-19) are integrated in new section 1.6.1.4.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
28751	99	44			second highest emissions scenario in terms of CO2 emissions or in terms of warming (e.g. due to large reduction in aerosol forcing)? [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. In terms of total CO2 emissions. Now clarified.
114367	99	47	99	47	I think this is a bit more than just a "nuance" [Jan Fuglestedt, Norway]	Not applicable. Text deleted.
50665	99	51	100	1	How did/do the CO2 concentration pathways in the scenarios compare with observed CO2 concentrations? [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Text revised. We now write: Historical emissions over 2000 to 2010 approximately track the upper half of SRES and RCP projections (Figure 1.28). More generally, the global fossil and industrial CO2 emissions of recent decades tracked approximately the middle of the projected scenario ranges (see Fig 1.28), although with regional differences (Pedersen et al., 2020).
50615	100	7	100	18	It would be clearer to use the term "Global Warming Levels" rather than "temperature levels", for 2 reasons. (1) The use of "temperature levels" can give the impression that 1.5C, 2C etc refer to the absolute temperature of the Earth, rather than their actual meaning of temperature change relative to pre-industrial. We have seen examples of results being presented in official IPCC meetings as "at a global temperature of 2C" which can give the appearance of the impression of scientific illiteracy, so should be guarded against by careful terminology otherwise it could attract easy criticism. (2) Many stakeholders think that the Paris Agreement target levels of limiting warming to 1.5C, 2C etc are somehow physically significant even at regional or local levels, when in fact they are only relevant at the global level. Hence a term with "Global" in the title will be far more clear. [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Text revised accordingly throughout the chapter.
114371	100	7	100	26	I think you need a brief discussion of limitations to be aware of in the use of temp levels. I miss some mention of importance of rate of change and the shape of the temp trajectories leading to a temp level [Jan Fuglestedt, Norway]	Accepted. Discussion of limitations, or better challenges, related to the definitions and application of GWL has been expanded.
70155	100	7	101	30	Following the Pre-LAM4 BOGs, there was an agreement among the regional chapters that it would make sense to add a cross-chapter box on the question of the use of global warming levels to present projections of climate extremes or other climate impact drivers, with a focus on communication to stakeholders. It would be useful to refer to this potential upcoming cross-chapter box in this section. [Sonia Seneviratne, Switzerland]	Accepted. Reference to Cross-Chapter Box 11.1 added.
18471	100	9	100	9	GMST v GSAT [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. We now state that by default GWLs are expressed as global -mean surface air temperatures (GSAT) For the purpose of this introduction of the approach, the distinction does not matter
114369	100	9	100	9	Is "Assuming" the best word here? What about "Focusing on" instead? [Jan Fuglestedt, Norway]	Taken into account. Text revised.
16109	100	9	100	9	Do you intend to link temperature levels explicitly to "global mean surface temperature change" (as written in the text), that is, GMST? It is more often GSAT in the report. [Gerhard Krinner, France]	Taken into account. We now state that by default GWLs are expressed as global -mean surface air temperatures (GSAT) For the purpose of this introduction of the approach, the distinction does not matter

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
90047	100	9	100	18	the discussion presented to support the concept of "temperature levels" and that it yields an dimension for socioeconomic actors is well articulated. A caveat to be added is impacts are possible even at lower temperature levels. [Govindarajalu Srinivasan, Thailand]	Noted. thanks. We refrain from adding the proposed caveat here. This is mentioned elsewhere (e.g., section 1.2)
70151	100	13	100	14	Could also mention here a) Seneviratne et al. 2016, Nature, and b) Seneviratne and Hauser 2020 Earth's Future (the latter also comparing the responses in CMIP5 and CMIP6). References: a) Seneviratne, SI, M. Donat, A.J. Pitman, R. Knutti, and R.L. Wilby, 2016: Allowable CO2 emissions based on regional and impact-related climate targets. Nature, 529, 477-483, doi:10.1038/nature16542 ; b) Seneviratne, S.I., and M. Hauser, in press: https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2019EF001474 . [Sonia Seneviratne, Switzerland]	Accepted. References added. Added reference to new cross chapter box on GWL.
8633	100	13	100	14	See also Li et al 2020, 10.1088/1748-9326/ab7d04 [Robert Kopp, United States of America]	Accepted. Reference added.
113085	100	14	100	14	has' [Diego Miralles, Belgium]	Accepted. Text revised.
21387	100	20	100	26	My understanding of later chapters is that they use 1850-1900 as the baseline for assessing thresholds. This requires clarifying in edits here. Also, the impact of recent dataset changes and GMST vs. GSAT choice is important so this should forward reference to where these are assessed in chapter 2. [Peter Thorne, Ireland]	Taken into account. Reference period 1850-1900 added. We now state that by default GWLs are expressed as global -mean surface air temperatures (GSAT) For the purpose of this introduction of the approach, the distinction does not matter
70153	100	21	100	21	Would make sense to also cite here Wartenburger et al. 2017, GMD, which specifically addressed this question: Geosci. Model Dev., 10, 3609–3634, 2017, https://doi.org/10.5194/gmd-10-3609-2017 [Sonia Seneviratne, Switzerland]	Accepted. Reference added.
35507	100	25	100	25	° C repeats [Carlos Antonio Poot Delgado, Mexico]	Noted. Editorial. Revised accordingly
114377	100	29	101	2	Last part if table 1.5: Please clarify what you mean by "Secondary tem ref levels" [Jan Fuglested, Norway]	Not Applicable. Table 1.5 has been deleted
19669	100	29	101	2	There is very little information in this table. Perhaps it might be spared [philippe waldteufel, France]	Accepted. Table 1.5 has been deleted
29747	100	31	100	31	Consider adding "(Tiers 1 and 2, respectively)" in order to enhance consistency with previous Cross-Chapter 1.5 (Table 1 and text). [Hernan Edgardo Sala, Argentina]	Not Applicable. Table 1.5 has been deleted
6465	100	31	100	31	"global mean-surface air temperature" should be "global-mean surface air temperature". [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Not Applicable. Table 1.5 has been deleted
50667	100	31	100	31	Please insert "change" after "temperature" [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Not Applicable. Table 1.5 has been deleted
112569	100	31	100	33	Interpreting the Paris Agreement warming levels as referring to changes in GSAT is policy prescriptive, and not consistent with the quantification of warming in the Structured Expert Dialogue prior to Paris. IPCC can choose to do this, but the decision should be flagged up. [Myles Allen, United Kingdom (of Great Britain and Northern Ireland)]	Not Applicable. Table 1.5 has been deleted
90049	100	31	100	33	mention time horizon - between 2030 and 2052 [Govindarajalu Srinivasan, Thailand]	Not Applicable. Table 1.5 has been deleted
24285	100	31	101	1	There is little value to this table. The concepts of 1.5, 2 etc have been outlined already [Bryan Weare, United States of America]	Not Applicable. Table 1.5 has been deleted
28753	100	31			Table 1.5 did not seem to me add any useful information above what was described in the text [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Not Applicable. Table 1.5 has been deleted
42105	100	32	100	32	pre-industrial = 1750 - refer to cross chapter box 1.2 [Julia Nabel, Germany]	Not Applicable. Table 1.5 has been deleted

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
125447	100	34	100	34	In the Notes cell for the 1.5°C row, suggest putting a finer point on the Paris Agreement context for this warming level. Article 2, para 1(a) of the Agreement states: "This Agreement, in enhancing the implementation of the Convention, including its objective, aims to strengthen the global response to the threat of climate change, in the context of sustainable development and efforts to eradicate poverty, including by: (a) Holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and..." While it would be ill-advised to insert direct Paris text as it could open a lengthy re-litigation, the 1.5°C threshold is explicitly mentioned in this Article. Provide this context for the warming level. Leave the 2°C Notes section as it is. [Trigg Talley, United States of America]	Not Applicable. Table 1.5 has been deleted
125449	100	34	100	34	Remove the last sentence in the Notes section of the 3°C row. The current round of NDCs only provide emissions targets for 2025 or 2030. It's impossible to extrapolate from that point to a future level of warming as the outcome is entirely dependent on what occurs after that. Could retain only if some context or caveat is provided about the assumptions post-2025 or 2030 to draw that conclusion [Trigg Talley, United States of America]	Not Applicable. Table 1.5 has been deleted
50669	100	34	101	1	At a glance, column 1 could be misunderstood as referring to absolute global temperature rather than temperature change relative to pre-industrial. Use of "global warming referene levels" would avoid this misunderstanding. The SPM uses Global Warming Levels. [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Not Applicable. Table 1.5 has been deleted

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
98575	100	48			<p>This section (10.5.2) could be strengthened by outlining the critical role art and culture are playing in communicating climate change and helping engage people into its complexities in a fundamentally different way from traditional communication approaches. Climate data often remains poorly understood and researchers are struggling to find ways to communicate this in a way that is not only comprehensible, but also catalyzes mitigation and adaptation action at a regional scale. There is a growing amount of evidence suggesting interdisciplinary scientific engagement (e.g. climate scientists working together with artists) can enhance and amplify climate messages. A number of initiatives on climate science and art practices offer different formats for such types of interdisciplinary collaborations that result in a climate message reaching a wider and broader audience via cultural institutions and channels than traditional communication channels. To name a few: UK-based Cape Farewell (https://capefarewell.com/) organisation, committed to the notion that artists can engage the public in this issue, through creative insight and vision. Among other activities they bring artists, media professionals and climate scientists on an Arctic sailing expedition to facilitate creative exchange and have the participants produce works that communicate the climate change on a deep and personal level Ukrainian Climate Art Labs (http://culturebridges.eu/en_success_stories/climate_art_labs) project that brings ukrainian climate and natural scientists, activists and artists for a residency where they form interdisciplinary tandems and work on a selected climate-related topic. Last year the collaborations resulted in a number of exhibitions, public engagement events, publications that explored regional climate change meanings, narratives and impacts through the art works created in the process UK-based Creative Carbon Scotland (https://www.creativecarbonscotland.com/) organisation that facilitates scottish artists' engagement with climate change by embedding them into the regional climate-related projects and initiatives and building a network of artists and cultural institutions who collectively create ways to respond to climate change [Iryna Zamuruieva, United Kingdom (of Great Britain and Northern Ireland)]</p>	<p>Not Applicable. Table 1.5 has been deleted [Comment seem completely misplaced, we cannot identify what it refers to] No action.</p>

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
98577	100	48			<p>The power of art to foster more critical and deep engagement with climate change and more broadly with individuals' and communities' locals environments has been also acknowledged and taken communicated by such major art institutions as Tate Modern (see on of their exhibitions here https://www.tate.org.uk/whats-on/tate-modern/exhibition/olafur-eliasson-and-minik-rosing-ice-watch), Scottish Opera (see their recent Anthropocene opera https://www.scottishopera.org.uk/shows/anthropocene/) and Venice Bienalle (see a number of climate-change related works at the 2019 show https://news.artnet.com/art-world/climate-change-venice-biennale-1532290)</p> <p>For more information of how climate science can be communicated through art-science partnerships, please see: Crossick, G., & Patrycja. (2016). Understanding the value of arts & culture (p. 204). A Report on the Cultural Value Project. Polaris House, North Star Avenue, Swindon, Wiltshire, UK: Arts and Humanities Research Council. Haraway, D. (2015). Anthropocene, capitalocene, plantationocene, chthulucene: Making kin. Environmental Humanities. Vol. 6, 159-165. Hawkins, H., Marston, S., Ingram, M., & Straughan, E. (2015). The Art of Socioecological Transformation. Annals of the Association of American Geographers, 1–11. Hulme, M. (2009). Why we disagree about climate change: understanding controversy, inaction and opportunity. Cambridge University Press. Lakoff, G. (2010). Why it Matters How We Frame the Environment. Environmental Communication, 4(1), 70–81. Light A, Wolstenholme R and Twist B. (2019) Creative practice and transformations to sustainability – insights from research. SSRP Working Paper No1, Sussex Sustainability Research Programme, Sussex University Nääs, H., et. al. (2017): Frozen-Ground Cartoons: An international collaboration between artists and permafrost scientists, [Miscellaneous] doi: 10.2312/GFZ.LIS.2017.001 It's time for a new age of Enlightenment: why climate change needs 60,000 artists to tell its</p>	Not Applicable. Table 1.5 has been deleted [Comment seem completely misplaced, we cannot identify what it refers to]
115749	100		101		I suggest to replace "no climate policy" by "no climate mitigation policy" (as a warming of 4°C would certainly require climate adaptation policies). [Valerie Masson-Delmotte, France]	Not applicable. Table 1.5 has been deleted from the FGD in response to reviewer comments. We now generally refer to "no additional climate policy" when addressing the reference scenarios.
70731	100				Table 1.5, 1.5C row. Replace 'Paris Agreement aspiration to pursue best efforts' with 'commitment to pursue efforts'. The original text is too weak. [Gillett Nathan, Canada]	Not Applicable. table 1.5 has been deleted from the FGD.
70733	100				Table 1.5, 2C row. Replace 'aspiration' with 'commitment' or 'agreement'. Aspiration is too weak. The Paris Agreement is an agreement to keep the increase in global mean temperature to well below 2C. [Gillett Nathan, Canada]	Not Applicable. table 1.5 has been deleted from the FGD.
28755	101	3			levels -> level [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Not Applicable. Table 1.5 has been deleted
879	101	5	45	91	delete "a" [Bart van den Hurk, Netherlands]	Taken into account. Revised accordingly
4787	101	5	101	5	delete "a" [Bart van den Hurk, Netherlands]	Taken into account. Revised accordingly
50671	101	5	101	25	There is a mix of use of "temperature" and "warming" in these 2 paragpsh. eg. lines 5, 12, 16 and 24 use "temperature" but lines 8, 13, 22 and 24 use "warming". The latter (warming) is clearer as it avoids the potential misunderstanding that the numbers might refer to absolute temperature. [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Revised accordingly
125451	101	5	101	30	These three paragraphs should be condensed into a couple of summary sentences. [Trigg Talley, United States of America]	Rejected. This is crucial text introducing the concept of GWLs for the AR6. We have in contrast expanded the discussion in response to review comments.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
114373	101	9	101	9	Can you say a bit more about this "empirical scaling relationship approach" ? [Jan Fuglestedt, Norway]	Rejected. We stick to just mentioning the methods, but refer to the new cross-Chapter box 11.1.
114375	101	12	101	14	The third point here does not seem to be an approach (the way it is presented here) like the two first points made. [Jan Fuglestedt, Norway]	Accepted. Text revised accordingly.
70865	101	17	101	20	Another important dependence of regional precipitation changes is on whether the temperature level is stabilized or transient, which can have first-order effects especially in water-stressed regions (Zappa et al. 2020, doi: 10.1073/pnas.1911015117) [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Revised accordingly. Reference added.
109489	101	20	101	20	Which scenario does it refer to? The ones analysed in the 1.5 reports? Is it climate mitigation or air pollution mitigation? [Sophie Szopa, France]	Not applicable. Sentence deleted.
70735	101	24			Insert 'increase' after 'global-mean temperature'. [Gillett Nathan, Canada]	Accepted. Revised accordingly.
779	101	34			Change Emissions to emissions [Baruch Rinkevich, Israel]	Accepted. Revised accordingly.
66183	101	34			<p>The role of N2O in cumulative carbon emissions is understated in this report. The sections where CCE and N2O are/could be discussed include 1.6.3 (Fig1.26), 5.5.2.2.3 (Fig 5.31), 7.1, SPM Box 2 (Table 3). For example, Ch. 7 has a key statement: "Therefore, the impacts of CO2, N2O and other long-lived gases are usually functions of cumulative emissions.(P 7-113 / L34)".</p> <p>The discussion about the linearity of the CCE vs T response across scenarios and the conclusion is a bit optimistic, especially when looking at 1.5C or 2C, where CCE ramps down and may reverse. For these, I question the utility of TCRE/CCE without including N2O.</p> <p>For example, the CCE for the for the two lowest warming SSPs is 578 & 1279, while the equiv CCE-N2O over the same period (2015-2090) ranges from 190 to 350 GTCO2e, a large fraction of the CCE.</p> <p>The problem with ignoring N2O is that the path to carbon neutrality is unlikely to reduce N2O: for CO2 it is CCS/BECCS and renewable energy, while for N2O, it is based on feeding people. The ability to control N2O emissions from fixed-N is not well studied and has no obvious strategy (at least as I can find here). N2O emissions look harder to control than any other SLCFs like CH4. There is an odd note (Ch 5-88 L14) that says something about "used to estimate the non-CO2 contribution across a wide variety of stringent mitigation scenarios (Huppmann et al., 2018)" - I looked up the Huppmann commentary, but could find little on non-CO2 or N2O.</p> <p>Maybe putting the SLCF & N2O equiv CCE in SPM Box 2 Table 3 would add a useful perspective. [Michael PRATHER, United States of America]</p>	<p>Taken into account. The importance of N2O and other long-lived GHGs is indeed not explicitly mentioned for long-term climate change, as this section 1.6 only considers CO2 as one dimension of integration. Chapter 5 is considering warming by other GHGs as well. Chapter 7 in its metric discussion has more a focus on short-lived substances and also does not highlight the role of N2O. We however extended the figure 1.29 with a clearer depiction of N2O across the five main SSP scenarios.</p>
29749	101	36	101	36	Orphan parenthesis. [Hernan Edgardo Sala, Argentina]	Accepted. Revised accordingly.
13171	101	36	101	36	Missing () [Maria Amparo Martinez Arroyo, Mexico]	Accepted. Revised accordingly.
37845	101	54	105	54	In this Report: "R" should be lowercase? [Junhee Lee, Republic of Korea]	Accepted. Done. [Comment refers to page 105, Section 1.8 of the SOD]
125453	102	5	102	5	Insert: "... effect chain from emissions to ATMOSPHERIC CONCENTRATIONS to temperature change..." Important to reflect that part of the causal change explicitly, as well. [Trigg Talley, United States of America]	Accepted. Revised accordingly.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
13215	102	7	102	7	It's recommended to explain why the increase of CO2 plays an important role in the increase of air temperature, if it is due to the effects it triggers in the climate system or it is more abundant than the rest of the greenhouse gases. [Maria Amparo Martinez Arroyo, Mexico]	Noted. We point to Chapter 5 and 7 for that substantial discussion - Chapter 7 in particular considers the radiative efficiencies of the different gases, showing that on a mole by mole basis, CO2 is less effective a greenhouse gas than most other substances - but emitted in very large amounts - with the total effect in terms of radiative forcing now highlighted in Figure 1.29 [CO2 DRIVER].
45785	102	7	102	7	Change "cumulative greenhouse gase emissions" to "cumulative CO2 equivalent greenhouse gas emissions". [Twan van Noije, Netherlands]	Rejected. Both are captured in the existing sentence: GHGs and CO2
44295	102	7	102	18	CO2-forcing-equivalent emissions are a much better indicator of warming response as a function of cumulative emissions, since they convert all pollutants into CO2-like timeseries. [Stuart Jenkins, United Kingdom (of Great Britain and Northern Ireland)]	Noted. No change.
66657	102	7	102	18	This could be simplified a lot. Cumulative GHG emissions have a "close relationship" with cumulative CO2 emissions because CO2 dominates the forcing (and increasingly so). Elsewhere in the chapter and in the report there is far clearer text which points out that there is a straightforward relationship between cumulative long-lived (CO2, N2O, etc - anything with residence time >100 years) gases and temperature, and a straightforward relationship between short-lived (CH4, black carbon, etc - anything with a lifetime <20 years) and warming. The rest of the report is moving away from pretending that GWP100 does a good job of giving the temperature implications of a time-series of emissions. And the material about cost-effectiveness should be cut: (1) that's not a physical science point that belongs in a WGI report; (2) focusing only on results is not what's done in the rest of the chapter - and in the more general case the relationship does not obviously hold; (3) the sentence doesn't really scan. [Dave Frame, New Zealand]	Noted. The point that CO2 dominates the forcing is now explicitly made. The GWP-100 concept is used by 191 countries around the world to formulate their NDCs under the Paris Agreement. It is hence important to consider how close GWP-100 weighted emissions are to the cumulative CO2 emissions. A purely factional analysis of the largest scenario databases to date show that there is a very close relationship, which lends confidence to the fact that GWP-100 is predominantly used in existing emission trading systems. As the author of this comment stated in a separate email correspondence, the other GWP* and CGTP concepts are not to be used in multi-gas single-basket emission trading systems, which renders these new GWP* and CGTP concepts not useful for the realm of uses that GWP-100 is used for. The GWP* and CGTP concepts fail to adequately reflect some key characteristics that emission metrics need to be used in emission trading systems that are build on the concept of comparing emissions in a specific year of different gases with a "currency conversion". Thus, while these concepts that the author brings into play are useful for projecting temperatures without the use of climate models, they are not replacing GWP or GTP as pulse-emission metrics.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
114379	102	7	102	18	I think a bit more explanation is needed regarding close relation between cumulative CO2 emissions and cumulative GHG emissions. This is repeated also on lines 13-14 and the reasoning here is unclear to me. The point seems to be that you can still simplify by using CO2 as key indicator, which strengthens the use of CumCO2 as a DoI. But the close relationship, that is based in the scenarios available, right? Thus, I think the para would benefit from some clarifications. [Jan Fuglestedt, Norway]	Taken into account. We slightly simplified the paragraph to point out the close relationship between GWP-weighted cumulative emissions and CO2 cumulative emissions. While the fundamental reasons for this close relationship are a bit more complex, related to both the co-emitting nature of GHGs in many sectors, but also in the way that IAMs optimise multi-gas baskets for emission scenarios, we feel this relatively succinct consideration here (pointing out the strong correlation) is the role of WG1, whereas WG3 can take a deeper dive into the multi-gas metrics for policy settings (in a more encompassing way than WG1 is able to do).
111955	102	13		16	when calculating how much can be still emitted to keep below the temperature limit (or for how long) the difference seems to me to be important [Tomas Halenka, Czech Republic]	Noted. No change. The focus of this paragraph is on the possibility to assess the broad range of emission scenario literature also by using cumulative CO2 emissions as a key indicator. The discussion of remaining carbon budgets for a particular temperature target is presented elsewhere, i.e. predominantly in Chapter 5.
114381	102	14	102	14	Are you writing "cost effective" since the emissions pathways are taken from the scenario database based on models that calculate cost effective scenarios? [Jan Fuglestedt, Norway]	Not applicable. Text revised, term no longer used.
114383	102	20	102	30	This para contains important points but could probably be a bit more clear wrt to implications. If the point is to present and discuss different tools and their weaknesses and strengths for use in WGIII, then that could be made a bit more clear. [Jan Fuglestedt, Norway]	Taken into account. Paragraph has been rewritten to more clearly present some of the important caveats associated with the concept.
102493	102	22	102	22	"global-mean temperature levels" should presumably be "global-mean surface temperature levels" [Philippe Tulkens, Belgium]	Not applicable. Comment seems to be misplaced.
39573	102	31	102	39	Following Myrhe, G., et al 1998. Geophys. Res. Lett. 25, 2715, it is generally admitted that the radiative forcing, hence temperature, is logarithmic versus CO2 concentration. Why here is it linear? [François Gervais, France]	Rejected. It is not linear. The second y-axis clearly shows the non-linear relationship between CO2 atmospheric concentrations and radiative forcing (first y-axis).

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
112571	102	35	102	44	Cumulative CO2-e emissions, combining CO2, methane and nitrous oxide using conventional GWPs, is a meaningless quantity that has no climate relevance. Also, recent papers (Mengis and Matthews, 2020) show clearly that the assumption of a fixed fraction of climate forcing due to CO2, or constant "effective TCRE", breaks down particularly for ambitious mitigation scenarios. What would make sense would be to show E and Delta F / alpha, where alpha = AGWP_H/H of CO2 and Delta F is the change in non-CO2 radiative forcing. This, at least, makes physical sense. [Myles Allen, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. Cumulative CO2-e emissions are used in various policy settings, whether it is the Kyoto Protocol for 5-year cumulative emissions in each commitment period or in various state and national legislations. Thus, it is important to consider to what degree that metric - as it is used in policy circles - is related to the one that makes physical sense, which is the TCRE concept and warming related to cumulative CO2 emissions. Furthermore, metrics need to fulfil a broad range of fairness and practicability criteria to be of policy-relevance, not at least given that 191 countries in the world use GWP-100 to define their NDCs. Thus, the IPCC NOT examining GWP-100 from different angles would equate for the IPCC to lock itself up in a space that is maybe attractive for physical scientists, but irrelevant for policy-makers.
14901	102	35		44	This figure should not use just the 100 year GWP for methane; perhaps a second panel showing the results using GWP20? AND it seems very wrong to be using GWP values from AR4, which are quite out of date (even compared to the AR5) and are too low. See for example Etminan et al. 2016 Geophysical Research Letters 43: 12,614-612,623 [Robert Howarth, United States of America]	Rejected. The main point of the inlet is to examine the closeness of the metric that is mainly used in policy circles. 191 Parties to the Paris Agreement use GWP-100 to communicate their NDCs. The majority of which uses GWP-100-AR4 at this stage. Thus, GWP-100-AR4 is here the correct metric to test in terms of how closely it correlates with cumulative CO2 emissions - as the inlet shows. The actual radiative forcing in the main part of the figure as - as Chapter 7 - based on the Oslo line by line model results shown in Etminan et al. 2016.
34831	102	44	103	45	This section describing factors limiting the SOD assessment is very welcome, and seriously questions the degree of confidence used in many of the SOD conclusions. Please see general comment #15 above. [Jim O'Brien, Ireland]	Noted. Section 1.7 has been reframed for the FGD to ensure consistency across chapters [Comment seems to refer to page 103, not 102, and Section 1.7, not 1.6; Please note that referring to personally numbered comments from individual reviewers is untraceable for the authors.]
67703	102	53	103	6	I feel the text here and the figure (Figure 1.27) do not correspond. How does one understand the integration of scientific knowledge of each WG from this figure? [Hiroaki Kondo, Japan]	Taken into account. The Figure is now replaced as Figure 1.26 into the restructured section 1.6.1 - in that placement, the figure is hopefully providing a sense to the reader how scenarios span a broad future scope until 2300 (which is quite different from the last 2000 years).

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
112891	102	53	103	16	In Section 1.6.4 it is shown Figure 1.27. The temperature proxy reconstruction provided by the PAGES 2k Consortium is here introduced without any comment on its validity and reliability. This temperature reconstruction tries to reconstruct past climate using a very large number of proxy data. The result looks spurious because the record becomes more and more flattering for older ages. This is what one expects when inhomogeneous records are merged which could in part be faulty or very noisy. However, more homogeneous records do not show such a flatness and also show a medieval warm period comparable to modern times in many places. See References. Adding here the PAGES 2k Consortium temperature reconstruction in Figure 1.27 has only hockey stick scenographic effect that claiming that the temperature has been nearly constant for two millennia before 1900 and then started rising, which is not confirmed by numerous other studies. Christiansen B. & Ljungqvist F.C. (2012) - The extra-tropical Northern Hemisphere temperature in the last two millennia: reconstructions of low-frequency variability. <i>Clim. Past</i> , 8: 765-786. Ljungqvist, F. C., Krusic, P. J., Brattström, G., and Sundqvist, H. S.: Northern Hemisphere temperature patterns in the last 12 centuries, <i>Clim. Past</i> , 8, 227–249, https://doi.org/10.5194/cp-8-227-2012 , 2012. [Nicola Scafetta, Italy]	Noted. The consolidated temperature timeseries by the PAGES 2k consortium combines a large set of reconstructions. More detail is provided in Chapter 2.
114385	102	54	102	54	Fig 1.27 is important but I am not sure if it is referred to in the right place. May need better integration to the text. [Jan Fuglestad, Norway]	Taken into account. The Figure is now replaced as Figure 1.26 into the restructured section 1.6.1 - in that placement, the figure is hopefully providing a sense to the reader how scenarios span a broad future scope until 2300 (which is quite different from the last 2000 years).
70157	103	2	103	2	Also refer here to Chapter 11, Section 11.8 ("Compound events") [Sonia Seneviratne, Switzerland]	Accepted. Revised accordingly.
101489	103	5	103	5	Kopp et al. seems a bit arbitrary [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Noted. We additionally include a reference to Chapter 9 for more details.
102495	103	5	103	7	It might be argued here that "The interdisciplinary scientific literature within this field is still poorly developed" [Philippe Tulkens, Belgium]	Noted. That is correct. This section however does not provide a synthesis or assessment of the literature on this point but rather point out the generic "dimension of integration".
125455	103	11	103	15	Figure 1.27 is well conceived but it may fit better into a chapter that focuses more on paleoclimate. This stunning picture of CO ₂ , methane, and nitrous oxide concentrations over the past 2000 years is definitely better than a thousand words. [Trigg Talley, United States of America]	Noted. Thanks. We agree that this is an important figure and thus want to keep it here. It connects the discussions on the long-term context provided in Section 1.2 with the discussion of the basis for future projections in Section 1.6.
112573	103	11	103	15	Suggest rescale vertical axes on top three panels to indicate similar impact on radiative forcing (similar CO ₂ -equivalent concentrations -- which is unambiguous). [Myles Allen, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. We prefer not to introduce the concept of CO ₂ equivalent concentrations but to just show the GHG concentrations alongside global mean temperature.
41387	103	11			Figure 1.27: Please provide more horizontal and vertical space for the temperature projections. At the moment, the GMT projections are not distinguishable, hence the visualisation is hardly useful. While I can see the value of showing one consistent 2300 year long axis to underline the relative stability of the historical climate, I would suggest to split x-axis with left part covering 0-2000 (2/3) and right part (1/3) covering 2000-2300. [Alexander Nauels, Germany]	Taken into account -- partly. We have increased the vertical scale for temperature. We prefer to keep a continuous time axis.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
29753	103	20	103	22	If the aim is to emphasize the cause-effect chain, check if might be better to present the aforementioned policy-relevant dimensions in an inverted order. That would be: "cumulative carbon emissions and global-mean temperature levels" instead of "global-mean temperature levels and cumulative carbon emissions". [Hernan Edgardo Sala, Argentina]	Not applicable. Section has been deleted as it was repeating a lot that is said before.
67705	103	20	103	28	It is highly appreciated that the integration of all three WGs has progressed. [Hiroaki Kondo, Japan]	Noted. Thanks.
50609	103	23	103	28	We welcome the identification for potential synthesis across the working groups. However the language of this paragraph is not straightforward. Perhaps you could use "bridge" or "link" instead of "handover"? [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. Section has been deleted as it was repeating a lot that is said before. "Link" is now used in the introductory para to Section 1.6
114389	103	24	103	24	Re "The handover with WGIII are the emissions": Unclear wich part of the process you mean here. WGI received emissions from WGIII, but we hand over simple models that encapsulate the WGI findings on RF, ECS, carbon cycle etc [Jan Fuglestedt, Norway]	Not applicable. Section has been deleted as it was repeating a lot that is said before. "Link" is now used in the introductory para to Section 1.6. Also, Section 1.6.1.2 discusses the scenario generation process for CMIP6 and expands on the linkages between the different WGs as part of this process. Also Fig. 1.27.
14537	103	24	103	25	change "are" to "is", twice, for subject-verb agreement [Amy East, United States of America]	Not applicable. Section has been deleted as it was repeating a lot that is said before.
24291	103	24			CMIP6 models are largely running with concentrations, not emissions, from WGIII. Again the actual modeling process used in Ch.3 and 4 is not being well described. [Bryan Weare, United States of America]	Taken into account. Section has been restructured and the Cross-Chapter Boxes deleted or incorporated into the main text. A new Cross-Chapter Box was added on "The SSP scenarios as used in Working Group I". The main text is now streamlined and the RCP-SSP comparison has been added in different places including many new references to recent literature. A discussion of emission- vs concentration-driven runs has been included. We revised the text to make it clear that the majority of WG1-assessed scenarios and CMIP6 experiments is indeed concentration driven and that the carbon cycle and gas cycle steps between emissions and concentrations come with uncertainties.
125457	103	33	103	37	Figure 1.28 does not add a lot of value to the chapter. The text narrative about dimensions of integration is sufficient. [Trigg Talley, United States of America]	Rejected. Figure 1.28 summarizes what is covered in Section 1.6, visually connecting the dimensions of integration discussed in detail.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
19671	103	33	103	37	<p>Figure 1.28 illustrates the problems encountered when describing the 3 dimensions of integration of AR6: no satisfactory way is found to present emissions and scenarios, because both dimensions are all but independent.</p> <p>This does not lead of course to suggest to remove the dimension of scenarios, but to stick humbly to its purpose (as I understand it): throughout the whole spectrum of possible futures depending principally on mitigation options, select (inevitably in a somewhat empirical manner) a small number of representative, typical, possibly caricatural scenarios, so that the scientists modelling the climate system are able to use the same, well defined dynamic limit conditions, and the citizens get an understanding of the main features of the mitigation options resulting in each projected future.</p> <p>Whether this view of scenarios is shared by WG1 authors or not, it is far from emerging from the historical guiding principles adopted in section 1.6 [philippe waldteufel, France]</p>	Noted. Apart from the naming of "dimension", there is no suggestion made that those "dimensions of integration" are independent. They merely allow different research communities to integrate their respective findings via the same coordinate system. For some purposes, the levels of warming are the key consideration, whereas other research domains consider the transient nature of scenarios. As per the suggestion to consider caricatural scenarios with future mitigation options. That is an option, but would then lose the ability to integrate the rich knowledge from WG3. There, different mixes and timings and regional expressions of mitigation options might get to similar emission levels - depending on the socio-economic development that is assumed as a starting point (the SSP family).
125459	103	42	104	45	There also are limitations on geographic coverage of observations and projections. [Trigg Talley, United States of America]	Noted.
106263	103	42	104	45	This section could be significantly strengthened by clarifying two aspects that are core to understanding the limitations of the assessment: (i) First, in some cases the limitations are simply indicating that there is a possibility that a study was missed and that this could affect the assessment. In isolation this information can be used to undermine the authority of the assessment. More useful would be to highlight the measures that have been taken to ensure as large a selection of relevant literature was captured (i.e. international, multi-lingual author teams and several expert review rounds); (ii) second, it is clear that new information can change the assessment. However, it is particularly useful to know which statements, especially in the ES of the chapter, are affected by potential gaps in knowledge or, framed in a positive way, how further advances in data or understanding would help improve the clarity and confidence of statements of the ES. [Rogel] Joeri, United Kingdom (of Great Britain and Northern Ireland)]	Noted. New text has been added to highlight the extensive review process. The specifics of which ES is affected or could be enhanced is beyond the scope of this section as it is now very short.
31345	103	42	104	45	The section could rather be written from the point of view of the purpose and intention of an assessment. It is not to go through everything that exists, but rather in a systematically way collect sufficient amount of representative information that allows well-founded statements (including calibrated uncertainty language) to be made. The text is now a bit on "how little we have and how little we know" style, rather than "this is what we have and know." It would be more interesting to have clear statements from the authors on how confident they are on their assessment (process) rather than unqualified caveats (e.g. page 14, lines 16-18, line 29, line 31, lines 41-42). [Markku Rummukainen, Sweden]	Noted. This section is designed to highlight the factors that may limit the assessment. Throughout the rest of the report the confidence in the findings is noted.
31339	103	44	103	45	The text becomes overly defensive, to the degree that it reduces the substantive assessment itself. It is hardly unknown of unexpected that there are limitations. What is key here is to assess/understand whether limitations are such that the assessment outcomes are in doubt, or such that the outcomes still are useful and well-founded knowledge. This does not get expressed clearly enough here. The uncertainty (including deep uncertainty) is furthermore explained in the assessment's findings, as is later mentioned, so there is a risk here of artificial inflation of limitations in readers' minds. [Markku Rummukainen, Sweden]	Noted. This section has been shortened and re-worded.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
114391	103	51	103	51	This is not a limitation in itself. This is a challenge, and I think you need to reformulate this. E.g. in sert "related to" after "limitation is" [Jan Fuglestedt, Norway]	Noted. This section has been shortened but the point about the broader focus remains, however it is now framed more positively, highlighting the multi-lingual author team and extensive review process.
50611	103	51	104	1	This acknowledgement of the difficulty of assessing a rapidly-growing volume of literature is welcome. Do the authors have any suggestions to offer on how this can be managed in future? Or can the academic community help, eg by conducting more systematic reviews? [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Noted. This section has been shortened but the point about the broader focus remains, however it is now framed more positively, highlighting the multi-lingual author team and extensive review process.
70737	103	51	104	3	The volume of published peer-reviewed climate literature is a key factor underlying the robustness of this assessment, not a factor limiting the assessment. The authors are arguing that it is hard to assess all this literature, but this is our role as IPCC authors. Also including the 'volume of published, peer-reviewed climate literature' and in particular papers published in language other than English as one of the factors limiting our assessment sends the wrong message to the climate research community, and especially the part of the community which published in languages other than English. Delete this. [Gillett Nathan, Canada]	Noted. This section has been shortened but the point about the broader focus remains, however it is now framed more positively, highlighting the multi-lingual author team and extensive review process.
19673	103	51	104	3	Here is a good example of the ambiguity about the word "assessment". Since nowhere does the WG1 report suggest a judgment on the value of the publications, rather than assessing them it proposes to list the publications (in a structured manner whenever possible), to mention them, to report on them. [philippe waldteufel, France]	Noted. The IPCC is an assessment, not a review, and as you say, the authors endeavour at all times to reference only the key references that support the findings.
19675	103	51	104	3	This SOD includes close to 750 pages of references (on a total of circa 3500 pages). I trust you understand that its enormous size is the main weakness of the report. The space allocated to references contributes to this gigantism; although certainly there is no foolproof way of selecting key literature, as you say, selecting here is a must. [philippe waldteufel, France]	Noted. The IPCC is an assessment, not a review, and as you say, the authors endeavour at all times to reference only the key references that support the findings.
125461	103	52	103	52	A bibliographic analysis that revealed the doubling of the climate literature every 5 years and the preponderance of the climate literature being devoted to physical climate science was a key conclusion in the WGII AR5 SPM and Chapter 1 (2014), which should be cited here. [Trigg Talley, United States of America]	Accepted. This point and citation has been added.
31341	103	54	103	55	The ARs have always been "assessments, not reviews". A review would also be of lesser value compared to an assessment that provides an additional layer of analysis compared to a review that more or less simply summarises what others have found. These lines are selling AR6 a bit short... [Markku Rummukainen, Sweden]	Noted. This section has been shortened, and the key steps to ensure a quality assessment have been added.
39155	103	54	104	1	What do you mean by "key literature vs. all-encompassing literature review"? What constitutes "key literature"? [Lourdes Tibig, Philippines]	Noted. This phrase has been removed. Key literature might include reviews, but also those studies at the cutting edge of climate science, presenting new understanding that extends what was found in previous assessments.
66659	103	54	104	2	"Crucially" seems the wrong word here, and the sentence as a whole might strike people from outside Europe and North America as a bit of an excuse to ignore science from outside the North Atlantic countries. [Dave Frame, New Zealand]	Noted. The sentence has been deleted, but your point is well taken.
31343	103	55	104	3	It is of course clear that the authors have not been able to read all the literature in the world (and they hardly are not expected to do so either). The important aspect here is whether the authors are sufficiently confident that they have sounded the literature in a comprehensive fashion and can conclude that the assessment reflects the collective body of knowledge (even if not every single published paper has been leafed through). Could this be expressed better? [Markku Rummukainen, Sweden]	Noted. This has been shortened and re-written to highlight the rigorous process by which this assessment is written.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
115751	103		104		It could be good to provide an assessment of the expansion of the climate change literature from AR4 to AR5 and AR6 (number of peer reviewed papers per year; number of papers assessed in reports; numbers of papers assessed in successive drafts (building on the review process which adds literature for consideration) in a more quantified way. [Valerie Masson-Delmotte, France]	Taken into account. This sort of assessment would usefully help build the point made here which was that the amount of literature that could be assessed has increased dramatically every year. Not all of it will be cited in the assessments, and so it makes sense to point to the large increase each year. " Recently, scientific climate change research has doubled in output every 5–6 years; the majority of publications deal with issues related to the physical climate system (Burkett et al., 2014; Haunschild et al., 43 2016)."
45787	103				Figure 1.27: Please indicate the reference period for the temperature time series in the caption. [Twan van Noije, Netherlands]	Accepted. The reference period is now indicated.
114393	104	1	104	3	You could also mention the review process [Jan Fuglestedt, Norway]	Accepted. This has been added.
125463	104	3	104	3	It might be worth inserting a reference to traditional and indigenous knowledge here, as well, and the challenges of intergrating that into an assessment like this ... and where it may be particularly important (e.g., some of the most biodiverse places on Earth, in the Arctic; etc.). [Trigg Talley, United States of America]	Accepted.
14539	104	5	104	5	starting two consecutive sentences with "Further..." is awkward [Amy East, United States of America]	Not Applicable. This has been removed.
125465	104	5	104	10	[SCOPE] This paragraph does not belong in the WGI report. It's more appropriate for the SYR. Delete here. [Trigg Talley, United States of America]	Noted. This has been deleted.
70739	104	5		10	This bullet seems to be arguing that difficulties in linking between working groups are a factor limiting the assessment, and hence providing an end-to-end assessment of risks, mitigation choices, adaptation responses, and shifts in the physical climate system. This end-to-end assessment will be accomplished primarily in the Synthesis Report, which includes authors from all three Working Groups. The factors listed here should focus on factors limiting the Ch1 WGI assessment. Also in the phrase 'The IPCC recognises this challenge' are the authors refer to some decision document of the IPCC? Note of course, that as authors we are part of the Working Groups of the IPCC, but not the IPCC itself. Overall, I recommend deleting this bullet. [Gillett Nathan, Canada]	Not Applicable. This has been removed.
81001	104	8	104	10	with reference to the words 'limits to the extent'. Perhaps this needs to be re-worded to avoid doubt about the extent of the strength of linkages between the groups. Similarly, the merits of the 'new approach' could be elaborated upon to inform the reader of the substance and importance of the IPCC special reports. [Jeffrey Philip OBBARD, Singapore]	Not Applicable. This has been removed.
31347	104	8	104	10	This is rather non-descriptive. What are these limits and how do they affect AR6/WGI? Why is the SR-experience relevant here and what is the take-home message for the reader? Delete? [Markku Rummukainen, Sweden]	Not Applicable. This has been removed.
125467	104	8	107	16	Section 1.8 (structure / key elements of AR6) is hugely important and valuable to the reader. But it's buried after 100 pages of other introductory text. Strongly suggest moving this section to far earlier in the chapter, including Figure 1.29 and Table 1.6). [Trigg Talley, United States of America]	Accepted. This part is now moved to section 1.1.
70741	104	12		18	Rather than saying that there is too much literature for us to assess on regional scales, and that this is a factor limiting the assessment, I would re-frame as a bullet saying that because of space and resource constraints we can't comprehensively assess climate change on local scales in this report. [Gillett Nathan, Canada]	Noted. Regional climate change will be assessed in this report more than in AR5 WGI.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
106073	104	16	104	55	Mapping AR5 chapters onto all the "regional" chapters is highly problematic. The English expression that comes to mind is, "trying to fit a square peg into a round hole". It would be better if Ch1 stated that chapters 10, 11, 12 and the Atlas have a new, regional emphasis not found so extensively in previous ARs, and that it was done (at least in part) to make for a closer relationship between WG1 and WG2 (as well as to recognize the large, new volume of climate research at regional scales. This is not, by any means, simply an expansion of AR5 Ch14 into AR6 Chapters 10, 11, 12 and the Atlas. [William Gutowski, United States of America]	Noted. But we didn't have a space to describe it fully.
114395	104	35	104	35	you may add "inescapable" here [Jan Fuglestedt, Norway]	Noted. The sentence has been restructured, and now includes factors that are 'escapable' such as <u>geoengineering</u> .
8637	104	35	104	45	In general, the scenario sets are missing abrupt changes: geoengineering, nuclear war, plague, economic collapse... [Robert Kopp, United States of America]	Accepted. These extra factors have been added.
70743	104	35		37	The mention of volcanic eruptions needs more explanation. I think what the authors should say is that the scenarios considered are a possible set of futures, but they do not encompass all possible events which might alter radiative forcing in the future, such as possible future large eruptions. Could also broaden to cover other unexpected events like the Covid-19 pandemic. [Gillett Nathan, Canada]	Accepted. The sentence has been altered to include your suggestion.
107849	104	36	104	37	Earlier (can't remember where exactly) it was stated that volcanic effects were only for several years. Here it says 'even decades'. Needs to be resolved. [Linda Mearns, United States of America]	Noted. The timescale has been removed, and the link to the section where it is discussed has been added.
31349	104	36	104	37	It should be made clear that this is not an uncertainty for the anthropogenic warming or for the long-term climate change, so it is hardly an uncertainty for climate projections. (It can, however, be an uncertainty for climate prediction and temperature signal)). [Markku Rummukainen, Sweden]	Rejected. Major volcanic eruptions (e.g. 1250 CE) can alter the radiative forcing. A string of these would have a major impact.
8635	104	36	104	37	I suggest 'such as volcanic eruptions' rather than 'specifically volcanic eruptions.' Other large natural forcings (e.g., a bolide impact) are also missing. [Robert Kopp, United States of America]	Accepted. The text has been altered to say 'such as'. Meteorite impact has also been added.
107851	104	38	104	38	How is this falsely, exactly? A little more detail here would be good. [Linda Mearns, United States of America]	Noted. 'falsely' has been removed, and a more general statement around the fact that scenarios cannot encompass all possible events that might induce radiative forcing in the future.
107853	104	40	104	40	Is this 'unlikely' in standard IPCC parlance? [Linda Mearns, United States of America]	Noted. No, this is not standard IPCC parlance, and has been replaced with 'may not'.
31351	104	41	104	42	Would it not be relevant to state that the range of (emission) scenarios is assessed to be representative for the possible range of outcomes (or do the authors foresee very major outliers)? Is this uncertainty relevant for the purposes? [Markku Rummukainen, Sweden]	Noted. The range is based upon assumptions of our future that are deemed to encompass the range of possibilities. However, there are pathways outside of these, as noted in the list of possibilities listed above that are not accounted for (e.g. major meteorite impact)
21389	104	48			My feeling is that the overall chapter would make a lot more sense from a narrative perspective if this section started rather than finished the chapter so came immediately after the introduction. Then the reason for introduction of many of the concepts would be much clearer potentially. [Peter Thorne, Ireland]	Accepted. Now the structure part is moved to section 1.1.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
12433	105	6	105	8	It is not clear how these cross-cutting themes were decided and defined. And the broadness of these themes are totally different: atmospheric circulation is one aspect of atmosphere, but cryosphere is listed as one theme here, which is much broader than many other themes such as atmospheric circulation, aerosols ect. Water cycle is listed here but not Carbon cycle and energy budget. I wonder if it is really needed to have such a list here?? because it can never be comprehensive. [Lijing Cheng, China]	Taken into account. The themes were selected based on cross-chapter discussions, and the discretion of the Chapter 1 authors. We have harmonized the scope somewhat.
19677	105	16	105	29	My unique criticism on this structure has to do with the chapter Atlas, which was not part of the outline decided by the Panel. Explicit reasons are to be found when commenting chapter Atlas. [philippe waldteufel, France]	Not applicable. The specific comments are answered in the Atlas section.
71429	105	19			Chapter 10 also assesses the performance of models for regional climate information. [Douglas Maraun, Austria]	Taken into account. Text added.
70159	105	23	105	23	Add ", including compound events" after "an assessment of projected changes in extremes". [Sonia Seneviratne, Switzerland]	Accepted. It is added.
125469	105	27	105	29	Move these two sentences about the interactive Atlas to the front of the chapter, and refer to it more explicitly in the Executive Summary and the SPM. [Trigg Talley, United States of America]	Taken into account. The Interactive Atlas is now mentioned more explicitly at the beginning of the chapter (Sect.1.1).
107855	105	27	105	29	This is not an apt description of what the Atlas provides. Needs to be clarified and expanded on. [Linda Mearns, United States of America]	Taken into account. The description of Atlas is revised.
114397	105	32	105	33	re "The AR6 is structured around topics such as large-scale information,...": You mean WGI here, which should be made clear. [Jan Fuglestedt, Norway]	Accepted.
111365	105	34	105	35	"including for the global stocktake and for regional adaptation planning based on a 35 risk management framework." regional perspective is very important. [Neeshad Shafi, Qatar]	Noted.
114399	105	40	105	41	Figure 1.29 is useful, although a bit busy. I suggest you expand vertically the WGI AR5 part to same size as WGI AR6. I suggest you add "chapters" after WGI AR5 and WGI AR6. [Jan Fuglestedt, Norway]	Taken into account. The figure is now redesigned.
6467	105	46	105	46	"observations" should be "osservations, observational analyses" or simply "observational analyses". Much of the observational information presented is from processed (analysed) datasets, rather than direct observations. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. This part is totally rewritten and moved to section 1.1.
41091	105	52	105	52	This might be a good place to mention the glossary, as it may help the reader better understand the report. [TSU WGI, France]	Taken into account. This part is moved to section 1.1 and now glossary is mentioned there.
41093	105	52	105	52	This might be a good place to mention the glossary, as it may help the reader better understand the report. Also at one point it would be good to mention the full name of the 3 SRs. SRCL get very little credit throughout this assessment. [TSU WGI, France]	Taken into account. This part is moved to section 1.1 and now glossary and the names of the special reports are mentioned there.
71853	106	6	106	8	I was surprisd that sea elvel was not listed in this table. [John Church, Australia]	Noted. Sea Level is primarily discussed in Chapter 9, so was not included here. Oceans in general are, though.
88163	106	6			Table 1.6 - Polar Regions are also covered in Ch 2 for example in assessment of cryospheric change. Chapter 2 should therefore be added to this section (pg 107) of the table. [Sharon Smith, Canada]	Noted. Each chapter has given input on the table, Chapter 2 did not flag polar regions as a key topic for them.
125471	106	8	106	8	SRM is also discussed in Chapter 6. [Trigg Talley, United States of America]	Noted and added to the table.
21391	106	8	106	8	My feeling would be that within bold / non-bold the chapters should be ordered sequentially for readability. [Peter Thorne, Ireland]	Accepted. Table revised.
44369	106		106		Table 1.6 has a typo: should be "Global warming hiatus" starting with a capital letter. [Jana Sillmann, Norway]	Noted and corrected.
115753	106		107		I have made suggestions for additional themes (model evaluation, land use). [Valerie Masson-Delmotte, France]	Noted. They have been added.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
70745	106		107		Table 1.6. I suggest adding Chapter 3 as an additional chapter to the aerosol and polar regions rows. Ch3 assesses attribution of temperature and precip changes to aeosols; and it assesses attribution of changes in sea ice and snow, which are focussed in the polar regions. [Gillett Nathan, Canada]	Accepted. Ch.3 is added there.
70161	106				note missing capitals for "global warming hiatus" [Sonia Seneviratne, Switzerland]	Noted and corrected.
125473	107	6	107	15	[SCOPE] This paragraph does not belong in the WGI report. It's more appropriate for the SYR. Delete here. [Trigg Talley, United States of America]	Rejected. The linkage with other WGs from the perspective of WGI deserves a place here.
70747	107	6	107	15	This paragraph on integration with other WGs is a bit of a weak note to end on. I would strengthen, and explain how key topics relevant to integration across WGs have been introduced here in order to support strong cross-WG integration in AR6, and facilitate better integration in the SYR. [Gillett Nathan, Canada]	Taken into account. The part has been elaborated.
18615	107	6	107	15	It would be useful here to also note that Chapter 12 (Section 12.3) connects each climatic impact driver to sectoral assets using the organization of WGII chapters, providing a direct bridge between physical climate information (climatic impact drivers) and sectoral impacts and risk. [Alexander Ruane, United States of America]	Taken into account. Note that this part is now moved to section 1.1.
114401	107	6	107	15	This last para on integration with other WGs is importnat but does not work well enough, in my view. I think some more concrete examples with explanation of linkages would be usefueal to add. Regardig location of this para: I guess it is placed here as an extension" of table 1.6; i.e. looking beyond the WGI report. I strongly support having this para given the more integrated nature of Ar6, but it needs a bit more substance. I am happy to discuss and help further [Jan Fuglestedt, Norway]	Taken into account. The part has been elaborated.
29755	107	8	107	8	Use ""WGs" instead of "Working Groups" [Hernan Edgardo Sala, Argentina]	Editorial. Rejected.
50673	107	8	107	9	"Global Warming Levels", as used in the SPM, is preferable to "temperature levels" [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Text revised.
29757	107	11	107	11	Use ""WGs" instead of "Working Groups" [Hernan Edgardo Sala, Argentina]	Editorial. Rejected.
125475	107	14	107	15	[PRECISION] Here it states that ""Chapter 1 provides an introduction to the scenarios as an overarching topic for easier integration across all three Working Groups."" But without a better explianion of SSPs, the chapter does not accomplish this introduction very well. [Trigg Talley, United States of America]	Taken into account. Section 1.6 now includes a more thorough introduction to the SSPs. See also CC-Box 1.4.
29759	107	15	107	15	Use ""WGs" instead of "Working Groups" [Hernan Edgardo Sala, Argentina]	Editorial. Rejected.
9111	107		107		"Polar regions" are also covered in chapters 2 and 3. [Olaf Morgenstern, New Zealand]	Noted. Each chapter has given input on the table, Chapter 2 and 3 did not flag polar regions as a key topic for them.
40103	108	0			FAQ1.1-- very nice FAQ: reads well, to the point and interesting. [TSU WGI, France]	Noted. Thanks!
107857	108	1	108	1	The FAQs seem rather limited. What about one about how the strucutre and emphases in WG1 have changed, particularly in AR6? [Linda Mearns, United States of America]	Rejected. The audience of the FAQs (lay readers) is very different from the audience of chapters (scientists). The new stucture of the report would not be something of interest for our target audience. Additionnally, the FAQs are more about communicating on climate science rather than on the IPCC reports.
125477	108	1	108	52	This seems an odd question to ask given four assessment cycles between the FAR and AR6. [Trigg Talley, United States of America]	Noted. No action.
71341	108	1	114	7	The four FAQs for Chapter 1 are nicely posed and written - I think they are at just the right level for te likely audiences. Please ensure you keep all four FAQs in the final draft. [David Wratt, New Zealand]	Noted. Thanks!

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
125479	108	3	108	52	FAQ 1.1 is well written. But where is Figure 1 that goes with FAQ1.1? All figures should have been available for the Government and Expert Review. The word "PLACEHOLDER" on a blank page is not acceptable. [Trigg Talley, United States of America]	Noted. Apologies for our failure to have this infographic ready in time.
2907	108	3	109	6	Climate models (CMIPs) have been used in several chapters of the IPCC reports since 1990. It should mention more advances of CMIPs and shown by Figure. [Zong Ci Zhao, China]	Noted. CMIPs are the subject of FAQ 1.1's final paragraph. Since this is a plain-language FAQ, we do not use the phrase or acronym, which would not be intelligible to the general public. Revised version: "While most climate models in 1990 focused on the atmosphere, using highly simplified representations of oceans and land surfaces, today's Earth system simulations include detailed models of oceans, ice, snow, vegetation and often many other variables. An important test of models is their ability to simulate Earth's climate over the period of instrumental records (since about 1850). Several rounds of such testing have taken place since 1990, and the testing itself has become much more rigorous and extensive. As a group and at large scales, models have predicted the observed changes reasonably well in these tests (see FAQ 3.3). Since there is no way to do a controlled laboratory experiment on the actual Earth, climate model simulations can also provide a kind of 'alternate Earth' to test what would have happened without human influences. Such experiments show that the observed warming would not have occurred without human influence."
52147	108	6			Please change "evidence" to "the evidence" [Mohammad Rahimi, United States of America]	Rejected. Unnecessary.
81003	108	9	108	10	In recognition of how global ecosystems play a critical role in the global carbon cycle, then perhaps reference should be made to the biosphere and/or to global ecosystems rather than just reference to oceans, vegetation and land surfaces? [Jeffrey Philip OBBARD, Singapore]	Noted. No action.
70749	108	10			Replace 'significantly' with 'dramatically'. [Gillett Nathan, Canada]	Accepted.
114403	108	14	108	14	I suggest deleting "outer" [Jan Fuglested, Norway]	Rejected. Left this in because it's a plain-language FAQ and the phrase "outer space" is clearer for some English-speaking readers.
40417	108	21		26	improved understanding of the climate system: when you use your example of excess heat it is not clear what was known at the time of FAR. Nothing? Also, I am not sure we can assume a lay audience knows what "excess heat" refers to, it might be worth briefly explaining what it is. [TSU WGI, France]	Taken into account. Revised to read: "We now know that the oceans absorb most of the excess energy trapped by greenhouse gases and that even the deep ocean is warming up." As for what was known at the time of the FAR, the answer is "very little." The infographic accompanying FAQ 1.1 notes that ocean heat content was known for only two regions, not globally, in 1990.

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39661	108	21		26	improved understanding of the climate system -- for the example of the ice sheets, would it be worth mentioning that at the time some even thought they would grow (at least Antarctica)? [TSU WGI, France]	Noted. Thanks! The FAQ's goal is to answer the Q, namely "Do we understand climate change better now than when the IPCC started?" so we would not best address new research areas here.
68033	108	28	108	46	Thanks also to the paleoclimate modeling intercomparison project (PMIP1-4, part of the CMIPs1-6), and also improvements in observing and reconstructing past climate (temperature, moisture, circulation, ...) we also have a better understanding, or at least working hypotheses, for the forced variation of climate on decadal-millennial timescales, complementary estimates of the ECS that include the slower processes (e.g. Palaeosens, 2012), and estimates of the unforced variability on these timescales that is important for emergence, detection and attribution studies. [Michael Evans, United States of America]	Noted. In a plain-language FAQ, a discussion such as this one would be too technical.
39841	108	29			"sun's energy output" do you mean input or "incoming solar energy"? [TSU WGI, France]	Noted. No action. Changes in incoming solar energy are caused by changes in the sun's energy output. Incoming solar energy is mentioned later in the FAQ.
109745	108	30	108	30	It is rather over the past 70, not 100, years there has been no solar forcing increase. Until about 1950 it was an increase since the early 20th century. [Charpentier Ljungqvist Fredrik, Sweden]	Taken into account. Revised to read: "Today, data show that, on average, changes in incoming solar energy since 1900 have contributed only slightly to global warming, and they exhibit a slight downward trend since the 1970s."
9113	108	38	108	46	A reference here to FAQ 3.2 would be good to have. [Olaf Morgenstern, New Zealand]	Noted. We have referenced 3.1 and 3.3, but not 3.2.
3275	108	41	108	41	no need for parenthesis (since 1850) [Sergio Aquino, Canada]	Editorial. Rejected.
81005	108	48	108	52	Perhaps referwence is needed in this paragraph to the confounding effect of atmospheric aerosols on global warming and climate change, with reference to the relevant sub-section that provides a fuller expalnation. [Jeffrey Philip OBBARD, Singapore]	Taken into account. Revised to read: "The main human causes of climate change are the heat-absorbing greenhouse gases created by fossil fuel combustion, deforestation, and agriculture, which warm the planet, and aerosols such as sulphate from burning coal, which have a short-term cooling effect that partially counteracts human-caused warming."
21393	108	49	108	49	The nights warming faster than days statement here is a little problematic because the timeseries is highly non-linear and more indicative of a predominant influence of aerosols and to my knowledge there has been a complete absence or at the very least a paucity of formal attribution studies that could back up the conjecture. It would be safer to remove this and replace with an alternative example for which there is a firmer attribution basis. For example increases in extreme rainfall events for which there now exist very many attribution studies. [Peter Thorne, Ireland]	Noted. No change. Cox et al. 2020 (doi: 10.1111/gcb.15336) reviews a substantial number of studies of this phenomenon, all linking it to greenhouse warming (albeit via different mechanisms).
28759	108	50			it is not clear to me what "satellite measurements show that less heat is escaping to space," means and if it is correct. Ocean data shows that there is more heat arriving than leaving the planet while satellite and ocean data show that this imbalance is increasing. A nice FAQ overall. [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Noted. This is a plain-language way of saying that the Earth is retaining more heat.

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87655	108	51	108	51	You say the stratosphere is cooling, but in chapter 3 it says the cooling has "levelled off", ie it is no longer cooling. I would say there is good evidence (Philipona et al JGR 2018 https://doi.org/10.1029/2018JD028901) it is in fact now warming. [Matthew Tully, Australia]	Taken into account. Revised to read: "For example, nights are warming faster than days, less heat is escaping to space, and the lower atmosphere (troposphere) is warming but the upper atmosphere (stratosphere) has cooled." Given your comment, this may not be perfectly accurate, but the first sentence of your cited article reads "Since the mid-twentieth century, radiosonde and satellite measurements show that the troposphere has warmed and the stratosphere has cooled."
9115	108	51	108	51	To atmospheric scientists the stratosphere is part of the "middle" not the "upper atmosphere". This distinction may be lost on lay people. I suggest to cut out the "middle atmosphere" and just say that the "stratosphere" is cooling. [Olaf Morgenstern, New Zealand]	Noted. This is a plain-language FAQ, and we agree that the middle/upper distinction would be lost on lay people. Now reads: "For example, nights are warming faster than days, less heat is escaping to space, and the lower atmosphere (troposphere) is warming but the upper atmosphere (stratosphere) has cooled."
100517	109	2	109	2	It is not clear, what kind of figure is planned here. A figure is necessary for the FAQ [Peter Lemke, Germany]	Noted. We apologize for failing to complete the infographic in time for this review.
40105	110	0			FAQ1.2: very nice FAQ that reads very nicely but the summary isn't really a summary and looks more like an introduction (it doesn't reflect the content of the main text). [TSU WGI, France]	Taken into account.
125481	110	1	110	53	This is a well done FAQ but the title is not consistent with the content, which more specifically focuses on climate signals and geography. Consider changing the title for FAQ 1.2 to "Where is the climate signal most apparent?" It will surprise many readers that the signal is greater in the tropics but the actual "change" is greater in the northern latitudes. [Trigg Talley, United States of America]	Taken into account. Text revised.
125483	110	1	110	53	Wasn't this covered in previous WGI contributions? [Trigg Talley, United States of America]	Noted. Yes, but the previous comment suggests this may be a surprise to readers.
114405	110	1	110	53	This is a useful FAQ with a useful fig [Jan Fuglestedt, Norway]	Noted.
98663	110	3	110	8	This first paragraph should answer the question in a succinct way, following which the other paragraphs will give details. However, the question is not answered in this paragraph, which instead gives a historical introduction to climate change research. [Sonya Legg, United States of America]	Taken into account. Text revised.
71855	110	7	110	8	Add atmospheric and ocean temperatures and sea level change to this list. [John Church, Australia]	Taken into account. Not enough space to include every aspect.
90801	110	15			Atlantic Niño (Niña) dominates the interannual variability in the equatorial Atlantic at its warm (cold) phase and peaks in the boreal summer, causing climate models that significantly underestimate the natural cold upwelling to create El Niño like conditions (Refer https://advances.sciencemag.org/content/5/8/eaax4111) [Vivien How, Malaysia]	Noted. Unclear what is requested to be changed, and as this is an FAQ it has to be brief.

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70751	110	20		23	The text here notes that is not necessarily the size of the change which is most important for climate-related risks. This is true. But also, it is not necessarily the ratio of the warming to the interannual standard deviation which is most important for climate-related risks. Climate-related risks will also depend on vulnerability and exposure, and could be high even in areas which have high variability. For example, a 10 m/s increase in the annual maximum windspeed might have little impact in an area with low mean wind and low variability in windspeed, but a large impact in an area with strong variability impacted by tropical cyclones. While the question of emergence is a good one from the perspective of the perception of climate change, we should avoid communicating the message that the ratio of change to interannual variability is necessarily the most important metric for impacts. It is more complicated than this. [Gillett Nathan, Canada]	Taken into account. The text is revised to ensure that it is clear that this is one way of assessing impacts.
83935	110	22	110	23	species are adapted, not ecosystems. Perhaps rephrase to "species in the communities that form the ecosystems" [Marco Tulio Cabral, Brazil]	Taken into account. Text revised.
70753	110	26			Replace 'most apparent warming' with 'strongest warming relative to natural variability'. [Gillett Nathan, Canada]	Rejected. After much discussion we have kept 'most apparent'.
109491	110	27	110	27	Please specify "climate" mitigation. (All the more important than some tropical countries can encounter side climatic effects due to strong air pollution mitigation). [Sophie Szopa, France]	Taken into account. Text revised.
70755	110	27			How do we know that the fact that the ratio of projected change to internal variability is largest in the tropics means that 'the tropics also stand to benefit the most from mitigation in this context'? The authors are assuming that impacts scale with the ratio of warming to internal variability, which hasn't been demonstrated. The impacts will depend on the vulnerability and exposure, not just on the ratio of change to internal variability. [Gillett Nathan, Canada]	Taken into account. The text is revised to ensure that it is clear that this is one way of assessing impacts.
28761	110	31			Nice FAQ. Specifying in which regions rainfall changes are becoming clear may be beneficial. I think it is safer physical grounds to say that extreme rainfall is becoming more severe or intense rather than frequent since the increased frequency applies to present day thresholds where less extreme events are promoted above the threshold rather than appearing from nowhere. [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Text revised.
111367	110	32	110	33	Need addition on desertification issue [Neeshad Shafi, Qatar]	Rejected. Not enough space to cover every aspect.
82591	110	33	110	33	Suggest adding "in many areas" after "more frequent", since this result does not hold everywhere. [Blair Trewin, Australia]	Taken into account. Text revised.
100519	110	47	110	47	This is a good figure [Peter Lemke, Germany]	Noted.
40107	111	0			FAQ1.3 - I think given the way the question is phrased, there is a big point missing in the text: the fact that the past is also used to test our understanding of the climate system i.e. if models can reproduce the past changes, we've got more confidence in their ability to predict future changes. It is currently mentioned but you don't really develop that point very much. [TSU WGI, France]	Taken into account. Text revised accordingly.
40109	111	0			FAQ1.3-- CO2 concentration are given but without mentioning the current level (pre-industrial) therefore it can be hard for the reader to grasp what those changes in CO2 mean, or in other words, to understand the difference and common points between those periods and today [TSU WGI, France]	Taken into account. Current CO2, temp, sea level are now provided.
40111	111	0			FAQ1.3-- the periods of time presented in the text are not necessarily easy to connect to what is in the figure [TSU WGI, France]	Taken into account. Text is now better aligned with the figure.

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40113	111	0			FAQ1.3. -- very interesting FAQ but the text is sometimes slightly too jargony/complicated for a lay-audience (e.g. when words like forcing, irradiance, anthropogenic, El Nino are used without explanations) [TSU WGI, France]	Taken into account. Text revised accordingly.
101491	111	1	111	48	As you know this overlaps a bit with the FAQ in Ch 9 on long-term/irreversible climate change, which was also intended as a "palaeo" cross-cutting FAQ. This might be OK but we might want to reduce direct overlaps e.g. lines 13-14, 32-35 [Tamsin Edwards, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Text revised.
85013	111	1	111	49	No comments [Katrine Husum, Norway]	noted
21401	111	1			This FAQ makes a number of assertions that could easily be seen as either alarmist or misleading. If retained there needs to be far greater care taken over its redrafting to ensure that all statements made can be rigorously defended. I have called out a couple of very obvious issues in specific comments but the overall piece needs a considerable revision to avoid making statements that later cannot be rigorously defended. [Peter Thorne, Ireland]	Taken into account. Text revised.
107217	111	2		5	It says, "Rising greenhouse gas concentrations are driving a suite of profound changes to the earth system, including warming, sea level rise, increases in climate and weather extremes, ocean acidification, and ecological shifts." As I pointed out in my FOD comments, that's wrong. Rising GHG concentrations have caused no detectable increase in rate of either sea-level rise or extreme weather. In fact, tropical cyclone destructive potential, strong tornadoes, and droughts have all declined. Refs: https://sealevel.info/1612340_Honolulu_Wismar_Stockholm_vs_CO2_annot3.png http://link.springer.com/article/10.1007%2Fs00382-013-1771-3 https://www.academia.edu/30694598/Tide_gauge_location_and_the_measurement_of_global_sea_level_rise?auto=download http://journals.ametsoc.org/doi/abs/10.1175/JCLI-D-12-00319.1 https://www.sciencedirect.com/science/article/pii/S0378383913000082 https://threadreaderapp.com/thread/98705253688376128.html [David Burton, United States of America]	Rejected. Greenhouse gases have had a significant impact on the Earth system, including sea level rise and weather extremes (e.g. extreme heat). This is well-established across previous assessments.
663	111	3	111	3	"earth" should be "Earth" for consistency with rest of chapter. See also this page, lines 7,14,15,20. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Text revised accordingly.
28763	111	3			"a suite of" is vague and not needed so could be removed. The 2nd use of "suite" could say "range" which seems more plain English to me. Some sentences in this FAQ could be shorter. [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Text revised accordingly.
82593	111	10	111	10	"Late 20th century" doesn't look right (unless this is intended to refer mostly to remote sensing platforms, which I don't think it is). "20th century" would be accurate and I suspect is what was intended. [Blair Trewin, Australia]	Taken into account. Text revised accordingly.
70757	111	13			Replace 'inform' with 'help us understand and predict'. [Gillett Nathan, Canada]	Taken into account. Text revised.
29761	111	14	111	14	Typo in "earth". [Hernan Edgardo Sala, Argentina]	Editorial.
70759	111	18		20	Paleoclimate records are not generally the primary line of evidence underpinning detection of anthropogenic influence on climate as implied here. Suggest replacing 'allowing for the separation of' with 'providing one way of distinguishing'. [Gillett Nathan, Canada]	Taken into account. Text revised.
28765	111	19			"greenhouse-gas induced"? Also, natural variability is not distinct from greenhouse gas changes which are natural feedbacks to climate change over glacial cycles though I assume this line is talking about the past 2000 years or so. [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Text revised.

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115033	111	20		23	It says, "In recent millennia, atmospheric CO2 concentrations were relatively stable, such that changes in solar irradiance and volcanic eruptions represented the primary drivers of global climate variability. During this time, global temperature varied by less than 0.5°C and sea level varied by no more than 10cm." This is a very dubious claim. You need to balance Pages2K's revisionist claims with contrary points of view, like the many studies showing evidence of a pronounced global or near-global MWP, cataloged here: http://co2science.org/data/mwp/mwpp.php At the very least you should mention the proven fact that southern and western coastal Greenland, at least, was warmer during the MWP than it is, now (yet without causing appreciable ice loss from the ice sheet). We know it was warmer then than now from archeological findings that Viking settlers grew barley in Greenland http://sciencenordic.com/vikings-grew-barley-greenland and the fact that the growing season is too short to grow barley there, now, even with modern, quick-maturing cultivars. Additionally, it is well-known that many locations clearly experienced much more sea-level change than that over the last few millennia. E.g., I've personally visited the historic coastal city of Ephesus, which is now several miles inland, and Pevensey Castle tells a similar story http://todieadrydeath.com/2013/02/07/climate-change-isnt-new/ [David Burton, United States of America]	Not applicable. Specified section of text has been removed.
107219	111	20		23	It says, "In recent millennia, atmospheric CO2 concentrations were relatively stable, such that changes in solar irradiance and volcanic eruptions represented the primary drivers of global climate variability. During this time, global temperature varied by less than 0.5°C and sea level varied by no more than 10cm." This is a very dubious claim. You need to balance Pages2K's revisionist claims with contrary points of view, like the many studies showing evidence of a pronounced global or near-global MWP, cataloged here: http://co2science.org/data/mwp/mwpp.php At the very least you should mention the proven fact that southern and western coastal Greenland, at least, was warmer during the MWP than it is, now (yet without causing appreciable ice loss from the ice sheet). We know it was warmer then than now from archeological findings that Viking settlers grew barley in Greenland http://sciencenordic.com/vikings-grew-barley-greenland and the fact that the growing season is too short to grow barley there, now, even with modern, quick-maturing cultivars. Additionally, it is well-known that many locations clearly experienced much more sea-level change than that over the last few millenia. E.g., I've personally visited the historic coastal city of Ephesus, which is now several miles inland, and Pevensey Castle tells a similar story http://todieadrydeath.com/2013/02/07/climate-change-isnt-new/ [David Burton, United States of America]	Not applicable. Specified section of text has been removed.
21395	111	22	111	23	This statement on sea-level is potentially inconsistent with the in-depth assessment in chapters 2 and 9 and needs to be checked noting that there likely needs to be significant redrafting of this material still to be done in these chapters. [Peter Thorne, Ireland]	Taken into account. Treatment of SLR is now consistent with CH2 and CH9.
82595	111	22	111	23	These values are not quite consistent with (slightly smaller than) those shown in Chapter 2 (Figure 2.11 and 2.27). Suggest also qualifying the variation with "on centennial timescales" or similar. [Blair Trewin, Australia]	Taken into account. Treatment of all climate variables are now consistent with CH2 and CH9.
71343	111	22	111	23	Change "...and sea level varied by no more than ..." to "... Annual globally-averaged sea level varied by no more than ...". Reason: The sea level at some individual locations has probably varied by significantly more than the variation in the global average. [David Wratt, New Zealand]	Not applicable. Specified section of text has been removed.

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71345	111	22	111	23	I'm not convinced that the statements that in recent millenia global temperature varied by less than 0.5°C and global sea level varied by no more than 5 cm are consistent with Figure 2.11A (temperature) and Figure 2.27 (sea level). If you take into account the uncertainty band in Fig 2.11A you could argue that the global temperature variation over the 2000 years up to 1900 could have been up to about 1.0°C. Similarly taking into account the uncertainty band in Fig 2.27 global sea level may have varied by up to about 20 cm. I suggest you consult with LAs from Chapter 2 over the wording of this sentence. [David Wratt, New Zealand]	Not applicable. Specified section of text has been removed.
4495	111	23	111	23	It is not true that pre-industrial Holocene temperatures varied by less than 0.5°C. You are probably thinking of the hockey stick and a paper by Marcott et al. 2013. Whilst the hockey stick is discredited, Marcott et al. 2013 is predominantly based on sea surface temperatures. Only about 10% of the proxies used in the paper originate from land sites. The warming of the Holocene Thermal Maximum (HTM) in this paper appears significantly underestimated because (1) the oceans warm slower and less intense than land, and (2) switch of currents leading to a colder HTM were misinterpreted as a cooling. The results of Marcott et al. 2013 therefore have to be treated with caution. It is very likely that the HTM on a global scale was much warmer, when reconstructed using a more balanced mix of land and oceanic sites. In many parts of the Arctic, summer temperatures were up to 4°C warmer than today. The Greenland ice sheet was smaller than today and many glaciers in the Alps were smaller than today or have disappeared altogether. Likewise, the claim that sea level only varies by 10 cm is wrong. During the HTM, the sea level in many parts of the world was up to several metres higher than today. This makes sense because the Greenland ice sheet at the time was smaller than today. Your statements are misleading and suggest a steady state for the pre-industrial last few millennia that did not exist. [Sebastian Luening, Switzerland]	Not applicable. Specified section of text has been removed.
14541	111	23	111	43	lines 23 and 43, add spaces between numbers and units: 10 cm, 20 m [Amy East, United States of America]	Editorial.
8951	111	24	111	24	Fire impacts are referred in the chapter with different expressions: wildfires, bushfires, forest fires. Since in all these case, they refer to general impacts of fire, not in specific regions, I think they should be unify. The term wildfires seems to me the most adequate in this context. [Chuvieco Emilio, Spain]	Editorial.
9117	111	25	111	25	Do you mean "millennia" (plural) or "millennium" (singular) here? The latter would be appropriate; it is covered by the "last-millennium" PMIP experiment. [Olaf Morgenstern, New Zealand]	Not applicable. Specified section of text has been removed.
70761	111	26		28	This is unclear - re-write. Something like 'Observations of past climate states also provide an opportunity to test climate models' simulations of past climates, including their responses to volcanoes, solar variations, and responses to different levels of greenhouse gases.' [Gillett Nathan, Canada]	Taken into account. Text revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
99169	111	28	111	30	There is a gap in this section between what palaeoclimate data has to tell us about past climates from the high resolution data of the last 1k years and the glacial to interglacial timescales of the next section. There are many records around the globe that can provide long sections of past climate reconstruction over a few thousand years, at decadal to centennial timescales. These have revealed important aspects of change in different regions and in some cases across hemispheres. In some cases these records are underpinned by comparisons with Earth System climate models and suggest complex patterns of abrupt change within the climate system of the last ~20ka BP. Examples include attempts to understand the 8.2ka BP event or model the transient pattern of change during the Last Glacial to Interglacial Transition in the Northern Hemisphere. One issue is that within the community studying abrupt climate change there is a clear focus on the importance of high resolution archives, with chronological resolution and proxy sensitivity to detect the nature of abrupt events. Such studies tend to disappear in model/data comparison exercises where large data sets of varying quality are compiled. This means that the palaeo-data that is often used to evaluate climate models used for prediction is not suited to resolving abrupt events. Given that the changes over the next one or two centuries are likely to be abrupt and extreme this is a major challenge for palaeo-data model comparisons in the future. [Simon Blockley, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. The focus on the last millennium has been removed.
665	111	30	111	30	"Rising greenhouse gas concentrations" should be "Increasing greenhouse gas concentrations", because "rising" counjours up vertical motion in the general public's mind. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. "Rising" is frequently used in the context of temperatures, so the general public will likely understand the meaning of "rising" greenhouse gas concentrations.
21397	111	32	111	34	This is disingenuous in leaving the unwary reader to imply that it is these variations that led to changes between glacial and interglacial instead of being a feedback that accentuates a change initiated by variations in solar radiation and its seasonality. This needs to be modified to avoid such a potential inference being made by the reader. [Peter Thorne, Ireland]	Taken into account. Text revised.
42857	111	33			either 180 ppm or <200 ppm would be more accurate. [Eric Wolff, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Treatment of all climate variables are now consistent with CH2 and CH9.
9119	111	35	111	35	Would it be appropriate to list ocean acidity here as well? It would be inextricably tied to changes in CO2. [Olaf Morgenstern, New Zealand]	Taken into account. Text revised.
70763	111	38			Delete 'a high-risk but highly uncertain scenario for 21st century climate changes'. I think the authors are referring to AMOC shutdown, but this is not assessed to be a 'high risk' scenario for 21st century climate change in this report - see e.g. Section 4.7. [Gillett Nathan, Canada]	Taken into account. Text revised.
100569	111	40	111	40	Note: I think the Miocene Climatic Optimum should be inserted here. It's about as warm as the Eocene, but with relatively low pCO2 (c. 500 ppm), and sea level is thought to have been 50 m higher. However, the way this sentence is structured prevents that. Rewrite? [Matthew Kohn, United States of America]	Not applicable. Specified section of text has been removed.
24293	111	40	111	48	Hardly anything here agrees with FAQ1.3, Fig. 1 There is no discussion as to why the LGM with preindustrial CO2 values is so much warmer. [Bryan Weare, United States of America]	Taken into account. Text revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
107221	111	40		46	It says, "Much further back in geologic time, deep-sea sediments record a climate state when changes in the Earth's carbon cycle caused atmospheric CO2 concentrations to climb to ~1000ppm – similar to levels expected in coming decades if emissions continue unabated. During this time, roughly 50 million years ago, global temperatures were as much as 8°C warmer, sea level was more than 20m higher, and ocean pH varied appreciably. While the rates of present-day atmospheric CO2 change, temperature change, ocean pH change, and sea level rise are much higher than they were during past geologic intervals, these "hothouse" worlds hold key lessons for our climate future." That's just plain silly. During the Eocene, there was no Antarctic ice sheet. There probably were no C4 plants, to draw down CO2 levels, either. There's no possibility that mankind's resource-limited CO2 emissions could drive CO2 levels to 1000 ppmv, nor that doing so would cause 8°C of warming, nor that the brief anthropogenic spike in CO2 levels could melt the Antarctic ice sheet, which averages more than 40° below zero. [David Burton, United States of America]	Not applicable. Specified section of text has been removed.
21399	111	41	111	42	We will not reach 1000ppm in coming decades by any reasonable definition of 'coming' even under the most hawkish emissions scenarios coupled with the strongest conceivable carbon cycle feedbacks. Such a statement must be changed to avoid accusations of alarmism. [Peter Thorne, Ireland]	Taken into account. Text revised.
68839	111	41	111	42	1000 ppm in "coming decades" is an overstatement. [Darrell Kaufman, United States of America]	Taken into account. Text revised.
667	111	41	111	43	Check that "1000ppmv", "8 degrees" and "20m" are consistent with what is assessed in Chapter 2 for the EECO. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Treatment of all climate variables are now consistent with CH2 and CH9.
68841	111	42	111	43	Temperature and sea level for the early Eocene are assessed in CH2. The CH2 values are much higher than those reported here. Let's be consistent (Fig. 2.33). [Darrell Kaufman, United States of America]	Taken into account. Treatment of all climate variables are now consistent with CH2 and CH9.
21403	111	42	111	44	These numbers are somewhat at odds with those given in the substantive assessment undertaken in Section 2.3 and need to be reconciled. [Peter Thorne, Ireland]	Taken into account. Treatment of all climate variables are now consistent with CH2 and CH9.
100521	111	43	111	43	In FAQ 1.3, Figure 1 it says: global temperature relative to 1850 was +10-15°C, and sea level was 15-20m higher. The inconsistency has to be clarified [Peter Lemke, Germany]	Taken into account. Treatment of all climate variables are now consistent with CH2 and CH9.
68843	111	44	111	45	The only rate of change that is quantified for a "hothouse" world in the WG1 report is for CO2, and the same dataset is used to infer pH or vice versa. CH2 reports the rate of sea level rise for the last deglacial, which was certainly higher than now. You might want to back off on some of rate-of-change assentation. [Darrell Kaufman, United States of America]	Taken into account. Treatment of all climate variables are now consistent with CH2 and CH9.
669	111	45	111	45	"greater" rather than "higher" for a rate. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Text revised.
671	112	3	112	3	FAQ1.3 Figure 1: The "PETM" is mentioned here in teh figure, but I think that the FAQ text is referring to the EECO? Also, I am not sure where "15-20m" sea level comes from. Also, the CO2 and temp changes are both relative to modern so this is confusing if the sea level is a change relative to the Paleocene baseline. Also, it is a bit odd that the Last Interglacial is in the Figure but not mentioned in the FAQ text. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. PETM no longer discussed.
100523	112	3	112	3	This is a good figure [Peter Lemke, Germany]	Noted.
41017	113	0			the text emphasizes a lot the challenges that need to be accounted for to determine the level of global warming. If this is fine, I think it would gain from emphasizing a bit more that/how this measurements are calibrated/checked [TSU WGI, France]	Not applicable. FAQ1.4 was withdrawn for FGD.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
41105	113	0			To improve a bit the flow I would guide the reader and announce the amount of issues you're going to explain later [TSU WGI, France]	Not applicable. FAQ1.4 was withdrawn for FGD.
40115	113	0			FAQ1.4 is very nicely written, easy to understand! [TSU WGI, France]	Not applicable. FAQ1.4 was withdrawn for FGD.
39647	113	0			a sort of mini conclusion would make the text stronger I reckon (e.g. Even after tackling those issues differently, scientific organisations agree on the recorded level of global warming or something similar) [TSU WGI, France]	Not applicable. FAQ1.4 was withdrawn for FGD.
125485	113	1	113	47	This is the weakest of the Chapter 1 FAQs. One problem with this FAQ is that it makes it appear that most land and ocean temperature measurements are recorded in situ. If the figure is kept, insert a better graphic and a paragraph about temperature now being derived from the combination of weather stations and satellite remote sensing. [Trigg Talley, United States of America]	Not applicable. FAQ1.4 was withdrawn for FGD.
125487	113	1	113	47	Include the various metrics used, including GMST, global mean surface air temperature, global temperature, surface temperature, and other metrics. [Trigg Talley, United States of America]	Not applicable. FAQ1.4 was withdrawn for FGD.
68035	113	1	113	47	Missing is the change in observational coverage over time. At what point is it sufficient for what level of uncertainty in climate change estimates? Very different for T vs moisture and circulation. A figure for this section should also illustrate this; a paragraph should discuss this problem and the various solutions that have been developed to deal with it (e.g. underlying all the gridded and interpolated climate data 'products'. Since paleoclimate is also part of this Chapter, it should also be pointed out that the same problems are evident in analyses of climate change derived from those sources as well, adding as well additional problems of indirect observation and chronological control. Cite also Fig 1.16 (panel A: add also: pressure and winds); FAQ 1.4 Fig 1. [Michael Evans, United States of America]	Not applicable. FAQ1.4 was withdrawn for FGD.
114407	113	1	113	47	Please coordinate with CCB 2.3 in the further revisions [Jan Fuglestedt, Norway]	Not applicable. FAQ1.4 was withdrawn for FGD.
40465	113	3		9	it might be worth mentioning the 1.1 C warming in the summary as well [TSU WGI, France]	Not applicable. FAQ1.4 was withdrawn for FGD.
70765	113	6			Insert 'and instruments' after 'measurement standards'. [Gillett Nathan, Canada]	Not applicable. FAQ1.4 was withdrawn for FGD.
6469	113	7	113	9	The major temperature datasets are not as independent as the sentence spanning these lines suggests. The NOAA and NASA datasets use the same SST analysis. Berkeley Earth uses a Hadley Centre SST analysis. As does the ERA5 reanalysis. And so on. Chapter 2 could be clearer on this point. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. FAQ1.4 was withdrawn for FGD.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
107223	113	11		12	It says, "The surface temperature of the world has, on average, increased by around 1.1°C since the late-19th century – hence the term 'global warming'." I notice that you deleted the sentence which followed that one in the FOD: "Making such a statement implies that we are confident in the ability of science to determine how surface temperatures change over time," which is ironic, since from the FOD to the SOD you increased the implied precision by an order of magnitude, changing the claimed amount of warming from "1°C" to "1.1°C". In fact, the new claim is highly deceptive, because it implies a precision we don't have, and it fails to acknowledge the large disagreements between different temperature indices! E.g., if you believe GISS then the Earth warmed an average of about 0.8 °C between 1960 and 2014 (starting and ending dates chosen to avoid large ENSO spikes). But if you trust UAH6 & HadCRUT then it warmed only about half that amount. https://sealevel.info/GISS_vs_UAH_and_HadCRUT_1960-2014_woodfortrees_annot2.png https://tinyurl.com/wft1960-2014 This Report should point out things like that, and not pretend that we know data with far, far greater certainty than we actually do. [David Burton, United States of America]	Not applicable. FAQ1.4 was withdrawn for FGD.
70767	113	12		13	Much of the Arctic is ocean, so the statement that the Arctic is warming fastest appears to contradict the first part of the sentence that land areas have warmed more than oceans. Do the authors intend to focus on Arctic land areas here? If so, write 'Arctic land'. [Gillett Nathan, Canada]	Not applicable. FAQ1.4 was withdrawn for FGD.
26241	113	17	113	18	Maybe would be worthy to mention where usually are those areas with little or no information. Not only in terms of location, but also the socio-economic conditions (e.g. middle-low income countries)... [Tania Guillén Bolaños, Germany]	Not applicable. FAQ1.4 was withdrawn for FGD.
70769	113	38			Replace 'is' with 'are'. [Gillett Nathan, Canada]	Not applicable. FAQ1.4 was withdrawn for FGD.
70771	113	40		47	I don't think this discussion on baseline periods is needed. [Gillett Nathan, Canada]	Not applicable. FAQ1.4 was withdrawn for FGD.
24297	113				This section does not correct the major failings previously as to what is the wealth of available data. It does talk of adjustment, which should have been made earlier. There are no citations, which is important given how little has come before. This is just the area of this report that must be very carefully crafted so as to not to leave the false impression that data are being manipulated to agree with preconceived ideas. [Bryan Weare, United States of America]	Not applicable. FAQ1.4 was withdrawn for FGD.
11369	114	1	114	1	I would add another FAQ, which I'm often asked: "How does actual global warming compare to historic warming periods?" Answer: There were periods in the geological history of the earth with much higher temperatures than we currently experience. However, the current rate of temperature change is unprecedented in geological history of the Earth. Historic warming rates are on the order of 1K over periods of many centuries or even millennia, while current warming arrives at a rate of 1K per century and more. Thus, adaption to the changing temperatures for ecosystems and for sociosystems that co-evolute with the ecosystems is getting increasingly difficult. Secondly, and for modern societies even more important, is the fact that temperature anomalies in the last 800.000 years met a much smaller number of individuals with a high mobility. Modern societies are much less adapted to rapid changes. Regarding the fact, that nowadays 10 of the 15 largest cities are costal towns, which are endangered by rising sea-level, the thread to modern societies exceeds that to ancient societies manyfold. [Michael Schmitt, Germany]	Not applicable. FAQ1.4 was withdrawn for FGD.
13173	114	4	114	4	Make icons for each [Maria Amparo Martinez Arroyo, Mexico]	Not applicable. FAQ1.4 was withdrawn for FGD.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
108999	115	3	115	3	The citation author list for Abram et al., 2016 is not complete. Please add after author D. S. Kaufman the words '& the PAGES 2k consortium' or 'et al.' (as referenced in chapter 3) [Belen Martrat, Spain]	Editorial. Reference has been fixed.
13175	115	18	115	18	Wrong style of reference name in all caps. [Maria Amparo Martinez Arroyo, Mexico]	Noted. Style has been fixed
13177	117	3	117	3	Wrong style of reference name in all caps. [Maria Amparo Martinez Arroyo, Mexico]	Noted. Style has been fixed
13179	121	51	121	51	Missing () [Maria Amparo Martinez Arroyo, Mexico]	Accepted. The reference has been updated.
13181	130	3	130	3	Incomplete citing reference [Maria Amparo Martinez Arroyo, Mexico]	Accepted. The reference has been updated.
13183	130	8	130	8	Incomplete citing reference [Maria Amparo Martinez Arroyo, Mexico]	Accepted. The reference has been updated.
13185	130	17	130	18	incomplete citing reference [Maria Amparo Martinez Arroyo, Mexico]	Accepted. Duplicated references have been removed.
637	131	52	131	52	Can we use a phrase other than "Tertiary", ideally one of the time periods defined in Chapter 2. Otherwise, state in brackets what time period the Tertiary covers. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Noted. This comment refers to Page 31 line 52. The term 'Tertiary' is not used in the FGD .
9237	134	2	134	2	Insert the following citation after line 2. Kusunoki, S., Ose, T., and Hosaka, M. (2020) Emergence of unprecedented climate change in projected future precipitation. Sci. Rep. 10, 4802. doi:10.1038/s41598-020-61792-8. [Shoji Kusunoki, Japan]	Not applicable. The reference is not included.
67021	138	4	138	6	remove duplicate reference [Liese Coulter, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Duplicated references have been removed.
70867	138	4	138	9	This paper is duplicated here, and it is now published: doi: 10.1007/s00382-020-05234-1 [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. The reference has been updated.
223	140	54	141	1	A reference has been cited twice. 2019a and 2019b are the same article. [feng shi, China]	Accepted. Duplicated references have been removed.
83403	143	6	143	7	Rahmstorf et al. (2008) is not the correct reference/does not exist as listed here. The correct reference is: Lenton, T.M., Held, H., Kriegler, E., Hall, J.W., Lucht, W., Rahmstorf, S., Schellnhuber, H.J., 2008. Tipping elements in the Earth's climate system. Proceedings of the National Academy of Sciences 105, 1786-1793, doi: 10.1073/pnas.0705414105. [Antje H. L. Voelker, Portugal]	Accepted. The reference has been updated.
14543	143	6	143	7	something appears to be wrong with this reference. The PNAS article with that DOI number, volume, and page numbers has the authors in the following order: Lenton, Held, Krieger, Hall, Lucht, Rahmstorf, Schellnhuber [Amy East, United States of America]	Accepted. The reference has been updated.
14545	143	8	143	8	fix spelling of Rahmstorf's name [Amy East, United States of America]	Editorial. Reference has been fixed.
13187	147	43	147	43	incomplete citing reference [Maria Amparo Martinez Arroyo, Mexico]	Accepted. The reference has been updated.
13189	150	15	150	31	incomplete citing references [Maria Amparo Martinez Arroyo, Mexico]	Accepted. The reference has been updated.
87521	150	32	150	34	Should probably read United Nations, UN Doc. A/CONF.48/14/Rev.1, Report of the United Nations Conference on the Human Environment, Stockholm, 5-16 June 1972 (New York : 1973: UN), available at... [Stephen Humphreys, United Kingdom (of Great Britain and Northern Ireland)]	Editorial. Reference will be fixed in Corrigenda.
13191	152	22	152	22	incomplete citing references [Maria Amparo Martinez Arroyo, Mexico]	Accepted. The reference has been updated.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
19679	153	3	163	2	: this table takes a lot of space (11 pages). At the same time, it leaves aside significant issues such as the acidification of oceans. A serious effort needs to be done to compact considerably the content of the present table, by rewriting the information included in SPM. It is possible. Here is an example for AR4, the case of AMOC: ☐ SOD text: Based on current model simulations, it is very likely that the meridional overturning circulation (MOC) of the Atlantic Ocean will slow down during the 21st century. It is very unlikely that the MOC will undergo a large abrupt transition during the 21st century. Longer-term changes in the MOC cannot be assessed with confidence. ☐ Shortened text: During the 21st century, the AMOC will slow down (very likely). A large abrupt transition is unlikely. From 329 to 102 characters, including spaces. [philippe waldteufel, France]	Rejected. We appreciate the reviewers suggestion to reduce the information in the table by rephrasing the SPM statements. However, the purpose of the Appendix is exactly to compare the SPM statements on key findings and to present their evolution over time, i.e., the core of the history section 1.3.
21405	154	1			An abstraction of this table would be very useful in the main text to help frame the how did we get here section. I would strongly urge the authors to consider how to boil this down to a table that may take up one page to help frame that section. That table could then be supported by this detailed basis. [Peter Thorne, Ireland]	Rejected. We appreciate the reviewers suggestion to reduce the information in the table by rephrasing the SPM statements. However, the purpose of the Appendix is exactly to compare the SPM statements on key findings and to present their evolution over time, i.e., the core of the history section 1.3.
2909	154	4	157	4	It is hard to compare among the observed climate changes of the different reports, because the different time periods and various baselines were used. Can you provide some observed agreement comparisons? [Zong Ci Zhao, China]	Rejected. The Appendix combines SPM findings on their particular time period etc. using the approved wording.
76795	154	4	163	1	I appreciate the space issues, but it would be good to also include statement from the special reports in here (e.g. see the similar table in the supplement of SROCC chapter 1) [Nerilie Abram, Australia]	Rejected. The SRs are already covered in Box 1.2, with many key SPM statements reproduced ad verbatim. Covering them in the appendix would be unnecessary duplication. Moreover, the subjects covered by the different SR SPMs are disparate, leading to most cells being empty and often only one valid statement per category.
77633	154	4	163	2	Is there a better way to present Table 1.A.1? E.g as an A3 or larger pull out, so that it is easier for the reader to follow? [Emer Griffin, Ireland]	Noted. Editorial.
29763	154	5	154	5	Consider adding "from the Summary for policymakers (SPD)" in the following way: "The table provides a non-comprehensive selection of key statements from the Summary for policymakers (SPD) from previous assessment reports". [Hernan Edgardo Sala, Argentina]	Accepted. Done.
113621	154	7	154	7	"AR4; IPCC, 2007" instead of "AR4; IPCC, 2001" [Agnieszka Kowalczyk, Poland]	Accepted. Done.
29765	154	8	154	8	Replace "first assessment report" by "FAR". [Hernan Edgardo Sala, Argentina]	Accepted. Done.
3273	154	10	154	10	missing contents under AR6 [Sergio Aquino, Canada]	Noted. To be added once available after the SPM approval.
14903	154	10			In the table that starts below line 10, it is stated that methane comes largely from agriculture. This is not true, and increasingly evidence in the peer-reviewed literature indicates that fossil fuel emissions are larger. See for example Hmiel et al. 2020 Nature 578: 409-412 and Howarth 2019 Biogeosciences 16:3033–3046, and the many references in these. [Robert Howarth, United States of America]	Noted. No change. This entry repeats key SPM statements from previous assessment reports using the approved wording.
52589	154	11	154	11	I suggest adding the year of the report to the first row of table 1.A.1., while these are in the table caption, it will add immediate visibility to the evolution of statements. [Gema Martínez-Méndez, Germany]	Accepted. Done.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
115941	154		163		Chapter 1, Appendix 1A. I would suggest to expand this table, first to also cover the understanding of feedbacks (clouds; carbon cycle); and to also cover, on chosen topics, insights from AR6 special reports (SR15, SRCL and SROCC) (especially SROCC for sea level and AMOC). The AR6 SR are part of the starting point for AR6, many of them building on the same approaches as in AR5, but also with new approaches. [Valerie Masson-Delmotte, France]	Rejected. The SRs are already covered in Box 1.2, with many key SPM statements reproduced ad verbatim. Covering them in the appendix would be unnecessary duplication. In Appendix Table 1.A subjects were chosen for which the majority of the ARs had SPM statements. Adding more subjects will produce many empty cells. The subjects covered by the different SRs are disparate, again leading to most cells being empty and often only one valid statement per category.
82161	155	10	155	10	Column AR4: "Very high confidence that the global average net effect of human activities since 1750 has been one of warming, with a radiative forcing of +1.6 [+0.6 to +2.4] Wm ⁻² ." For which year? [Borbála Gálos, Hungary]	Noted. No change. This entry repeats key SPM statements from previous assessment reports using the approved wording.
29767	158	13	158	13	Please, replace "pH16 of" by "pH of". [Hernan Edgardo Sala, Argentina]	Accepted. Done.
29769	160	12	160	13	Consider adding "scenario" in this way: "Under the IPCC Business-as-Usual emissions scenario of...". [Hernan Edgardo Sala, Argentina]	Rejected. The Appendix combines previous SPM findings using the approved wording.
23851	161	1	193	12	Most of Figs have excessively long Captions; that ought to be simplified. [Branko Grisogono, Croatia]	Noted. Comment does not apply to Appendix A.1
108005	162	0	162	0	the assessment of AMOC transition being "very unlikely" does not correspond with the confidence-likelihood assessment of the predominant mechanism (Greenland Ice Sheet) collapse, which is assessed as high confidence to precipitate AMOC state change. See modeled irreversibility comment in AR6 WG1 pg. 56 line 42-44 [Kelly Wanser, United States of America]	Rejected. No change. This entry repeats key SPM statements from previous assessment reports using the approved wording.
83409	162		162		The first sentence in the AR5 SPM statement for AMOC is incomplete, i.e. the assessment phrase is missing. [Antje H. L. Voelker, Portugal]	Accepted. Missing text added.
3271	164	1	164	5	please enlarge the graph so that it fits the page width [Sergio Aquino, Canada]	Accepted.
12435	164	1	164	15	Wondering if the colorbar can be the same for all parameters, makes the plot simpler. [Lijing Cheng, China]	Rejected. There are different "standard colours" in use elsewhere, and we want to be consistent throughout the report.
125489	164	1	164	54	Looks like limitations leads to roadmap in Figure 1.1. Doesn't the whole figure make up the "roadmap"? It would be better to replace "roadmap" with "structure of this report", or another short title for Section 1.8. [Trigg Talley, United States of America]	Accepted. Sections 1.1 and 1.8 have now been merged, including summary figures of the whole report and of Ch1. Now the chapter ends with the "Limitations" section.
115755	164		164		Figure 1.1, please also consider regional models [Valerie Masson-Delmotte, France]	Taken into account (included in "regions" and "CORDEX").
19359	165	0	165	0	Figure 1.2 is an amazing summary of observed changes. I'd be interested to see additional years on the axis especially in more recent years e.g. 1990, 2000, 2010. [Lia Cairone, United States of America]	Rejected. Thanks for the positive assessment. Additional years were found to clutter the figure, and hence not included; hopefully the evolution is still clear.
125495	165	1	165	1	The text says the biosphere is part of climate system. Please make consistent. [Trigg Talley, United States of America]	Accepted.
29771	165	1	165	1	In Figure 1.2 try to use a different color palette (instead of grayscale) because it is difficult to distinguish CO2 values from missing data (grey also indicates missing data). [Hernan Edgardo Sala, Argentina]	Rejected. A number of colours were tried, all had their strengths and weaknesses. We landed on a grey background in the end.
111999	165	1	165	1	Suggest using color scales that have blues representative of negative anomalies and red as positive anomalies, as this is how most people are used to seeing colorscales [Cynthia Randles, United States of America]	Rejected. There are different "standard colours" in use elsewhere, and we want to be consistent throughout the report.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
8639	165	1	165	1	The sea level bar can be extended to 1850 (or earlier) using the paleo reconstruction of Kopp et al 2016/Kemp et al 2018. Relative to 1915, 1850 is about -4 cm, so there should be some color shown here. [Robert Kopp, United States of America]	Taken into account. The sea level data used have been coordinated with chapters 2 and 9.
76797	165	1	165	1	Figure 1.2: The CO2 concentration dataset indicates gaps in the record (grey shading), but these should instead be represented by averages that go across the interval of measurements (e.g, the ice core gas samples cover multiple years). What is the reason for choosing NH temperature land and SH subtropical land for the precipitation data? The multiple baselines used for this figure are confusing and are different to the baselines used for these parameters in other figures. [Nerilie Abram, Australia]	Taken into account. This comment raises multiple issues. All have been considered, though there are technical and practical reasons behind the final choices made.
125493	165	1	165	2	For the cryosphere, why is only glacial mass loss shown when ice sheets contain far more ice? Consider showing GIS and/or Antarctic Ice Sheet trend. [Trigg Talley, United States of America]	Rejected. Many observables were considered, the final choice came as a compromise between comprehensiveness and the space available in the Figure.
125491	165	1	165	15	This is an excellent figure, conceptually and in the clear way that it presents trends from extensive data global sets. "Soil moisture" would be a good addition at the interface of the atmosphere and land. [Trigg Talley, United States of America]	Rejected. Thanks for the positive assessment. Soil moisture was considered, but in the end not included so as not to overload the figure.
24211	165	1	165	15	The globe figure needs to shrink to allow the expansion of the bar graphs, which are too small to be easily read. The color schemes on these bar graphs need to be standardized so that glacial loss and sea level are red for greater warming. There needs to be separate colors for low values like for CO2 and no values. Is it really necessary to have different baselines for each variable? [Bryan Weare, United States of America]	Taken into account. This comment raises multiple issues. All have been considered, though there are technical and practical reasons behind the final choices made.
109181	165	1	165	16	Figure 1.2: I like the idea of the figure but it is fairly overwhelming - the fact that some indicators are moving towards red and some towards blue, and that there are three shades of blue-ish colors representing completely different metrics, muddies the overall takeaway of the figure. The crowding of multiple precipitation metrics is also difficult to discern a pattern from. Different color indicators, maybe moving from white to opaque but not blue so it isn't confused with "cold", would help. [Steph Courtney, United States of America]	Taken into account. This comment raises multiple issues. All have been considered, though there are technical and practical reasons behind the final choices made.
10395	165	1			The bars showing climate changes are not a very good way of communicating the changes in the variables. For instance the precipitation looks a complete mess here. It is impossible to gauge if any of the changes are 'significant' or if trends in changes are accelerating or not. There are known issues with the use of colours in graphics, (e.g., Stauffer et al, SOMEWHERE OVER THE RAINBOW How to Make Effective Use of Colors in Meteorological Visualizations, BAMS, 2015), so if a clearer alternative is available, i.e., timeseries plots, they should be used instead. [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. The bars represent an alternative visualization that is compelling in its own way, but of course the regular time series are present in later chapters.
11329	165	3	165	15	Add Northern Hemisphere = NH, Southern Hemisphere = SH to the caption for precipitation [Michael Schmitt, Germany]	Rejected, due to length constraints. We consider these abbreviations standard enough for use here.
90803	165	3			Glacier Mass Loss to be updated. Refer https://www.climate.gov/news-features/understanding-climate/climate-change-glacier-mass-balance and content writeup to https://www.frontiersin.org/articles/10.3389/feart.2019.00096/full [Vivien How, Malaysia]	Taken into account. All data series have been updated to be consistent with the assessments of later chapters.
21407	165	4	165	4	Biosphere exists both on the land and in the oceans. Also, inclusion of land in the figure and the caption is problematic vis-à-vis consistency with cross-chapter box 2.2 text and the approach of chapters 2-4 in looking at atmosphere, oceans, cryosphere and biosphere. The most obvious solution is to remove land from the figure and caption here I suspect. [Peter Thorne, Ireland]	Accepted.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
77631	165	7	165	7	Subscript the 2. [Emer Griffin, Ireland]	Accepted.
115757	165		165		Figure 1.2, representation of biosphere changes? Note, I am always worried about showing CO2 concentration and not RF or cumulative emissions, more directly related to the climate responses. [Valerie Masson-Delmotte, France]	Rejected. Some biosphere indicators were tried, but did not work out in this format. CO2 concentration is a rapidly responding climate observable, and important also for the history discussion of section 1.3. Hence we retain it here instead of e.g. cumulative emissions or RF, which are not directly observable.
111777	165		165		Figure 1.2: I am really NOT happy with seeing "land and biosphere" together. It conveys the idea that the biosphere is on land and not on ocean. Ocean biota(phytoplankton) provides more than half of the world's oxygen(50% to 80%). And of course Marine ecosystems are a major sink for atmospheric CO2. Hence this figure is misleading. Please, either make a 5-slice figure, with biosphere on its own, or split biosphere in two, i.e., modify the ocean slice title in "oceans and biosphere" [Alessandra Conversi, Italy]	Accepted, figure revised.
70773	165				No clear trend is apparent in the SH subtropical land precip - I'm not sure if I would call this a 'common indicator of ongoing changes'. [Gillett Nathan, Canada]	Taken into account. Precipitation change is a common indicator, we would argue, but cannot be shown on global (or land) mean as that hides differing trends. The regions chosen were selected based on the assessment of Chapter 2, to show differing (but not necessarily visually obvious) evolutions.
81275	165				For the caption of Figure 1.2 on page 1.165: A more recent reference or at least an additional reference to the heat gain of all climate subsystem, including ocean heat content is: von Schuckmann, K., Cheng, L., Palmer, M. D., Tassone, C., Aich, V., Adusumilli, S., Beltrami, H., Boyer, T., Cuesta-Valero, F. J., Desbruyères, D., Domingues, C., García-García, A., Gentile, P., Gilson, J., Gorfer, M., Haimberger, L., Ishii, M., Johnson, G. C., Killik, R., King, B. A., Kirchengast, G., Kolodziejczyk, N., Lyman, J., Marzeion, B., Mayer, M., Monier, M., Monselesan, D. P., Purkey, S., Roemmich, D., Schweiger, A., Seneviratne, S. I., Shepherd, A., Slater, D. A., Steiner, A. K., Straneo, F., Timmermans, M.-L., and Wijffels, S. E.: Heat stored in the Earth system: Where does the energy go? The GCOS Earth heat inventory team, Earth Syst. Sci. Data Discuss., https://doi.org/10.5194/essd-2019-255 , in review, 2020. The caption also appears in page 1-12, lines 6-18 [Hugo Beltrami, Canada]	Rejected. References are to the data series assessed in later chapters.
85987	166	0	166	0	Figure 1.3 - Please explain why sea level was 16m higher when temperature was not as high as at other times? Graphically, something along the lines of Fig 1 in https://doi.org/10.1007/s41748-019-00093-1 would be much more effective. [Debra Roberts and the Durban WGII TSU, South Africa]	Taken into account. Figure has been updated and made more consistent with the thorough assessment in Chs 2, 5, 9 for the three indicators shown. We now include specific assessed markers for different time periods as summarized in Ch2, including their uncertainties. Sea-level and temperature do not necessarily co-vary for particular time intervals. Explaining this is beyond the scope of this figure. The sea level panels have been revised nevertheless to avoid misinterpretation..

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
109183	166	0	166	25	Figure 1.3: Y-axes should be repeated on the right-hand side, which would also help show the needed higher axis values (the way they're currently depicted are confusing). [Steph Courtney, United States of America]	Taken into account. Figure has been updated and made more consistent with the thorough assessment in CHs 2, 5, 9 for the three indicators shown. We now include specific assessed markers for different time periods as summarized in Ch2, including their uncertainties. Scaling has been revised for more clarity and to avoid misinterpretation
109185	166	0	166	25	Figure 1.3: The dots in the left and middle columns are confusing -it took a long time for me to figure out what they're supposed to represent since it is not explained clearly in the caption. At first it seems that they're supposed to transpose from left to mid, within the same metric, but I see now it's perhaps marking averages from the same time point down the metrics instead. It should either be marked more distinctly and given a key, or spelled out in text in the figure rather than visually, or disregarded. [Steph Courtney, United States of America]	Taken into account. Figure has been updated and made more consistent with the thorough assessment in CHs 2, 5, 9 for the three indicators shown. We now include specific assessed markers for different time periods as summarized in Ch2, including their uncertainties. Explanations have been added to the caption where missing.
125499	166	1	166	1	A few comments on the panels in this figure: (1) In the top right panel, what do the red numbers indicate (2500, 2000, 1500, 1000); (2) in the bottom left, why is the discrepancy so large between the black dot and the peak in the blue line?; and (3) the SLR projections for 2100 appear surprisingly small across the full range of scenarios. [Trigg Talley, United States of America]	Taken into account. Figure has been updated and made more consistent with the thorough assessment in CHs 2, 5, 9 for the three indicators shown. We now include specific assessed markers for different time periods as summarized in Ch2, including their uncertainties.
42083	166	1	166	1	16m peak in panel c is very dominant in the figure. I would recommend to at least include a note in the figure caption about the differences in the positive and negative y-axis. Furthermore, maybe a dashed line or a change in colour for the positive part if the curve would help to quicker understand the different scales/discontinuity of the positive and the negative values? [Julia Nabel, Germany]	Taken into account. Figure has been updated and made more consistent with the thorough assessment in CHs 2, 5, 9 for the three indicators shown. We now include specific assessed markers for different time periods as summarized in Ch2, including their uncertainties.
21409	166	1	166	1	I find the split sea-level axis problematic and also the sea-level assessment implied in this figure goes far beyond the assessments performed in chapters 2 and 9 in terms of the temporal completeness. Similar concerns also pertain to the temperature series shown here in that chapter 2 looks at a contiguous series back over the CE but then looks at snapshot assessments of other epochs. I don't think it wise to show temperature and sea-level reconstructions in greater detail than is then subsequently assessed in the latter chapters. Hence I think this figure needs considerable adjustments to not undertake or imply a more substantive assessment than is undertaken in the latter chapters, particularly in terms of a contiguous timeseries. [Peter Thorne, Ireland]	Taken into account. Figure has been updated and made more consistent with the thorough assessment in CHs 2, 5, 9 for the three indicators shown. We now include specific assessed markers for different time periods as summarized in Ch2, including their uncertainties.
8641	166	1	166	1	I find the change of axis on the sea level curve makes for a misleading figure -- I'd like to get some sort of usability expert to evaluate. Jevrejeva et al 2014 is not the best available record for the historical period, and I would suggest updating to Dangendorf et al 2019. Unclear what uncertainty range is being used on SL projections. I do not believe 16 m for MWP 11. Not sure where the ± 5 m error is coming from on your Spratt & Lisiecki stack -- I see a mean estimate of 19 m, with a 95% confidence range of -11 to 40 m, in their Table 3. [Robert Kopp, United States of America]	Taken into account. Figure has been updated and made more consistent with the thorough assessment in CHs 2, 5, 9 for the three indicators shown. We now include specific assessed markers for different time periods as summarized in Ch2, including their uncertainties. Dangendorf et al. 2019 used instead of Jevrejeva et al. 2014.
3269	166	1	166	7	please enlarge the graph so that it fits the page width [Sergio Aquino, Canada]	Noted. Size will be dealt with in the layout/production process.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
125497	166	1	166	24	[PRECISION] The left and middle panel of Figure 1.3 do not make sense if the y-axis is the same in each. Mid-Holocene and "0" are too close to interpret and cause confusion. Shouldn't the ppm level at "0" years on the left correspond with ppm at 1985-2014 in the middle panel, assuming zero is the latest data point (i.e., 2014)? Same problem in panel B. Panel C (sea level change) left and middle figures align much better, if not perfectly. [Trigg Talley, United States of America]	Taken into account. Figure has been updated and made more consistent with the thorough assessment in CHs 2, 5, 9 for the three indicators shown. We now include specific assessed markers for different time periods as summarized in Ch2, including their uncertainties.
79963	166	1	166	24	Fig.1.2c sea level. I find the reversed version of this figure even more confusing than in the FOD. At first sight it looks like there's a massive spike in sea level at 400Kyr BP. Even when you realise that the positive and negative y-axes have different scales this impression persist. Suggest a revised figure in which the negative and positive values follow the same scale in the left hand panel of c. Otherwise, whenever this figure is shown you'll get asked why is there such a huge increase at 400 Kyr BP! [Simon Josey, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Figure has been updated and made more consistent with the thorough assessment in CHs 2, 5, 9 for the three indicators shown. We now include specific assessed markers for different time periods as summarized in Ch2, including their uncertainties.
17753	166	1	166	25	I do not like that there is no indication of relative uncertainty in the observed parts of this figure. It would be significantly more compelling were thickened lines or shaded regions used to indicate a likely range. This is particularly true of the paleoclimate proxy-based reconstructions vs. the historical reconstructions vs. the post-satellite observations. This figure does show uncertainty ranges in models, but does not reflect our growing understanding of the earth system observationally. [Baylor Fox-Kemper, United States of America]	Taken into account. Figure has been updated and made more consistent with the thorough assessment in CHs 2, 5, 9 for the three indicators shown. We now include specific assessed markers for different time periods as summarized in Ch2, including their uncertainties.
76799	166	1	166	25	Figure 1.3: I find the various scalings used on this figure (e.g. changes in scale on sea level and CO2 plots, differences in time representation across the four panels for each parameter) quite confusing and easy to misinterpret. [Nerilie Abram, Australia]	Noted. Different scalings are necessary to present the information in a visually compelling way, we think. Note that the figure has been updated and made more consistent with the thorough assessment in CHs 2, 5, 9 for the three indicators shown. We now include specific assessed markers for different time periods as summarized in Ch2, including their uncertainties.
130411	166	2	166	2	In Figure 1.3, the top and middle figures placed at the middle, need to have the corresponding vertical scale (numbers), as was done for the bottom middle figure. [Rubén Piacentini, Argentina]	Rejected. Matching scales for co2 and temperature purposely left out to draw the reader's attention to the change of scale for sea level
11331	166	2	166	24	Explain the black and red dots in the two left diagrams of a), b), and c) [Michael Schmitt, Germany]	Taken into account. Explained in the caption. These are best estimates for selected time periods as assessed by CH2
90805	166	2			climate model projections published between 1973 and 2013 are compared with observed temperatures. The models used in the projections vary in complexity, comparing these models with observations can be somewhat tricky exercises. Suggest to use blended model fields to match what is actually measured in the observations. [Vivien How, Malaysia]	Noted. The purpose of the figure is not to compare models with observations, but to provide the long-term context of current and projected future climate change.
29773	166	7	166	7	Typo in "right-hind". [Hernan Edgardo Sala, Argentina]	Accepted. Text revised.
52591	166	13	166	14	Figure 1.3. The change in the scaling of sea level is iniatially misleading. The highstands of MIS 11 and 5e result "too highlighted" and this representation does not fit with figure 1.3.a (no changing of scale for the CO2 of the past 800 ka). I understand the difficulty of keeping the same scaling for the larger range of sea level change, I suggest to make it explicit in the caption so the reader immediatly realise of it, e.g. Sea level changes reconstructed from a stack of oxygen isotope measurements on seven ocean sediment cores (Spratt & Lisiecki, 2016; uncertainty +/- 5m). Please note the change of scaling in the sea level axis. [Gema Martínez-Méndez, Germany]	Taken into account. Different scalings are necessary to present the information in a visually compelling way, we think. Note that the figure has been updated and made more consistent with the thorough assessment in CHs 2, 5, 9 for the three indicators shown. We now include specific assessed markers for different time periods as summarized in Ch2, including their uncertainties.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
52593	166	13	166	14	Figure 1.3. I am missing in the caption an explanation about the blacks dots presented in all figures, I infer: LGI, LGM, pre-Industrial, modern? [Gema Martínez-Méndez, Germany]	Accepted. Caption revised. Black dots are best estimates from paleo-markers for selected time periods taken from Ch2. Note that the figure has been updated and made more consistent with the thorough assessment in CHs 2, 5, 9 for the three indicators shown. We now include specific assessed markers for different time periods as summarized in Ch2, including their uncertainties.
52595	166	13	166	14	Figure 1.3. Spratt and Lisiecki 2016 report a mean standard deviation for the sea level estimates of 9.4 m (when they use 7 records) and of 12 m (when they use 5 records) (conclusions section), in Figure 1.3. an uncertainty of +/- 5 m is given). [Gema Martínez-Méndez, Germany]	Taken into account. Figure has been updated and made more consistent with the thorough assessment in CHs 2, 5, 9 for the three indicators shown. We now include specific assessed markers for different time periods as summarized in Ch2, including their uncertainties. Caption revised.
52597	166	13	166	14	Figure 1.3. the estimation given in the figure seems to be 7.5 +/- 3 m. I cannot find that estimation in Spratt and Lisiecki 2016 . [Gema Martínez-Méndez, Germany]	Taken into account. Figure has been updated and made more consistent with the thorough assessment in CHs 2, 5, 9 for the three indicators shown. We now include specific assessed markers for different time periods as summarized in Ch2, including their uncertainties.
52599	166	13	166	14	Figure 1.3. the estimation given in the figure seems to be 7.5 +/- 3 m, in figure 2.33 an estimation of 7 +/-4 m is given and in Figure FAQ 1.3. Figure 1 of 3-10 m [Gema Martínez-Méndez, Germany]	Taken into account. Figure has been updated and made more consistent with the thorough assessment in CHs 2, 5, 9 for the three indicators shown. We now include specific assessed markers for different time periods as summarized in Ch2, including their uncertainties.
42859	166	20			I notice that palaeo and paleo are used in the same sentence. Needs an editorial decision throughout (UK or US spelling). [Eric Wolff, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Editorial change made. IPCC uses British spelling.
115759	166		166		Figure 1.3, it would be good if the figure could explicitly include a description of forcing for past glacial interglacial variations; what about using a log scale for CO2 (better / RF); showing uncertainty for paleo estimates; and changing the vertical axis for the lower panel, maybe on a log scale again? (if possibly related to the albedo effect) (we cannot see the range of projections with the broad scale here). [Valerie Masson-Delmotte, France]	Taken into account. Figure has been updated and made more consistent with the thorough assessment in CHs 2, 5, 9 for the three indicators shown. We now include specific assessed markers for different time periods as summarized in Ch2, including their uncertainties. Forcing is beyond the scope of this section; log scale, though at point considered, is not user friendly and can be easily misread.
111779	166		166		Figure 2.2: In the first panel, is 0=1850 the last tick? Or there is an extra period corresponding to the 150 years, that is then enlarged in the central panel? I can think this is the case, but it should be stated If tat is correct, I would use a different color for that segment of the line ant I would use that color in the central panel. ALSO: I would think that the 2 dots in the central panel (in a different color with respect to the line) correspond to the last two dots in the left panel, enlarged. However, there are 3 dots in the left panel, not two, so I do not understand. In any case, these dots should be explained in the caption. [Alessandra Conversi, Italy]	Taken into account. Figure has been updated and made more consistent with the thorough assessment in CHs 2, 5, 9 for the three indicators shown. We now include specific assessed markers for different time periods as summarized in Ch2, including their uncertainties. Yes, 0=1850 to which all records have been referenced to. Please note that the left panel is in thousands of years. Middle panel is not a zoom, it's 1850-present.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
83937	166				Figure 1.3 should have better quality, the upper part of the top texts are cut, and it should be reviewed for small adjustments such as on panel a, Projections the y-axis is not visible; panel c, Paleoclimatic data, the y-axis should be cut-off to fit both MIS 11 and the uncertainty bar of the Last Interglacial GMSL [Marco Tulio Cabral, Brazil]	Taken into account. Figure has been updated and made more consistent with the thorough assessment in CHs 2, 5, 9 for the three indicators shown. We now include specific assessed markers for different time periods as summarized in Ch2, including their uncertainties. A higher res figure will be provided with the final report. The sea level scale has been revised.
68845	166				Fig. 1.3; The newer version of this figure in the TS is better. I'm still concerned that the 2081-2100 projections will be misinterpreted to represent a time series from left to right. I don't think that all of the scenarios need to be included in this big-picture CH1 context-setting figure, just three stacked vertically (or close to vertical) would suffice. [Darrell Kaufman, United States of America]	Taken into account. Figure has been further updated and made more consistent with the thorough assessment in CHs 2, 5, 9 for the three indicators shown. We now include specific assessed markers for different time periods as summarized in Ch2, including their uncertainties. Reducing the number of scenarios will lead to criticism as we would have to make a choice between five core scenarios which are considered equally likely. We prefer to keep the core set used in WGI AR6 in this figure. Figure has been updated to avoid confusion with regard to the scenarios.
19361	167	0	167	0	Box 1.1, Figure 1.1: Is it possible to map levels of confidence to a quantitative indicator as has been done with levels of likelihood and outcome probability on this page? That mapping is very helpful to better understanding the language. [Lia Cairone, United States of America]	Noted. We don't see any easy way to do this, but agree that visualization could be useful.
76801	167	1	167	1	Box 1.1, Figure 1.1: You could consider whether the figure used in SROCC chapter 1 could be adapted. This figure was based on the Mach et al figure, but with additional information (e.g. how the calibrated language is used when referring to a range - e.g. the likely range of future sea level rise), and how risk and impact should also be considered alongside likelihood. [Nerilie Abram, Australia]	Taken into account. The information about the ranges is included in the main text providing the background to the use of the IPCC uncertainty language and now visually presented in the figure. In contrast, we have decided not to include "deep uncertainty" in the figure, but to expand on it in the main text. There was not enough space to appropriately explain what is meant by deep uncertainty in the figure and we thus prefer to introduce it properly in the main text. Risk and impacts are the topic of WGII report, so not included here in this WGI report figure.
125501	167	1	167	1	Box 1.1, Figure 1.1 is generally very helpful, but it begs the question: Could you ever have very low or even low confidence statements since it'd appear there is NOT sufficient evidence and agreement to evaluate the confidence? Clarify in the caption? [Trigg Talley, United States of America]	Noted. Yes, but the boundaries are fuzzy as also mentioned in the Mastrandrea et al. IPCC guidance note.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
7531	167	1	167	1	Box 1.1 Figure 1.1 has a statistical flaw. Under #4 it lists five degrees of statistical confidence (Very high, high, medium, low, very low). Three of these would suggest to the public that the IPCC is "confident" in the colloquial meaning of the word. Furthermore, "medium" is not a neutral term. The correct term should be "neither high nor low". Therefore, the use of these terms makes it more likely that the AR will report higher confidence than lower confidence. Under #6 there is a similar serious flaw. In all the papers I have ever published less than 95% confidence is "not significant at alpha = 0.05". You use terms that the general public interpret as "significant", i.e., "likely" for P values equal to 0.34. Climate change is too important an issue to loosen the conservative nature of science. We are going to lose the public's respect. [Hugh Lefcort, United States of America]	Noted. The box and the figure lay out what the AR6 guidance note defines.
109335	167	1	167	10	It's mystifying why the cosmic ray example in this figure cannot be evaluated for confidence, since the box in the following step suggests that ANY combination of evidence and agreement levels could be evaluated for confidence. Needs an explanation! [Paul Edwards, United States of America]	Not applicable. Text from AR5 has been replaced with AR6 examples.
78677	167	3	167	3	On page 28, line 8-9, it is said: "...likelihood statements are limited to findings for which the authors' assessment of confidence is "high" or "very high". Why is then something with high confidence ("ocean warming ...") given as an example for "not sufficient for likelihood-evaluation"? [Heike Wex, Germany]	Not applicable. Text from AR5 has been replaced with AR6 examples.
130413	167	3	167	3	In Box 1.1, Figure 1.1, the text "Medium agreement Medium evidence" in point 4, at the middle of the figure, is difficult to read, since it is in black and the corresponding box in in hard gray. Please modify. [Rubén Piacentini, Argentina]	Done. Text now white.
3267	167	5	167	5	Authors present evidence (omit /agreement), [Sergio Aquino, Canada]	Rejected. Authors assess evidence and agreement.
125503	167	7	167	7	Delete the word "are" after "conclusions" and insert "are presented in gray bar across the bottom of the figure," after the "(2013)". [Trigg Talley, United States of America]	Accepted. Text revised.
115761	167		167		It could be good to also show the use of likely and very likely ranges + refer to deep uncertainty in the panel (as done for SROCC) [Valerie Masson-Delmotte, France]	Taken into account. The information about the ranges is included in the main text providing the background to the use of the IPCC uncertainty language and now visually presented in the figure. In contrast, we have decided not to include "deep uncertainty" in the figure, but to expand on it in the main text. There was not enough space to appropriately explain what is meant by deep uncertainty in the figure and we thus prefer to introduce it properly in the main text.
70775	167				Box 1.1, Figure 1.1. Statistics are used to evaluate evidence, they aren't a type of evidence by themselves, independent of models, observations and experiments. Delete 'Statistics' from the box labelled 'What evidence exists?'. [Gillett Nathan, Canada]	Rejected. We stick to the items used in the original guidance note. Expanded to include SROCC examples.
69761	167				Figure Box 1.1 Figure 1.1. central confidence arrow from #5 - should yes - no be interchanged? Is this a typo or am I misunderstanding? [Gyami Shrestha, United States of America]	Rejected. No, correct as displayed. For high/very high confidence findings, likelihood assessments can be made.
102497	168	1	168	1	It is slightly confusing that there is no title on the x-axis of the top panel [Philippe Tulkens, Belgium]	Noted. This figure from Callendar (1938) is included for illustrative purposes. From the top and lower axis it is however clear the x-axis is for calendar time in years.
32647	168	1	168	9	Show, if possible, the meteorological stations distribution used to plot this chart on a map. [sadegh zeyaeyan, Iran]	Rejected. Limited space does not permit to make such a plot. The original Callendar (1938) does not contain this information either.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
32977	168	1	168	9	Show, if possible, the meteorological stations distribution used to plot this chart on a map. [Sahar Tajbakhsh Mosalman, Iran]	Rejected. Limited space does not permit to make such a plot. The original Callandar (1938) does not contain this information either.
125505	168	2	168	3	[PRECISION] In Figure 1.4, is the y-axis degrees Celsius? If so, consider saying so explicitly in the caption text. [Trigg Talley, United States of America]	Accepted. The temperatures are in degrees Celsius. This is now mentioned in the caption.
130415	168	5	168	5	In Figure 1.4, in the figure caption, please include the unit of temperature, if it is Celcius (at that time "degree centigrate") or Fahrenheit. [Rubén Piacentini, Argentina]	Accepted. The temperatures units are in degree Celsius. This is now mentioned in the caption.
109187	169	0	169	3	Figure 1.5: If the main message is just that we've been broadly accurate in projections, then leave as is. However, I'm also trying to discern whether projections have gotten more accurate over time, in which case coloring the trend lines in more of an order (orange-ish oldest to green-ish newest so there are several color steps in between, for example) would be useful. [Steph Courtney, United States of America]	Noted. The publications on which this figure is based did not examine whether the projections can become more accurate over time so that is not included here.
82573	169	1	169	1	Suggest labelling the vertical axis as 0.3, 0.6 etc. - the decimal point is hard to see and at first glance they look like integers (although they obviously aren't). [Blair Trewin, Australia]	Taken into account. Figure and caption revised.
11341	169	1	169	2	Please chnege the colors and line styles of the projections. MA70,RS71, N77 and H88 can not be distinguished [Michael Schmitt, Germany]	Taken into account. Figure and caption revised.
67707	169	1	169	2	It is a little bit difficult to distinguish the color of lines. [Hiroaki Kondo, Japan]	Taken into account. Figure and caption revised.
28289	169	1	169	2	In x axis legend, use uppercase W in W m-2 [Alexander Graf, Germany]	Taken into account. Figure and caption revised.
2943	169	1	169	10	FOD Figure 1.5 should be also provided in SOD Figure 1.5. Both qualitative and quantitative analysis should be shown here. [Zong Ci Zhao, China]	Rejected. We have chosen this figure for simplicity.
2911	169	1	169	14	AR5 should add in top of Figure. [Zong Ci Zhao, China]	Rejected. The AR5 equivalent analysis has not been published.
21411	169	1	169	14	Given the decision to use GSAT in AR6 the use of GMST in this figure may be problematic? At a minimum there probably needs to be some caveat applied around this in the caption but it should be considered whether to replot as GSAT for consistency with elsewhere and forward reference made to the GSAT vs GMST box? [Peter Thorne, Ireland]	Taken into account. Figure and caption revised.
32649	169	1	169	16	Show the average prediction made by all models in a single line [sadegh zeyaeyan, Iran]	Rejected. The intent of the figure is to show the individual projections made at different times. The average is not a well defined quantity in this instance.
32979	169	1	169	16	Show the average prediction made by all models in a single line [Sahar Tajbakhsh Mosalman, Iran]	Rejected. The intent of the figure is to show the individual projections made at different times. The average is not a well defined quantity in this instance.
42861	169	2			W/m2 not w/m2 in x-axis label [Eric Wolff, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Figure revised.
130417	169	4	169	4	In Figure 1.5, explain in the figure caption what means "GMST" in the vertical axis, as was made at the begining of the leyend to Figure 1.7. [Rubén Piacentini, Argentina]	Taken into account. Figure and caption revised.
29775	169	6	169	9	This figure caption differs from the one in pages 41-42. [Hernan Edgardo Sala, Argentina]	Taken into account. Figure and caption revised.
115763	169		169		is I suspect that projections are GSAT not GMST, please check [Valerie Masson-Delmotte, France]	Taken into account. Figure and caption revised.
111931	169				Fig. 1.5 axis title should be "delta"GMST I would say [Tomas Halenka, Czech Republic]	Taken into account. Figure and caption revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
109189	170	0	170	1	Figure 1.6: More axis labels needed, even if not every axis on every graph. The key is also unclear, and though this would require re-arranging, giving it more space so the labels could be meaningful on their own would be useful - i.e., "best estimate for 1.8C global warming", "trend 1990-2018 extrapolated", not sure what would be best in place of "scaled" but that one has to change. Just a touch more explanation. I'm sure even more space/explanation could be useful but my examples are the bare minimum. And as long as you have the space, may as well spell out observed rather than obs. Also consider coloring the extrapolated trend differently than the estimates since they are different kinds of data. Perhaps also make clear whether 0 is global average or regional average and reference period. [Steph Courtney, United States of America]	Taken into account. Figure has been revised.
29777	170	1	170	1	The label of panel "a" is missing inside the Figure 1.6. [Hernan Edgardo Sala, Argentina]	Taken into account. Figure has been revised.
113623	170	1	170	1	The panel (a) is not labeled in the picture. [Agnieszka Kowalczyk, Poland]	Taken into account. Figure has been revised.
125507	170	1	170	2	In the legend of panel (b), specify that the red line is the "model projection" trend. Clarify caption text (line 7) as well. [Trigg Talley, United States of America]	Taken into account. Figure has been revised.
99927	170	1	170	8	Figure 1.6 with a place holder on page 42. Panel "a" is not labelled and in fact all the panels are too small to appreciate the color subtleties the author(s) is wanting the reader to observe. You can get a general idea of the intention, but not the subtlety. [Dan Helman, United States of America]	Taken into account. Figure has been revised.
32495	170	1	170	9	Can we get a global plot too? [Robert Colman, Australia]	Noted. The focus here is on the regional aspects so global temperature is not included.
865	170	3	31	8	Figure 1.6: it is unclear why the projections start at a given temperature value in 1990. What determines this temperature offset? [Bart van den Hurk, Netherlands]	Taken into account. Figure has been revised.
4767	170	3	170	8	Figure 1.6: it is unclear why the projections start at a given temperature value in 1990. What determines this temperature offset? [Bart van den Hurk, Netherlands]	Taken into account. Figure has been revised.
52143	170				I would remove the word "Box" on the top of the figures. [Mohammad Rahimi, United States of America]	Taken into account. Figure has been revised.
76803	171	1	171	1	I wonder if it is helpful to show to top panel here, or if it opens up unjustified criticism of the models. Would it be better to just show 1850-2014 panels for the two baselines? [Nerilie Abram, Australia]	Noted. However, we think it is helpful to show the process of going from absolute values from the models to making the baseline choice so have retained the top panel.
11343	171	1	171	2	The upper rim of the light blue shaded area is below 14.5°C. The area is not symmetric with respect to the mean of 14.0°C. [Michael Schmitt, Germany]	Rejected. The shaded area is as described.
2913	171	1	171	6	The y-axis of two bottom figures should be the same scale. [Zong Ci Zhao, China]	Noted. The scales already had the same magnitude but are offset and we consider the most appropriate way to show the data.
54529	171	1	171	10	I understand that Figure 1.7 is included to illustrate the sensitivity of an analysis to the choice of the baseline or reference period. However, the upper panel is very similar to Figure 3.3 and is then basically shown twice in the report. Since this is only an illustration, an easy solution would be to show CMIP5 instead of CMIP6 models in this figure. In Chapter 3 the anomalies in this figure are differences from the 1850–1900 time-mean of each individual time series. Maybe this reference period can be illustrated as well? [Veronika Eyring, Germany]	Noted. We have included 1850-1900 and retained the CMIP6 models. We accept that much of this information is repeated in Chapter 3 but think this is acceptable for this illustration.
24235	171	1	171	10	The upper panel is not meaningful. Differences in global means can be strongly linked to resolution and topography. All subsequent comparisons remove such means. In the lower right panel, why the 1981-2000 baseline, which is not used elsewhere in the report? [Bryan Weare, United States of America]	Noted. We have switched to using the 1850-1900 and 1995-2014 baselines as these are the two mostly used throughout AR6. We have kept the top panel to highlight the amplitude of the differences between models.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
17755	171	1	171	11	I think the models here should be a bit lighter or thinner lines to avoid a messy appearance. The observational "truth" should stand out moreso. [Baylor Fox-Kemper, United States of America]	Noted. The line thicknesses have been edited and figure improved.
2945	171	1	171	11	How many CMIP6 models, also model names? Chapter 1 should include 32 CMIP6 model results, or as many as possible CMIP6 models results. [Zong Ci Zhao, China]	Noted. We have indicated the number of models used in the caption.
130419	171	3	171	3	This Figure 1.7 do not start at the year 1850, as described in the corresponding legend. Please verify. [Rubén Piacentini, Argentina]	Incorrect. The timeseries all started at 1850.
70539	171				This figure compares simulated GSAT changes with observed changes in GMST. But we know these are different - see for example Cross-Chapter Box 2.3. The authors should scale the observed GMST estimates by the assessed ratio of GSAT to GMST warming to be consistent with the other GSAT timeseries shown. [Gillett Nathan, Canada]	Noted. The assessment of CCBBox2.3 has changed and now considers GMST and GSAT to be equivalent for AR6. We have clarified the difference global temperature assumptions in the caption.
104501	172	1	172	1	The short baselines of different lengths and different periods are odd. It looks like the attempt was to search for intervalls which may qualify as a plateau. This makes no sense and is misleading. Why not use a 10 year baseline every 10 years? [Frederik Schenk, Sweden]	Rejected. The caption describes the reason for the choices which are the baselines and reference periods used in previous IPCC Assessment Reports. We have retained these.
2915	172	1	172	3	It should provide the averaged absolute value of GMST for 1850-1900 period. [Zong Ci Zhao, China]	Rejected. In this context the average absolute value is not important and not known with any degree of certainty for the observations.
17757	172	1	172	15	It would be nice to have more datasets than just HadCRUT on this figure. This is a good summary figure for lectures, teaching, etc., but would be stronger with a sense of the certainty in temperature. [Baylor Fox-Kemper, United States of America]	Noted. Figure has been revised to include all four datasets used by Chapter 2.
2947	172	1	172	15	GAST should be also shown in cross chapter box 1.2, Figure 1. [Zong Ci Zhao, China]	CCBox2.3 has changed its assessment. GMST is retained here.
96077	172	1	172	16	We appreciate Figure 1 and suggest to use such a figure in the SPM. [Nicole Wilke, Germany]	Noted. Unlikely to be used in the SPM unfortunately.
115765	172		172		why is only one dataset used here and not the same as in figure 1.9? [Valerie Masson-Delmotte, France]	Noted. Figure has been revised to include all four datasets used by Chapter 2.
115767	172		172		why is only one dataset used here and not the same as in x chapter box 1.2? [Valerie Masson-Delmotte, France]	Noted. Figure has been revised to include all four datasets used by Chapter 2.
109191	173	0	173	13	Figure 1.8: Quite a few ways to make this friendlier, such as axis labels (total area instead of extent, like in the caption), units (is there a reason for K instead of C on temp change?), and biggest to me, making the short-term linear trends more understandable. This could be in the title (instead of "interacts", something about differences between short-term variability and long-term trends), definitely the depiction (use color to show which short trend belongs to which long trend), and the key (short-term linear trends observed from 2011-2021). [Steph Courtney, United States of America]	Noted. Figure has been improved.
125509	173	1	173	1	It seems like this might be more convincing or clear if the authors did not switch variables. For example, show: (1) global annual temperature, (2) UK annual temperature, (3) global Sept temperature, and (4) UK Sept temperature. [Trigg Talley, United States of America]	Rejected. Aim of the figure is to show that variability is important for a range of climate variables.
11345	173	1	173	1	Give the linear trends the same color as the members from which they are calculated. [Michael Schmitt, Germany]	Accepted. Figure edited.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
29779	173	1	173	12	Two considerations about Figure 1.8: 1) The lower right panel of Figure 1.8 has the title "September Arctic sea ice extent", but in the corresponding figure caption says "September sea-ice area". Strictly speaking sea ice "extent" and sea ice "area" are two different variables (but related each other). According to the NSIDC, "Area and extent are different measures and give scientists slightly different information" (http://nsidc.org/arcticseaicenews/faq/). So, I suggest to check consistency between the aforementioned title and the corresponding text in the legend. 2) Please, consider using "Global temperature change" instead of solely "Global temperature" in the title of the first top row panel, and also in the correspondingly text in the legend. [Hernan Edgardo Sala, Argentina]	Noted. This was a typo - extent is shown in the figure and now the caption. We have also added 'change' to the axis.
3265	173	5	173	5	2000 m [Sergio Aquino, Canada]	Noted.
125511	174	1	174	1	Several comments for Figure 1.9: (1) Specify the units on the scales for the top two panels; (2) in line 3, is this showing temperature in [2018]?; and (3) like 4, is this showing "anthropogenic" warming or just total warming? [Trigg Talley, United States of America]	Noted. Figure has been edited and improved, noting these comments.
17759	174	1	174	11	It would be nice to have more datasets than just Berkeley in this figure. The regions chosen here are a blend of continents, subcontinental areas, etc. It would be nice to be more consistent with regions or continents in Fig. 1.15 if possible. It is also not clear to me if the temperatures here are GSAT over land only--caption could be clarified. [Baylor Fox-Kemper, United States of America]	Noted. Time series are over land only - caption has been clarified. Regions are now chosen from the official AR6 regions. Maps and timeseries only use Berkeley Earth for clarity.
10371	174	2			What are units in top left panel? [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Units added.
67709	174	8	174	8	standard deviation': Which standard deviation, temporal or spatial? [Hiroaki Kondo, Japan]	Noted. Caption has been edited for clarity.
113625	174	8	174	8	"Australasia (50S-10S," instead of "Australasia (10S-50S," [Agnieszka Kowalczyk, Poland]	Regions have been changed and latitude bands no longer appear in caption.
19363	175	0	175	0	Figure 1.10 is quite helpful to understanding the SSPs relative to potential global warming. Because the lines are overlapping from the various SSPs, it's difficult to read. Is there space to give each SSP its own chart in addition to the chart that compares all of the SSPs? [Lia Cairone, United States of America]	Noted. No space to do this.
17761	175	1	175	9	The placement of the words on the lower right hand "tree" was not easy for me to find. The upper left hand "tree" or a better management of typeface or connection to the tree with horizontal arrows, shading, etc., would have been helpful. [Baylor Fox-Kemper, United States of America]	Noted. Figure has been improved with additional guides for the reader.
21413	175	1	175	9	This is a nice figure but the cascade is arguably cut mid-way for many applications because it misses out the use of regional models / downscaling techniques to then produce local information. Should this potentially be added? [Peter Thorne, Ireland]	Noted, and agree this would be really useful, but not enough time to consider, e.g. CIDs in this context.
24237	175	1	175	9	This important figure is very difficult to follow. The panels need to be stretch vertically considerably so that the transitions are clear. The upper frames need to have the x-axis repeated and expanded with added labels for the regions. Reduce the examples to 2.5 and 8.5 for clarity. [Bryan Weare, United States of America]	Noted. The figure has been edited, but all the SSPs have been retained as it is important to highlight how different SSPs behave.
115769	175		175		It seems that the figure does not show that one scenario could lead to different global + regional forcings in models. How are carbon cycle feedbacks addressed here (for the global projections)? [Valerie Masson-Delmotte, France]	Noted. The examples now shown include East Asia rainfall where local aerosol forcings are important, and discussed briefly in the text.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
17763	176	1	176	19	This figure does not illustrate the storyline concept very well. There are too many small elements, the coloring and labeling of the different colors is obscure, and four examples (a, b, c, d) is maybe too many--selecting 2 would be better. [Baylor Fox-Kemper, United States of America]	Not applicable. Figure deleted
24239	176	1	176	19	The color scheme adds little to the upper three panels. Why is there no example which includes socio-economic responses? Overall, this adds little. [Bryan Weare, United States of America]	Not applicable. Figure deleted
869	176	2	31	6	The phrase "dynamical storyline" as title for the lowest panel in this figure is not very insightful. An alternative could be "localized" or "regional" storyline, if you want to avoid "event storyline". [Bart van den Hurk, Netherlands]	Not applicable. Figure deleted
4771	176	2	176	6	The phrase "dynamical storyline" as title for the lowest panel in this figure is not very insightful. An alternative could be "localized" or "regional" storyline, if you want to avoid "event storyline". [Bart van den Hurk, Netherlands]	Not applicable. Figure deleted
125513	176	2	176	18	[SCOPE] This figure is not helpful and should be deleted. Consider sending to WGII where it might make more sense. [Trigg Talley, United States of America]	Not applicable. Figure deleted
67005	176	6	176	7	change "storyline" to "scenario storyline" to differentiate from physical climate storylines [Liese Coulter, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. Figure deleted
29781	176	9	176	9	Add "." in "SR15 report". [Hernan Edgardo Sala, Argentina]	Not applicable. Figure deleted
29783	176	17	176	17	Add "." in "SR15 Cross-Chapter". [Hernan Edgardo Sala, Argentina]	Not applicable. Figure deleted
115771	176		176		It seems that natural external forcing and surprises / abrupt change are missing here [Valerie Masson-Delmotte, France]	Not applicable. Figure deleted
99371	177	1	177	1	A nice and innovative figure, I hope that a way to provide combined WGI+WGII information can be found to make full use of the concept. On the details: - left panels: I do not understand the reasons for "colouring" the bottom panel; it seems to highlight the area under the curve, but I do not see how this could have an interpretation (one sees a red area of a certain size, but it is under a cumulative probability curve, so what does it mean?). Wouldn't it be more logical to have the colours of the embers in the upper left panel, as in that case the size of e.g. the purple area would be proportional to the probability of very high risks? - bottom-right panel: I have the impression that it would be easier to understand with a reversed vertical scale - starting at 100 and declining to 0 (upwards). In this way, the top 10% of the figure would be the area showing the most severe risks. The probability of risks at least as severe as indicated along the 10% line would be 10%, I have the impression that it is easier to convey the message of the figure in this way. - bottom-right panel, detail: I have the impression that the vertical axis should be labelled probability (or likelihood) of exceedance (as on the left), not just likelihood (what the colours show is a level of risk that has the indicated probability to be exceeded, not the probability of getting that level of risk; for example, at 98% the risk is almost moderate for the entire century, that does not mean that the probability of getting a moderate risk is 98% but rather that the probability to get a risk that is worse than moderate is 98%). - the meaning of the bottom-right panel might probably be further explained by indicating the values for the probability of each risk level (moderate, high...) for a given time snapshot, e.g. 2100, on the right of the figure. [Philippe Marbaix, Belgium]	Noted. Figure revised for FGD.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
31653	177	1	177	1	This figure illustrates a probabilistic approach toward low-likelihood, high impact events. However, there is also an approach using scenarios, starting from scenarios that are considered impossible, and progressively decreasing the magnitude of change to "less unlikely" scenarios. This approach is illustrated in the Figure 2 of Stammer et al 2019, and could be considered to complement the upper left panel of the figure. https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2019EF001163 [Gonéri Le Cozannet, France]	Noted. The figure is already designed to highlight that ECS might be above or below the very likely range, so we consider this similar to the comment.
21415	177	1	177	1	Should GMST change be changed to GSAT change within the figure and caption for consistency with decision to use GSAT as the primary metric? [Peter Thorne, Ireland]	Noted. GSAT is used.
125515	177	1	177	18	Several comments on Figure 1.12: (1) It is unclear why the lower left-hand panel is there. Is it related to ECS of 6°C? If not, make it clear that it's distinct and why it's there; (2) line 4 - define what "pdf" is; (3) line 4 suggests this is all based on IPCC AR5, but it seems like this should be updated with the AR6 ECS distribution; (4) the text in lines 13-18 is very confusing. Is it really necessary to include? If so, consider ways to make it more accessible. [Trigg Talley, United States of America]	Noted. Figure redesigned and updated to AR6 values.
70777	177	3		18	Use ECS range/PDF assessed in AR6, not AR5. Also, I didn't understand from the caption how the likelihood shown in the bottom right panel was calculated. [Gillett Nathan, Canada]	Noted. Figure redesigned and updated to AR6 values.
29785	177	4	177	4	Please consider including the significance of "pdf" or replacing it by "probability density function" in order to reach a wider audience. [Hernan Edgardo Sala, Argentina]	Noted. Text edited.
76805	178	1	178	1	SROCC Figure CB2.1 would be a better option I think [Nerilie Abram, Australia]	Not applicable any more. Figure deleted
29787	178	1	178	1	I think the schematic might be enriched if a short list of one or two examples were added under the key concepts of the AR6 risk framing. For instance, under "Exposure" can be added "human population potentially affected by coastal storm surges", and so in each concept. [Hernan Edgardo Sala, Argentina]	Not applicable any more. Figure deleted
50613	178	1	178	8	The middle of the venn diagram has impacts and risks, it would be useful to understand the difference between these two terms. According to WMO 1150 the risk of impact is based on the combined likelihood of the three components as well as the impact resulting from the three components. In impact based forecasting this is sometimes selected as risk = likelihood of impact. [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable any more. Figure deleted
17765	178	1	179	28	This is a small quibble, but if "bifurcation" is interpreted using the common definition, rather than in the technical use of "bifurcation" from dynamical systems is not what is illustrated in c, d. In time, two potential states become one, which is a "unification" rather than a "bifurcation". I.e., the chosen direction of time should perhaps be reversed to link the common meaning of the word bifurcation with the technical one better. [Baylor Fox-Kemper, United States of America]	Noted, but we use the standardised description of bifurcation tipping. It's not a unification, 2 states (1 stable, 1 unstable) become none rather than 1 they collide
125517	178	4	178	8	[SCOPE] This text box figure should be deleted. It is not appropriate for or needed in the WGI contribution to AR6. [Trigg Talley, United States of America]	Noted. Figure deleted
112177	178	5	178	5	I'm really happy to see that this issue concerning hazards and risks has been resolved with some new wording describing the climate-related drivers, though I would add a hyphen to avoid any ambiguity: "climatic impact-drivers", to distinguish from "climatic-impact drivers" - see comment on SPM [Timothy Carter, Finland]	Noted. Chapter 12 has revised the terminology of CIDs.
131411	178				Cross-Chapter Box 1.3, Figure 1 - changes to the "risk propeller diagram" should be carefully coordinated and agreed on with WGII [Hans Poertner and WGII TSU, Germany]	Noted. Figure has been deleted

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
70779	178				Cross-chapter Box 1.3, Figure 1. I don't completely understand the risk framing illustrated here. The diagram indicates that Climate Impact Drivers, exposure, and vulnerability all contribute to impacts and risks. But isn't vulnerability a subset of exposure? i.e. I can see how something can be exposed to climate change without being vulnerable, due to suitable adaptation. But can something be vulnerable to climate change without being exposed? If not, then why is 'exposure' needed as part of the risk framing? Isn't it only vulnerability and climatic impact drivers which contribute to impacts and risks? This should either be revised, or the role of exposure, independent from vulnerability should be more clearly explained in the caption. [Gillett Nathan, Canada]	Not applicable any more. Figure deleted
24241	178				Waste of space. An example might be useful. [Bryan Weare, United States of America]	Not applicable any more. Figure deleted
11353	179	1	179	1	I would remove the arrows from the climate state axes (a,c,e in Figure 1.13). Reason: shown are two different climate states with no specified path between them. This is different in traces b, d, and f where stability can be quantified. [Michael Schmitt, Germany]	Noted, but axes for these types of plots typically have arrows on them.
125519	179	20	179	22	Can you give a climate-related example instead of the compost heap combusting? [Trigg Talley, United States of America]	Taken into account. Discussion on the compost bomb instability and rate-dependent tipping has been removed
70781	179	20		21	The example of combustion of compost heaps seems rather off-topic and not obviously climate related. I had not come across the concept before, but apparently 'compost bomb instability' is also applied to a process which could occur in peatlands, which could be associated with climate change - is this what was intended? In any case, it would be helpful to add a reference here. [Gillett Nathan, Canada]	Taken into account. Discussion on the compost bomb instability and rate-dependent tipping has been removed
115773	179		179		Missing reference in the figure caption (it seems to come from papers of Wieczorek). Is the compost bomb instability relevant for ch 5? Please check that these aspects are the ones discussed in the other chapters (in particular, 5, 9). [Valerie Masson-Delmotte, France]	Taken into account. Discussion on the compost bomb instability has been removed
28233	179				Fig. 1.13 is good in principle. I am wondering however, if it is necessary in the context of the rest of the report. The distinction of the three types of tippings makes sense in the very simple dynamical systems presented here. But it is not obvious how they relate to actual events in the climate record or future projections. At least I don't see where the types of tipping reappear anywhere in the AR6. [Sebastian Bathiany, Germany]	Taken into account. Rate-dependent tipping has been removed, but we feel it is insightful to highlight different mechanisms between types of tipping
29789	180	1	180	1	Please, consider adding in the Figure 1.14 some climate process associated with the cryosphere. For instance, the annual cycle of sea ice extent (or snow cover), the quasi-periodic calving of tabular icebergs from iceshelves, etc. [Hernan Edgardo Sala, Argentina]	Not applicable: The figure is no longer in the chapter.
2917	180	1	180	20	The different types such as forcing, or feedback or weather phenomena, or circulations put in this figure. It might make readers confusing. [Zong Ci Zhao, China]	Not applicable: The figure is no longer in the chapter.
125521	180	1	180	22	Consider adding "atmospheric rivers" near "basin currents" in the upper right of this figure. [Trigg Talley, United States of America]	Not applicable: The figure is no longer in the chapter.
115775	180		180		I am puzzled by the space and time scales linked with urban forcing (downstream effects). Are aspects related to aerosols (eg dust) covered here with land atmosphere feedbacks? (check scales). [Valerie Masson-Delmotte, France]	Not applicable: The figure is no longer in the chapter.
90439	180		180		It is not clear on Figure. 1-14 what the sizes (length) and colours of the bars (Typological, continental, reference) represent. [Holly Kyeore Han, Canada]	Not applicable: The figure is no longer in the chapter.
11357	181	1	181	1	Sorting the definitions of reference regions alphabetically would help [Michael Schmitt, Germany]	Accepted.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
17751	181	1	181	13	Fig 1a is explicitly listed as made for the "entire report", but it is unsuitable in a variety of applications if interpreted literally. For one, the coastal regions are included within the land boxes, by default, which is unsuitable for a variety of ocean regions (western boundary currents and upwelling zones, in particular, but also smaller-scale phenomena such as estuaries and marginal seas). Secondly, it is simple in a rectangular projection, but is not so simple in other projections, which severely distorts the polar regions. To illustrate these issues, please compare these regions to those illustrated in Fig. 9.1. [Baylor Fox-Kemper, United States of America]	Noted.
23787	181	1	181	13	Figure 1.15 should be checked for consistency with the latest version of Figure 8.12 in Chapter 8, if indeed it is intended that they be the same. Does it need also the South Africa and northern-South America pseudo-monsoon regions as depicted by stipples in Fig. 8.12? In addition, note that the North American monsoon domain extends a few degrees further north in Fig. 8.12 than in Fig. 1.15, whereas in Fig. 1.15 it includes Florida! There are also subtle differences in the SAM domain, for example with Fig. 1.15 showing extension much further south. Finally, the Maritime Continent is not entirely covered in Fig. 1.15. [Andrew Turner, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Map has been updated to the latest version of Ch.8.
130421	181	3	181	3	In Figure 1.15, the light gray text in the map corresponding to Small Islands is difficult to read. Please modify. [Rubén Piacentini, Argentina]	Accepted. The map has been updated.
18611	181	3	181	10	Please note that Chapter 12 associates several of the AR6 regions with the Arctic, including Greenland and the Russian Arctic. 12.9 also looks at polar portions of NWN, NEC, and NEU, but the current panel 1.15c delineates this with the Arctic Circle. [Alexander Ruane, United States of America]	Taken into account. This issue has been extensively discussed in the Regional meetings.
125523	181	4	181	4	Change "Acronyms are explained below the map" to "Acronyms are explained TO THE RIGHT OF THE MAP." [Trigg Talley, United States of America]	Accepted. Corrected.
113627	181	4	181	4	"Acronyms are explained next to the map" not "below the map" [Agnieszka Kowalczyk, Poland]	Accepted. Corrected.
111945	181	4			Actually, acronyms are not explained below the map [Tomas Halenka, Czech Republic]	Accepted. Corrected.
63885	181				Fig.1.15 NSA, SES, SSA, SWS, NES is labeled wrong in the list. Furthermore, I am suggesting to order the abbreviations alphabetically [APECS, MRI, PAGES ECN, PYRN and YESS ECS group review, Canada]	Accepted.
24247	181				Unfortunately, these many regions are rarely used in the report. Even the typological regions are inconsistently used. See for instance Fig. 1.9 [Bryan Weare, United States of America]	Noted.
76807	182	1	182	1	Putting an ~1500CE start date on Indigenous knowledge is problematic, and isn't reflective of the much longer accepted length of knowledge of the Australian Aborigines. Also, better to capitalise the "I" in Indigenous. [Nerilie Abram, Australia]	Accepted. Indigenous is now written with a capital 'I'. The left taper has been extended to ca. 7000 years ago.
104503	182	1	182	1	If it can be adjusted, lake sediments are available even further back in time than 10,000 years, e.g. Lake Elgygytyn even million of years. Perhaps use a dotted line to indicate there are lakes but not so many back in time. [Frederik Schenk, Sweden]	Taken into account. Lake sediments now extend to 100000 years ago.
8643	182	1	182	1	There are Dutch TG records from 1700. The range of coral records seems way too short, given the paleoclimate and paleo-sea level data from these stretching back multiple interglacials. [Robert Kopp, United States of America]	Accepted. The bar for corals has been extended to include the glacial-interglacial time scale.
125525	182	1	182	2	[PRECISION] The x-axis on the bottom panel is confusing. Not only does it conflate logarithmic (to the left) with linear (to the right) timescales, but it's unclear how the same tick mark is labeled: "0 yrs BP" and "1950 CE". Please clarify both points in the caption text, if not the plot itself. [Trigg Talley, United States of America]	Accepted. x-axis on the bottom panel has been changed to logarithmic all over.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
21417	182	1	182	2	The top panel of this could be considerably improved. At present it gives no inclination about the changes in observing system capabilities e.g. weather balloons or satellites. Rather than looking at it from a variables being monitored perspective it would be more informative to think about presenting as major innovations in our ability to observe key facets in key ways. Also bringing in the reanalyses would be useful I think here. So, I would suggest substantively revising the top panel to better highlight key observing system innovations rather than some nominal ability to monitor individual ECVs. At present the reason why there are potential improvements is opaque. [Peter Thorne, Ireland]	Rejected. The intention of this figure is to schematically illustrate the temporal coverage of selected instrumental climate observations, and to contrast them with paleoclimate archives. The focus is on variables, not observing systems capabilities, which are discussed in more detail in chapter 2.
100571	182	4	182	4	Add: "Plant micro- and macro-fossils" to figure; covers entire range [Matthew Kohn, United States of America]	Rejected. This would add too much detail to the figure which only intends to show a selection of records.
100573	182	4	182	4	Add: "Animal micro- and macro-fossils" to figure; covers entire range [Matthew Kohn, United States of America]	Rejected. This would add too much detail to the figure which only intends to show a selection of records.
100575	182	4	182	4	Add: "Soils" to figure; covers entire range [Matthew Kohn, United States of America]	Rejected. This would add too much detail to the figure which only intends to show a selection of records.
100577	182	4	182	4	Add: packrat middens (maybe?) to figure. I'm not positive of the temporal range, and I'm not positive of how _quantitatively_ they resolve climate. [Matthew Kohn, United States of America]	Rejected. This would add too much detail to the figure which only intends to show a selection of records.
100579	182	4	182	4	Add: exposure ages (maybe?) to figure. They help constrain areal extent of glaciers. Time range would be up to millions of years [Matthew Kohn, United States of America]	Rejected. This would add too much detail to the figure which only intends to show a selection of records.
100581	182	4	182	4	Note: I think it's important to show how many different proxies we have - it's not just a couple. So, while "Plant and animal micro- and macro-fossils" could be combined, I wouldn't do that [Matthew Kohn, United States of America]	Rejected. This would add too much detail to the figure which only intends to show a selection of records.
100583	182	4	182	4	Note: I can provide details on any of these methods (except packrat middens) [Matthew Kohn, United States of America]	Rejected. This would add too much detail to the figure which only intends to show a selection of records.
100585	182	4	182	4	Note: I distinguish marine "sediments" from marine "micro-fossils". There's a big difference in evaluating the extent of ice sheets from ice rafted debris (dropstones, etc.) vs. sea-surface temperature from trace element and isotope analysis of forams [Matthew Kohn, United States of America]	Rejected. This would add too much detail to the figure which only intends to show a selection of records.
3261	182	6	182	6	1976 CE [Sergio Aquino, Canada]	Noted. Comment unclear.
108995	182	7	182	7	Please change to read 'PAGES 2k', i.e. 'k' to refer to 'kilo'; 'K' is used for 'Kelvin', not the case here [Belen Martrat, Spain]	Not applicable. The reference to PAGES2k has been removed from the caption.
83939	182	7	182	7	The last part of the caption "coverage over the last 2,000 years available from PAGES2K Consortium, 2017." is not strictly true. The PAGES2k Consortium has provide a very important gathering of paleoclimatic records over the last 2,000 years, but it is not the soul source of paleoclimatic records. As this Figure has a broad aspect of showing the generic temporal cover of climate observations, that statment should not be in the caption. [Marco Tulio Cabral, Brazil]	Accepted. The reference to PAGES2k has been removed from the caption.
115777	182		182		Please consider other sources of information on long time scales (eg geologic data). I know exceptions to each arrow (very ancient glacier ice cores, or lake sediment records). Could local knowledge be added to indigenous knowledge? [Valerie Masson-Delmotte, France]	Taken into account. Borehole temperatures were added as an additional paleoclimatic data source. In the text, indigenous and local knowledge are considered together.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
111947	182				Interpretation of graphic should be explained (width of the graphics - relation to spatial coverage?), not clear for CO2, ocean pH [Tomas Halenka, Czech Republic]	Taken into account. The width of the tapers have been revised wherever needed by updated information. The caption explains the width of the tapers (amount of records).
42863	182				It's a bit misleading that corals are only shown as extending 100 years into the past when in fact palaeo work has extended way further back than that. [Eric Wolff, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Taper has been adjusted to cover the glacial-interglacial time scale.
70783	182				Figure 1.16. Why do documentary archives stop in ~1970 on the diagram? Also the time axis is confusing. Why not just use a logarithmic axis for the whole thing? Also the year labelled 0 yrs BP (i.e. zero years before present), is also labelled '1950'. How can 1950 be zero years before present? [Gillett Nathan, Canada]	Accepted. A logarithmic time scale has been used to cover the whole time range for the lower graph. Documentary archives have been removed from the upper panel and now taper off to ca. 1000 years ago.
24249	182				This poorly summarizes available data. Further, it is not at all clear what the thickness of lines means. Clearly documentary evidence is not global and daily like most satellite era data. This should be more quantitative summarizing the space time density of observations for the two different eras. It should NOT imply the the data density for the paleo periods is comparable to that of the last 20 years. [Bryan Weare, United States of America]	Taken into account. The width of the tapers have been revised wherever needed by updated information. The caption explains the width of the tapers (amount of records).
68847	182				Fig. 1.16; This figure is really shaping up. I still think that boreholes must to be included. It's a major source of independent evidence supported by a large international community. The global borehole temperature composite is now featured in the Technical Summary Figure TS.12. [Darrell Kaufman, United States of America]	Accepted. Boreholes are included now.
125527	183	1	183	1	Several questions/comments on Figure 1.17: (1) The sum of the numbers in the individual circles in panels (a) and (d) do not equal the "Total" model number in the bottom left of each plot; and (2) consider inserting grid lines in each plot, so it's clear where models fall, then put numbers in the actual grid cells. It'd make the plot easier to read. [Trigg Talley, United States of America]	Taken into account. The figure has been modified to enhance the readability.
11359	183	1	183	1	please explain color code [Michael Schmitt, Germany]	Taken into account. The figure format has been modified and the colour code now indicates the different MIPs.
70785	183				Figure 1.17: This is a nice plot and useful context for Chapter 3. [Gillett Nathan, Canada]	Thanks for this positive comment.
24257	183				This figure should compare CMIP5 and 6 runs that are summarized in the multi-model means in Ch. 3 and 4. Fig. 4.1 indicates at most 22 models in any ssp. What are all of the models in b) for instance? I assume axes are grid spacing. Isn't it also possible to summarize the vertical in both the atmosphere and ocean. [Bryan Weare, United States of America]	Accepted. All CMIP6 models used in Chapter 3 are now included. The figure has been modified and it also includes information on the vertical resolution.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
68849	183				Fig. 1.16; Some minor-to-picky suggestions from top to bottom: (1) The shift in bar thickness at 1979 for precipitation and temperature suggests that there was a step-wise improvement in these at that time. I don't think that is correct. (2) I assume ocean pH was measured before ~1990. (3) Documentary archives and indigenous knowledge really are not "instrumental". Maybe change the title to "A. Instrumental and qualitative observations". (4) Change "Palaeoclimate" to "Paleoclimate". This decision was made by TSU. (5) Remove "documentary archives" from panel B. (6) I don't know about tropical ice or bivalves, but the majority of tree rings (about 2/3rds based on PAGES 2k) are younger than 500 years and only a few percent extend to 2000 years; only a few go to 10,000 years. (7) Lake sediments extend back 100,000 years in many cases; there are as many that extend back to 5000 years as to 1000 years. (8) There are fewer marine, stalagmites and polar ice that extend to 100,000 years compared to 10,000 years. (9) There are fewer marine, stalagmites and polar ice that extend up to now than there are at say 2000 (they should taper toward present like corals). (10) As much as I love PAGES 2k Consortium, I don't think it should be singled out here. [Darrell Kaufman, United States of America]	Noted. This figure has been updated and some suggestions have been implemented, now new Figure 1.7. Thickness of bars change. Spelling of paleo, reference to PAGES 2k deleted.
69935	184	1	184	1	I think CORDEX information in East Asian region should be updated. NIMS-KMA has operated CORDEX-EA Data Center since 2013 and started to provide CORDEX Phase II data last year. This CORDEX Phase II data is generated by NIMS-KMA using HadGEM3-RA model, and also multi-RCM data produced by domestic university under collaboration with NIMS-KMA is provided through CORDEX-EA data center. Additionally, according to past survey conducted by CORDEX international community, several universities and institutions in China and Japan was known to be involved in CORDEX-EA activities. Therefore I think these information should be noted in the figure. [Young-Hwa BYUN, Republic of Korea]	Accepted. NIMS-KMA added
100789	184	1	184	1	Figure 1.18 – The CMIP simulations carried out by the EC-Earth model consortium are carried out at 10 research centres in Europe. So 4 more lines should be added in the cartoon (pointing Spain, Italy, Norway and Germany). Also, since EC-Earth is a consortium including many European countries, it should be added "EC-Earth-Consortium" under Institution (now this tag is missing), and something like "10 European Cities" under "City". [Corti Susanna, Italy]	Accepted. The figure has been modified.
38305	184	1	184	3	The East Section of China-India Border is wrongly drawn and the Dotted Line of South China Sea, Nanhai Zhudao (the South China Sea Islands), Diaoyu Dao and its affiliated islands of China are missing in Figure 1.18. In order to avoid unnecessary disputes, it is suggested to delete the national boundary lines in the figure. [Yaming LIU, China]	Noted. National boundary lines are not relevant for this figure and have been removed.
108289	184	1	184	4	In Figure 1.18, as I understand that Seogwipo NIMS-KMA contributed CMIP3, CMIP5, CMIP6 and CORDEX but CORDEX contribution was not noted [Won-Tae Kwon, Republic of Korea]	Accepted. NIMS-KMA added
70787	184				Figure 1.18: Whereas many ESMS are developed in multiple locations (for example, CanESM5 was developed in Victoria and Toronto), the map shows single locations for all models except EC-Earth, which has multiple locations marked. Pick one location for EC-Earth. [Gillett Nathan, Canada]	Accepted. The figure has been modified accordingly.
17767	185	1	185	10	In the MME, initial conditions also vary across the ensemble, please make explicit in caption. [Baylor Fox-Kemper, United States of America]	Accepted, caption revised.
70789	185	7			This phrase is not needed. The multi-model mean is the ensemble average of a multi-model ensemble. [Gillett Nathan, Canada]	Taken into account. We have tried to clarify accordingly.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
38567	185				I like the idea of the schematic. I wonder if there is a danger people read too much in to the relative spread of the three types of ensemble. The schematic could better reflect the relative spreads of these ensembles more accurately. Having compared lots of multi-model and PPE ranges and seen cases where PPE is wider than multi-model and vice versa, these two need to have similar sizes but be larger than the initial condition ensemble. [David Sexton, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. We have tried to clarify accordingly.
24265	185				As it is, this figure is of little value. One needs specific examples for say global surface temperature and specific time periods. Only then can one judge the magnitude of variability for the different ensemble sets. [Bryan Weare, United States of America]	Noted. We still find it of good conceptual value (as do other commenters).
17769	186	1	186	10	Given that many MIPs are named throughout the report, it would be nice to add their names to an outer ring appropriately. [Baylor Fox-Kemper, United States of America]	Accepted. The outer ring has been added to the figure.
3259	186	3	186	5	align text after figure 1.2 and under Structure [Sergio Aquino, Canada]	Taken into account.
130423	187	2	187	2	Figure 1.17: [Rubén Piacentini, Argentina]	Comment seems to be missing
10397	187	3			What is the difference between the bell curves and the shaded rectangles? [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account, we have tried to clarify further.
3263	187	4	178	7	align text after figure 1 under S [Sergio Aquino, Canada]	Accepted, editorial.
70791	187				Figure 1.21. Why is the label 'Long-term intermodel uncertainty needed'? What does this mean? I would suggest removing this label. [Gillett Nathan, Canada]	Rejected. The right-side label is meant for comparison with the left-side one, showing both that the model spread is larger than the assessed sensitivity and that the constraint can work for both.
24269	187				This is so vague to be of almost no value. It might be useful if it showed an example and defined the terms of "constrained values" and "earth system sensitivity" [Bryan Weare, United States of America]	Rejected. Such a schematic has proved useful in explaining the concept; several examples are given elsewhere in the report (and linked to in the text in Chapter 1).
19365	188	0	188	0	Another excellent synthesis chart. Could you please also include a table that lists the years where emissions must peak, halve, and zero out for each SSP? This is incredibly important guide post information for policy makers. [Lia Cairone, United States of America]	Rejected. We refrain from adding an extra table, but more clearly mark these aspects in the figure. This information will be available from WGIII.
109193	188	0	188	10	Figure 1.22: Because I think this will be a popular and important figure, I think it's worth providing a temp/color scale and a small key for the CO2 markers across the bottom. If there was a key for the latter then you could even avoid the text in the figure (only the X, diamond, circle). A declarative title may also be good for future sharing of this figure, something like "the five socioeconomic pathways describe/determine possible future emissions and warming" or more general like "future emissions and warming depend on human decisions and conditions" [Steph Courtney, United States of America]	Accepted. Colour bar added. It is an editorial decision not to add this to the figure itself.
42085	188	1	188	1	add a colourbar to understand the involved magnitudes [Julia Nabel, Germany]	Accepted. Figure revised accordingly.
14521	188	1	188	1	On Figure 1.22, why is one scenario's peak CO2 emission not shown? [Amy East, United States of America]	Noted. Emissions do not peak in the 21st century in this scenario.
108291	188	1	188	10	In Figure 1.22, for SSP3-7.0 CO2 emission peak is not clear (mark emission peak with other color). [Won-Tae Kwon, Republic of Korea]	Noted. Emissions do not peak in the 21st century in this scenario.
18473	188	1	190	13	I liked the figures! [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Thanks.
77635	188	6	188	6	Replace 'data is' with 'data are'. [Emer Griffin, Ireland]	Not applicable. Text deleted.
115779	188		188		It could be good to acknowledge the initial source for this visual representation somewhere in the caption. Note, the wording "middle of the road" can be perceived quite differently by policy makers than what it intends to say, I would suggest cautious use of it here. [Valerie Masson-Delmotte, France]	Noted. The descriptive names of the SSPs have been deleted from the figure, though they are directly taken from the literature.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
113007	188				Please add colorbar. [Diego Miralles, Belgium]	Accepted. Figure revised accordingly.
70793	188				This figure lacks a colour scale. Without one, the figure conveys no quantitative information at all. [Gillett Nathan, Canada]	Accepted. Figure revised accordingly.
24277	188				This is pretty meaningless without a clear description of the SSPs. "peak" and "half" have different GHG concentrations in different scenarios. There is no color scale so one does not know what the differences really mean. [Bryan Weare, United States of America]	Accepted. Figure revised accordingly. SSPs are described in the main text, Section 1.6.1.1 and Cross-Chapter Box 1.4
125529	189	1	189	1	This figure is hard to interpret. Also, the cause-effect implication is wrong. There are lots of factors that affect whether there is an impact, including adaptation, mitigation, and development. [Trigg Talley, United States of America]	Taken into account. The adapted figure now explicitly includes an indication of mitigation action and adaptation. The relationship between climatic impact drivers, adaptation, exposure and etc. is more closely described elsewhere in the Report and particularly in WGIII.
21419	189	1	189	1	The text in this figure is too small to read and in many parts is not clearly distinguishable from the background colour. Figure is very complicated. Can it be simplified? [Peter Thorne, Ireland]	Taken into account. Figures have been revised for clarity and readability.
17771	189	1	189	10	The typeface used in figure 1.23 is too small. Please be mindful of the visually challenged. [Baylor Fox-Kemper, United States of America]	Taken into account. Figures have been revised for clarity and readability.
3257	189	2	189	9	please explain the concept of dimension of integration [Sergio Aquino, Canada]	Rejected. The DOIs are explained in the main text, not in the figure or its caption
115781	189		189		Please check the relevance of the figure for WGII as scenarios have implications for exposure and vulnerability (and adaptation capacity / resilience) together with changes in climate impact drivers. Climate projections could include air quality. Maybe add mention of ecosystem and biodiversity models (check with WGII for wording to be used). What are "gas cycle models"? The figure could also stress the links between global levels of warming (and rates of changes) and regional consequences [Valerie Masson-Delmotte, France]	Taken into account. The "ecosystem and biodiversity models" are now explicitly mentioned, as well as a specific arrow for adaptation. Gas cycle models is the general term for carbon cycle, CH4 cycle, N2O cycle and other lifetime sink-sources models (not all are necessarily "cycles").
113009	189				Small fonts will be unreadable. Also their font type is inconsistent from panel to panel. [Diego Miralles, Belgium]	Taken into account. Figures have been revised for clarity and readability.
24279	189				Even highly magnified this is nearly unreadable. Earlier in the chapter a conceptual plot of the overall AR6 process would be useful. However, here one needs specifics of how scenarios are generated and then how emission rates are passed to models, mainly through concentrations. The Box1.3, Fig.1 is wholly inadequate, partly because it too is illegible, but more importantly it only shows C emissions and not other drivers and because it does not show the concentrations that nearly all CMIP6 models are actually using. There is a HUGE distance between what is shown in these figures and what needs to be conveyed for readers to appreciate Ch. 3 and 4. [Bryan Weare, United States of America]	Taken into account. The new figure has increased font sizes. The additional detail in terms of emission and concentration inputs is now provided in a tabular format in the Cross Chapter Box 1.4 - which includes a figure on the various specific gases so that the reader can fully appreciate the results in Chapters 3 and 4 and 5..
42087	190	1	190	1	right panel, intersection of 8.5 and SSP5: "SSP1-8.5" -> "SSP5-8.5" [Julia Nabel, Germany]	Accepted. Figure revised accordingly.
67711	190	1	190	1	It seems that there are two scenarios for SSP3 in the left figure, but there are two scenarios for SSP4 in the right figure. [Hiroaki Kondo, Japan]	Noted. Yes, there are two scenarios for SSP3 and two scenarios for SSP4 in both figures (although the left perspective figure slightly overshadows the lower SSP4-3.4 timeseries). The SSP3 family has two scenarios, both shown at the level of 7.0, although the one variant features lower methane and/or SLCFs - which results in lower temperatures (shown indicatively on the left).

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
113629	190	1	190	1	In the right panel, in the matrix, the brown tile should read "SSP5-8.5" not "SSP1-8.5". [Agnieszka Kowalczyk, Poland]	Accepted. Figure revised accordingly.
11363	190	1	190	2	The text within the Figure is way too small. The scenario at top right is "SSP5-8.5" not "SSP1-8.5" [Michael Schmitt, Germany]	Accepted. Figure revised accordingly.
21421	190	1	190	2	Much of the text in this figure is so small as to be illegible. The text needs to be made much clearer. [Peter Thorne, Ireland]	Taken into account. Figures have been revised for clarity and readability.
17911	190	1	190	13	The perspective on the left panel makes it difficult to see the scenarios, particularly for SSP3/4. Additionally, the text is too small to read and the legend is missing. I'm not convinced this figure wouldn't be easier to understand if it were a standard line chart with time on the x-axis and temperature on the y-axis. What do the colors mean on the right panel? [Katherine Calvin, United States of America]	Noted. The Colours reflect the colour guidance adopted for the AR6. The point of the left panel is not to provide a quantitative time-series of temperatures, but to indicate that the scenario evolve from a current starting point in different socio-economic development directions.
23533	190	1	190	70	In Fig. 1.24, "SSP1-8.5" should be corrected as "SSP5-8.5". [Masaki Satoh, Japan]	Accepted. Figure revised accordingly.
125531	190	3	190	13	[PRECISION] Need to add a table with the five SSP assumptions about development pathways and other societal characterizations for each. The figure needs this supporting table. It should also be brought into the SPM. [Trigg Talley, United States of America]	Rejected. The new box 1.4 now focuses on the SSPs and their use in this WGI report. For definitions, we now refer to the Glossary. Presentation of SSP was restructured to provide more clarity. However, this is the report on the physical science basis. The socioeconomic details on the SSPs will be provided in the WGIII report.
8645	190	9	190	9	'classical' seems an odd word choice for something that was invented in the last five years [Robert Kopp, United States of America]	Accepted. Deleted.
70797	190	9			Avoid terming this the 'SSP-RCP matrix'. Just call this the SSP matrix, with approximately equivalent RCPs shown for comparison. Also 'classical' is not the best word to use here, since this diagram is less than five years old. [Gillett Nathan, Canada]	Accepted. We now refer to this as the SSP-radiative forcing matrix
70795	190				Figure 1.24. SSP5 is labelled 'Fossil-fuel development' but some SSP5 scenarios show warming of less than 2C. Such scenarios (SSP5-2.5) actually have reductions in fossil fuel use to ~zero by 2100. Use a different label, or clearly flag in the caption that the label applies only to the baseline SSP5 scenario, not to all variants. Otherwise readers may get the impression that we can have fossil fuel intensive development and still restrict warming to below 2C. [Gillett Nathan, Canada]	Accepted. Label is taken directly from the original publication. In the new SSP section 1.6.1.1, we clarify that IAMs can derive multiple emission futures for each socio-economic development pathway, assuming no new mitigation policies or various levels of additional mitigation action (in the case of reference scenarios and mitigation scenarios, respectively). Also we explicitly added to Cross-Chapter Box 1.4, Caption the following: "Note that the descriptive labels for the five SSP narratives refer mainly to the reference scenario futures without additional climate policies. For example, SSP5 can accommodate strong mitigation scenarios leading to net-zero emissions; these do not match a 'fossil-fuelled development' label"
52605	191	0	191	0	Figure 1.25. Bottom row, I suggest to write "Change in crop cover 2020-2100", "Change in forest cover 2020-2100" instead of "Change in crop cover 2100-2020" ... [Gema Martínez-Méndez, Germany]	Not applicable. Figures has been deleted. SOx emissions have been incorporated into new figure Cross-Chapter Box 1.4, Figure 2, where SSP and RCP forcings are compared in terms of concentrations and emissions.
52607	191	0	192	0	Box 1.3, Figure 1. the scenarios in the right hand can hardly be read. [Gema Martínez-Méndez, Germany]	Taken into account. Figures have been revised for clarity and readability.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
42089	191	1	191	1	I find it rather unintuitive that the loss in forest is depicted in green colour [Julia Nabel, Germany]	Not applicable. Figure has been deleted. SOx emissions have been incorporated into new figure Cross-Chapter Box 1.4, Figure 2, where SSP and RCP forcings are compared in terms of concentrations and emissions.
42091	191	1	191	1	I would appreciate if also change in pasture could be depicted, since (1) its an important further main category and (2) particularly since in SSP3-7.0 e.g. the large loss in African forest is in favour of pasture expansion (Hurt et al., in review) and without this information it is not possible to comprehend why the forest is decreasing [Julia Nabel, Germany]	Not applicable. Figure has been deleted. SOx emissions have been incorporated into new figure Cross-Chapter Box 1.4, Figure 2, where SSP and RCP forcings are compared in terms of concentrations and emissions.
42093	191	8	191	8	SSP370 -> SSP3-7.0 [Julia Nabel, Germany]	Not applicable. Figure has been deleted. SOx emissions have been incorporated into new figure Cross-Chapter Box 1.4, Figure 2, where SSP and RCP forcings are compared in terms of concentrations and emissions.
113631	191	8	191	8	Please change "SSP370" to "SSP3-7.0". [Agnieszka Kowalczyk, Poland]	Not applicable. Figure has been deleted. SOx emissions have been incorporated into new figure Cross-Chapter Box 1.4, Figure 2, where SSP and RCP forcings are compared in terms of concentrations and emissions.
115783	191		191		I would suggest to also include demography and urbanisation here to illustrate what are SSPs for non specialists. [Valerie Masson-Delmotte, France]	Noted. We however leave the contextualisation of the SSP scenarios and their driving forces like population etc to WG3.
70799	191				Figure 1.25. Given that the text flags that the F-gases have similar evolution (the same evolution?) in all the SSPs, consider adding F-gas emissions to the figure to illustrate this. [Gillett Nathan, Canada]	Accepted. Figure 1.25 has been deleted. SOx emissions have been incorporated into new figure Cross-Chapter Box 1.4, Figure 2, where SSP and RCP forcings are compared in terms of concentrations and emissions. F-Gases are part of the new figure, too.
881	192	1	16	68	make sure to have identical vertical axes for each of the panels as well. And would be helpful to add horizontal reference lines [Bart van den Hurk, Netherlands]	Taken into account. Vertical axes are identical. No horizontal grid lines added (style guide AR6)
42095	192	1	192	1	small letters on the right are hardly readable [Julia Nabel, Germany]	Taken into account. Figures have been revised for clarity and readability.
42097	192	1	192	1	in the last panel (2020:AR6) there is an odd looking, not continued bold brown line at around 20 GtC/yr in 2060? [Julia Nabel, Germany]	Noted. Yes, some scenarios in the SR1.5 database end in 2060, but are still plotted here. Several scenarios that are adjacent to each other give the impression of a bolder thick line.
4789	192	1	192	1	make sure to have identical vertical axes for each of the panels as well. And would be helpful to add horizontal reference lines [Bart van den Hurk, Netherlands]	Taken into account. Vertical axes are identical. No horizontal grid lines added (style guide AR6)
113633	192	1	192	1	The labels on the right side of the panels are blurred and hard to read. Please provide a higher resolution picture. [Agnieszka Kowalczyk, Poland]	Taken into account. Figures have been revised for clarity and readability.
11365	192	1	192	2	The scenarios at the left are not readable (too small) [Michael Schmitt, Germany]	Taken into account. Figures have been revised for clarity and readability.
17773	192	1	192	10	The typeface used in this Box 1.3, Fig 1 is too small. Please be mindful of the visually challenged. [Baylor Fox-Kemper, United States of America]	Taken into account. Figures have been revised for clarity and readability.
3255	192	2	192	7	align text after figure 1 [Sergio Aquino, Canada]	Taken into account. Editorial
130425	192	3	192	3	In Box 1.3. Figure 1, the numbers of years in the horizontal axis are difficult to read. Please modify. [Rubén Piacentini, Argentina]	Taken into account. Figures have been revised for clarity and readability.
37847	192	3	192	3	Please check the indent in the caption [Junhee Lee, Republic of Korea]	Taken into account. Editorial

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
115785	192		192		It is problematic to only show CO2 and not other aspects (non CO2 RF?) (including what can be very important for air quality). [Valerie Masson-Delmotte, France]	Accepted. The figure focusing on the history of CO2 emissions is kept. However, former Figure 1.25 has been deleted. SOx emissions have been incorporated into new figure Cross-Chapter Box 1.4, Figure 2, where SSP and RCP forcings are compared in terms of CO2, CH4 and N2O atmospheric concentrations, and their CO2, non-CO2 GHG, and other global emissions.
5019	192		192		The visual effect of the last figure (2020 : AR6 Database of scenarios) tends to minimize the future global warming, because there are a lot more trajectories which go downwards. I don't know if it's done on purpose, but for a strong communication it's harmful to let anyone think at first sight that there are higher probabilities of a fall from a global warming to a global cooling. [Olivier RAGUENES, France]	Noted. We show the range of fossil and industrial CO2 emissions from scenarios used in previous assessments up to AR6. For the AR6, we also show a more complete set of scenarios that was assessed in SR1.5. Obviously those are mostly focusing low temperature futures - although emission are shown here, not temperatures.
42865	192				What is the significance of the colours in this figure. Not obvious to me and yet is what draws the eye. [Eric Wolff, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Different colours are used for the different sets of emission scenarios, from IS92 to SSPs.
109195	193	0	193	13	Figure 1.26 but also a general note: Like last comment, we're used to descriptive titles but declarative titles make the message of the graph so much more clear. Please change to declarative when possible -- for this figure, even a change of the blue box text to "CO2 will continue to dominate GHG-induced warming" and maybe an added ellipses at the end if the sentence is intended to continue on to the a, b, c boxes. Also those boxes could be made more prominent, especially since the high-emissions scenario takes up so much more room. Also in this figure, minute details of the axes could be omitted since they should be covered in the caption instead (i.e., GWP-100 weighting on box c y-axis). [Steph Courtney, United States of America]	Noted. We clarified the figure with a new design that hopefully is easier for the eye. We however reduced the amount of "declarative titles" in order to let the data speak for itself.
883	193	1	26	68	Are you sure the units in panel c of fig 1.26 are GtCO2 and not GtC? [Bart van den Hurk, Netherlands]	Noted. Yes, the units are correct. Note that the cumulation starts in year 2013, not in year 1850.
4791	193	1	193	1	Are you sure the units in panel c of fig 1.26 are GtCO2 and not GtC? [Bart van den Hurk, Netherlands]	Noted. Yes, the units are correct. Note that the cumulation starts in year 2013, not in year 1850.
37849	193	1	193	1	Upper-right panel in Figure 1.26 is very difficult to understand. [Junhee Lee, Republic of Korea]	Noted. The inset graph is simply showing cumulative CO2 versus cumulative GWP-weighted GHG emissions.
125533	193	1	193	13	Delete Figure 1.26. It is fairly dense /difficult to understand and does not add very much beyond what the text states very clearly. [Trigg Talley, United States of America]	Rejected. Figure has been substantially revised for clarity. The overall point that CO2 is - across all scenarios - the dominant driver of future climate change is a central message from this report and important for several lines of assessments that the subsequent chapters perform (such as remaining carbon emissions etc.).
14905	193	3		10	As with the figure on page 102, this figure should not use just the 100 year GWP for methane; perhaps a second panel showing the results using GWP20? AND it seems very wrong to be using GWP values from AR4, which are quite out of date (even compared to the AR5) and are too low. [Robert Howarth, United States of America]	Rejected. The inset panel uses GWP-100 values as 191 Parties to the Paris Agreement uses this metric to communicate their NDCs. Thus, if IPCC wants to be policy-relevant then we should link to these policy realities. Furthermore, most of the Parties - as of now - communicate their NDC using GWP-100 AR4 values, which is why this metric is chosen in this particular context. The results and graphical representation is robust, i.e. providing the same message, if AR5 or AR6 metrics were chosen.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
52609	193	4	193	4	Figure 1.26 . I suggest using CH4 instead of "methane" for consistency (CO2, N2O). [Gema Martínez-Méndez, Germany]	Accepted. Revised accordingly.
70801	193	7		10	Weighting GHG emissions with their GWPs will not give you a timeseries radiative forcing, as stated here. You need to first calculate the concentrations of the greenhouse gases, using either a full ESM, or some simpler model, and then you can use the concentrations to calculate the timeseries of radiative forcing. Were the radiative forcing timeseries shown in Fig 1.26 calculated by multiplying emissions by GWPs? If so, they are wrong and should be corrected. If not, correct the caption. [Gillett Nathan, Canada]	Taken into account. That particular sentence was referring to the inset panel. That is now clarified in the revised figure with the revised figure caption.
115787	193		193		Why not show RCP4.5 here too? I am not sure that I understand the reason for showing "cumulative GHG emissions" (validity of the concept of cumulative emissions of non CO2?). [Valerie Masson-Delmotte, France]	Taken into account. We now changed the figure to show all main SSPs with levels from 1.9 to 8.5, including 4.5. The validity of the concept of cumulative GHG emissions is simply that it is closely correlated to cumulative CO2 emissions over the policy-relevant timescales (until 2030 and even until 2050, as shown here). Thus, different legislatures can legitimately continue to use cumulative GHG emissions for their target design as those are de-facto tightly coupled to CO2 emissions - simply due to the dominant nature of CO2 (big blue triangle in inlet figure).
5021	193		193		Anthropogenic CO2 emissions has reached nearly 2000 Gt CO2 since the industrial revolution as we can read it in figure. But we know for a fact fossil energies extraction is limited for geological reasons, and that we will not keep on emitting CO2 from the ground for centuries. Some studies made a case for a limit at around 5525 Gt CO2 when we already emitted 1760 GtCO2 (https://doi.org/10.1051/refdp/201543046 Treiner, 2015, in Reflets de la Physique). So we will not be able to emit 6000, 7000, or 8000 GtCO2 as suggested by this figure. More precisely a study published in Energy and Environmental Science (https://pubs.rsc.org/en/content/articlelanding/2016/EE/C6EE01008C#1divAbstract , Capellan-Perez and al., 2016) finds that the "ultimately recoverable [fossil] resources" (URR) were overestimated by the IPCC in the AR5. It seems that the AR6 at the moment hasn't updated potential emissions. According to Capellan-Perez we will not be able to emit more than 1150 GtCO2 before 2100. Another study (http://www.its.caltech.edu/~rutledge/Rutledge2018ACS.pptx Rutledge, 2018) shows that the ultimate production projection is about 1006 GtCO2 before 2100. If those estimates are robust, fortunately for us both scenarios RCP6.0 and RCP8.5 are unsustainable. Why does the AR6 incorporate this kind of scenarios? Business-as-usual scenarios aren't sustainable because of geological limits. Even if IPCC's missions voluntarily omit forecasts of fossil energy extraction, the publication of emissions scenarios implies keeping data up-to-date. [Olivier RAGUENES, France]	Noted. The discussion of the SSP narratives and their quantification is performed in WG3.
113011	193				Watch again small fonts. [Diego Miralles, Belgium]	Taken into account. Figures have been revised for clarity and readability.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
24287	193				Given the time scales of these figures goes 200 years beyond nearly all of the discussion in Ch. 4 and that extension obliterates nearly all of what is important in these figures, they should be redone for just the 1850-2100 period. It further makes no sense that c) ends in 2050. What is the point of c)? Why are not ozone and aerosols discussed? [Bryan Weare, United States of America]	Rejected. The point of this figure is to show the role of CO2 in comparison to other GHGs. The very short-lived influences like ozone and aerosols are further shown in Figure 2 of the Cross Chapter Box on Scenarios. The point of limiting the inlet figure from 2013 to 2050 is to use a policy-relevant time period over which the majority of approximately 100 long-term emission targets are chosen since the moment when AR5 first brought up the remaining carbon budget concept. Thus, the policy-relevance of cumulative emissions until 2300 is not obvious. The policy-relevance of a time horizon until 2050 however directly answers to the timeframe that most countries have chosen under the UNFCCC/Paris Agreement for their long-term low emission development strategies.
67713	194	1	194	1	The meaning of many lines after 2000 in the top figure should be added. [Hiroaki Kondo, Japan]	Accepted. The caption is amended to state that these various concentration lines correspond to various SSP scenarios.
37853	194	1	194	1	What does 2 C and 1.5 C inserted in Figure 1.27 indicate? [Junhee Lee, Republic of Korea]	Noted. Those are the temperature goals of the Paris Agreement (as stated in red font).
125535	194	1	194	8	It's entirely unclear how Figure 1.27 fits into this part of the text. Seeing how rapid and unprecedented the recent changes are in a paleo context is important and definitely worth highlighting in the report, but not here. It should appear in whatever chapter covers paleoclimate. Delete from Chapter 1. Out of place and its deletion will save space. [Trigg Talley, United States of America]	Rejected. The contextualisation of scenarios in light of the last 2000 years is considered an important framing element for the report (which - unlike AR5 - does not contain a specific paleoclimate chapter). In response to the comment, the position of the figure within the Chapter is however altered to better integrated with the flow.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
109759	194	1	194	8	<p>As one of the authors to the PAGES 2k Consortium (2019), I deem it less suitable to only show this reconstruction in this context. It is not, due to limitations in the input data, capturing the full low-frequency temperature variability over the past two millennium. This issue was recently addressed in:</p> <p>Klippel, L., St. George, S., Büntgen, U., Krusic, P. J., and Esper, J.: Differing pre-industrial cooling trends between tree rings and lower-resolution temperature proxies, <i>Clim. Past</i>, 16, 729–742, https://doi.org/10.5194/cp-16-729-2020, 2020.</p> <p>I would instead suggest to show an envelope of all reconstructions, for the Northern Hemisphere as well as global ones, published during the past c. 10 years similar to what was done in the Paleo chapter of AR5. Such an approach provides for a more accurate estimate of the uncertainties in the low-frequency temperature variability over the past two millennium. [Charpentier Ljungqvist Fredrik, Sweden]</p>	<p>Rejected. The reviewer is probably correct that the temperature reconstruction underestimates the low-frequency variability. This is a feature of many tree-ring-based reconstructions, although the magnitude of the underestimate is probably small. The PAGES reconstruction is dominated by tree rings, but not exclusively, which is an advantage over most others. The reviewer suggests that we show a spaghetti plot of multiple reconstructions, like previous ARs. Chapter 2 of WGI AR6, which comprehensively assessed all the evidence available, decided not to do so because the focus was placed on assessing climate indicators at the largest scale that the data allow. For temperature, PAGES 2k is a significant advance because it's global. So Chapter 2 focused there, while citing other new NH and regional reconstructions, and stating that they mainly agree with the global trends. There are very few truly global reconstructions against which to compare PAGES 2k, and none since the one or two in AR5. Moreover, PAGES 2k is based on an ensemble of multiple methods which captures differences among different reconstruction methods, which is what the reviewer is advocating. We don't think that plotting multiple reconstructions for the NH will help to solve the issue of possible under-representation of the low-frequency variability. Here in Chapter 1 we stick to the thorough Chapter 2 assessment.</p>
130427	194	3	194	3	<p>Figure 1.27 is of fundamental importance, but unfortunately the projection to the next centuries (up to the end of 2300) for the highest model value goes up to values that are not represented in the vertical scale. Please change this part of the figure, including the temperature change scale up to its maximum possible value. [Rubén Piacentini, Argentina]</p>	<p>Rejected. We refrain from providing a temperature scale to these high values though, as future temperature projections up to 2300 are assessed in Chapter 4 and here only the raw data from individual CMIP6 models is shown. Thus, a temperature scale for individual CMIP6 models would overemphasise individual models.</p>

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
4497	194	3	194	3	Figure 1.27. The illustrated new “hockey stick” by PAGES2k 2019 is highly questionable and should not be used. The database is controversial and contains numerous flaws and gaps. Notably, their database in the Southern Hemisphere is rather weak and contains various questionable proxy series (see Lüning et al. 2017: chapter 4.7; Lüning et al. 2019: chapter 5.7). Large parts of the continent interiors of Africa, Australia and South America (outside the Andes) are not covered by palaeotemperature data, hence represent palaeotemperature “white space”. The IPCC climate status report is the right place to acknowledge these major data gaps and stimulate additional research on the palaeoclimate of the past millennia in these regions. Details can be found in the following papers. It is important to mention this side of the debate: Lüning et al. (2019): The Medieval Climate Anomaly in South America. Quaternary International, 508: 70-87. doi: 10.1016/j.quaint.2018.10.041; Lüning et al. (2017): Warming and cooling: The Medieval Climate Anomaly in Africa and Arabia. Paleoclimatology 32 (11): 1219-1235, doi: 10.1002/2017PA003237, Lüning et al. 2019: The Medieval Climate Anomaly in the Mediterranean region. Paleoclimatology and Paleoclimatology, 34 (10): 1625-1649, doi: 10.1029/2019PA003734, The Medieval Climate Anomaly in Oceania. Environmental Reviews, doi: 10.1139/er-2019-0012, Lüning, S., M. Gäfka, F. Vahrenholt (2019): The Medieval Climate Anomaly in Antarctica. Palaeogeogr., Palaeoclimatol., Palaeoecol., 532, doi: 10.1016/j.palaeo.2019.109251. [Sebastian Luening, Switzerland]	Rejected. We refer to Chapter 2 for a thorough assessment of the available evidence. According to Chapter 2, PAGES 2k is a significant advance for temperature because it is global. The Chapter 2 assessment focused on PAGES 2k, while citing other new NH and regional reconstructions, and stating that they mainly agree with the global trends. They note that there are very few truly global reconstructions against which to compare PAGES 2k, and none since the one or two in AR5. Moreover, PAGES 2k is based on an ensemble of multiple methods which captures differences among different reconstruction methods.
29793	194	5	194	6	Use simply "(2019)", instead of "(PAGES 2k Consortium, 2019)". [Hernan Edgardo Sala, Argentina]	Implemented (although we now use both 2017 and 2019).
108997	194	5	194	6	I think the reference should be (PAGES 2k consortium, 2017) or refer to both (PAGES 2k consortium, 2017, 2019), because the original compilation is indeed in 2017; the 2019 study explores the database with different statistical methods and compares results with simulations [Belen Martrat, Spain]	Accepted. The 2017 and 2019 references are now both used.
115789	194		194		I prefer when data points are shown for ice core records (including small variability). What temperature is shown (GMST? GSAT?). Some overlap between this figure and figure 1.3 (but with a zoom on the last 2000 years instead of 150 years). To consider carefully (what is the key message? why not combine with Figure 1.3?). [Valerie Masson-Delmotte, France]	Noted. In order to provide a figure on a single time axis, this Figure is kept separate. We agree with the preference of showing individual ice core and firn record datasets - in the early discussions of this figure it was however thought that the detail is left to Chapter 2.
113013	194				What are the different colors in the concentration projections referring to? I guess the scenarios but not noted. [Diego Miralles, Belgium]	Taken into account. Now noted in the figure caption.
70803	194				Figure 1.27 appears to show approximately 1-3C warming in 2015 in the CMIP6 simulations (looking where the coloured curves intersect the left of the grey band). This is incorrect. The actual range is much lower. See e.g. Fig 3.3. [Gillett Nathan, Canada]	Taken into account. The grey band was previously incorrectly starting in year 2035, rather than 2015. Now corrected.
24289	194				Like Fig .26 this should be recast to the time period 1850-2100. All of the important information is totally obscured. This is just another example of how poorly the SSPs are described and justified. Where are ozone and aerosols? [Bryan Weare, United States of America]	Rejected. The detailed SSP information for the 21st century are provided in another figure, namely in Figure 2 of the Cross-Chapter Box 1.4. While ozone is not directly provided, several tropospheric ozone precursors (NOX, VOC) are.
37851	195	1	195	1	The use and purpose of Figure 1.28 are ambiguous. [Junhee Lee, Republic of Korea]	Noted. The DOIs are explained in the main text because they are relevant for WGI, not just the SYR.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
125537	195	1	195	7	[SCOPE] Figure 1.28 should be deleted. It would save space and is not needed in the WGI report. It's unclear how or why the Dimensions of Integration are needed at all, to be frank. The brief paragraph on page 103, lines 20-28, encapsulates the idea very well. Just leave that paragraph and delete the rest. This figure can be transferred to the Synthesis Report. It does not belong in the WG1 report. [Trigg Talley, United States of America]	Rejected. The DOIs are explained in the main text because they are relevant for WGI, not just the SYR.
17775	195	1	195	10	The expression of scenarios as time-dependent is a little hidden here. Please note in the caption what date the tail and head of the arrows represent. [Baylor Fox-Kemper, United States of America]	Taken into account. We clarified the figure with explicit time-stamps.
3253	195	2	195	5	please explain what is dimension of integration. explicit dimensions of integration to (combine) knowledge. Difficult to read stand alone graph. [Sergio Aquino, Canada]	Taken into account. The DOIs are explained in the main text because they are relevant for WGI, not just the SYR.
115791	195		195		it could be good to also consider non CO2 RF + land use as dimensions of integration (especially having in mind ecosystems and air quality). [Valerie Masson-Delmotte, France]	Noted. In the interest of limiting the dimension of integration to clear indicators that are relatively widely used, we however did not implement additional dimensions of integration. It would be good to see future development in this regard, likely starting with a clear uni-dimensional scale of how to consider non-CO2 RF and land use usefully across different research domains.
42867	195				This figure 1.28 is a bit incomprehensible - I have no idea why it's entitled dimensions of integration when all it seems to be is an illustration of how scenarios affect temperature. At minimum it needs a new caption to explain what the reader is meant to see. [Eric Wolff, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The surrounding text explains the three dimension of integration in more detail and should be sufficient for the reader to place scenarios, global warming levels and cumulative CO2 emissions.
113015	195				Note what the line colors refers to. [Diego Miralles, Belgium]	Noted. The line colours are simply denoting different scenarios.
82589	196	1	196	1	In Figure 1.29, there should be a link between AR5 Chapter 13 and AR6 Chapter 2 (which contains some sea level material). [Blair Trewin, Australia]	Accepted. Figure revised.
37855	196	1	196	1	Arrows in Figure 1.29 are complicated. [Junhee Lee, Republic of Korea]	Noted. The figure is now redesigned.
113635	196	1	196	1	Please double check colors of the arrows, I think some of them are mixed up. [Agnieszka Kowalczyk, Poland]	Not applicable. The figure is now redesigned.
125539	196	1	196	4	Figure 1.29 is a great and helpful figure to assist the reader in finding the information they're looking for. However, the caption should explain what a dotted outline for Chapters 5 and 9 of the AR5 WGI report mean -- presumably that those topics do not exist in standalone chapters anymore in AR6. Furthermore, it's worth emphasizing how Chapters 10 through the Atlas represent the explosion of regional climate information. That is a primary advance in the science since AR5 and should be highlighted explicitly here and in the text. The text (page 105, line 46 - page 106, line 1) does a great job in capturing these points. Bring it into the figure. [Trigg Talley, United States of America]	Noted. The figure is now redesigned.
23789	196	1	196	8	This figure strongly misunderstands the role of chapter 10. Climat[ic] Impact Drivers are barely mentioned in Ch10 - they are the domain of Ch12. [Andrew Turner, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. It was a simple mistake and now corrected.
17777	196	1	196	10	This is more of a comment than a suggestion, but the complexity of the web of connectivity here makes it clear to me why our LAMs have been so complex. I'd suggest this figure should be shown at any future scoping meetings to as to avoid unnecessary restructuring in future reports! Thank you for providing it. [Baylor Fox-Kemper, United States of America]	Noted. The figure is now redesigned and losing that complexity.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
18613	196	3	196	3	This overview of topics and WGI chapters is missing some key factors that would better illustrate Chapter 12's role synthesizing regional climate change information. Specifically, thin lines could connect the left column items #2, 3, 4, 8, 11,12 and 13 to Chapter 12 in addition to the thick line connecting #14 (Regional Climate Change). The short title for Chapter 10 is also confusing here, as 'climate impact drivers' is very similar to (but different than) 'climatic impact drivers', while climatic impact drivers are the main focus of Chapter 12. Perhaps 'Global to regional information' could be a better short title for Chapter 10? [Alexander Ruane, United States of America]	Noted. The figure is now redesigned. The title of Ch.10 was a simple mistake and now corrected.
3251	196	3	196	4	indicates the correlation (omit strength) between the chapters. [Sergio Aquino, Canada]	Noted. The figure is now redesigned.
71431	196	3			This figure needs some revision regarding the regional chapters. A new title for Chapter 10 is needed, and it should be made clear that these chapters are new and don't necessarily have a corresponding chapter in AR5. Some arrows though should be added. Happy to discuss. [Douglas Maraun, Austria]	Noted. The figure is now redesigned.
21425	196	4	196	4	I wonder whether correlation should be reserved for quantitative statistical comparisons and instead a word like strength of the mapping should be used here that avoids potential reader inference of a quantitative statistical analysis having been undertaken here [Peter Thorne, Ireland]	Not applicable. The figure is now redesigned and the term correlation is no longer used for that purpose.
115793	196		196		the titles are not the exact ones, this could cause confusion (both AR5 and AR6). I am not sure that "correlation" is the right term. I suggest to reconsider the figure to help a reader know where to find updates compared to the AR5, but also SREX, SR15, SROCC and SRCCL here. [Valerie Masson-Delmotte, France]	Accepted. Figure revised with exact titles.
112033	196		196		Annex I Atlas (from AR5) should better point to "Interactive Atlas" (a new element in the diagram), which is the online equivalent Annex in AR6. Atlas (as a chapter, providing regional assessment of mean climate) could stay in the regional information block (with incoming link from 14. Regional Climate AR5, as it is now). That would better reflect the relations between AR5 and AR6 chapters. [jose manuel gutierrez, Spain]	Noted. The figure is now redesigned.
110829	196		196		This figure contains several inconsistencies in the part that refers to the regional chapters: Chapter 10 does not deal with climate impact drivers, this is done in Chapter 12 and they are called "climatic impact drivers", while Chapter 10 deals with the methodological aspects of generating climate information (you might want to use something like "regional climate methodologies"); Chapter 12 is not the only one dealing with regional climate change, 10, 11 and Atlas also do it; the Atlas Chapter is more than an Atlas; most of the thin arrows from AR5 point to Chapter 11, when they are relevant to all the regional chapters; an arrow from Chapter 9 AR5 to Chapter 10 AR6 is missing. [Francisco Doblaz-Reyes, Spain]	Noted. The figure is now redesigned. The name of Ch.10 was a simple mistake and now corrected.
41143	198	0			Very nice figure but the title of FAQ1.2 in the figure no longer reflects the title in the text. [TSU WGI, France]	Taken into account. Text revised.
40175	198	0			Fig FAQ1.2: I would change the 1-line explanation with "Climate change is most apparent in regions with fewer natural variations" [TSU WGI, France]	Taken into account. Figure revised.
3249	198	1	198	8	please define what is northern america and tropical america [Sergio Aquino, Canada]	Noted. Figure revised.
125541	198	1	198	53	Add the words "in Northern America" after the words "but the background variations are also larger." Otherwise the reader may think authors are talking about Tropical America in the last phrase. Also refer the reader to the signal-to-noise ratio for other regions such as Central Africa (see Figure 1.9). [Trigg Talley, United States of America]	Taken into account. Text revised.
10399	198	3			Where have the measures of interannual variability come from? What about variability on longer than interannual timescales? [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Noted. See Section 1.4.2 for explanation.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
26045	198	6	198	6	FAQ 1.2, Figure 1: For a better visualization of the variability add the text between brackets (In a normal distribution approximately 68%, and 95% of the values lie respectively within the 1 and 2 standard deviations bands around the mean) [Don Alfonso Pino Maeso, Spain]	Taken into account. Figure revised.
70805	198				FAQ1.2, Figure 1: 'Northern America' doesn't seem appropriate for a latitude range from 40N to 64N. First North America extends to 83N, so a latitude band that finishes almost 20 degrees south of this is not the most northern part of the continent. Also 'America' is commonly used to refer to the USA, whereas much of this region is in Canada. The continent is N America. I suggest "Northern USA and Southern Canada" or 'Mid North America'. Secondly 'Tropical America' may be interpreted as 'Tropical USA', whereas the region defined is mostly in S America. I suggest 'Tropical S America'. [Gillett Nathan, Canada]	Taken into account. Text revised.
40177	199	0			Fig FAQ1.3: seeing the figure one might wonder what causes the differences between the pre-industrial period and last interglacial as CO2 level is the same [TSU WGI, France]	Taken into account. Text and figure revised to note role of orbital forcing.
40179	199	0			Fig FAQ1.3: The acronym of the periods in the figure should either be removed or at least explain in the caption [TSU WGI, France]	Taken into account. Text revised.
96079	199	1	199	1	FAQ 1.3, Figure 1: The second box from the right states that for "effective emissions mitigation" global warming would be 2-4 °C. Does this mean that the authors of WG I can provide scientific evidence that even with effective emissions mitigation limiting warming to 1.5C is out of reach? We do not find such evidence in this report and the figure seems grossly policy prescriptive. Please revise. [Nicole Wilke, Germany]	Taken into account. Figure revised.
96081	199	1	199	1	FAQ 1.3, Figure 1: Title of the temperature legend is "Global temperature". This suggests it is the absolute global temperature. Would be better to write "Global temperature anomaly" or "Global temperature relative to preindustrial". The figure defines the pre-industrial era as 1850 - this is not consistent with the remainder of the report that states either 1750 or 1850-1900. Please revise. [Nicole Wilke, Germany]	Taken into account. All climate variables are now consistent with remainder of report.
29795	199	1	199	1	Please, include in the figure caption the full length name (Paleocene- Eocene Thermal Maximum) of the acronym "PETM", located in the left side of the figure. PETM is not defined in this chapter. [Hernan Edgardo Sala, Argentina]	Not applicable. PETM no longer included.
11367	199	1	199	1	The meaning of the bottom graph (Global Temperature) is not clear. Why are temperature differences given in °C and not in K? The use of K makes it harder to confuse the changes with absolute temperatures. [Michael Schmitt, Germany]	Rejected. Temperatures are reported in C throughout the assessment.
42099	199	1	199	1	temperature colour bar does not cover the 10-15°C PETM [Julia Nabel, Germany]	Not applicable. The PETM is no longer included.
42101	199	1	199	1	The figure caption does indicate that the comparison is about previous warm periods, however, without this explanation the figure could be interpreted in a wrong way? Would it be possible to extend the temperature colour bar for negative values and add 2 examples of past low sea level/ low temperatures? [Julia Nabel, Germany]	Rejected. Adding cool periods is beyond the scope of this FAQ.
100525	199	1	199	1	In the text on page 111, line 43, the global temperature for PETM is given as +8°C and sea level as more than 20m higher. The inconsistency has to be clarified. [Peter Lemke, Germany]	Taken into account. Treatment of all climate variables are now consistent with CH2 and CH9.
21179	199	1	199	1	PETM started at ~55.9 Ma. The 55 Ma date is outdated now. (see also in other chapters) [Robert Speijer, Belgium]	Not applicable. The PETM is no longer included.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
21181	199	1	199	1	It's not clear that the sea-level rise during the PETM is relative to the latest Paleocene (an epoch with no or small ice caps) and not to present day. The 15-20 m estimate was proposed for the first time in my paper Speijer & Morsi, 2002 Ostracode turnover and sea-level changes associated with the Paleocene-Eocene thermal maximum. <i>Geology</i> 30, 23-26 <i>Geology</i> , but is currently not being cited in this or in any other chapter. It is not mentioned in Annex II - Paleo either. [Robert Speijer, Belgium]	Not applicable. The PETM is no longer included.
21183	199	1	199	1	CO2 concentration during the PETM is thought to have been in the order of 2000-3000 ppm. 1000 ppm may have been the level during the EECO (Hollis et al. 2019: The DeepMIP contribution to PMIP4: methodologies for selection, compilation and analysis of latest Paleocene and early Eocene climate proxy data, incorporating version 0.1 of the DeepMIP database. <i>Geoscientific Model Development</i> , 12, 3149-3206). Note that various figures and ranges are given for CO2 concentration as well as for the warming in the different chapters. These must be checked for consistency. [Robert Speijer, Belgium]	Not applicable. The PETM is no longer included.
113637	199	1	199	1	I would specify the label "sea level" next to the very first bar, and write "sea level relative to 1850" instead. [Agnieszka Kowalczyk, Poland]	Taken into account. Figure revised for clarity.
3247	199	1	199	5	the figure needs to explain why the PETM was so hot. The same for interglacial period. Otherwise it looks like its cyclical. [Sergio Aquino, Canada]	Not applicable. The PETM is no longer included.
125543	199	1	199	6	FAQ 1.3, Figure 1 is a great figure, but two things should be included to provide additional context: (1) Define what "PETM" stands for over the far left bar [perhaps in the caption text], and (2) somehow reflect how the RATE of change in the latter three bars is far more compressed than in any of the prior bars. It's not just the magnitude of the [CO2] or temperature change. It's how quickly it's happening. [Trigg Talley, United States of America]	Rejected. A comparison of rates is beyond the scope of this FAQ. And the PETM is no longer mentioned.
17161	199	1	199	9	Where does PETM number come from? That's a huge amount of continental ice sheet implied -- contrasted with ch. 2 assessment. Also, a greater focus is placed on EECO in ch. 2 than the PETM. LIG SL assessment is inconsistent with ch. 2/9. Present-day SL assessment is inconsistent with ch. 2/9. 2100 numbers need to be consistent with ch. 4/9. [Robert Kopp, United States of America]	Not applicable. PETM no longer discussed.
96083	199	1	199	9	FAQ 1.3, Figure: In this figure, the present-day warming is 1.2°C. Everywhere else in the report it is lower (e.g. 1.1 as found in Table 2.4). Please revise. Also pre-industrial is defined as a period from 1850 to 1900. Please verify. [Nicole Wilke, Germany]	Taken into account. Treatment of all climate variables are now consistent with CH2 and CH9.
125545	199	3	199	5	Explain "PETM". [Trigg Talley, United States of America]	Not applicable. The PETM is no longer included.
26047	199		199		FAQ 1.3, Figure 1: Explain acronym PETM [Don Alfonso Pino Maeso, Spain]	Not applicable. The PETM is no longer included.
42869	199				I need to see what Ch 2 says, but I don't think 1-2 degrees is an accurate description of the global temperature change in the LIG. There are certainly reputable estimates below 1 degree. [Eric Wolff, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Treatment of all climate variables are now consistent with CH2 and CH9.
83941	199				FAQ 1.3, Figure 1: 2100 future scenarios boxes should be placed one on top of the other (branching from the present day box) instead of side-by-side, following the same rationale used for showing future scenarios in other figures, with the "effective emissions mitigation" scenario placed just under the "little emissions mitigation". It would also be a good idea to use the standard nomenclature to identify the future scenarios applied here, as this is the only place in chapter 1 that uses the terms "little" and "effective" to describe emissions mitigation. [Marco Tulio Cabral, Brazil]	Taken into account. Figure revised for clarity.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
24295	199				The labels are incorrect. The CO2 values are absolute; those of T and sea level are relative. The temperature scale does not cover the plotted range. [Bryan Weare, United States of America]	Taken into account. Treatment of all climate variables are now consistent with CH2 and CH9.
68851	199				FAQ 1.3 Fig. 1. Global temperature, sea level and CO2 are assessed for PETM and LIG in CH2. Let's make sure that our numbers match (Fig. 2.33). For scale bar: specify that temperatures are relative to 1850-1900 reference period. [Darrell Kaufman, United States of America]	Taken into account. Treatment of all climate variables are now consistent with CH2 and CH9.
125549	200	1	200	5	Probably need to start over with this figure. Remote sensing (from many different sensors) now records temperature over land and oceans all over the world with equal precision. No simple map could accurately convey that geographic distribution and density of those points of observation. [Trigg Talley, United States of America]	Not applicable. FAQ1.4 was withdrawn for FGD.
81695	200	1	200	6	This graphic is very interesting. Please make sure that it is colorblind safe. If the colors stay like this, it is difficult to distinguish even for people with normal vision. [Swantje Preuschmann, Germany]	Not applicable. FAQ1.4 was withdrawn for FGD.
38307	200	1	200	6	The East Section of China-India Border is wrongly drawn and the Dotted Line of South China Sea, Nanhai Zhudao, Diaoyu Dao and its affiliated islands of China are missing in FAQ1.4 Figure 1. In order to avoid unnecessary disputes, it is suggested to delete the national boundary lines in the figure. [Yaming LIU, China]	Not applicable. FAQ1.4 was withdrawn for FGD.
3245	200	1	200	6	not sure what the dots and legends are. Should there be a legend for buoys, satellites, ships? [Sergio Aquino, Canada]	Not applicable. FAQ1.4 was withdrawn for FGD.
125547	200	1	200	9	Where is the side list of the measurement techniques? This figure does not make sense without it. [Trigg Talley, United States of America]	Not applicable. FAQ1.4 was withdrawn for FGD.
100527	200	5	200	5	Currently, there are 3959 ARGO drifters in the ocean. They should be shown, too. [Peter Lemke, Germany]	Not applicable. FAQ1.4 was withdrawn for FGD.
24299	200				This is of very limited value. I assume it refers only to surface air temperature. I say nothing of the wealth of recent observations over the oceans. Hopefully, something much more useful will be substituted, [Bryan Weare, United States of America]	Not applicable. FAQ1.4 was withdrawn for FGD.
31469	1-66	31	1-66	33	The following paper is recommended to be added. It is the review paper of the Himawari-8 satellite. Bessho, K, Date, L., Hayashi, M., Ikeda, A., Imai, T, Inoue, H., Kumagai, Y., Miyakawa, T., Murata, H., Ohno, T., Okuyama, A., Oyama, R., Sasaki, Y., Shimazu, Y., Shimoji, K., Sumida, Y., Suzuki, M., Taniguchi, H., Tsuchiya, H., Yoshida, R. (2016). An Introduction to Himawari-8/9— Japan's New-Generation Geostationary Meteorological Satellites. J. Meteorol. Soc. Jpn.. 94. 151-183. 10.2151/jmsj.2016-009. [Maki Kikuchi, Japan]	Accepted. Reference added.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
31471	1-66	31	1-66	33	<p>The major advances in the new geostationary imaging satellites (such as Himawari-8) are in their (1) high temporal resolution (i.e. capability to observe every 10-15 minutes) and (2) increased number of observation wavelengths compared to the conventional geostationary satellites (i.e. improving geophysical property estimates). This enabled improved monitoring of aerosols (Yoshida et al. 2018; Kikuchi et al. 2018) and understanding on deep convective cloud processes (Letu et al. 2019). The additional descriptions on these major improvements and relevant references are recommended.</p> <p>Yoshida, M., Kikuchi, M., Nagao, T. M., Murakami, H., and Higurashi, A., Common retrieval of aerosol properties for imaging satellite sensors, J. Meteor. Soc. Japan, 96B, doi: https://doi.org/10.2151/jmsj.2018-039, 2018.</p> <p>Kikuchi, M., Murakami, H., Suzuki, K., Nagao, T. M., and Higurashi, A., Improved Hourly Estimates of Aerosol Optical Thickness using Spatiotemporal Variability Derived from Himawari-8 Geostationary Satellite, IEEE Trans. Geosci. Remote Sens., 56, doi: 10.1109/TGRS.2018.2800060, 2018</p> <p>Letu, H., Nagao, T. M., Nakajima, T. Y., Riedi, J., Ishimoto, H., Baran, A. J., Shang, H., Sekiguchi, M., Kikuchi, M., Ice Cloud Properties From Himawari-8/AHI Next-Generation Geostationary Satellite: Capability of the AHI to Monitor the DC Cloud Generation Process, IEEE Trans. Geosci. Remote Sens, 57, doi: 10.1109/TGRS.2018.2882803, 2019 [Maki Kikuchi, Japan]</p>	Noted. The section has been reorganized and the Himawari satellite is now cited as an example of retrieving new variables relevant to the biosphere. The proposed references do not fit in this context, it is not possible to add them.
21375	o				I felt overall that there was quite some room for reduction in text length without harm on the assessment being performed. There is quite a lot of repetition of points between sections which gives the reader a degree of déjà vu and these could be identified in redrafting and minimised (I'm afraid I did not keep any kind of log as I went through the chapter). Also, although section introductory texts and structural signposting are nice I'm not sure they are essential or at the end of the day add much value. Quite often text could also be tightened which may also aid readability. [Peter Thorne, Ireland]	Taken into account. The text has been reduced in length where possible.
773	whole				Much of the new literature has not been cited. For example, p 12 lines 35-36 (...in air trapped in ice at Dome Concordia, Antarctica (Lüthi et al., 2008; Bereiter et al., 2015.....). There are many newer publications that deliver recent scientific results, such as: Lucie Bazin, et al.. Phase relationships between orbital forcing and the composition of air trapped in Antarctic ice cores. Climate of the Past, European Geosciences Union (EGU), 2016, 12 (3), pp.729-748; KévinFourteau, et al.. 2019 Multitracer study of gas trapping in an East Antarctic ice core. The Cryosphere, Copernicus In press, 10.5194/tc-2019-89 . hal-02389077 [Baruch Rinkevich, Israel]	Rejected. Detailed references are provided in later chapters.
775	whole				Suggest to cite mainly publications following the 5th report [Baruch Rinkevich, Israel]	Rejected. This chapter needs to give context, and hence have some earlier references too.
70417					Overall this is a well-written chapter, with a lot of good discussion of the historical evolution of our understanding over time, and descriptions of concepts used across the report, and the authors should be commended on a well-written SOD. Given that the chapter is somewhat too long, my main comments below relate to areas where the chapter might be shortened, especially where the discussion overlaps with the assessment of later chapters. As described in more detail in other comments, I would suggest deleting 1.2.1, due to overlap with later chapters, and 1.2.3, since I'm not clear its within the approved scope of this chapter. [Gillett Nathan, Canada]	Rejected. The final contents of the chapter are consistent with our scoping, which goes somewhat beyond previous Chapter 1s in that it asks us to frame the physical science information relevant for mitigation, adaptation and risk assessment. The context into which we deliver our assessment, and the way it is communicated, were considered to be relevant for this point.

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70419					Although the use of calibrated language is introduced and described in this chapter in Box 1.1, Chapter 1 makes little use of calibrated language in most of the chapter text, and much of the chapter is written more as a review than as an assessment. In much of the chapter, this is appropriate, for example when describing the evolution of climate research over time. However, for some key policy-relevant issues, for which I think Chapter 1 provides the only assessment, more careful assessment of the literature and use of calibrated language, including a traceable account of how the confidence/likelihood assessments were arrived, is needed. For example, I think the main place in the report which assesses the future emissions scenario most consistent with the NDCs is Box 1.3, Table 1, which in the column for SSP4-3.4 notes 'Scenario approximately in line with aggregate NDCs'. No references are cited to support this, nor is there any assessment of confidence in this finding, or quantification of what 'approximately' means in this context. Similarly, the discussion of abrupt change in 1.4.5 contains some of the most extensive discussion on this topic in report, but does not include calibrated confidence language. [Gillett Nathan, Canada]	Taken into account. Rigorous assessment has been included in several places, although not for the scenario discussions as this will be undertaken by WG3. We have instead highlighted that we use what is available in the literature, without considering feasibility. Some statements have also been removed.
23831					Chapter 1 now seems somewhat better, and perhaps marginally shorter. It would make more impact, if it were shorter... [Branko Grisogono, Croatia]	Noted. Thanks.
115735					When describing progress in climate science (history), and major developments and their implications, please check carefully the relative attention given to observations, models, theory, and process based understanding. I have the impression that the focus is more on the tools (observation capacities, reanalyses, types of models) than on the processes. For section 1.5, it could be good to work on how these developments affect the current assessment. In terms of observations for instance, progress has been made on reprocessing of past observations, leading to revisit the current level of warming, which is an important aspect. Progress for instance can be in characterizing processes not yet represented in climate models, and it would be good to highlight that (as done in chapter 2 of SRCCCL) and the potential implications (confidence in projections). Also, the discussion of model tuning to observed trends and implications may deserve to be expanded. [Valerie Masson-Delmotte, France]	Taken into account. Thanks, we have brought these considerations with us in preparing the final version. Not everything could be included, but see e.g. the new figure 1.6.
23833					Glacier mass balance and more is refined now satisfactory. [Branko Grisogono, Croatia]	Noted. Thanks.
23835					The comment remains as before, it perhaps can be extended to the whole Report, that Figures, Tables, etc. are far away from places where discussed. That troubles the reading and following the Report. [Branko Grisogono, Croatia]	Accepted. Editorial, will be changed for the final report.
115747					A matter of cross WG coordination is on reference to the possible effects of COVID19 compared to pre existing scenarios. [Valerie Masson-Delmotte, France]	Noted. This will be considered for the SYR.
70467					References to other chapters should be to particular sections, not to the whole chapter. In order to follow a reference to the whole chapter, the reader may have to read the entire chapter to find the relevant material. For example, see pg 12, ln 42-43, pg 13, ln 53. [Gillett Nathan, Canada]	Accepted. Text revised throughout.
66637					I think it's problematic to highlight human rights here. It makes us sound like we really are just boosters for the UN, and I don't think that's a good look at all. I don't see what it adds to a WGI report. You could cut this sentence and just state the next, which is factual. [Dave Frame, New Zealand]	Taken into account. The reference is kept, but the relevance has been expanded on and more literature added.

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66639					There is real value in this section in the discussion of type I and type II errors, though I would probably change the bit about the precautionary principle to something more about precautionary approaches. (People who disagree that the PP makes any sense (some argue it is either hollow or paralysing) can still favour precautionary approaches across a range of actions, without endorsing a specific principle.) [Dave Frame, New Zealand]	Accepted. Text revised.
89947					The chapter has undergone a remarkable transformation since the FOD and now serves as an effective point of departure for the entire WGI AR6 -- thank you very much! [Jochem Marotzke, Germany]	Noted - with thanks!
89949					The only major comment I still have is not one of structure but of implementation. The historical scientific context in 1.3 is valuable because it reminds the reader that, counter to widespread public perception, our assessment of anthropogenic climate change is based on many lines of evidence, many of which have been developed over a long time and most of which are empirical/observational. But section 1.3 is somewhat uneven in how effectively and how accurately it connects to present or recent (as in AR5) knowledge. Inaccuracy: There are a number of factual errors, which I will point out below; more fact-checking is needed than I can provide quickly. Unevenness example: The account of abrupt AMOC changes lists 1988 as the latest reference; on other topics such as past temperatures, the connection to the present is made. At the very least, the inaccuracies must be eliminated. [Jochem Marotzke, Germany]	Taken into account. Some references have been updated. Factual errors have been corrected wherever required.
130409					Congratulations for the excellent effort in doing this Chapter. [Rubén Piacentini, Argentina]	Noted - with thanks!
9069					I congratulate the authors on a thoroughly readable, well researched, and helpful introduction to AR6. I have reviewed the previous two drafts; this one represents a clear improvement. My other comments are generally minor in nature. [Olaf Morgenstern, New Zealand]	Noted - with thanks!
125551					[SCOPE] The structure of Chapter 1 is just terrible to follow. The Talanoa dialog (Where are we? How did we get here?) works well for problem solving but it does not work well as structure for a highly influential scientific document that is supposed to present the physical science basis for understanding climate change. The outline approved by the IPCC Bureau does not appear to have had much influence over the structure and content of this chapter. Here is the IPCC's approved outline for Chapter 1 (please adhere to it): Framing, context, methodsExecutive Summary; synthesis of key findings from AR5 and earlier assessment reports, and connections to AR6 Special Reports; framing of the physical science information relevant for mitigation, adaptation, and risk assessment in the context of the Global Stocktake; assessment approach; observational and reanalysis developments since the AR5; model and experimental design developments since the AR5; emissions and forcing scenarios; treatment and evaluation of uncertainty throughout the report; and Frequently Asked Questions. [Trigg Talley, United States of America]	Noted. The Talanoa Dialogue questions may resemble some of our section headers, but that was never our intent, nor did we say so. I do not see that we have deviated substantially from the approved outline, except that the chapter does not follow the outline order exactly.
125553					The chapter is too long and repeats (preempts) a more thorough presentation of key findings and supporting documentation in the other chapters. Very little of Chapter 1 was brought into the SPM. Not a single figure was picked up. The material that was brought in to the SPM from Chapter 1 mainly relates to communicating uncertainty, the evidence base, and scenarios, which was in the approved outline. The SPM and Technical Summary are intended to contain the highlights of the other chapters, not Chapter 1. [Trigg Talley, United States of America]	Noted. That the introduction is not elevated to the SPM is natural. Also, Chapter 1 serves as the introduction to the report, and thus should naturally pre-empt some of the overarching messages, in addition to the synthesis in the TS and SPM which are separate documents.

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125555					There is no temperature "target" stated in the Paris Agreement. Please reformulate to match the actual agreement text or describe as temperature goals to be consistent with the framing from other chapters. [Trigg Talley, United States of America]	Accepted. Text revised.
125557					[SCOPE] The chapter is too long. Over 100 pages for "framing and context" is unnecessary. There are several sections that are out of scope for a WGI report focused on the Physical Science and should, therefore, be deleted. These include 1.2.2 (policy and governance); Cross-Chapter Box 1.1 (global stocktake); 1.2.2.1 (risk and solution framing); 1.2.3 (science and society); 1.2.3.1 (communications and uncertainty); 1.2.3.2 (values in science); and 1.2.3.3 (media messaging). [Trigg Talley, United States of America]	Rejected. This Chapter 1 has been deliberately changed in format relative to earlier Assessment Reports, to also focus on the broader context of a Physical Science assessment. The key point made in the sections referenced in the comment is that even physical science information and assessment is made in a context, and should be mindful of its own messaging. While observations and modelling can be said to be context-free and objective, the questions asked of the IPCC are not, and fulfilling our mandate requires consideration also of the external context into which our assessments will be delivered. Hence, while the clear majority of WG1 presents and assesses pure physical science evidence, we consider it in scope (and in line with the approved outline) to discuss also the topics covered in sections 1.2.2, 1.2.3 and parts of Chapter 10.
125559					Authors need to take greater care when talking about "CO2." In many places, it's stated without context when what is meant is "atmospheric CO2 concentrations". [Trigg Talley, United States of America]	Accepted. Text revised.
125561					The history lessons scattered throughout the chapter are not really needed for something that is supposed to serve as an introduction. [Trigg Talley, United States of America]	Rejected. The title of the chapter is "Framing, context and methods", and the scoping goes beyond serving as an introduction. One of the LAs is a merited historian, selected precisely to give this type of context to the report and subsequent assessments.
125563					The chapter refers to GMST, global mean surface air temperature, global temperature, surface temperature, and other metrics. It would be helpful to provide definitions and ensure consistent use of metrics. [Trigg Talley, United States of America]	Accepted. The terminology has been harmonized.
69757					This framing chapter is 200 pages long. Many of its sections are very important. Could they be handled more succinctly? Or should this chapter be renamed to truly convey what it truly encompasses? [Gyami Shrestha, United States of America]	Noted. A re-naming was considered, but not found to be possible since it is determined by the scoping.
29309					Dear colleagues, my most sincere congratulations because the AR6 report is truly an exceptional work! However, I have not found any issues on the Pandemic COVID-19 which shocked the World. I am sure that most of the other expert reviewers have noticed this shortcoming, certainly due to the fact that the report was concluded and prepared before the pandemic started. For this reason, the COVID-19 pandemic is truly a "surprise", which must be included among the "surprises" (See chapter 1 pag. 57) and in the risk perspectives (See chapter 1-page 22). We are in fact experiencing a strong anthropogenic effect, which represents both a negative forcing for the earth system and a further important confirmation of the validity of the hypotheses of the "human influence" on Earth system (See chapter 3). In fact, never as in this pandemic worldwide crisis have we demonstrated the correctness of the assumption regarding the anthropogenic effects on Earth system. [Zangari del Balzo Gianluigi, Italy]	Accepted. COVID-19 is discussed in several places in the final report.

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125565					In the spirit of reducing length of the WGI AR6 and Chapter 1 in particular, Figures 1.12, 1.16, 1.21, 1.25, and 1.28 could be cut without detracting from overall messaging. [Trigg Talley, United States of America]	Rejected. All suggestions for deletion were considered by the authors, but the figures are considered relevant for the material presented in Chapter 1.
639					I really like the structure of this chapter, and it is illustrated very clearly and concisely in Figure 1. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Noted - with thanks!
70535					This is an incorrect summary of the SROCC assessment, and is in disagreement with other parts of this report. The exact sentence in SROCC SPM is 'Feedbacks from the loss of summer sea ice and spring snow cover on land have contributed to amplified warming in the Arctic (high confidence) where surface air temperature likely increased by more than double the global average over the last two decades.' Whereas here the authors are reporting that the SROCC directly attributed a doubling of the rate of Arctic warming to feedbacks from loss of summer sea ice and spring snow cover, at the likely level. The SROCC only concludes that these feedbacks contributed to this warming, and they don't make a quantified assessment of probability (they assess high confidence). Moreover, although surface albedo feedbacks are one contributor to polar amplification, there are others e.g. see section 4.5.1.1: 'A variety of mechanisms contribute to Arctic amplification (see Chapter 7 Section 7.6.2). While surface albedo feedbacks associated with the loss of sea ice and snow have long been known play important roles (Arrhenius, 1896; Manabe and Stouffer, 1980; Robock, 1983; Hall, 2004), it is now recognized that temperature (lapse-rate and Planck) feedbacks also contribute substantially to Arctic amplification with longwave radiative damping to space with warming being less efficient at high latitudes (Winton, 2006; Pithan and Mauritsen, 2014; Goosse et al., 2018)'. Revise to be consistent with the SROCC statement and ch7. [Gillett Nathan, Canada]	Accepted. Revised as suggested.
112527					this is an important chapter for the report and I commend the authors in producing an excellent SOD. I found the naming of sections 1.2 and 1.3 somewhat colloquial: where we are now and how we got here. Given the importance of what is being discussed in these two sections I suggest the use of stronger naming. Section 1.2 could be called: Climate science and policy. Section 1.3 could be called: a brief history of climate science. Your current section 1.2 includes a lot of important issues: recent changes in the physical climate system, policy context, risk and solution framing, etc. given the importance of these topics please consider elevating these issues to the section 1.X level. [Suraje Dessai, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Thanks. The suggestions were considered, but alternatives had other issues. In the end we stuck close to the SOD section naming.
8595					Throughout the term 'sea level' is used to refer to 'global-mean sea level.' Clarify. [Robert Kopp, United States of America]	Accepted. Revised as suggested.
70557					I recommend reserving the word 'traditional' for use in the concept of 'traditional knowledge'. By my count there are 11 uses of traditional/traditionally in the chapter excluding references, five of which are used in 'traditional knowledge' and the rest not. Some readers will read 'traditional methods' and think of indigenous practises. [Gillett Nathan, Canada]	Taken into account. There are now only two instances of this word, although they do not occur in the context suggested here. It is a valid point, but we do not agree that "traditional knowledge" is the only clear usage for the word "traditional".

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115869					FAQ1.1 check what "in the last century" means here (1920-2020?). The 4th paragraph does not say that aerosols have an overall, short lasting cooling effects, amplified by clouds. The whole description of understanding should also refer to "re processing of data" (eg updated level of warming) + understanding processes (eg processes that amplify the effect of greenhouse gases, albedo, water vapour, clouds). [Valerie Masson-Delmotte, France]	Accepted. Phrase "in the last century" no longer appears. 4th paragraph now reads: "Data also show that major volcanic eruptions have sometimes cooled the entire planet for relatively short periods of time (typically several years) by erupting aerosols (tiny airborne particles) high into the atmosphere," and 5th paragraph adds "The main human causes of climate change are the heat-absorbing greenhouse gases created by fossil fuel combustion, deforestation, and agriculture, which warm the planet, and aerosols such as sulphate from burning coal, which have a short-term cooling effect that partially counteracts human-caused warming." Re-processing of data is described in the 2nd paragraph. Third paragraph begins "Understanding of climate system processes has also improved" and provides examples, albeit not the ones you mention.
115871					FAQ1.2, please be explicit that sea ice changes refers to Arctic sea ice, not Antarctic sea ice (preamble). Note contrasted regional Antarctic sea ice trends but no overall trend. The figure caption needs to provide traceability to source data (what about using x obs datasets and show the uncertainty range?). [Valerie Masson-Delmotte, France]	Taken into account.
115873					FAQ1.3, I think that the text needs work to reflect that the future cannot be extrapolated from the past, but there are insights on : how current or projected changes are unusual in a long term context; role of components of the climate system and insight on feedbacks from a range of natural experiences on the climate system (response to plate tectonics, orbital, solar, volcanic forcing) and on response time scales also from natural variability (eg past abrupt change); use of paleo evidence to test models outside of the range for which they are developed and tuned. This could stress the lack of analogue (also because ecosystems are different now than millions of years ago) and because of changes in human societies (this could include contributors from WGII). Note, avoid duplication of the term "rich" (twice). It would even be better to explain recent insights (improved knowledge of recent regional variations, improved description of past abrupt changes). PMIP could be highlighted (what climate models can do is important for confidence in projections at least on equilibrium responses).The figure of FAQ1.3 needs special consideration and needs to include contributors from all related chapters, and report uncertainty ranges + be explicit on causes for different climate states. Wording related to mitigation needs to be consistent with other parts of the WGI report (replace "effective" / "little" by adequate, careful wording). [Valerie Masson-Delmotte, France]	Taken into account. Text and figure revised.
115875					FAQ1.4, not sure about how the analogy with watches will work with a non specialist reader (to test) (I usually use the analogy with your own family scale and the doctor's scale (different absolute weight but capture correctly amplitudes of changes compared to a reference period). "close to the poles" could be replaced by "in remote regions" (deserts, high mountains). The problem about sea temperature and air temperature can also be explained about the reduced area of sea ice. The last paragraph could be reformulated. I would suggest to explain why it matters (to build on chapter 2 x chapter box). [Valerie Masson-Delmotte, France]	Not applicable. FAQ1.4 was withdrawn for FGD.

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105145					There are several papers pointing out a rapid recovery of ice in certain areas as well as a strong ice change correlation with ocean oscillations. It is therefore a bit far fetched to connect the "rapid" melting (is it? compared to what?). Particularly not for the time periods observed. Oscillations usually have an overturning time period of +/- 30 years. To conclude something being "rapid" derived from a relatively short time period is not serious science imo. One may conclude that IF the rate continues it will be a major concern. But, as records show, the presented relatively high value is not representative for the current state of knowledge. https://twitter.com/JustinWeather/status/1227421257148305408 [Jan Lindstrom, Sweden]	Rejected. Rapid refers to the overall, global change here, and the absolute changes over the time period of observations. For details, see Chapters 2 and 9.
112827					Great chapter, really clearly written, good start of the report [Maarten van Aalst, Netherlands]	Noted - with thanks!
5311					methane' and 'CH4' are used interchangeably throughout chapter, suggest using CH4 after defining on first appearance [Sheel Bansal, United States of America]	Rejected. The point is good, but common usage differs between scenarios, historical literature etc.
112067					AR6 is making a great effort towards reproducibility and FAIR practises using open-source tools and frameworks (such as ESMValTool or the climate4R framework used in the Atlas). In Ch1 this is only mentioned in 1.5.4.4 very partially. It would be good to introduce and provide proper context for this in Ch1, maybe as an additional subsection in 1.5, and maybe also link to the Interactive Atlas as a new online IPCC product building on these principles to ensure transparency and reproducibility. We have a subsection on this in the Atlas (Atlas.7.3) but we could move part of the material to Ch1 to provide appropriate context. TG-Data/TSU could contribute to this by enrolling some contributing author. [jose manuel gutierrez, Spain]	Noted. FAIR is now mentioned in section 1.2.3.2 and Interactive Atlas in 1.1.1
64715					General: The chapter gets into conclusions, this is not the objective of the framing chapter. Suggest to focus more on the framing and less in extracting conclusions or judgements. [Sanz Sanchez Maria Jose, Spain]	Noted. We have aimed for a different type of Chapter 1 than in previous reports, and provide some (brief) overarching introduction for the reader also of the coming assessments from later chapters.
64719					General, summary ex: A figure or diagram indicating structure and differences with the 5AR (new additions, ect) will be welcomed in the Ex Sum [Sanz Sanchez Maria Jose, Spain]	Accepted. See Figure 1.2.
115665					I suggest to consider land use (pressure on land) as an additional cross cutting theme. It builds on SRCL and is also relevant for cross-WG integration (having in mind issues related to food security and preservation of ecosystems and biodiversity). [Valerie Masson-Delmotte, France]	Accepted.
115669					Figures of chapter 1 need specific attention. Many (most) of them do not show uncertainty ranges, and sometimes rely on a single data source (one observational dataset, results from one model) while multiple lines of evidence are used in other chapters. Each figure with reference to "global temperature" must be clear on what is shown (GMST, GSAT). [Valerie Masson-Delmotte, France]	Accepted. All figures have been revised for the final report.
115671					Please check carefully each statement in the executive summary. Is it a statement of fact? If not, please provide confidence levels. [Valerie Masson-Delmotte, France]	Accepted. The ES has been revised accordingly.
64727					The chapter is too long for a framing chapter. Is easy to be lost in the text. It should do much shorter go to the points of structure for subsequent chapters flow to be understood. Some of the history details and context should be moved to boxes or annexes. [Sanz Sanchez Maria Jose, Spain]	Rejected. We have deliberately aimed for a broader introduction and context/framing for the report, and provide material that goes beyond just introducing what comes in later chapters.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
115679					Please check carefully the use of the word "plausible" and its meaning, for instance related to the description of a range of scenarios, including very low or very high emission scenarios (for which there could be "conditions for plausibility" and "implausibility"). [Valerie Masson-Delmotte, France]	Noted. The wording has been checked, and only retained where warranted.
115687					Some parts of chapter 1 have a "textbook" style and are formulated without use of the confidence language. This is for instance the case for section 1.2.1.1. For instance, it provides an attribution of the "Little Ice Age" ("primarily driven by volcanic eruptions") while the AR5 had a more cautious statement. This needs careful consideration across chapters related to the attribution of the role of volcanic forcing. Additional new literature since AR5 on this topic exists but is not assessed in an exhaustive way (a few references are provided to support the statement, rather than an assessment of the state of understanding). [Valerie Masson-Delmotte, France]	Taken into account. References have been added throughout, to where the rigorous assessment can be found.
115943					Congratulations for the maturation of WGI draft, and for providing overarching framing to the WGI report on many aspects. Some parts of the chapter could still be reduced in length (altogether, by around 10% of the current length), and some figures be re-considered, having the full picture from all chapters (for instance, coordination is needed with ch 2 on paleo aspects to avoid duplication). [Valerie Masson-Delmotte, France]	Taken into account. The final chapter is reduced in length, and has seen extensive coordination activity with other chapters.
116711					Several chapters refer to the notion of "analogue" for past periods, which can be problematic. It could be worth for ch 1 to consider having a description of relevant insights from past periods, and limits to these insights (or to analogies) due to eg different forcing? [Valerie Masson-Delmotte, France]	Rejected. This relevant suggestion was considered, but in the end we found no good place for it in Chapter 1.
116213					Cross chapter coordination on the issue of model evaluation, "model bias", "model error" and "bias correction" is needed. They are multiple occurrences throughout many chapters, especially ch 3 and ch 10. This could be considered in the list of cross cutting themes. [Valerie Masson-Delmotte, France]	Noted. Some coordination was done on this, but material was not added to Chapter 1 beyond what we already had.
2041					As part of framing and methods, this chapter could also note a short discussion around climate paleorecords due to modern high-resolution core scanning including hyperspectral core scanners (using remote sensing techniques) and also XRF core scanning, providing high temporal resolution records that otherwise cannot be reconstructed earlier than by monitoring datasets that are limited to more recent decades. In this context it could be noted that varves (in lakes and fjords) allow to reconstruct climate changes in unprecedented detail, which has even led to the term "paleoweather" reconstructions due to the resolution of interannual climate variability. References to the work of Prof Grosjean and his team at the University of Bern would be very useful in this context. [Sebastian Naeher, New Zealand]	Rejected. It is a good point, but we were unable to go into this level of detail in section 1.5.
52221					Apologies if I have missed this but I can't see discussion of the impact of spin-up strategies on model performance (eg, Seferian et al., 2016, GMD). [Helene Hewitt, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. A sentence and the reference have been added at the end of section 1.5.3.1 (earth system models).
15871					According to the Covid-19 outbreak, I suggest to add to this report, a section about the feedback experience concerning the reduction of GHG emissions during the lockdown period. This will represent a quantitative example of the potential impact of the limitation of our activities on GHG emissions and, thus, on climate change dynamics [Emmanuel Garbolino, France]	Accepted. See Chapter 6, CC-Box 6.1.