Comment ID	From Page	From Line	To Page	To Line	Comment	Response
28742	0	0	0	0	Wow [Piers Piers Forster, United Kingdom (of Great Britain and Northern Ireland)]	Noted. We take this as a compliment.
28744	0	0	0	0	There is a lot of great material here but it currently comes across as somewhat disjointed and unbalanced. [Piers Piers Forster, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The structure of the Chapter was revised
24436	0	0	0	0	This Chapter is very well written,very comprehensive and contain the fundamental aspects of its title. [Rubén D Piacentini, Argentina]	Noted. Thanks for your positive comment!
48014	0	0	0	0	Scoping Outline Check: All bullets in the approved outline are covered. Please note the history of science section is not mandated by the bullets and the sections on scenarios in part is more WG3 material. [WGI TSU, France]	The history section has been shortened. The part of scenarios that belong to WG3 has been removed.
32406	0	0	0	0	Suggest box with depiction and description of Earth energy budget and anthro perturbations. I provide text and figure caption here. For formatted suggestion and image see https://www.bnl.gov/envsci/schwartz/more/EarthEnergyBudget.pdf A representation of Earth's radiation budget is given in Figure B1, which shows global and annual mean values of the fluxes that constitute transfer of energy into and out of the climate system from space and between the major compartments that comprise the climate system. It should be stressed that these fluxes are averages of quantities that vary greatly as a function of space and time. As indicated in the figure some of these fluxes are determined directly by measurement; the others are inferred based on measurement together with modeling and the constraint that the preindustrial budget be balanced, i.e., total flux into and out of each compartment is zero. The energy budget at the top of the atmosphere is balanced within the uncertainty of satellite measurements, the imbalance, consisting mainly of the rate of increase of ocean heat content, being less than the measurement uncertainty. Earth's climate system is driven almost entirely by uptake of solar radiation, the increment from non-radiative sources (natural radioactivity, geological collapse; anthropogenic energy production) being negligible. The difference between the emitted longwave flux at the Earth's surface, 385 W m-2, corresponding to global means surface temperature 287 K (14 ˚C) and that at the top of the atmosphere, 239 W m-2, is a consequence of, and a measure of, Earth's natural greenhouse effect. Also indicated as boxed quantities in the figure are changes in fluxes over the Anthropocene due mainly to changes in atmospheric composition: increased absorption and emission of longwave radiation by increased amounts of greenhouse gases and increased reflection of solar radiation due to increases in atmospheric aerosols. As these changes in the radiation budget and the associated increase in global mean surface temperature are small perturbations on the natural budget. For example the incremental	This description and discussion belong to Chapter 7 which has a similar figure (7.3).
27048	0	0	0	0	the treatment of scenarios in the chapter is quite difficult to read and understand. (i) it is scattered between many subsections (1.5.4, 1.6.1, 1.6.2, 1.6.3, 1.6.4, 1.6.5 and Box 1.6); (ii) the definitions are given at the end (box 1.6), it would help to have them before (otherwise when the text refers to RCP, SSP, SPA etc it is not understandable); (iii) it is not always clear what type of scenarios are refered to (emissions scenarios, concentration scenarios, climate scenarios, socioeconomic scenarios...), would need to be specified to avoid confusion; (iv) there seem to be repetition and overlap between some different sections (eg the discussion on the dimensions of integration along temperature levels and cumulative CO2 emissions in 1.6.1, and 1.6.3 - 1.6.4), it would be worth considering merging the elements, or differentiating more clearly the content. [Céline Guivarch, France]	Taken into account. The scenario section SOD 1.6 has been substantially revised and streamlined SOD 1.6.1, Box 1.3, and Cross-Chapter Box 1.5 now include all the scenario-related information in one sub-section.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
48040	0	0	0	0	Please be careful to not include statements that can be interpreted as policy perscriptive or value based in the assessment. IPCC reports should be policy relevant but not policy perscriptive. [WGI TSU, France]	We take this as a general advice and reminder.
28860	0	0	0	0	FAQ 1.1 - good FAQ 1.2 - I think better to merge with human induced climate change - as more pertinent to what public would ask FAQ 1.3 - I like this one FAQ.14 - I would like to see this as a chapter box more - either in chapter 1 or 2 [Piers Piers Forster, United Kingdom (of Great Britain and Northern Ireland)]	Noted. We have decided to keep the four FAQs after careful consideration.
35194	0		0		This Chapter strays from the approved outline in several potentially problematic ways. For example, the outline does not ask for an overview of the history of climate understanding, which I find it to be of limited usefulness. Also, section 1.2.1 provides an overly simplistic summary of the entire assessment that undermines the in-depth information to follow in this report (and others). It is imposible to convey the nuances of these key statements in five pages. Many of them are inaccurate or hard to follow. Further, this was not requested in the outline. Section 1.2.2, not called for in the outline, makes the statement that this IPCC cycle is prepared in the context of the post-2015 UN agenda (I am not aware the IPCC supports this distinction) and implies that the IPCC has taken a substantially different approach. It has not - this is a value judgement by the author of the statement. Further, while it is appropriate to highlight the Paris Agreement and SDGs, other UN endeavors are cherry-picked and problematic. Sendai? The UN Conference on Housing and Sustainable Development? The GFCS? These are a subset of the many, many endeavors that could be included. Suggest deleting this entire subsection, recognizing that the important contextual info on Parisis contained in the Cross-chapter box. [Ko Barrett, United States of America]	Noted. Thanks for the comment. On the one hand, it is clear that Chapter 1 should mainly serve the report and the scoped structure. On the other hand, we have also been given the freedom to provide assessment where necessary for topics that are not covered elsewhere, or where requested by the other chapters - and even to provide synthesizing messages (as done in introductory chapters in the special reports). We hope that the Second Order Draft makes clearer what choices were made, and why.
53282	0				The chapter contains many figures that are already good or that shows great potential. I hope the authors will continue the efforts to develop these further. Their integrative function - using elements from other chapters, as well as fundamental aspects of the climate change issue - will be very useful for outreach and will help us to produce some very useful figures for the TS and SPM. [Jan Fuglestvedt, Norway]	Noted. Thanks. Figures have been further advanced in the SOD preparations. New, compelling figures have been added; some less compelling figures were dropped.
53072	0				I find this chapter very promising, novel and "refreshing". It sets the scene nicely and places our IPCC work in a bigger picture. I encourage the authors to follow this direction towards SOD and the FGD. The chapter needs some further improvements in terms of style and levels of details. And some shortening may be needed for some sections. (Consider using Annexes if needed.) [Jan Fuglestvedt, Norway]	Noted. Thanks for the constructive suggestions which were followed in the revision!
53074	0				Chapter 1 in the FOD contains some perspectives, concepts and topics that are unusual to have in the first chapter of WGI. Given the new structure of AR6 compared to AR5, I think we need some new approaches (like this) regarding content and structure. In addition, the strong integration across SRs that we have seen in AR6, and the ambition for closer contact across WGs, requires this type of chapter1. [Jan Fuglestvedt, Norway]	Noted. Thanks. We have further strengthened cross-Chapter and cross-WG links in the Chapter 1 SOD.
44884	0				I very much enjoyed reading CH1 FOD! It covers a variety of interesting topics that span the breadth of climate science. It includes a tremendous range of essential background information for understanding the WG1 report. Overall, it's an excellent preface to the report. While I read most of the text, and learned a lot from it, my comments focus on my expertise in paleo limatology. [Darrell Kaufman, United States of America]	Thanks very much!

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
53848	0				Given the role for Ch1 in terms of framing and explaining concepts, I think giving some more attention to GMST vs GSAT could be considered. A figure showing the differences in developments over time for the different definitions and data sets for GSAT and GMST would be very useful for communication of this issue. This could fit in FAQ 1.4, but this could also be taken care of by a separate Box - which then could form the basis for the presentation and uses in the following chapters. [Jan Fuglestvedt, Norway]	This comment has been considered during the preparation of the FGD. (In FGD) Taken into account. CCBox2.3 tackles these issues, with a reference forward from Chapter 1.
54618	0				With all due respect to the authors, I think this chapter is way too long. I would suggest to delete some full sections and probably some others can be replace by figures, maybe? [Ruth Cerezo, Mexico]	Taken into account. We have substantially re-structured and re-focused the chapter. Some figures have been dropped.
28516	0				Integraration of climate smart landscape management and climate smart agriculture has potential for increasing adaptation, mitigate climate change and improve crop production and income for farmers [Wycliffe Tumwesigye, Uganda]	we agree. But the comment is not applicable for this chapter.
43114	0				Overall it looks like a really good start to the report - I have some concerrns about proximity to UN documents, processes, and goals, but most of the material is in really good shape for FOD stage. [David Frame, New Zealand]	Thanks very much!
50794	0				In general the current format of Chapter 1 works very well as a starting point for the assessment report. In your executive summary it could also be useful to refer to other chapters within the report for ease of reference, or make a reference early in the executive summary that highlights section1.8 that presents a good overview of important themes covered by the assessment report. [Ole-Kristian Kvissel, Norway]	Yes, an item describing the main themes covered by this assessment is added.
50804	0				The difference between and associated implications of choosing either Global Mean surface temperatures or Global Mean Surface Air Temperatures as basis for the assessment report will be very difficult to understand especially for policymakers. Also the potential implication of the fact that some policymakers may interpret this as if difference between current temperature levels and the temperature goals that they have agreed and discussed extensively are changing due to choice of methods from everyother IPCC report should be very well thought trough. [Ole-Kristian Kvissel, Norway]	Thanks for the reminder.
25978	0				The SSP and SSP scenario concept and usage are very difficult for a reader to understand. For example, a pathway is refered to as a pathway for concetration or emissions in cc box 1.6, but a SSP is neither. It is not clear if the SSP scenarios exclude pre-SSP scenarios? Suggest testing the description of SSPs in this chapter with lay-readers to see if it can be interpreted correctly. [Haroon Kheshgi, United States of America]	Taken into account. The scenario section SOD 1.6 has been substantially revised to ensure readability and accessibility of the concepts underlying the scenarios used in the report. See also Cross-Chapter Box 1.5 for definitions.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
53884	0				This FOD of chapter 1 contains a lot of very useful information for introducing the subsequent chapters of the WG I report. I commend the authors on their efforts. However, it is currently much, much too long. I suspect that areas of duplication with various chapters will be identified and can allow whole sections to be removed from this chapter. Moreover, the chapter contains some sections on historical background that are better placed in a review journal or text book, but are simply untenable as contributions here. There are some sections that treat issues no longer treated explicitly in other chapters (e.g. model emulators), so these are justifiably treated here, though again, some consideration is needed for cutting down the length of the descriptions (one option is to make more use of Annex III for tabulating and listing these models too). I'm not sure what the page target is for this first chapter, but it really needs to be concise and only contain essential background for understanding how to interpret the content and context of subsequent chapters. Cutting this down to an appropriate size will be a significant challenge for the authors. I wish them well in their next round of revison. [Timothy Carter, Finland]	Taken into account. We have substantially re-structured and re-focused the chapter, in particular the "history" part. Duplication with other chapters has been reduced. Topics not covered in other parts of the WGI AR6 report were dropped. The chapter, however, still fulfils its mandate as defined by governments in the scoping process.
53886	0				Some figures are very poorly defined and illegible, so difficult to comment on, which is a pity, because these are fundamental to many issues of communication in the report and have been a weakness of previous reports. They need to be worked on (and commented on!) at an early stage, so that refinements can be made well ahead of the final government review and Plenary, where final selection of "iconic" figures´for the SPM takes place. Some figures I see here look very promising, if only I could read all of the detail! There are too many figures, and some thought is needed on which figures save words, which figures may be better placed in other chapters, which figures are mere indulgences (i.e. non-essential) and which figures might ultimately end up in the Synthesis report. [Timothy Carter, Finland]	Noted.This problem regarding the quality of the figures occurred during the compilation of the FOD, to keep the size of the chapter file to an acceptable level. The actual figures have a better resolution. We have seriously been considering all figures for readability and accessibility and dropped some.
51842	0				Just an overall comment that the chapter as a whole is looking good. It feels like it suffers from too many x-chapter boxes and in particular some of the tables of these feel too long and specific. It feels like less is more applies to those x-chapter box tables. [Peter Thorne, Ireland]	taken into account. some boxes have been removed and the presentation of tables has been improved.
56204	0				Overall nice chapter! However, I am missing an overview of the overall report in this chapter, eg. An illustration showing how the different chapters are related (e.g. global chapters, process chapters, regional chapters). [Sonia Seneviratne, Switzerland]	Done. SOD Figure 1.29.
35216	0				Section 1.2.1: Please reconsider the rationale for this entire section. It is not helpful to try to provide a cursory summary of all assessment findings in a few pages. [Ko Barrett, United States of America]	We thank the reviewer, but believe that the section is warranted and serves as a good introduction to the material of Chapter 1 and indeed the entire WG1 report.
45718	0				ANNEX 1 OBSERVATIONS - This is a bit of a mess as regards the greenhouse gases. The NOAA greenhouse gas data are not properly cited and instead referred to chaotically - for example MLO CO2 but not all the other stations as far as I could see, nor the CH4 stations - and CH4 d13C attributed to INSTAAR who do it under contract to NOAA so they are correctly NOAA's property. Maybe refer to NOAA Global Greenhouse Gas Reference Network - NOAA Earth System Research Laboratory, Global Monitoring Division ... https://www.esrl.noaa.gov/gmd/ [Euan Nisbet, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Annex 1 has been revised.

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52388	0				The overall tone and level of language in this chapter is excellent and readily understandable for even policy makers with little scientific expertise, especially in the Executive Summary -- strong kudos to the author team! [Pam Pearson, Sweden]	Noted with thanks!
43686	0				Overall, the chapter captures the essence of the full AR6 report, however I see four major issues - 1) it is too long (over 100 pages while the page limit is 60) and 2) some sections read more like a review paper rather than an assessment; especially section 1.3 on the historical evolution of knowledge of climate change, 3) the role of SLCFs, especially the role of aerosols, in influencing climate change is not amply highlighted, and 4) I do not understand the need for the section on wider perceptions of climate change and climate science in this chapter of WGI1 that is focused on providing the scientific basis for climate science. I provide more specific comments below to address these problems. [Vaishali Naik, United States of America]	1) The revised chapter is shorter. 2) Section 1.3 is deigned to be a historical account of evolution of knowledge of climate change. 3) The role of SLCFs, especially the role of aerosols are to be dealt with in Chapter X. and 4) This chapter is set to provide a wider context for the hole report.
35256	0				Tables 1.1-1.7: Pages and pages of tables don't seem to be the best presentation tool for these various collections of progressive understanding. Please consider deleting some and other graphical presentations.for those preserved. [Ko Barrett, United States of America]	The tables have been shortened.
26320	0				This is a very substantive introduction to the WGI AR6 and povides valuable service to the later chapters on many cross-cutting issues. [Jochem Marotzke, Germany]	Noted. Thanks for your positive comment!
26322	0				I struggled quite a bit with the structure and logical flow of the early part of the chapter draft. All seems fine from Section 1.3.4 onward. But the earlier (sub-)sections sometimes had me wonder about their specific purpose at this specific place. The international governance context (1.2.2) must be provided, including the role for the stocktake, but 1.2.1 seems to compete with 1.3.4 as the point of departure for the physical climate science itself. And here, 1.3.4 seems the superior choice, as witnessed by the fact that 1.2.1.1 cannot yet make concrete statements and would compete with the CH2 ES or the TS anyway. Sections 1.2.3 and 1.3.1--1.3.3 also had me wonder where the chapter was heading. I think a clearer definition of governance context and point of departure would benefit the chapter greatly. [Jochem Marotzke, Germany]	Noted. The chapter has been restructured.
26324	0				"Early-industrial" for the period 1850-1900 has not been agreed across WGI, and I don't think the term should be adopted. I understand that introducing it would serve the fundamental communication principle that the same term (here, per-industrial) should always mean the same thing. But this principle here competes with another one, which states that the intended audience's expectation must be taken into account. And all warming levels will be expected to be relative to pre-industrial, not early-industrial. I fear that introducing "early-industrial" will lead to more confusion than the SR1.5 approach of using the 1850-1900 temperature as a proxy for pre-industrial temperature and after that relates all warming levels above pre-industrial to the period 1850-1900. Chapter 4 will follow this SR1.5 approach. [Jochem Marotzke, Germany]	Taken into account; Much discussion of this topic. Text revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
38392	0				I enjoyed reading this chapter, and find that the authors have done a great job in describing the framing, context and methods for this report. I find, however, that the chapter lacks discussion of our recent progress in understanding to which degree insights inferred from climate models are robust (or rather: often are not robust), and some of the issues that arise when trying to establish fitness for purpose of our climate-research tools. For simplicity, I quote from a paper that we have under review on this topic for BAMS (I'll send the draft to Hui-Wen Lai): „In recent years, there has been a growing, albeit still comparably small, number of papers at the interface of philosophy and climate science to examine how such adequacy of our climate models can be established (e.g. Parker 2011; Notz 2015; Knutti 2018; Winsberg 2018). There is largely agreement that adequacy, or fitness-for-purpose, can usually not be inferred from the agreement of climate models with each other (Parker 2011; Winsberg 2018), nor generically from the agreement of climate models with observational records (Notz 2015; Knutti 2018). Most importantly for our topic, there is agreement that adequacy can not be inferred from the complexity of a given model (e.g. Shackley et al. 1998; Petersen 2000; Held 2005; Stevens and Brenguier 2009; Siebesma et al. 2009; Jeevanjee et al. 2017; Knutti 2018).“ I find that these aspects should be covered, for example in section 1.4.3 and 1.4.4, as they challenge the robustness of the wide-spread use of climate-model results in parts of AR6. This should of course be coordinated with chapter 3 that carries out the actual evaluation. I'd be happy to talk about these issues in Toulouse, if you feel that this could be helpful. [Dirk Notz, Germany]	Accepted. Section 1.4 is section 1.5 in the second order draft. A subsection 1.5.4.8 "model fitness for purpose" has been added.
53244	0				The chapter pesents and discusses several topics that are used extensively across chapters. It is therefore very important that the authors continue their efforts to connect to the other chapter teams and make the links (both ways) visible in the text; and ensure consistency. [Jan Fuglestvedt, Norway]	Noted. We agree, ensuring consistency was a priority in the SOD preparations.
45376	1	1	6	49	Very little of this opening discussion frames distinctions from past reports' approaches, aside from regons and general "science" improvements like tools, models, etc., However, as we have struggled to adhere to the new chapter structure of the report in writing, this too should be reflected. Global stocktake also probably deserves a bigger highlight given that it was a request from outside of the IPCC. This framing doesn't arrive until pg 21, by my count. [Baylor Fox-Kemper, United States of America]	Taken into account. We have discussed the order of the ES statements for the second order draft, and attempted to balance between presenting what the report is (which changes little between AR cycles) and how it is now framed and scoped (which is new in AR6). Global stocktake is now mentioned earlier in the chapter (under section 1.2, page 9).
28538	1	1	42	2	Climate change enhance the intensity, frequence and duration of storms, huricans and cyclones [Wycliffe Tumwesigye, Uganda]	Noted; unclear what part of the chapter this comment is referring to. messed up page/line numbers by reviewer

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
36698	1	1	184	20	Considering the main body of the report, final decisions and judgements are based on the document and available data. It is not clear how the final decisions and judgements are made. Are they based on scientific decision making method(s) or just simple descriptive statistics methods? It is necessary to illustrate the method(s) that the decision makers and experts use to make final decision. This could definitely help to increase the transparency of final judgements and decisions. If the scientific decision making methods could be illustrated, one may verify and track final decisions, suggest new ways of decision making or criticize. [Pakdaman Morteza, Iran]	A discussion on traceability and transparency in the IPCC process has been added in Box 1.1 (Treatment of uncertainty and calibrated uncertainty language used in IPCC reports) .
28524	1	2	6	3	Collaboration of the three working groups will broaden underatstanding of climate system and measures to addess associated challenges at all levels [Wycliffe Tumwesigye, Uganda]	Noted; unclear what part of the chapter this comment is referring to.
39786	1	3	1	7	These 2 sentences seem to be 'the summary of summaries' of the IPCC AR6 report. The following information should be included in the overall summary of AR6 WG1 and then also in the overall summary of AR6: The “international process” began about 50 years ago (UNEP 1972, etc.); 27 years ago the UNFCCC Treaty with 197 Parties was adopted with the Objective to "stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system” (hold global warming to well below 2°C, 1.5°C). The result of 50 years of the “international process” - including IPCC Assessment Reports - is that: (1) there has been NO stabilization of atmospheric greenhouse gas concentrations, there has only been de-stabilization with records broken every year (WMO); the cause of climate change (W/m2) has more than doubled, and no stabilization is intended for at least the next 11 years (NDCs); [Michael Wadleigh, United States of America]	Revised as follows: "The WGI contribution to the AR6 assesses scientific information on climate change relevant for a world whose climate system is rapidly changing. 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.” 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 above pre-industrial levels.” As part of these efforts, each country was required to submit a Nationally Determined Contribution (NDC) indicating its planned emission reductions, but the NDCs offered so far are insufficient to achieve the Paris goals (high confidence). {1.1, 1.2}"

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
39788	1	3	1	13	(2) natural resource extractions - including climate changing fossil fuels, biomass, minerals and metals - has nearly quadrupled. Resource extraction and climate change are the key scientific measures of humanity's destruction of nature from which humans, all products and life are made. Astonishingly, the scientific evidence is that the next 35 years of resource extractions and fossil fuel emissions will equal the last 300,000 years, the time of our H. sapiens species – 7 trillion tonnes, and it won't stop there. On closed mass Earth the likely, imminent result will be social-economic collapse. To stop collapse requires 197 Parties (nations) negotiating an "Agreement". AR6 concludes that "rapid emission cuts are required" but (1) the global "emission cuts" AR6 provides are basically irrelevant for negotiations, national emissions of the "197 Parties" and the "cuts" by responsibility and equal rights are required for an "Agreement" for "well below 2°C…1.5°C", and the AR6 should provide such information; [Michael Wadleigh, United States of America]	Revised as follows: "The WGI contribution to the AR6 assesses scientific information on climate change relevant for a world whose climate system is rapidly changing. 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." 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 above pre-industrial levels." As part of these efforts, each country was required to submit a Nationally Determined Contribution (NDC) indicating its planned emission reductions, but the NDCs offered so far are insufficient to achieve the Paris goals (high confidence). {1.1, 1.2}"

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
39790	1	3	1	13	(2) for general understanding, in addition to stating 'future cuts' like “by 2030”, 11 years from now, “around 2050”, 31 years from now, “around 2070”, 51 years from now, AR6 should also prominently feature immediate cuts - cuts now, per year, increasing with inaction; (3) Include the “carbon budget” for “well below 2°C”, what is was in 1992, the beginning of UNFCCC, what is was in 2015 (the Paris agreement) and what is likely will be in 2022. (4) Include that the scientific evidence of 50 years is that voluntary action - including that of UNFCCC “Agreements” - has not and will not likely ever succeed, laws are required, for nations and the “international process” for “well below 2°C…1.5°C”. [Michael Wadleigh, United States of America]	This is a great comment, but far beyond what we can include in an Executive Summary statement, especially because it essentially refers to the entire report, not just Ch 1. In future comments, please include references. Revised as follows: "The WGI contribution to the AR6 assesses scientific information on climate change relevant for a world whose climate system is rapidly changing. 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.” 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 above pre-industrial levels.” As part of these efforts, each country was required to submit a Nationally Determined Contribution (NDC) indicating its planned emission reductions, but the NDCs offered so far are insufficient to achieve the Paris goals (high confidence). {1.1, 1.2}"

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
47476	1	3	1	13	Because this is the pre-eminent key to the framing of the report, add 'The objective of the UNFCCC is to stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerouse anthropogenic interference with the climate system.' before 'The Paris agreement ..." It is also important for the framing of the report to notice here that for the 30 years of IPCC reports, greenhousegas emissions are ever increasing and concentrations have not been stabilized. [Birgit van Munster, United Kingdom (of Great Britain and Northern Ireland)]	Thank you for this comment. Revised as follows: "The WGI contribution to the AR6 assesses scientific information on climate change relevant for a world whose climate system is rapidly changing. 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.” 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 above pre-industrial levels.” As part of these efforts, each country was required to submit a Nationally Determined Contribution (NDC) indicating its planned emission reductions, but the NDCs offered so far are insufficient to achieve the Paris goals (high confidence). {1.1, 1.2}"
28534	1	3	36	4	Indigenous knowledge has been integrated with scientific knowledge in climate change migration in agriculture landscapes (Sereenonchai & Arunrat, 2018) and in water management best practices (FAO, 2017) [Wycliffe Tumwesigye, Uganda]	No specific modification of the text is proposed, so no action was taken. The indicated references are about forward-looking climate change mitigation, rather than use of indigenous knowledge for understanding and assessing climate change. Please convey them to WG2 and WG3.
28526	1	4	8	5	Additionally, snow cover on mount Rwenzori in Uganda and mount Kilimanjaro in Kenya has decreases in the recent century to agreat extent due to increased temperature in the region [Wycliffe Tumwesigye, Uganda]	This suggestion is too specific to include.
28546	1	6	126	7	Melting of Antarctic and Greenland ice sheets will result into substancial increase in sea level rise. This will negatively affect aquatic organisms like polar bears that use ice as their habitat and severe flooding will affect the infrustrcture for communities in the negbourhood [Wycliffe Tumwesigye, Uganda]	Noted. But we are not sure what part of the chapter this comment is referring to. In case , this chapter and indeed this WG report is focused on physical climate changes. Impacts of climate like the specific example are not supposed to be covered here.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
28556	1	9	99	10	iv) improved startegies in conservation of natural resources and biodiversity [Wycliffe Tumwesigye, Uganda]	This section has been shortened, and no longer includes a list of potential improvements in the state of climate knowledge given improvements in observations. Some of this discussion is now picked up in Chapters 2, 3, 8, 9. Also see Section 1.5.1 where this is included.
28522	1	13	6	14	98% of research scientists globally agree that climate change is caused majory by anthropogenic activties [Wycliffe Tumwesigye, Uganda]	Noted; unclear what part of the chapter this comment is referring to.
28532	1	13	21	14	Whatsup, Instagram and Facebook platforms need to be utilized in addressing Climate change related issues [Wycliffe Tumwesigye, Uganda]	Social media are discussed in Section 1.2.3.3.
28548	1	16	114	17	Downscaling of GCMs and validating them gives us results closer to the real local situation hence higher confidence in trusting their output [Wycliffe Tumwesigye, Uganda]	Noted. But we are not sure what part of the chapter this comment is referring to.
28520	1	19	5	20	natural climate forcing causes lkie big volcanic eruptions, Solar energy changes and variations in Earth's Orbit contribute toglobal climate change but to a less extent, [Wycliffe Tumwesigye, Uganda]	Natural climate forcings are covered in Section 1.3.
28540	1	23	45	24	Availability of free satellite images from landsat to study land use and croping systems are helpful [Wycliffe Tumwesigye, Uganda]	Noted; Land and biosphere sections have been significantly expanded in the SOD.
28544	1	23	52	24	Incomplete sentence beginning in the……complete this [Wycliffe Tumwesigye, Uganda]	Noted; unclear what part of the chapter this comment is referring to. May be mix-up with line numbers.
28554	1	26	98	27	Appropriate policies and laws need to be enacted and strogly implemented to protect ecosystems and natural resources [Wycliffe Tumwesigye, Uganda]	The mandate of IPCC WGI is to provide guidance on the physical climate system, rather than being policy prescriptive. This is also more relevant to WGII.
28536	1	27	36	28	Land use change affects soil organic carbon across agroecological landscapes (Tumwesigye et al., 2015) [Wycliffe Tumwesigye, Uganda]	No specific action proposed for a 36-page range of text, so no action was taken.
28530	1	30	20	31	Climate change impact, adapation and mitigation need to be introduced into the curricula for primary and secondary schools across the globe to provide relevant knowledge to learners at a lower levels for better understanding and appropriate future action and policy formulation [Wycliffe Tumwesigye, Uganda]	Suggestion is more appropriate for Working Group 2.
28550	1	35	76	36	agriculture and transport and increased use of fossil fuels [Wycliffe Tumwesigye, Uganda]	Rejected; Unclear where in the text this refers to
28552	1	35	84	36	is to is to repeatetion [Wycliffe Tumwesigye, Uganda]	Not Applicable. Unclear what part of the chapter this comment is referring to. messed up page/line numbers by reviewer
28528	1	36	11	37	climate change and biodiversity are interlinked and affect each other either directly or indirectly [Wycliffe Tumwesigye, Uganda]	Section 1.2.1 mentions mass extinction of species.
28542	1	46	45	47	NDVI analysis has helped in assessment of vegetation structure and climate risks in landacape (Atampugre et al., 2019; Belay et al., 2014) [Wycliffe Tumwesigye, Uganda]	Noted; Land and biosphere sections have been significantly expanded in the SOD.
29658	1		2		In index for a clearer and faster reading, it is advisable to insert after index a list of all the acronyms used in the chapter (including those present in figures and tables) [luisa Sturiale, Italy]	Noted. We will include a list of acronyms in the final version of this Chapter
41294	1		184		A well structured and useful chapter but too long [Debra Roberts, South Africa]	Taken into account.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
27068	2	15	2	34	The first letter of the sub-titles had better be in consistent with the other sub-titles. For example, Climate Models --> Climate models, Earth System Models --> Earth system models, etc. [Nyein Chan NIL, Myanmar]	Noted. It was taken into consideration during preparation of SOD.
6265	2	19	2	19	General: (1.3.3.) Energy is one of the main climate change driver. Energy balance and energy consumption pattern is also needed to be considered, in local, national and global levels (Jafari, M. and Smith, P., (2018). Climate Change as a Driving Force on Urban Energy Consumption Patterns. In Encyclopedia of Information Science and Technology (4th ed., pp. 7815-7830). IGI Global. https://doi.org/10.4018/978-1-5225-2255-3.ch680) [Mostafa Jafari, Iran]	Section 1.6 of Ch 1 discusses scenarios involving different large-scale energy consumption patterns. Energy consumption per se is mainly assessed in WG2 and WG3.
47478	2	22	2	26	It is important in this statement to compare the maginitude of a vulcanic eruption with the magnitude of anthropogenic emissions [Birgit van Munster, United Kingdom (of Great Britain and Northern Ireland)]	Unclear what reviewer is reading - p. 2 is the table of contents
47480	2	28	2	35	This sentence is not clear: Two additional ‘dimensions of integration’ are global mean temperature levels as well as a categorization of emission scenarios or geophysical impacts in relation to their cumulative carbon emissions. Which are the dimensions and why is it 'emission scenario or geophysical impact'? [Birgit van Munster, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Text revised accordingly
47482	2	37	39		A better understanding of climate processes and phenomena, as well as decision makers motives and rationale regarding climate policies leads to better informed risk assessment … [Birgit van Munster, United Kingdom (of Great Britain and Northern Ireland)]	WG1 is not assessing decisionmakers' motives and rationales.
27070	3	37	3	37	Figures had better be mentioned as List of Figures [Nyein Chan NIL, Myanmar]	Rejected. List of Figures is not considered in the report format
29612	3		4		The executive summary is quite clear and reports all the elements covered in chapter 1. [luisa Sturiale, Italy]	Noted. Thanks very much!

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
15188	4	1	4	5	I'm sure this is an oversight, but this first sentence reads very awkwardly, it is not clear what it is meant, and…it does not make the chapter start with the best foot. [Claudia Tebaldi, United States of America]	Revised as follows: "The WGI contribution to the AR6 assesses scientific information on climate change relevant for a world whose climate system is rapidly changing. 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.” 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 above pre-industrial levels.” As part of these efforts, each country was required to submit a Nationally Determined Contribution (NDC) indicating its planned emission reductions, but the NDCs offered so far are insufficient to achieve the Paris goals (high confidence). {1.1, 1.2}"

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
27158	4	1	4	12	The reference to a political agenda is confusing and suggests the question: does the AR6 report is scientific as it is supposed to be, or is it driven by a political agenda? [François GERVAIS, France]	Revised as follows: "The WGI contribution to the AR6 assesses scientific information on climate change relevant for a world whose climate system is rapidly changing. 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.” 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 above pre-industrial levels.” As part of these efforts, each country was required to submit a Nationally Determined Contribution (NDC) indicating its planned emission reductions, but the NDCs offered so far are insufficient to achieve the Paris goals (high confidence). {1.1, 1.2}"
55470	4	1	4	55	Excellent executive summary of the chapter. Covers all the main points and very easy to read and understand. Very detailed but not too extensive overview of all other reports and frameworks including the risk and reasons for concern. [Daniela Schmidt, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Thanks very much!
41296	4	1	5	39	A couple of the ES statements do not have confidence statements [Debra Roberts, South Africa]	Noted. Not all underlying findings in Chapter 1 need to have confidence assigned. This is because the actual assessment follows in the later chapters.
53086	4	1	5	39	The ES starts with pointing to the changing context; in terms of physical changes and international processes addressing these. I think this is a useful opening that should be kept. It would also strengthen the report if all the following chapters follow up this more systemtaically. And it would be good and useful for development of TS and SPM if all chapters have a statement in the ES that follows up this point. [Jan Fuglestvedt, Norway]	Thanks - noted.
57286	4	1	5	39	Chapter 1 is excellent and provides a very useful framing for the report. My only criticism is that it is both long and doesn't do everything it should, notably provide clear definitions of things like "global warming" in a single place for the rest of the report to use. This seems inconsistent of me, but I think there is plenty of scope for editing without loss of content. [Myles Allen, United Kingdom (of Great Britain and Northern Ireland)]	Thanks. More and fuller definitions of key concepts have been introduced throughout Ch 1. Note that there is a Glossary of key terms.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
57288	4	1	5	39	Chapter 1 is an ideal place for a summary of key concepts required in this report, along the lines of the box we had in SR1.5. That box could itself serve as a useful starting point, revisiting any definitions that may have been less than ideal in their final wording, but bearing in mind it is approved text, so could save a lot of time. [Myles Allen, United Kingdom (of Great Britain and Northern Ireland)]	More and fuller definitions of key concepts have been introduced throughout Ch 1. Note that there is a Glossary of key terms.
13616	4	1	5	40	The Executive summary makes no mention of the global stocktake, which features in the chapter and would seem to be worth mentioning in the Exec Sum. [Stephen Humphreys, United Kingdom (of Great Britain and Northern Ireland)]	We added this as a separate bullet point: "The AR6 provides information of potential relevance to the 2023 Global Stocktake, a 5-yearly evaluation of alignment between overall global climate mitigation and adaptation efforts, and the Paris Agreement's long-term goals and it's means of implementation and support. 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}"
28746	4	1	5	40	I missed the tracebility of the ES. I think a brief synthesis paragraph at the end of each subsection would improve this. [Piers Piers Forster, United Kingdom (of Great Britain and Northern Ireland)]	Length considerations preclude adding summary paragraphs, but we have indicated the relevant subsection(s) for each bullet in the ES. In addition, the whole report is producing a traceback table for each point.
28748	4	1	5	40	Only one bullet has a confidence statement, I'm not sure if needed. [Piers Piers Forster, United Kingdom (of Great Britain and Northern Ireland)]	Confidence statements have been integrated where appropriate, but this is a framing chapter so we have left fuller assessments to the other chapters. Those include confidence assessments.
28750	4	1	5	40	I think you are a hostage to fortune that your risk framing will be used everywhere. Other WGs may want more autonomy? Bullet on historic trends seems to overstretch the mark and better in Chapter 2/SPM? I would like to see the bullet on observtion gaps reworded to less sound like a ask for more resource as this is traditionally an IPCC no-no. I think the same point can be made indirectly. Last bullet is somewhat obvious so possibly delete, but I generally like the ES. I sort of missed a clear point about where we were at the time of AR5, this could be cleaer in Chapter sections as well [Piers Piers Forster, United Kingdom (of Great Britain and Northern Ireland)]	This comment addresses the entire Exec Summary. Most of these points have been addressed in the SOD ES. Discussions of cross-WG risk framing are ongoing in a cross-WG discussion group.
47994	4	1	5	40	Exec Summary format: ES has not been divided up into subsections and does not include a summarising paragrah explaining the purpose of the chapter (see SR1.5 for guidance). [WGI TSU, France]	Accepted. Those elements were included in SOD

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
28464	4	1	101	55	I really enjoyed reading this Chapter. As a point of departure, I think it does an excellent job. There are a few minor typoes here and there, but I won't pick them out, as I'm sure they'll get polishied in the next round. My only other major comment is that it is a pity that so many of the figures were of such low resolution that I could not really follow them in any detail. Again, I am sure that this will be improved by the SOD. [David Schoeman, Australia]	Editorial. Thanks very much! The resolution of figures in SOD has been improved.
57246	4	1	106	41	Since terms like "policymaker/-making", "leaders" or "decisionmaker/-making" is used regularly in the report, it might be good to define these in the glossary, maybe even in chapter 1. It would be good to know for readers what processes the authors are referring to when talking about these groups. These are quite ambiguous terms, and even in the social sciences there is no uniform use. Those who define terms like 'policymaker' tend towards a more restrictive use (see, for example, Cairney, The Politics of Evidence-Based Policymaking, Palgrave 2016) [Oliver Geden, Germany]	Rejected. We don't see the need to define these terms.
50698	4	3	4	3	I suggest to include "(AR6)" in "The IPCC 6th Assessment Report assessing information...", because AR6 it is used later in the same page but it has not been previously defined. [Hernan Edgardo Sala, Argentina]	Accepted. This was included in the introductory paragraph of the Executive Summary.
31506	4	3	4	3	"assessing" should be "assesses" or "is assessing" ? [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Text was revised.
56178	4	3	4	3	"is" is missing before "assessing" [Sonia Seneviratne, Switzerland]	Rejected. Sentence was reworded differently.
6523	4	3	4	3	"The IPCC 6th Assesment Report IS assessing...." [Tim Christiane Thys, Belgium]	Taken into account. Text was revised.
6525	4	3	4	3	replace "knowlegde needs" by "understanding" [Tim Christiane Thys, Belgium]	Taken into account. Sentence was reworded.
9360	4	3	4	3	Suggested wording: The IPCC 6th Assessment Report provides information .... [Klaus Radunsky Radunsky, Austria]	Rejected. Sentence was reworded differently.
39438	4	3	4	5	The world is also rapidly changing in terms of vulnerability and exposure of natural and human systems. Some human systems are increasing their vulnerability for non-climatic reasons [Carolina Vera, Argentina]	Vulnerability and exposure are treated by WG2 and WG3. We mention these but cannot discuss in depth in Chapter 1.
55064	4	3	4	5	Please don't open the whole chapter with a grammatically flawed sentence [Trude Storelvmo, Norway]	Taken into account. First sentence revised to improve clarity
28466	4	3	4	5	The first headline statement could be written more clearly. As it stands, I had to read it several times to understand what was meant. [David Schoeman, Australia]	Taken into account. Text was revised.
45370	4	3	4	5	This first executive summary statement is not a sentence. I believe "assesses" should replace "assessing". Overall, could just be made into a simpler sentence. [Baylor Fox-Kemper, United States of America]	Accepted. First sentence revised to improve clarity
42820	4	3	4	5	The sentence could be deleted and the paragraph begin with the next sentence as the thesis of the paragraph. [Michael Evans, United States of America]	Rejected. The proposed change is rejected. We revised the first sentence to improve clarity.
49396	4	3	4	5	This item (in bold, beginning "The IPCC 6th Assessment Report") does not make sense. [Sonya Legg, United States of America]	Accepted. First sentence revised to improve clarity
39436	4	3	4	12	Although I kind of like to start with a statement that introduces the AR6 challenges, notice that the AR6 has started already with the 3 special reports. [Carolina Vera, Argentina]	Special reports are now mentioned in first bullet.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
32580	4	3	4	13	For the IPCC, the key underlying agreement is the UN Framework Convention on Climate Change and its objective of preventing "dangerous anthropogenic interference with the climate system" and doing so ensuring ecosystems can adapt, agriculture can provide sufficient food and a sustainable economy can prosper (rough recollection--see the objective). This is why IPCC was formed. While the Paris Accord set its temperature goals and these have gotten much attention, it is not at all clear that they satisfy the UNFCCC Objective--indeed, I'd suggest that they are not really close to adequate, especially in terms of the commitment to future sea level rise that a long-term rise of 1.5 to 2 C would lead to given the equilibrium sea level sensitivity to global temperature change is likely of order 20 METERS per degree C based on paleoclimatic analyses. It thus seems to me that the key role of AR6 is to evaluate whether the Paris goals meet the UNFCCC objective. Thus, I would urge that this first paragraph be redone focusing on what is the internationally agreed to objective in the agreement that underpins Paris. It is imperative in my view that the authoritative scientific community (so IPCC) do a very credible and critical evaluation of whether the Paris goals will meet the UNFCCC objective--and the negotiating community needs to be clearly informed that just doing Paris will result in very serious impacts and is not an end point that come close to meeting the quite sensible objective in the UNFCCC. [Michael MacCracken, United States of America]	Revised as follows: "The WGI contribution to the AR6 assesses scientific information on climate change relevant for a world whose climate system is rapidly changing. 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.” 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 above pre-industrial levels.” As part of these efforts, each country was required to submit a Nationally Determined Contribution (NDC) indicating its planned emission reductions, but the NDCs offered so far are insufficient to achieve the Paris goals (high confidence). {1.1, 1.2}"
27504	4	3	4	13	It would be important to mention at this high level that it's not just the physical system changing and the policy response to that but also solcial systems effecting vulnerability and exposure are shifting very rapidly & then say that WG1 is focussing on the physical response. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	We added a separate bullet on risk framing. Comment is more relevant to the discussion of risk within the chapter, not the ES; this is too much detail for an ES statement.
53888	4	3	4	13	I would focus only on the international processes that provide the context for this report. The final sentence refers to the risk framework adopted across the AR6 - this is a different issue and merits its own bullet point along with some explanation of what this framework entails. Note also that the grammar of the emboldened wording can be improved. [Timothy Carter, Finland]	First bullet revised. Separate risk framework bullet added.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
27506	4	3	5	39	There are a few things missing which are important for the framing not mentioned here but given their relevance should be part of the high level summary: 1) Vulnerability and exposure and the concept of risk and application of the framework need to be mentioned and what that means for our current understanding. 2) locally damages from anthropogenic climate change manifest in changing likelihoods and intensities of extreme weather and climate related events + sea-level rise hence the big focus in chapter 11&12, 3) tipping points and what we know and crucially do not know about them would be important to mention here as well. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	This comment has been considered during the preparation of the FGD. (In FGD) Taken into account. Several subsections and an XC Box now address the risk framework. Exec Summary point now reads: "The AR6 has adopted a unified definition of climate risk. This risk framework is supported by an increased focus in WGI on low-likelihood, high-impact eventualities. Systematic risk framing is intended to aid formulation of effective responses to the challenges posed by current climatic changes, and to better inform risk assessment and decision making. The storylines approach contributes to building a robust and comprehensive picture of climate information, allowing a more flexible consideration of risk, and can explicitly address low-likelihood, high-impact events. {1.2.2, 1.2.4, 1.4.4, Cross-Chapter Box 1.3}"

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
42994	4	3		13	The first Exec Sum point doesn't scan well. Also, the focus on rapidly changing international processes seems a surprisingly political (and contestable) way to start. A suggested alternative is: "The IPCC 6th Assessment Report assesses information relevant for world that is rapidly changing, in terms of the physical climate system and the social systems in which human life takes place." (I've also tried to simplify the English and make more use of active verbs.) [David Frame, New Zealand]	Revised as follows: "The WGI contribution to the AR6 assesses scientific information on climate change relevant for a world whose climate system is rapidly changing. 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.” 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 above pre-industrial levels.” As part of these efforts, each country was required to submit a Nationally Determined Contribution (NDC) indicating its planned emission reductions, but the NDCs offered so far are insufficient to achieve the Paris goals (high confidence). {1.1, 1.2}"
6527	4	4	4	4	replace "international processes" by "global policies" [Tim Christiane Thys, Belgium]	UN agreements are not policies in the ordinary sense
6529	4	5	4	5	replace "set" by "sets" [Tim Christiane Thys, Belgium]	Editorial. Sentence was reworded.
9362	4	5	4	5	Suggested wording: The Paris Agreement has set a long-term goal .. [Klaus Radunsky Radunsky, Austria]	Editorial. Sentence was reworded.
32582	4	5	4	8	From my discussion with the lead US negotiator at Paris, while the specific numbers were included, there was no consideration or agreement on the temporal aspects--specifically about whether the temperatures were to be short-term peaks followed by a return to a lower value (that might be more likely to meet the underlying UNFCCC objective) versus be values that would persist indefinitely into the future as was the focus of the IPCC 1.5 C report. It seems to me that this is another aspect of what negotiators have agreed to that merits scientific review and assessment as the scientific community was not really party to what was agreed to (its results sort of being interpreted to achieve a political outcome). So, I think this paragraph (and the IPCC assessment need to be critically evaluating the goal set in the Paris Accord. [Michael MacCracken, United States of America]	Thanks for this important comment. We did not succeed in fully addressing it during this round of drafting, but the scenarios described in Section 1.6 include one which might come in below the 1.5°C target. We will revisit this comment in the next round of drafting. (In FGD) Noted. The temporal aspects of the Paris goals did not become a significant aspect of Chapter 1.
42996	4	5		5	The Paris Agreement's article 2 uses the word "aim" rather than "goal" (though goal is used elsewhere in the PA). I would choose aim, since the language is then more faithful to Paris. [David Frame, New Zealand]	Rejected. Text was revised and "goal" remained.
6531	4	6	4	6	replace "hold" by "keep" [Tim Christiane Thys, Belgium]	Editorial. Sentence was reworded

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
32586	4	6	4	12	While the Paris Accord did focus on changes in global average temperature, it would seem to me incumbent on the report to make clear in the very first paragraph that the variabiles being affected are far more than temperature, so affecting water resources, sea level, extreme weather, flooding and drought events, subtropical expansion and aridification, ocean acidification and on and on. These other agreements relate to a far wider range of conditions than just temperature, and so there is a real need in this paragraph to make clear the breadth and range of the changes to the Earth system being affected. This would be far easier to do if the focus were the UNFCCC objective rather than the Paris temperature goals. [Michael MacCracken, United States of America]	This comment has been considered during the preparation of the FGD. (In FGD) Taken into account. First paragraph of Executive Summary now reads: "The WGI contribution to the IPCC Sixth Assessment report (AR6) assesses physical science evidence regarding climate change relevant for a world whose climate system is rapidly changing, with a clear human influence. The five IPCC assessment cycles since 1990 have comprehensively and consistently laid out the vast evidence of a changing climate system, with the Fourth Assessment Report (AR4, 2007) first concluding that warming of the climate system is unequivocal. Sustained changes have been documented in all major elements of the climate system, including the atmosphere, cryosphere, biosphere and oceans. Multiple independent lines of evidence indicate the unusual nature of the present rate and scale of global changes, even in a multi-millennial context, and that they represent a multi-century commitment to worldwide loss of ice, sea level rise, and other changes to the climate
10006	4	9	4	9	international programmes are named correctly except one, i.e. Sustainable Development Goals ought to be replaced by the official title: Transforming our world: the 2030 Agenda for Sustainable Development [Tibor Farago, Hungary]	Noted. The paragraph was modified and that part of the text is no longer included.
6533	4	9	4	9	replace "international processes" by "global policies" [Tim Christiane Thys, Belgium]	UN agreements are not policies in the ordinary sense - not enforceable except at national level.
15348	4	10	4	10	The correct name is "Global Framework for Climate Services" https://public.wmo.int/en/resources/bulletin/global-framework-climate-services [Oksana Lipka, Russian Federation]	Noted. The paragraph was modified and that part of the text is no longer included.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
53078	4	11	4	12	I wonder if this formulation "forms a key framing" could be perceived as a bit too strong. The authors may consider writing "…are reflected in the framing…" [Jan Fuglestvedt, Norway]	Revised as follows: "The WGI contribution to the AR6 assesses scientific information on climate change relevant for a world whose climate system is rapidly changing. 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.” 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 above pre-industrial levels.” As part of these efforts, each country was required to submit a Nationally Determined Contribution (NDC) indicating its planned emission reductions, but the NDCs offered so far are insufficient to achieve the Paris goals (high confidence). {1.1, 1.2}"
10008	4	12	4	12	Addition is proposed: The first global stocktake of the Paris Agreement will take place in 2023 and in relation to that critical stage of the international climate policy cooperation, the AR6 will provide a key source of science-based information for the Parties to the UNFCCC and the Paris Agreement. (explanation: the Paris A. is a legal instrument for the implementation of the Convention similarly to the Kyoto Protocol, and reference to the Convention would be essential for another reason, namely, it is unclear whether all Parties to the UNFCCC will be Parties to the Paris A. in 2023) [Tibor Farago, Hungary]	New bullet says: "The AR6 provides information of potential relevance to the 2023 Global Stocktake, a 5-yearly evaluation of alignment between overall global climate mitigation and adaptation efforts, and the Paris Agreement’s long-term goals and it’s means of implementation and support. 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}."

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
46178	4	12	4	12	From a WG III perspective, I would be cautious about asserting a common risk framework. We have worked to a common definition, but this encompasses multiple applications of a high-level risk concept. This applies especially to financial risks associated with response options. [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	We did not succeed in changing the ES wording for the SOD, but the discussion of the risk framework in sections 1.2 and 1.4 reflects the following, which we plan to introduce into the ES in the next round of drafting: "The risk framework adopted by Working Group 1 of AR6 focuses on assessing physical hazards, providing input to the vulnerability and exposure assessments of Working Groups 2 and 3."
55288	4	12	4	12	There is a single short reference to a risk framework adopted in the report - perhaps a slight elaboration would be useful at this early point [Wesley Fraser, United Kingdom (of Great Britain and Northern Ireland)]	New bullet says: "The AR6 adopts a consistent risk framework across all three working groups. This is supported by an increased use of climate change storylines in WGI to address low-likelihood, high-impact events. Systematic risk framing is intended to aid formulation of effective responses to the challenges posed by current climatic changes, and to better inform risk assessment and decision making. The storylines approach contributes to building a robust and comprehensive picture of climate information, allowing a more flexible consideration of risk, and can explicitly address low-likelihood, high-impact events. {1.2.2, 1.2.4, 1.4.4, Cross Chapter Box 1.3}." In the next round of drafting, we plan to change the first sentence of that bullet to: ""The risk framework adopted by Working Group 1 of AR6 focuses on assessing physical hazards, providing input to the vulnerability and exposure assessments of Working Groups 2 and 3.""
53080	4	12	4	13	The last sentence in this para could say a bit more in order to function better. [Jan Fuglestvedt, Norway]	Revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
42998	4	12		13	"A consistent risk framework is adopted across the 6th Assessment Report." I'd hold this back until you're sure it's true. We found it hard enough to get our cross-WG act together on uncertainty - claiming we have a cross-WG approach to risk sorted and ready to go seems to me quite a big promise. You could frame the language a bit more aspirationally here - sort of a "towards a consistent risk framework" type of thing. [David Frame, New Zealand]	New bullet says: "The AR6 adopts a consistent risk framework across all three working groups. This is supported by an increased use of climate change storylines in WGI to address low-likelihood, high-impact events. Systematic risk framing is intended to aid formulation of effective responses to the challenges posed by current climatic changes, and to better inform risk assessment and decision making. The storylines approach contributes to building a robust and comprehensive picture of climate information, allowing a more flexible consideration of risk, and can explicitly address low-likelihood, high-impact events. {1.2.2, 1.2.4, 1.4.4, Cross Chapter Box 1.3}." In the next round of drafting, we plan to change the first sentence of that bullet to: ""The risk framework adopted by Working Group 1 of AR6 focuses on assessing physical hazards, providing input to the vulnerability and exposure assessments of Working Groups 2 and 3." This way of putting it is already reflected in the body text of the chapter.
47474	4	15	4	15	In 2007 the 4th Assessment Report also concluded that warming is unequivocal. Should be restated to demonstrate that we have known this for a very long time. [Pauline Midgley, Germany]	Revised to read: "This report builds on the AR5 assessment that human influence on the climate system is clear. In 2018, the IPCC Special Report on Global Warming of 1.5°C (SR15) assessed that the warming caused by human activities matches the level of observed warming since the year 2000 to within ±20% (likely range). This observed warming already represents a multi-century commitment to worldwide loss of ice, sea level rise, and many other impacts on other components of the climate system. {1.3, Box 1.2}"

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
25974	4	15	4	15	Since the AR4 concluded warming unequivocal, attributing this conclusion solely to the AR5 is inappropriate. Suggest changing the first sentence: e.g. The AR5 reinforced the conclusion of the AR4 that warming…is unequivocal. [Haroon Kheshgi, United States of America]	Revised to read: "This report builds on the AR5 assessment that human influence on the climate system is clear. In 2018, the IPCC Special Report on Global Warming of 1.5°C (SR15) assessed that the warming caused by human activities matches the level of observed warming since the year 2000 to within ±20% (likely range). This observed warming already represents a multi-century commitment to worldwide loss of ice, sea level rise, and many other impacts on other components of the climate system. {1.3, Box 1.2}"
15318	4	15	4	16	Include the year in which the AR5 was completed (2013/2014). This will put the sentence, "Since the AR5, multiple concurrent changes have continued.." into context for readers not closely acquainted with the history of the IPCC's reports. [Lia Cairone, United States of America]	This comment has been considered during the preparation of the FGD. (In FGD) Noted. Sentence no longer appears.
29796	4	15	4	18	The increase in extreme events could be included in this list of observed changes. [Govindasamy Bala, India]	Taken into account. Text revised to include "extreme weather". But it is difficult to make a generalized statement here as the term 'extremes' (or any similar one) will encompass a wide range of phenomena. Leave a more detailed statement for later chapters and their ES statements.
39440	4	15	4	24	I think that a reference to the knowledge increment resulted from the 3 special reports, and in particular SR1.5 might be included here [Carolina Vera, Argentina]	Special reports mentioned where appropriate.
42822	4	15	4	24	Can these additional concurrent changes also be labeled using the consistent risk framework? Add also: ocean acidification (cf p7 l. 54-55)? To compare paleoclimatological rates of change with rates of change estimated over years or decades (make this more specific), an extrapolation or an interpolation must be made. Are these valid comparisons? And are these statements possibly to make for changes other than for temperature? [Michael Evans, United States of America]	Rejected. Thanks for the comment. This part of the ES has been substantially revised. Regarding the risk framework, we do not see how to clearly make that link in this particular ES statement.
15190	4	15	4	24	This item, like others down the line, seem to belong more to specific chapters' assessment. The relation then between Chapter 1 and what comes out of individual, subsequent chapters is not clear. [Claudia Tebaldi, United States of America]	Ch 1's mandate is to present the overall context and major themes of the assessment. References to chapters treating some items have been added to the ES summary statements.
51820	4	15	4	24	While this ES statement is factually correct it is, of course, restated in considerably more detail in chapter 2 which has a key finding that is very similar. Perhaps this is unavoidable. If it is then we need to ensure that they are entirely consistent. Presently they are to my view consistent but we should guard against their diverging and, obviously, the chapter 1 finding should reflect that in chapter 2 where the substantive assessment is performed. Another way to manage this would be to place less emphasis on changes since AR5 here in this statement. I'm not sure how feasible that is though. [Peter Thorne, Ireland]	Thanks. We think it's unavoidable, but the section has been reduced in length here, so there's less overlap. Consistency will be checked and re-checked, and please tell us if/when we diverge!

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
56180	4	15	4	24	Probably this paragraph should also refer to relevant material from Chapter 2 [Sonia Seneviratne, Switzerland]	Thanks. We decided not to refer to other chapters in the ES, which is already too long, but numerous references to other chapters were added in the body text. This section has been reduced in length here, so there's less overlap with Ch 2. Consistency will be checked and re-checked, and please tell us if/when we diverge!
9104	4	15	4	24	The generalistic claims made in this paragraph on the current rate and magnitude of climate parameters as being unprecedented and beyond natural variability might need to be reconsidered for example the apparently sudden Younder Dryas event. [Jim O'Brien, Ireland]	Noted. Text revised to be fully in line with the underlying Chapter assessments in WGI AR6.
26102	4	15	4	25	I disagree. The changes presently observed (i.e within the last 100 years of ~ 1.0 degC warming and ~ 200mm of sea-level rise would not be significant if they occurred over a 2000 or a million year period. It is the rate of change that is significant. [Stephen Taylor, United Kingdom (of Great Britain and Northern Ireland)]	Thanks. The word 'magnitudes' was indeed misplaced, it is the rates of change (and the links to our society) that make the current changes significant. The wording has been changed.
26104	4	15	4	25	Suggest. “Since the AR5, multiple concurrent changes throughout the physical climate system have been reported, iincluding increasing global mean surface temperature, loss of glacial mass, sea level rise, increasing 18 ocean heat content, changes to global precipitation patterns, and rising greenhouse gas concentrations. Many of these changes are reported to have occured at rates and magnitudes beyond what can be attributed to natural variabilit. These reported rapid changes to the physical climate system provide the backdrop for the present report. Multiple independent lines of evidence, reaching from the present back to the mid Pliocene 23 (3.6 million years BP), indicate the significant nature of the recently reported rate of change, even when seen in the context of a million year period. {1.2.1} [Stephen Taylor, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Thanks. This ES statement has been revised, and the intentions of this comment are retained.
6557	4	16	4	18	rephrase entire sentence - i suggest: “Since the AR5, rising greenhouse gas concentrations induced continued and multiple concurrent changes throughout the physical climate system, including increasing global mean surface temperature, loss of glacial mass, sea level rise, increasing ocean heat content and changes to global precipitation patterns.” [Tim Christiane Thys, Belgium]	Taken into account. Sentence was revised.
43000	4	16		16	Delete "multiple concurrent" - the point is made by the range of examples later in the sentence. [David Frame, New Zealand]	Deleted
15978	4	17	4	18	Please consider moving "rising greenhouse concentrations" upfront as it is the cause of climate change. [SAI MING LEE, China]	Rejected. The order of observed changed was kept.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
7718	4	18	4	18	The misnomer “greenhouse” is used here and 120 times elsewhere in Chapter 1. (I use it in these reviews to avoid confusion.) The IPCC AR5 report states: “The glass [or plastic] walls of a greenhouse reduce airflow and increase the temperature of the air inside. Analogously, but through a different physical process, the Earth’s green house effect warms the surface of the planet.” I quoted this in “Hawai’i’s Mauna Loa Observatory” (p. 97) and strongly suggest that you do likewise, hopefully by reprinting the FAQ on this topic from IPCC AR5 athttps://wg1.ipcc.ch/publications/wg1-ar4/faq/wg1_faq-1.3.html [Forrest Mims, United States of America]	This widely used term, now deeply embedded in English language discussions of global climate, is of course a metaphor for heat-absorbing gases. We have substituted "heat-absorbing" or "heat-trapping" in some places, but the metaphor remains useful and appears throughout AR6.
48228	4	18	4	18	Have global precipitation patterns changed (I do not see reference to this in 1.2.1) and, if so, how is "pattern change" defined? [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. We treat this more explicitly now through the precipitation illustrations in Figure 1.1.
31508	4	19	4	19	"what" should "those that" or "that which" ? [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The paragraph was revised and that part of the text is no longer included.
48230	4	19	4	19	Suggest rephrasing, if a "change" an be attributed to natural variability then it is not a change, it is just a manifestation of the climate. [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	The sentence has been reworded.
9080	4	19	4	19	"Many of these changes occur at rates and magnitudes beyond what can be attributed to natural variability." This language sounds to hedging. Can we say "All of these changes…"? Or maybe"Except in a very few ambiguous cases as indicated in the report, all of these changes..." [Peter Kalmus, United States of America]	Noted. No, we can't say "all" or "except in a very few ambiguous cases". This would be inconsistent with the underlying assessment in this report.
57978	4	19	4	19	Many of the changes - with "Many of these changes …" I undestand the changes from the above list, which when named, I would expect for sure being beyond the natural variability [Tomas Halenka, Czech Republic]	Noted. The paragraph was revised and that part of the text is no longer included.
26326	4	19	4	19	This sentence reads as if the observed change since 2013 could be attributed to anthropogenic influence. I have a hard time believing that. Possibly it's just the phrasing, but the issue is indicative of the ambiguous point of departure I mentioned earlier. [Jochem Marotzke, Germany]	The sentence has been reworded.
45372	4	19	4	24	More sections should be linked with {} to these statements. [Baylor Fox-Kemper, United States of America]	We have consistently indicated the sources of ES points within the chapter. We decided not to refer to other chapters in the ES, which is already too long, but we have added numerous references to other chapters in the body text.
43002	4	19		19	Possibly alter the text to "well beyond" rather than just "beyond", for emphasis. [David Frame, New Zealand]	Noted. The paragraph was revised and that part of the text is no longer included.
35196	4	19			Describe Holocene and Mid-Pliocene in terms a lay person will understand (ie. which years?) [Ko Barrett, United States of America]	This is now done in a Cross-Chapter Box in Ch 2.
6535	4	20	4	21	why is the timeframe of "last two millenia" chosen? Wouldn't it be better to say the last 8,000 years, as reported by Ruddiman (Ruddiman, W.F. Climatic Change (2003) 61: 261. https://doi.org/10.1023/B:CLIM.0000004577.17928.fa) ? [Tim Christiane Thys, Belgium]	Noted. "Two millennia" was chosen mainly to reflect the work of the PAGES2k consortium. We have ensured that the statement is in line with assessments made in other chapters.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
57796	4	20	4	21	I do not understand this sentence. How and in what way are they "significant"? Is 2000 years really a "long time frame" considering the next sentence which extends what could be considered the "significant" time frame back to 3.6 million years BP? Maybe clarification (or even deletion) of this sentence. [Peter Kalmus, United States of America]	The text has been revised. Significant refers to signal-to-noise ratio, but we agree that is confusing as it stood in the FOD.
35198	4	21			Anthropocene: Please use caution about endorsing a term that has neither been officially approved by the ICS nor the IUGS as a subdivision of geological time. As such, there is no agreed upon start date. I understand a decision on this will not be made before 2021. [Ko Barrett, United States of America]	Only reference to Anthropocene is now: "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 (Ceballos et al., 2017; Hoegh-Guldberg and Bruno, 2010; 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”.
44886	4	22	4	24	The statement about the rate of global-scale changes reaching back to the Pliocene refers to section 1.2.1, but I could not find information about rates of change over this period in this section. Also, see my comment about the difficulty in deriving rates of change from geological evidence (p26, line 45). CH2 is engaged in a more complete assessment of paleo rates of change for large-scale climate indicators, so CH1 might want to reference CH2 for this information. [Darrell Kaufman, United States of America]	Stronger links to Chapter 2 added, including discussion of rates of change.
51568	4	22	4	32	These are critical and clear sentences but should also include AR5 statement on 'human influenece is clear' at this stage, as it is far more effective than simply referring to 'anthropogenic' as you first do - not all policy makers (in various languages) appreciate the meaning - best to spell out in clear language that these 'significant', 'unique' changes are human influnced. [Lindsey Cook, Germany]	Noted. The text now makes reference to conclusions laid out in AR4 and AR5.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
55086	4	22		24	[pt 1 of 4] The paragraph says, "...Since the AR5, multiple concurrent changes have continued throughout the physical climate system, including increasing global mean surface temperature, loss of glacial mass, sea level rise, increasing ocean heat content, changes to global precipitation patterns, and rising greenhouse gas concentrations. Many of these changes occur at rates and magnitudes beyond what can be attributed to natural variability. The rapid changes to the physical climate system represent a key framing for the present report. ... Multiple independent lines of evidence, reaching from the recent observational era back to the mid Pliocene (3.6 million years BP), indicate the unique nature of the present, global scale rate of change, even when seen in the context of a million year period. {1.2.1}" That is extremely misleading, [cont'd…] [David Burton, United States of America]	Noted. Thanks for the comments. Partly we agree, in that the rate of change discussion should refer to the last few millennia (i.e. the time period of human civilization) rather than to millions of years. However, we also note that we rely here on other assessments of global changes, while the examples made in this set of comments refer e.g. to changes in Greenland temperatures only.
55088	4	22		24	[pt 2 of 4] ...because it falsely suggests that many or all of those six climate metrics have changed in an unusually "rapid" and "unique" way within the last million years. In fact, only one of those six metrics has changed in an unusually rapid or unique way in the last million years: greenhouse gas concentrations. Recent changes in the other five metrics have all been modest and benign, in the context of the last million years; in fact, 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]	See #55086
55090	4	22		24	[pt 3 of 4] ...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]	See #55086
55092	4	22		24	[pt 4 of 4] 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." ### [David Burton, United States of America]	See #55086
43004	4	22		24	I don't think the extra bit of paleo at the end adds anything. Suggest deletion. [David Frame, New Zealand]	Rejected. This sentence refers to the discussion around Figure 1.2. We wish to retain it.
6537	4	26	4	26	replace "Understanding" by "knowledge" [Tim Christiane Thys, Belgium]	Rejected. No reasons given for requested change. We prefer to retain "understanding," since to some people "knowledge" implies total certainty.
6555	4	26	4	26	Rephrase entire sentence - I suggest: "Well-established understanding of essential features of the climate system is robust and thoroughly documented." [Tim Christiane Thys, Belgium]	Rejected. Sentence already clear as written.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
52390	4	26	4	26	Strongly suggest that a new paragraph be inserted here noting the additional conclusions of the SR1.5, which are directly relevant to the Paris Agreement goals in terms of additional risk avoided at 1.5 degrees. This can be based on the existing section 1.3.4.2. [Pam Pearson, Sweden]	Noted. Special Reports are mentioned explicitly in the preamble to the ES. In addition, few key results from AR6 Special Reports are included in the ES when they contribute to the overall storyline of the chapter. A detailed high-level summary of the AR6 key conclusions relevant for the WGI AR6 is available from SOD Box 1.2.
9826	4	26	4	27	Authors claim that the understanding of natural climate drivers is "robust and well established". This is an exaggeration. Palaeoclimate case studies have produced numerous examples of a strong solar imprint on the climate development, yet models still struggle to replicate the climate of the past. The only solar effect that is considered in the models is TSI whilst likely amplifier processes associated with the magnetic field (and possibly cosmic rays) as well as UV radiation and effects in the stratosphere are being neglected. Considering this discrepancy between reconstructed and simulated climate, how can one say the understanding of natural climate drivers is "robust and well established"? The same applies to multidecadal cycles such as PDO, AMO, NAO etc. who are still not fully understood, nor fully implemented in the models. [Sebastian Luening, Portugal]	Rejected. Text states that "Understanding of essential features of the climate system is robust and well established." which is supported by the underlying assessment in, e.g., Chapter 3.
27160	4	26	4	32	Kenneth Richards provides lists of peer-reviewed papers that (i) cast doubt on the position that anthropogenic CO2 emissions function as the climate's fundamental control knob or that (ii) otherwise question the efficacy of climate models or the related "consensus" positions. These papers affirm the position that there are significant limitations and uncertainties inherent in our understanding of climate and climate changes. Natural mechanisms play well more than a negligible role. Projections of future climate states are speculative as the uncertainty and error ranges are considerable in a non-linear climate system. List of 200 papers published in 2019: https://notrickszone.com/2019/06/17/consensus-200-new-2019-papers-support-a-skeptical-position-on-climate-alarmism/ 500 papers published in 2018: https://notrickszone.com/skeptic-papers-2018-1/ + https://notrickszone.com/skeptic-papers-2018-2/ + https://notrickszone.com/skeptic-papers-2018-3/ This expert reviewer recommends to discuss them and take them into account for a more balanced report. [François GERVAIS, France]	Noted. IPCC authors cannot use contributions in blogs or social media as a resource for the scientific assessment. All published, relevant, peer-reviewed literature (and some more) can, however, be considered in the assessment.
57798	4	26	4	32	Consider adding a sentence to this paragraph along the lines of: "No other scientifically sound or even remotely plausible explanation for the myriad changes to the Earth system described in this report besides anthropogenic forcings has ever been suggested." [Peter Kalmus, United States of America]	Rejected. We do not think this statement is needed to make the case. No reason provided for this suggestion.
55290	4	26	4	32	This is a strong statement, and one that should be kept in the executive summary as it currently appears. [Wesley Fraser, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Text has been revised during the SOD preparations, but without substantially changing the key conclusion of this statement.
6539	4	28	4	28	insert: and "the mechanisms of" major anthropogenic…. [Tim Christiane Thys, Belgium]	Noted. Not longer applicable. Text has been revised during the SOD preparations.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
15192	4	28	4	29	This may be interpreted as wordsmithing and thus editorial, but to me the words chosen here, "proposed" and "established" just do not seem the right ones as concepts, not as linguistic choices. I would use "hypothesized" and "identified", respectively, for example. [Claudia Tebaldi, United States of America]	Accepted. ES text revised accordingly.
35200	4	28		31	Please see comments provided regarding taking care not to cherry-pick a small subset of global initiatives. Also, the chapter does not make a strong case that there IS currently a different framing for the present report. A stronger push for action is not necessarily a different framing from previous reports. [Ko Barrett, United States of America]	Taken into account, Comment refers to first item in ES (FOD lines 3-13). Revised version of that item now does no longer mention these initiatives.
10010	4	29	4	29	(primarily emissions of heat-trapping gases and aerosols) [Tibor Farago, Hungary]	Accepted. Revised to read "heat-absorbing gases and radiation-scattering aerosols"
45118	4	29	4	29	I suggest you asdd the words I have shown in CAPITALS: "...(primarily heat-trapping gases and RADIATION-SCATTERING aerosols)…" [Reason - otherwise this sentence could be taken to imply that aerosols trap heat) [David Wratt, New Zealand]	Accepted. Revised to read "Understanding of key features of the climate system is robust and well established. 19th-century scientists first hypothesized the possibility of anthropogenic climate change and identified the major heat-absorbing greenhouse gases. Other major anthropogenic drivers such as radiation-scattering aerosols and land use change were identified by the mid-1970s."
48232	4	29	4	29	Suggest "absorbing" in place of "trapping" and "identified" in place of "established" [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Revised to read "Understanding of key features of the climate system is robust and well established. 19th-century scientists first hypothesized the possibility of anthropogenic climate change and identified the major heat-absorbing greenhouse gases. Other major anthropogenic drivers such as radiation-scattering aerosols and land use change were identified by the mid-1970s."
43006	4	29		32	"Since systematic scientific assessments began in the late 1970s, anthropogenic climate change has evolved from a hypothesis to a fact." Invites objections: who decides when a hypothesis becomes a fact? What is the nature of that evolution? etc. How about: "The anthropogenic origins of current climate change have become progressively clearer since systematic scientific assessments began in the late 1970s; to the point at which human influence on the climate is clear and discernable." ? [David Frame, New Zealand]	Noted. The proposed alternative would also be good, though, we prefer to highlight that the "human influence on the climate system is clear" has been assessed to be a fact by AR5.
46126	4	30	4	30	The statement "anthropogenic climate change has evolved from a hypothesis to a fact" is overstated. What aspects of anthropogenic climate change are "facts" and which remain "hypotheses"? I would reword to allow for the fact that not ALL posited types of climate change are "proven" to be anthropogenically driven. A wise teacher once told me "nothing is ever proven, just shown to be the case with extremely high probability." [Cynthia Randles, United States of America]	Noted. The statement highlights that the "human influence on the climate system is clear" as assessed and presented as a factual statement in AR5.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
32588	4	30	4	30	Regarding "hypothesis to a fact", this is a really key point to make, but I think is done too tersely for the average reader to understand as it presumes an understanding of how science works, etc. I'd suggest devoting a bit more space to saying something like has evolved from a situation where human influences were hypothesized to be growing comparable to the variations caused by natural influences to definitively being identifed as the dominant cause of changes affecting the Earth's climatic zones and landscape. I just think that this point needs to be made with greater clarity. [Michael MacCracken, United States of America]	Noted. The statement highlights that the "human influence on the climate system is clear" as assessed and presented as a factual statement in AR5.
6541	4	30	4	30	replace: " a fact" by "scientifcally sound theory" [Tim Christiane Thys, Belgium]	Noted. The statement highlights that the "human influence on the climate system is clear" as assessed and presented as a factual statement in AR5.
36632	4	30			The Hypothesis to Fact claim is unhelpful. Complex physical theories (that underpin climate change) are never reffered to as "Facts". Gravity is not a fact. I understand the intention but this wording makes the report seem more political than scientific. It is after all unlikely that every single component of our understanding of Anthropogenic Climate Change is 100% correct. [Paul Copland, New Zealand]	Noted. The statement highlights that the "human influence on the climate system is clear" as assessed and presented as a factual statement in AR5.
37284	4	30			Using the word "fact" adds strength to the text, but we now appear to live in a world of "alternate facts". Also, the phrase "virtually certain" rather than "certain" is used elsewhere in the report. So I wonder if "from a hypothesis to a fact" shouldn't be replaced by "from hypothesis to virtual certainty". [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The statement highlights that the "human influence on the climate system is clear" as assessed and presented as a factual statement in AR5.
42830	4	31	4	32	We also have realistically forced paleoclimatic simulations that are consistent with information from paleoclimatic observations and reconstructions, which permit assessment of climate sensitivity, process understanding, and climate change over timescales contextualizing 1750-2100 (considered here as pre-industrial climate through projections through the 21st century). [Michael Evans, United States of America]	Taken into account. Include paleo information in the assessment. Focus on the past 40 years might leave out a lot of important information that would support our key conclusion here
9106	4	31	4	32	Climate change projections in AR5 are well above current observations, as in comment 6 above; the graphs in Figure 1.17 have clearly been updated starting from a new base and so made to appear as to be inside the current model projections. [Jim O'Brien, Ireland]	Rejected. Reviewer comment is unfounded. Caption of the Figure (Figure SOD 1.7) clearly identifies the different baselines, as the purpose of that figure is to show the effect of different baselines.
26106	4	31	4	33	Model predictions have not always been good – many were wildly out. Suggest it should read “Since systematic scientific assessments began in the late 1970s, the anthropogenic climate change hypothesis has evolved towards a widely accepted fact. [Stephen Taylor, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The statement highlights that the "human influence on the climate system is clear" as assessed and presented as a factual statement in AR5.
55094	4	31		32	[pt 1 of 5] The sentence says, "Climate change projections made since the 1980s are generally in good agreement with the amplitude and pattern of subsequent observed temperature change. {1.3}" That is untrue. 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. [cont'd] [David Burton, United States of America]	Rejected. Evidence supporting the statement is given in Chapter 1, the subsequent chapters of WGI AR6 and in the series of past IPCC reports. See. e.g., Technical Summary of WGI AR5, Stocker et al. 2013.

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55096	4	31		32	[pt 2 of 5] 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]	Noted. No action needed
55098	4	31		32	[pt 3 of 5] 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. Evidence supporting the statement is given in Chapter 1, the subsequent chapters of WGI AR6 and in the series of past IPCC reports. See. e.g., Technical Summary of WGI AR5, Stocker et al. 2013.
55100	4	31		32	[pt 4 of 5] 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 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. Evidence supporting the statement is given in Chapter 1, the subsequent chapters of WGI AR6 and in the series of past IPCC reports. See. e.g., Technical Summary of WGI AR5, Stocker et al. 2013.
55102	4	31		32	[pt 5 of 5] 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. Evidence supporting the statement is given in Chapter 1, the subsequent chapters of WGI AR6 and in the series of past IPCC reports. See. e.g., Technical Summary of WGI AR5, Stocker et al. 2013.
31510	4	32	4	32	"a million year period" should be "multi-million year timescales" ? [3.6 million years is more than "a million"]. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Text now reads "multi-million year period".
42824	4	34	4	43	Note that there have been substantial improvements to subsurface ocean measurements by autonomous profiling lagrangian floats, this has been important in accessing previously poorly observed regions such as the southern oceans for ocean heat uptake estimation, and for more recently variables other than temperature. [Michael Evans, United States of America]	Noted. These advances in observations are documented in the chapter, but the executive summary statement has to be concise and cannot list all the new developments.
48236	4	34	4	43	Suggest adding text on scarcity, accessibility and rescue of historical data [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	Added the following: "Substantial quantities of known instrumental observations of weather and other climate variables, which could fill gaps in existing datasets, remain undigitised. {1.5.1} "

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
51570	4	34	4	43	This could be used by some to conclude that your findings are not worthy. Can you say this in better perspective - despite challenges, the level of research findings available are ..... in comparison to the last 50 years/human history? While you proceed to define improvements, some countries might latch on this section as reason to dismiss findings overall and it may need to be set in perspective. [Lindsey Cook, Germany]	Thanks. We will revisit this comment in the next draft. For now, revised to read: "Overall, capabilities to observe the physical climate system have continued to improve and expand, but losses in existing observational capacity are also occurring. Progress in climate science relies on the quality and quantity of observations from a range of platforms, including surface-based instruments, aircraft observations, satellite-based retrievals, in situ measurements and paleoclimatic records. Emerging risks of loss of coverage or continuity include reductions in certain satellite coverage, surface station networks, and radiosonde launches. In addition, 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 (high confidence). Substantial quantities of known instrumental observations of weather and other climate variables, which could fill gaps in existing datasets, remain undigitized. {1.5.1} " (In FGD) Taken into account. FAQ1.1 and Section
48234	4	38	4	38	Suggest adding "historical and" before "paleoclimate" because I think these are understood as being different and obvsiouly both are crucially important. [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	Thanks. We decided this was not necessary.
41402	4	38	4	43	This paragrpah talks about of lossing coverage or continuity of some paleoclimate archives, among them, tree rings.Here, or in Section 1.4.1 Observational data and observing systems (Page 45 Line 1-2), specifically about tree rings, it could be desirable to mention the divergence issue regarding temperature reconstructions. See for example, George, S. S., & Esper, J. (2019). Concord and discord among Northern Hemisphere paleotemperature reconstructions from tree rings. Quaternary Science Reviews, 203, 278-281. [Lucas Bianchi, Argentina]	Thanks. We did not succeed in addressing this in the SOD, but we will revisit this comment in the next round of revision. (In FGD) Noted. Tree ring divergence is not addressed in Chapter 1.
43008	4	38		43	From "Overall..." this strikes me as an unnecessary level of detail for an Exec Summ point. [David Frame, New Zealand]	The executive summary point has been revised; some details are kept, being necessary to support this point.
48550	4	39	4	43	Please try to be as specific as possible. Rather than saying "notable improvements in some areas" can you specific what has improved? [Zinta Zommers, United States of America]	Taken into account. Text was revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
44888	4	40	4	43	I'm not sure what part of this sentence is assessed as "high confidence": is it the reduced coverage of observations or the cause of the loss of paleoclimate archives? It's also striking that this is the first element of CH1 that is assessed using controlled vocabulary. Also, if the "very likely" refers to the loss of paleoclimate archives, I didn't find any literature cited or other basis for the chosen level of confidence in section 1.4.1. [Darrell Kaufman, United States of America]	The sentence has been revised for a better use of the confidence language.
45952	4	40	4	43	underscoring the need not to lose continuity in the observing platforms should be one of the key messages in the Executive Summary [Lourdes Tibig, Philippines]	Accepted. The executive summary point has been revised for better clarity.
26108	4	40	4	43	This confuses the availability of evidence with reasons for the loss. Better to say "Some historical evidence required to verify climate change may be lost due to pressures on paleoclimate archives caused by climate change e.g. such as coral, ice cores, and trees. [Stephen Taylor, United Kingdom (of Great Britain and Northern Ireland)]	Sentence has been revised for clarity.
46096	4	41	4	42	Might be worth also adding hard tissue accretion in the list of paelo archvies, it's a rapidly growing field. [Amy Featherstone, United Kingdom (of Great Britain and Northern Ireland)]	Noted. No Action.
53890	4	41	4	43	The loss of palaeoclimatic records due to climate causes is an interesting irony, but probably should be separated from the decline of some operational monitoring and observation systems. The latter rely on human investment and management in equipment and maintenance rather than on fortuitous environmental conditions that are capable of preserving paleaoclimatic records. Some palaeoclimatic archives may be disappearing for varying reasons, not just climatic, and it could also be the case that some potential sources are actually being newly exposed by the very environmental changes that they are measuring. [Timothy Carter, Finland]	This remark is taken into account in the new executive summary statement.
55104	4	41		43	The sentence says, "...paleoclimate archives such as corals, tropical ice cores, and trees are rapidly disappearing owing to a host of anthropogenic pressures, including high temperatures caused by anthropogenic climate change (high confidence) {1.4.1}" 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. https://www.theguardian.com/environment/2017/apr/16/arctic-ice-cores-melt-university-alberta-canada [David Burton, United States of America]	This remark is taken into account in the new executive summary statement.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
37286	4	41			Delete or justify the reference to reduced coverage of radiosonde launches. Statistics on radiosonde data have been presented in GCOS(2015), an openly-reviewed report referenced later in Chapter 1. The report recorded a net increase of 10% from 2002 to 2014 in the number of radiosondes reporting a 500hPa temperature, based on ECMWF data receipts. The figure was 13% for dewpoint and wind. The report also documents improvements in instrument quality and increases in the heights reached by balloons. Since that report was published, countries have been disseminating radiosonde data in a new code that allows higher vertical resolution and information on the position and time of each datum. Data coverage could of course be better in some regions, notably Africa, but that has been the case for many years. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The phrasing remains, although some work still remains in the chapter text to fully document the statement. This will be done for the next draft, or the ES statement will be changed. (In FGD) "Noted. References to WMO 2017 and Lin and Huybers 2019 have been added regarding the loss of observational capability in some regions. A summary has been added near the end of 1.5.1.1 (after the "biosphere" paragraph), which reads: "In summary, the observational coverage of ongoing changes to the climate system is improved at the time of the AR6 (...)"
46772	4	42	4	42	Trees used for paleoclimate reconstructions are NOT “trees are rapidly disappearing”. They are rarely growing in regions suffering deforestation and, moreover, it is fossil and sub-fossil trees (deadwood) that are of interest for building up long tree-ring based climate reconstructions. No dendroclimate literature, to the knowledge of me, are support this statement. (Same comment as to Chapter 1, p. 47, lines 29–31.) [Charpentier Ljungqvist Fredrik, Sweden]	See also remark #55104. These remarks are taken into account in the new executive summary statement.
39442	4	45	4	49	This statement like others included in the Executive Summary do not have a confidence level. I don't know if it is because the assessment has not finished yet or not. Anyway, it is important that each of them results from an assessment. [Carolina Vera, Argentina]	Noted. The executive summary of chapter 1 has been revised to use the confidence language when appropriate.
42826	4	45	4	49	Data assimilation and reanalyses importantly also provide product error estimates, evaluation of model error, evaluation of observational error. [Michael Evans, United States of America]	This point will be considered to be brought into the text on reanalyses after SOD. At present, the help that reanalyses provide with GSAT is made. The executive summary point has been re-written. (In FGD) Noted. An example of the products available to help estimate uncertainty estimates is provided. "A 10-member ensemble is also available at coarser resolution, allowing uncertainty estimates to be provided (e.g., Chapter 2, Section 2.3)."
32590	4	45	4	49	I think terms like reanalyses, resolution and assimilation need to be explained, both in terms of what they are and what they are useful for. This is the Exec Summary of the introductory chapter--getting into jargon so early will very quickly turn off the reader. And then there is also mention of "forecast" models, which are different than the projection models used for climate simulations. This whole point is just not phrased to speak clearly to likely general readers of this assessment. [Michael MacCracken, United States of America]	Taken into account: The executive summary point has been revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
35202	4	48		49	It is not true that the difference between 1.5 and 2 degrees is "especially true" for biodiversity and ecosystems including loss and extinction. The report does not single them out as such. [Ko Barrett, United States of America]	Not applicable -- text not in Ch1 FOD… Comments fits with text from Ch1 Internal Draft. We cover this now in 1.3.4.2
7720	4	51	4	54	In view of the considerable criticism of the poor record of many models cited in ARs since 1990, this section should include a few lines generally summarizing what is meant by “further improved.” As noted below, Fig. 11-25 in AR5 generated considerable attention in the scientific and the public literature. At the publication date of this figure in AR5, the composite of 4 surface measurements was below ALL 138 model forecasts. Fig 11-25 also affirms the slight temperature decline from 2005 to 2012. What can the authors point to that shows an improvement over what is depicted in AR5’s Fig. 11-15? Is not an updated version of Fig. 11-25 required? Is this not what is expected by PRINCIPLES GOVERNING IPCC WORK that IPCC assessments must be “comprehensive, objective, open and transparent.”? [Forrest Mims, United States of America]	Accepted. The sentence has been revised to refer more clearly to modelling technique development.
15194	4	51	4	54	This to me is a very problematic statement, and -- as mentioned earlier -- should come from some of the later chapters' assessments and at the very least be consistent with them. I'm not convinced the literature and those assessments support this optimistic view about the effectiveness of constraints on climate sensitivity. As for the models having improved, given that most CMIP6 models have not been thoroughly assessed over the historical period one could question the robustness of such statement. More importantly though I do not understand what the role of Chapter 1 is here."Framing" or "summarizing" later results from the body of the report? [Claudia Tebaldi, United States of America]	Accepted. the statement has been revised to avoid overlap with Chapter 3.
32912	4	51	4	54	This paragraph is also not as clear as needed, talking about three different kinds of models in the first sentence alone. One could, for example, rewrite the first part of the first sentence to read something like: Capabilities for computer-based simulation of the Earth's coupled atmosphere-ocean-land system have been further improved since the AR5, in particular by more of the models now rincluding treatment of carbon and other biogeochemical cycles and with simulations that can treat the Earth's land surface and ocean motions with greater sparial resolution. ---Yes, more word, but I think the chapter Executive Summaries need to be having sentences that are generally understandable and can be pulled out as individual sentences and quoted and be sufficiently self-contained to be meaningful. The second sentence then needs to explain why cloud and carbon feedbacks matter, etc. I just think this is all too terse and jargony. [Michael MacCracken, United States of America]	Accepted. the statement has been revised to avoid overlap with Chapter 3.
31512	4	52	4	52	"better capture" rather than "catpure". [all models capute extremes, but higher resolution models likely capture them more accurately]. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	The text has been revised.
53892	4	52	4	52	The term "small-scale" is sometimes interpreted to imply map scales showing little local detail. The term "fine-scale" is less ambiguous. [Timothy Carter, Finland]	Noted. We now refer to "smaller scales" relative to the previous generation of models (AR5).
35204	4	52			Not helpful to make the statement that each assessment report has used a different set of future scenarios for their projections. Is this true? More importantly, doesn't this create a vulnerability for the IPCC laid out without explanation? I suggest deleting this sentence, especially in light of the statement on page 5, lines 37-42. [Ko Barrett, United States of America]	Not applicable -- text not in Ch1 FOD.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
29916	4	53	4	54	These constraints are still quite controversial, see e.g. Caldwell et al. (2018 J.Clim. doi: 10.1175/JCLI-D-17-0631.1) for climate sensitivity, and will presumably be discussed in later chapters, so I would suggest that Chapter 1 not try to draw conclusions on this topic, especially at the level of the Executive Summary. There is too much chance for inconsistency between chapters. [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	Noted. the statement has been revised to avoid overlap with Chapter 3.
45374	4	54	4	54	I think a placeholder here for comments on climate sensitivity is needed, but if CMIP6 sensitivity is much larger than CMIP5 (as seems to be the case), then different wording about constraints will be needed, since values used in past reports as "constraints" may be exceeded. [Baylor Fox-Kemper, United States of America]	Noted. the statement has been revised to avoid overlap with Chapter 3.
55066	4		5		The ES bullets need more confidence statements and use of calibrated uncertainty language [Trude Storelvmo, Norway]	Noted. ES statements have been revised to use the uncertainty language where appropriate.
16120	4		184		The Chapter is too long for the context intended. [Branko Grisogono, Croatia]	Accepted. Chapter is shortened.
39444	5	1	5	8	Not only models, tools and techniques have been improved for the description, simulation and attribution of the changes, but also the scientific community is larger and more literature is available for the assessment. This is an aspect worth of highlighting in any of these statements. [Carolina Vera, Argentina]	Accepted. The expansion of the literature is a good point. This has now been drawn into our section on 'limitations'
7994	5	1	5	8	This is pretty similar to a bullet point made in Ch3 about the improved ability to diagnose processes in climate models. I think this overlap needs to be managed and perhaps reduced. [Olaf Morgenstern, New Zealand]	Noted. the text has been revised to avoid overlap with chapter 3.
42828	5	1	5	8	Add: development of stochastic parameterization for evaluation of competing representation of physical and parameterized processes operating at or below the grid scale. [Michael Evans, United States of America]	Noted. this level of detail is not appropriate for the ES of chapter 1, but these elements are taken into account in 1.5.3.
55472	5	1	286	1	I highly value the risk and adaptation in this chapter are covering both human and natural systems. This thinking is throughout the chapter and fundamentally important for WGII chapters [Daniela Schmidt, United Kingdom (of Great Britain and Northern Ireland)]	Noted. No Action.
35206	5	2			Consider replacing "by accounting for additional" with "through better understanding of" [Ko Barrett, United States of America]	Comment refers to Chapter 1 internal draft
10012	5	3	5	4	Actually, not only the adaptive, but also the mitigation measures .. (unclear: methods to attribute change in .. even adaptive measures ?) [Tibor Farago, Hungary]	Text was revised.
32594	5	3	5	4	This is another sentence that is just too terse--explanation is needed. [Michael MacCracken, United States of America]	Text was revised
32592	5	3	5	8	I would like to know what the findngs are from having these new tools and capabilities, not just hear they exist. What is the "improved understanding" that is mentioned? What does the complementary approach indicate? Is there greater confidence" Etc. [Michael MacCracken, United States of America]	Not applicable. Thanks for the comment. This ES statement has been dropped from the Second Order Draft. In general, it is true that Chapter 1 should also present the use to which the tools we discuss are put in the report; we have tried to consistently do this for the updated version.
35208	5	7		8	I could not find evidence in section 1.4 that "many existing observational platforms and paleoclimate archives are at high risk." Please check the veracity of this statement. [Ko Barrett, United States of America]	Not applicable -- text not in Ch1 FOD… Comments fits with text from Ch1 Internal Draft

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
48238	5	10	5	11	Suggest rephrasing the second bold sentence as: "A reference set of … is introduced to facilitate a consistent assessment across chapters." [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. The statement has been heavily modified and merged with other statements, taking into account this comment.
39446	5	10	5	14	Following the narrative started with the previous two statements, this statement should say that regional climate change is emphasized in AR6 WG1 report because of the knowledge increase regarding regional climate changes from observations, modeling and projections and because of the policy demands of regional climate information for decision making [Carolina Vera, Argentina]	Taken into account. The statement has been heavily modified and merged with other statements, taking into account this comment.
32596	5	10	5	14	Again, nice to hear this can be done better, but what are the better kinds of results that one is getting--about extreme weather, what? [Michael MacCracken, United States of America]	Taken into account. The statement has been heavily modified and merged with other statements, taking into account this comment.
56182	5	10	5	14	Chapter 1 should also highlight further aspects of AR6 which are new compared to AR5, in particular: 1) Chapter dedicated to weather and climate extremes (Chapter 11); 2) Chapter dedicated to hazards and providing a link to WG 2 (Chapter 12), 3) Chapter on water cycle (Chapter 8). Since this is the introductory chapter, it would also be useful that these Chapters are explicitiy mention and referred to the executive summary, e.g. "The AR6 provides for the first time a chapter dedicated to weather and climate extremes (Chapter 11)". [Sonia Seneviratne, Switzerland]	Taken into account. The statement has been heavily modified and merged with other statements, taking into account this comment.
43010	5	10		14	Strikes me as unnecessary as an Exec Summ point - this is just an organisational emphasis point. [David Frame, New Zealand]	Taken into account. The statement has been heavily modified and merged with other statements, taking into account this comment.
53894	5	11	5	11	What is a "semi-continental" domain? On page 67, line 50 such domains are referred to as "sub-continental", which I think is more accurate and consistent with previous useage. [Timothy Carter, Finland]	Taken into account. The statement has been heavily modified and merged with other statements, taking into account this comment.
48240	5	13	5	13	Suggest adding "and/or" before "specialized" because it is not just higher resolution domains (e.g. the monsoon regions). [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. The statement has been heavily modified and merged with other statements, taking into account this comment.
10014	5	16	5	16	It is confusing, why an early industrial period is considered as a pre-industrial period for global temperatures; later on (page 69, lines 50-55) there is a clearer explanation of these terms. [Tibor Farago, Hungary]	The ES statement has been revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
9828	5	16	5	20	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. The claim that natural forcings of solar irradiance and volcanic activity around 1750 were similar to the modern period is hard to defend. The sun was just coming out of the deep Maunder Minimum which had a strong impact on climate in various places around the world. Likewise, volcanic activity 1750-1800 was particularly high, much higher than in modern times (Sigl et al. 2015). The theoretical forcings associated with these major changes in natural climate drivers may be erroneously close to zero in the climate models, however, in the real palaeoclimatic record, the climatic effects can be clearly seen. It is therefore misleading to claim that the situation in the natural drivers in the coldest part of the LIA resembles that of the modern last few decades. Readers will misunderstand this. [Sebastian Luening, Portugal]	The Maunder Minimum ended decades before 1750. The volcanic forcing in 1720-1800 is lower than surrounding periods. ES statement has been revised.
53896	5	16	5	20	This point is rather ambiguous and potentially misleading. It states that for temperatures, 1950-1900 is used to define pre-industrial, but for radiative forcing, 1750 is used. It then explains that 1750 was when the natural forcings were similar to the modern period, implying (perhaps unintentionally) that during 1850-1900 these forcings were somehow not similar to the modern period. Isn't 1750 used because at that time the anthropogenic contributions to radiative forcing (via atmospheric concentrations) were negligible? I'm not so sure about land use forcing, as natural forests had been cleared for agriculture in many populated regions already by then. Moreover, the reasons for adopting 1850-1900 for temperature are not explained here, but presumably relate to the availability of globally distributed climatological observations. So if these baselines are explained in this exec. summary, they should be explained consistently and unambiguously. Is it even necessary to refer to the 1750 date here, because it can be very confusing for the reader? 1850-1900 is clearly required as a baseline for the climate observations and projections, but how is 1750 being used in the AR6, except in the specialist radiative forcing chapter and in data Annexes showing the assumptions in simple models such as MAGICC? [Timothy Carter, Finland]	ES statement has been revised.
9108	5	16	5	20	The statement that pre-industrial solar radiative forcing was similar to that of now should be reviewed, for example in the context of solar irradiance, which was very low during the Little Ice Age; see also commemt 2. [Jim O'Brien, Ireland]	The solar irradiance was low during certain parts of the LIA, but not all the time. This is the point made here. The ES statement has been revised.
53082	5	17	4	19	"in terms of " before "radiative forcing" may seem a bit sloppy. Why not say that radiative forcing is given relative to the period around 1750. [Jan Fuglestvedt, Norway]	ES statement has been revised.
48242	5	19	5	19	After "modern period" need to add something about this being the period before anthropogenic atmospheric forcings. [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	ES statement has been revised.
32600	5	19	5	20	Can the cause of the early change be indicated--so perhaps methane coming from coal mines, rice cultivation, and elsewhere? Or perhaps due to land clearing that was taking place? Can some actual suggestions of cause be indicated? [Michael MacCracken, United States of America]	The main text now briefly discusses the sources of early GHG emissions.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
24438	5	19	5	20	In the text: “It is likely (medium confidence) that some anthropogenic warming occurred before 1850; the magnitude of this warming is between 0.0-0.1°C. {1.5.3}” Comment: If “some anthropogenic warming occurred before 1850”, consequently, the temperature anomaly must start from a value different from 0.0 in the text “the magnitude of this warming is between 0.0-0.1°C”. Also correct item “{1.5.3}”. Another possibility is to write: “some anthropogenic warming possibly occurred before 1850”. [Rubén D Piacentini, Argentina]	ES statement has been revised.
25976	5	19	5	20	It is unclear what is the probability of the 0 to 0.1 range; is this a likely (2/3 chance) range? If so, the previous statement says that it is also likely greater than 0. Suggest making it clear which (or both) are likely. [Haroon Kheshgi, United States of America]	ES statement has been revised.
26110	5	19	5	21	This is an exaggeration of the accuracy of climate science. It should read “ CO2 emissions between 1750 and 1850 were small compared to those now.Nevertheless, believe that even these emissions had a small warming effect on the climate.” Can anyone measure global temperature changes between 1750 to 1850 to +/- 0.1°C?? [Stephen Taylor, United Kingdom (of Great Britain and Northern Ireland)]	ES statement has been revised.
43012	5	19		20	It's unfortunate if the first use of the likely qualifier occurs in conjunction with medium confidence. Suggest reworking this to avoid that outcome. [David Frame, New Zealand]	ES statement has been revised though the medium confidence statement is likely to remain.
48244	5	22	5	22	Internal variability is not a "projection uncertainty" but an inherent property of the climatethough obviously it will influence the apparent projected change in a single realisation. Thus suggest removing this phrase from the bold text and then maybe adding the point in the first sentence of my comment. [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	ES statement has been revised.
26328	5	22	5	23	Why is the uncertainty from internal variability set apart like this? This is nontrivial since including the "unknown unknowns", we really have four sources of uncertainty, not three. [Jochem Marotzke, Germany]	Noted. Text has been revised.
13104	5	22	5	26	Consider specifiying the types of radiative forcings that are being referenced here to here. It is a bit confusing when compared to the last key point radiative forcing only refers to solar irradiance, astronomical factors, and volcanic activity, and not anthropogenic-induced radiative forcings (i.e., greenhouse gases). [Nora Richter, United States of America]	ES statement has been revised.
12594	5	22	5	26	Expand on this to reference self-reinforcing feedbacks that can further amplify warming outside the bounds of the future trajectory of radiation forcing and also reference the potential for surpassing irreversible tipping points that can becomes massive shifts on the climate system and cannot be remedied on a human timescale. [Kristin Campbell, United States of America]	ES statement has been revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
42308	5	22	5	26	Add to "(b) how the climate will respond to that specific trajectory" a reference to "self-reinforcing feedbacks, abrupt changes. and tipping points" as discussed in Drijfhout S., et al. (2015) Catalogue of abrupt shifts in Intergovernmental Panel on Climate Change climate models, PROC. NAT'L. ACAD. SCI. 112(43):E5777–E5786; and Steffen W., et al. (2018) Trajectories of the Earth System in the Anthropocene, PROC. NAT'L. ACAD. SCI. 115(33):8252–8259; 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; Xu and Ramanathan (2017) Well below 2 °C: Mitigation strategies for avoiding dangerous to catastrophic climate changes, Proc. Natl. Acad. Sciences; Xu Y., et al. (2018) Global warming will happen faster than we think, NATURE, Comment 564:30–32. [Gabrielle Dreyfus, United States of America]	ES statement has been revised.
53084	5	22	5	26	I think you need to mention "emissions" in this para. I suggest inserting this after "trajectory of" [Jan Fuglestvedt, Norway]	ES statement has been revised.
45954	5	22	5	26	Limiting uncertinties in the science, most especiall, projections as communicating to policymakers has always been an issue that often times lead to misunderstanding and lack of urgency for coherent actions. [Lourdes Tibig, Philippines]	No suggestion provided. No action required.
12744	5	22	5	26	Expand on this to reference self-reinforcing feedbacks that can further amplify warming outside the bounds of the future trajectory of radiation forcing and also reference the potential for surpassing irreversible tipping points that can becomes massive shifts on the climate system and cannot be remedied on a human timescale. Xu and Ramanathan 2017 show that the median staying well below 2ºC can keep warming to less than 1.5ºC, but the fat tail—the extension of the curve to the right—continues into the dangerous and catastrophic range, highlighting that even the best solutions still face some risk of excessive warming though far less risk than baseline scenarios that fail to include faster and much more aggressive mitigation. 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; Ramanathan and Feng (2008) On avoiding dangerous anthropogenic interference with the climate system: Formidable challenges ahead, Proc. Natl. Acad. Sci., doi: 10.1073/pnas.0803838105. [Durwood Zaelke, United States of America]	ES statement has been revised.
32598	5	23	5	23	There is a real jumping into jargon--so "radiative forcing". Why not take a few words and say due choices of energy technology and the associated emissions of climate-altering gases such as CO2 ….? I'd suggest really working to make the chapter readable by the general scientific community and replacing the jargon specialized to our field. [Michael MacCracken, United States of America]	Noted. This paragraph was completely changed in SOD.
44618	5	24	5	24	"natural events such as volcanic eruptions": I think that "solar activities" should be added here, which is the essential radiative source for the earth. And the variability of the sun in the future is uncertain but will certainly influence future trajectory of radiative forcing. [Liang Zhao, China]	ES statement has been revised.
15196	5	24	5	24	This is the very first time I encounter the word "sociotechnical" when talking about future scenarios. Where does it come from? [Claudia Tebaldi, United States of America]	Noted. This paragraph was completely changed in SOD.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
43014	5	24		26	As it's written, (b) and the "third source" are not clearly distinct phenomena - surely wildcards are part of "how the climate will respond to that specific trajectory"? I don't think you need the "third source" - you could just pack that into (b) by saying something like "..how the climate will respond to that specific trajectory, including unforseen contributions from phenomena not captured by models." That would give context, and clearly include both the uncertainties we know about and the ones we don't. [David Frame, New Zealand]	ES statement has been revised.
31514	5	25	5	25	"unkown unknowns" are part of (b) - "how the climate will respond to that specific trajectory". So, rather than "a third source of uncertainty regards", maybe say "A component of (b) regards" [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Noted. This paragraph was completely changed in SOD.
32602	5	25	5	26	So, why is the third source not introduced by ©? A bit of consistency would help [Michael MacCracken, United States of America]	Noted. This paragraph was completely changed in SOD.
15198	5	25	5	26	The way b) is phrased includes these unknown unknowns too. If b) is intended to talk about uncertainty in model structure and parameters, then it could expressed that more accurately/explicitly. [Claudia Tebaldi, United States of America]	ES statement has been revised.
24440	5	25	5	26	In the text: “A third source of uncertainty regards “unknown unknowns”, or possible aspects of climatic behavior not yet identified or accounted for. {1.5.4}” Comment: Please, change the expression “unknown unknowns” since it is not clear what it means (remember that it must be translated to different languages). Also correct item “{1.5.4}”. [Rubén D Piacentini, Argentina]	ES statement has been revised.
49398	5	25	5	26	I don't understand how the "unknown unknowns" are different from the ways in which the climate system may respond in an unknown way to the forcing (the second source of uncertainty). [Sonya Legg, United States of America]	ES statement has been revised.
10016	5	28	5	28	In AR6 scenarios, future global temperature levels and cumulative global carbon emissions .. (explanation: reference to global emissions is essential because of the international climate policy process and the CBDR-principle) [Tibor Farago, Hungary]	Noted. No change as not essential to specify here. Seems clear in the context of the sentence that this refers to global emissions.
53088	5	28	5	28	I think you can delete "In Ar6 scenarios". It is a bit imprecise and also not needed since the future perspective is obvious here. [Jan Fuglestvedt, Norway]	Taken into account. Scenarios should be referred to here as one of the three dimensions of integration. Revised accordingly.
15200	5	28	5	29	What is here written in bold type shortchanges the use of scenarios as a means of integration. Why only temperature levels and cumulative emissions are listed within the bold statement? [Claudia Tebaldi, United States of America]	Taken into account. Scenarios should be referred to here as one of the three dimensions of integration. Revised accordingly.
9830	5	28	5	35	Were the climate models that were used to calculate future temperature scenarios calibrated against well-known regional to global warm phases such as the Medieval Climate Anomaly and Roman Warm Period? Model performance success needs to be demonstrated by such a pre-industrial hindcast of the past 2000 years, both regionally and globally. [Sebastian Luening, Portugal]	Noted. The comprehensive assessment of the climate models used in the AR6 to project future climate change is part of the subsequent chapters, e.g., Chapters 4, 5, 11...
56436	5	28	5	35	The SSPs just describe the dimension of underlying socio-economic assumptions, the second dimension is the level of radiative forcing at the end of the century. Thus, it would be more accurate to write "A new set of emission and concentration scenarios, based on the Shared Socioeconomic Pathways (SSPs) and different levels of radiative forcing at the end of the 21st century, ..." [Elmar Kriegler, Germany]	Taken into account. The underlying text/figures in Chapter 1 have been revised. Text in the ES statement is revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
45956	5	28	5	35	The additional dimensions in the new AR6 scenarios (SSPs) could be better able to point the direction in which developing countries can keep abreast in achieving the Paris Agreement goal. [Lourdes Tibig, Philippines]	Noted. No action
53898	5	28	5	35	SSPs are not emission scenarios - they are socioeconomic pathways of driving factors that may result in different emissions, concentrations and radiative forcing outcomes (as well as levels of vulnerability or exposure to serve IAV analysis). They also require mitigation assumptions (shared policy assumptions or SPAs) to hit most of the concentration targets intended. Concentration and radiative forcing pathways were formerly referred to as RCPs - why are these not referred to here? RCPs are tied to SSPs in the Scenario-MIP simulations being carried out in CMIP6. Some traceability is needed back to AR5 where RCPs were the defined forcings. Some explanation of the shorthand now employed is needed right up front, so that readers can adjust from using RCPs to using SSP-RCP combinations. Describing them as SSP scenarios seems somewhat unfortunate, because these are only a few marker examples of SSPs, and not all can be covered by CMIP6 model runs. SSPs, as such, can result in many different concentrations and forcings (as shown in Fig. 1.23 - that's a very promising figure, by the way). Only an SSP marker, which is one example of an SSP outcome, can be associated with a specific emissions profile and hence forcing outcome (formerly known as RCP). All this needs to be explained more effectively here than it is currently. Or at least, the transition from RCP to SSP-RCP marker and now confusingly labelled SSP scenario needs to be communicated effectively in Chapter 1. [Timothy Carter, Finland]	Taken into account. The underlying text/figures in Chapter 1 have been revised. Text in the ES statement is revised. Point about traceability from AR5 to AR6 is now more prominently.
43016	5	28		29	Maybe I'm being a calculus dork, but I really don't like the phrase "dimensions of integration", especially when one of the variables then mentioned is an integrated variable, and the other is not usually thought of that way. But I see it's a cross-WG thing, so I suppose there's nothing we can do about it except explain it a thousand times. [David Frame, New Zealand]	Noted. No action
29334	5	29	5	30	Might be more appropriate to use the terminology consistently with SR.1.5. Please refer to SSP definition in the SR1.5 glossary. SSPs are shared socioeconomic pathways, alternative futures in absence of climate policy. [Minal Pathak, India]	Noted. To be addressed as part of the cross-WG negotiations on scenarios.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
30420	5	29	5	31	This seems to confuse the concept of the "Shared Socioeconomic Pathways" or SSPs, which are narratives that describe five different socioeconomic futures, with the scenarios that are developed with these different socioeconomic futures as a basis (and which are referred to as SSP2-4.5, SSP1-1.9, SSP5-8,5, etc). SSPs in themselves are not yet emission scenarios. Their quantification, combined with constraints/choices about their climate outcome are. SSP narratives are described here: O'Neill, B. C., E. Kriegler, K. L. Ebi, E. Kemp-Benedict, K. Riahi, D. S. Rothman, B. J. van Ruijven, D. P. van Vuuren, J. Birkmann, K. Kok, M. Levy and W. Solecki (2017). "The roads ahead: Narratives for shared socioeconomic pathways describing world futures in the 21st century." Global Environmental Change 42: 169-180. They are combined with a climate constraint and quantified to provide SSP-based emissions scenarios: Riahi, K., D. P. van Vuuren, E. Kriegler, J. Edmonds, B. C. O'Neill, S. Fujimori, N. Bauer, K. Calvin, R. Dellink, O. Fricko, W. Lutz, A. Popp, J. C. Cuaresma, S. Kc, M. Leimbach, L. Jiang, T. Kram, S. Rao, J. Emmerling, K. Ebi, T. Hasegawa, P. Havlik, F. Humpenöder, L. A. Da Silva, S. Smith, E. Stehfest, V. Bosetti, J. Eom, D. Gernaat, T. Masui, J. Rogelj, J. Strefler, L. Drouet, V. Krey, G. Luderer, M. Harmsen, K. Takahashi, L. Baumstark, J. C. Doelman, M. Kainuma, Z. Klimont, G. Marangoni, H. Lotze-Campen, M. Obersteiner, A. Tabeau and M. Tavoni (2017). "The Shared Socioeconomic Pathways and their energy, land use, and greenhouse gas emissions implications: An overview." Global Environmental Change 42: 153-168. And for the 1.5°C compatible scenarios (SSPx-1.9) here: Rogelj, J., A. Popp, K. V. Calvin, G. Luderer, J. Emmerling, D. Gernaat, S. Fujimori, J. Strefler, T. Hasegawa, G. Marangoni, V. Krey, E. Kriegler, K. Riahi, D. P. van Vuuren, J. Doelman, L. Drouet, J. Edmonds, O. Fricko, M. Harmsen, P. Havlík, F. Humpenöder, E. Stehfest and M. Tavoni (2018). "Scenarios towards limiting global mean temperature increase below 1.5 °C." Nature Climate Change 8(4): 325-332. [Joeri Rogelj, Austria]	Taken into account. The underlying text/figures in Chapter 1 have been revised. Text in the ES statement is revised.
32604	5	31	5	31	I don't understand--are not the "Two addditional dimensions" mentioned in this sentence the same ones as in the opening line of paragraph on line 28? While on this point, I'd suggest that sea level needs to be an additional dimension, especially the commitment to future sea level rise that is occurring, roughly estimating this amount based on a sea level sensitivity dervied from paleoclimatic analyses. [Michael MacCracken, United States of America]	Noted. No change
57800	5	31	5	31	The following phrase will need an additional comma or other clarification that a non-expert (i.e. lay) copy editor would be unable to supply: "the physical sciences, impact and adaptation and mitigation research" [Peter Kalmus, United States of America]	Noted. This paragraph was completely changed in SOD.
57802	5	31	5	33	Suggest clarifying by explicitly numbering the two additional dimensions here using text such as "1) ..." [Peter Kalmus, United States of America]	Noted. This paragraph was completely changed in SOD.
45120	5	33	5	33	I suggest you change: "… The SSP scenarios cover lower levels of warming compared to previous Assessment Reports" to "The SSP scenarios INCLUDE lower levels of warming …" [Reason: The "cover " wording could be interpreted to mean the SSP scenarios don't include the higher end of the scenarios considered in previous reports] [David Wratt, New Zealand]	Taken into account. Text revised to say "cover lower emission pathways"
53900	5	33	5	34	Lower levels of forcing rather than warming [Timothy Carter, Finland]	Taken into account. Text revised to say "cover lower emission pathways"

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
32606	5	33	5	35	To my mind it is really unfortunate that scenarios consistent with meeting the objective of the UNFCCC are not being included. One aspect of doing this would be to include a scenario with very aggressive resuctions in the emissions of short-lived species, which the UNEP Black Carbon and Ozone Assessment and Shindell et al.'s Science paper suggest could cut the projected warming between the present and 2050 on half--something that is simply not possible with a strategy of mainly mitigation of CO2 emissions. The set of scenarios, I would also suggest, would be more complete were it to also include a case that involved shaving off peak warming with SRM so that the increase in global average temperature would be pushed down to less than 0.5 C over the next few decades. I just don't think the effort has been sufficiently imaginative. [Michael MacCracken, United States of America]	Noted. No change
39448	5	37	5	39	I like a statement as this one in the CH1 ES. Although the sentence after the bold one requires further elaboration. There is literature concluding that interdisciplinary and transdiciplinary approaches provides the best framework for risk management. In that sense not only a better climate understanding is needed but also its understanding in the context of the non-climatic dimensions related with the risk. The second part of this last sentence is not clear. If the intention is to discuss there, climate knowledge gaps, it is good but it requires more elaboration [Carolina Vera, Argentina]	Thanks for the suggestion, it is noted. This section has been completely changed, and the limits to risk assessment forms only a small part.
44066	5	37	5	39	Include exmples of risk assessment areas, e.g. economic, sociopolitical, cultural, ecological, etc. [Sara Kahanamoku, United States of America]	This will be picked up further in WGII.
45958	5	37	5	39	A long-standing challenge in the developing world is risk assessment, in terms of knowledge gaps and lack of data/understanding. [Lourdes Tibig, Philippines]	Thanks for the comment. However WG1 does not do risk assessment. Hence, although it might be an important gap, it is not for WG1 to address, though the links to WGII and WGIII are mentioned in this section that has now been re-written.
43018	5	37		39	Reads a bit like a homily - do you really need this? [David Frame, New Zealand]	Section 1.7 has been completely changed. It now lists the limits to the assessment.
15202	5	39	5	39	I don't understand this and I'm not sure it follows from the previous sentence. Primed would suggest that they are intrinsically on the verge of providing new advanced understanding, while the fact that they are part of the risk structure simply says they are crucially important to understand (but they could be really hard to). Or am I misinterpreting what "primed" means? [Claudia Tebaldi, United States of America]	Section 1.7 has been completely changed. Hence not applicable anymore. The introduction of the risk assessment framing is important to come early in the section. This section is now referring to limitations to the assessment. This includes the breadth of literature (as we move to a more regional focus), the inability to perfectly capture all observations (and paleo-archives), or perfectly capture every process in climate models, or every future in the scenarios. The integration across the three WGs will help with full end-to-end risk assessment. This is mentioned, but only briefly.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
53090	5	39	5	39	re "informed risk assessment": I think this topic may need a bit more attention in the ES. This will help the reader since this is a topic that cuts through chapters and WG reports. [Jan Fuglestvedt, Norway]	Section 1.7 has been completely changed. Discussion of risk assessment comes earlier in the chapter. In Chapter 1, WGI it is merely introductory and will be picked up more fully in WGII.
53902	5	39	5	39	This might be the place where the IPCC risk assessment framing could be introduced (rather than the first point on Page 4). After explaining the risk framework, integration of knowledge across disciplines would be a logical outcome which could help to reduce key knowledge gaps and is one of the benefits of applying a consistent risk framework across the three WGs. [Timothy Carter, Finland]	Section 1.7 has been completely changed. Hence not applicable anymore. The introduction of the risk assessment framing is important to come early in the section. This section is now referring to limitations to the assessment. This includes the breadth of literature (as we move to a more regional focus), the inability to perfectly capture all observations (and paleo-archives), or perfectly capture every process in climate models, or every future in the scenarios. The integration across the three WGs will help with full end-to-end risk assessment. This is mentioned, but only briefly.
53904	5	40	5	40	Should there be a point in the Exec. Summary about the role of WG I in contributing to the Global Stocktake? Currently it isn't even mentioned. A whole box is devoted to this in Chapter 1, which seems like the right place to introduce this. [Timothy Carter, Finland]	Taken into account. The global stocktake is covered in the revised ES.
10018	6	4	6	7	(AR6/2022:) This cooperation began 50 years ago, i.e. in 1972 as the climate change problem was also addressed at the UNCHE held in Stockholm and some provisions for the international cooperation were also included in the Action Plan adopted there. Already that time, Bert Bolin was one of the key scientists focusing on this issue and later on he was elected as the first chairman of the IPCC. The cooperation was gradually enhanced when the first World Climate Conf. was held in 1979 (Geneva) and the World Climate Programme was launched from 1980. The IPCC was founded in 1988 (not 1990); 1990 is the year of the FAR that had important effect on the negotiations of the UNFCCC. (Personal remark: I dealt with this evolving international climate science and policy process in a paper, Farago T., 2016: The anthropogenic climate change hazard: role of precedents and the increasing science-policy gap. Időjárás, 120:1, pp. 1-40 ISSN 0324-6329. http://real.mtak.hu/60726) [Tibor Farago, Hungary]	Taken into account - combined with Comment ID 51572.
51572	6	4	6	13	This is exactly what I meant for the above - if there was any way to give this clarity in the summary, and not just in the main text (which sadly, few policy makers read). [Lindsey Cook, Germany]	The executive summary covers these topics.
43020	6	5		7	Is this needed? It comes across as a bit of IPCC self-congratualtion, and it's not obvious that climate change will be a challenge beyond this century (as in - who knows?) [David Frame, New Zealand]	Taken into account. Text revised.
41298	6	6	6	6	Add 'report' after IPCC to indicate that you are referring to IPCC report not the inception of IPCC [Debra Roberts, South Africa]	Taken into account. The text was revised to make clear it refers to IPCC.
54594	6	8	6	8	have substantially increased instead of has….. [KENEL DELUSCA, Canada]	Accepted. The suggested change has been implemented

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
54596	6	9	6	14	As per the last paragraph of 1.1, it would have been useful to mention in the introductory paragraph the gaps that this AR is intended to address or the needs to consider new developments/new challenges since AR5. Indeed, if some some key conclusions from previous IPCC assessments remain unchanged, some have been nuanced du to new knowledge, additionnal observations or new techniques; new questions/new challenges/new needs to which this AR seeks at answering have been emerged. [KENEL DELUSCA, Canada]	Taken into account. This point is now treated throughout both Chapter 1 and, indeed, much of the report.
57804	6	11	6	12	Are the words "some" and "practically" really the best word choices for this sentence? They sound at once imprecise and weak. Consider simply deleting both. In general, throughout this chapter, resist the urge to use these kinds of "softening" words if they do not actually enhance accuracy, precision, or meaning. [Peter Kalmus, United States of America]	The words "some" and "practically" have been removed from the mentioned sentence.
31516	6	12	6	12	"remained" should be "remain" ? [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. Text changed and that word is no longer used.
43290	6	16			The sentence begning from line 16 should be shortened and splitted. [Onema Adojoh, United States of America]	Text revised.
46180	6	17	6	17	The cross-WG risk definition carefully distinguishes between risks and impacts. In some places the distinction is not applied, [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	Noted
31518	6	18	6	18	"its" should be "and its" ? [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Sentence was reworded.
10022	6	18	6	18	It would be useful to insert (after the first sentence of this para) a “reminder” of the significant IPCC-COP relations; e.g.: The comprehensive, policy relevant information included in the ARs was also presented to the representatives of the Parties and apparently this science-based information had its catalyzing impact on the evolving global climate policy regime, the international climate governance. (Personal remark: I could closely follow the evolving IPCC-INC/COP cooperation, as I was the national climate negotiator and the IPCC focal point, 1991-2010. I used to be also the first chairman of the SBSTA; Bert Bolin and myself co-chaired the Joint Working Group that assisted the cooperation of the IPCC Bureau and the COP Bureau.) [Tibor Farago, Hungary]	Noted
10020	6	21	6	21	adaptation options to climate change, [Tibor Farago, Hungary]	Accepted. The suggested change was included.
35210	6	22		23	It is confusing to say the context of the present report is different and then to follow this statement with a verbatim statement of what we have said in previous reports. Is the context different? [Ko Barrett, United States of America]	Comment does not match FOD text.
43022	6	29			I would delete "for the first time in the IPCC" [David Frame, New Zealand]	Rejected. The phrase was kept in the text.
39450	6	31	6	32	The focus is not only on the international climate governance frameworks but also with a focus on the policy needs of regional climate change assessments. It is important to keep in mind that IPCC reports are not only to underpin discussion within UNFCCC and other global bodies, but also to underpin decision making at other society dimensions like regional levels, for example [Carolina Vera, Argentina]	The focus on the needs of regional climate change policy making has been added.
53092	6	32	6	32	regarding the ambition "to frame the AR6": perhaps a bit too ambitious to frame the full AR6. I would rather say chapter 1 (and the WGI report) supports the framing for other WG reports [Jan Fuglestvedt, Norway]	The sentence has been modified accordingly.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
43024	6	33		34	I don't see the justification for "with a focus on international climate governance frameworks". Which international climate governance frameworks? The UNFCCC, or the climate change regime complex (e.g. Victor and Keohane). Interpreted how? Viewed through what lens? For what purpose? This just seems like a can of worms. [David Frame, New Zealand]	Taken into account - combined with Comment 39450.
35212	6	37			Avoid use of profound or other adjectives that are not easily quantified. [Ko Barrett, United States of America]	Comment does not match FOD text.
31520	6	38	6	40	The title of Section 1.2 is "The global context of the present assessment", so I think that the word 'global' should appear in the description of the section here, or the title should be changed to simply "The context of the present assessment". [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	The mentioned section has been thoroughly revised and its heading renamed.
48380	6	48	5	49	The IPCC charter specifies "risks and impacts" of anthropogenic climate change. Apparently this has been interpreted to mean only the downside of warming and carbon dioxide will be considered. Add a disclaimer such as this: "This report deals chiefly with the known and potential adverse consequences of climate change. Although some currently arable land will be lost, other land, especially at high latitudes, will see longer growing seasons. In addition, higher CO2 levels have been shown to increase crop yields. In the judgment of IPCC, the net impact of climate change will be negative. Use an Internet search engine to find references to benign phenomena." [Stephen Parks, United States of America]	Unclear how this comment applies to the text here. Proposed disclaimer is incorrect and does not reflect the work done in this assessment nor in previous ones. IPCC assesses all impacts of CC independent of whether they might be perceived positive or negative.
35214	6	51			Insert "have changed and" before "are expected" [Ko Barrett, United States of America]	Rejected, comment refers to an earlier internal draft of the chapter and is not applicable to the FOD
55106	6	52	7	4	[pt 1 of 2] The paragraph says, "Numerous, substantial changes have been observed across the physical climate system, many of which can be attributed to anthropogenic influences, with impacts on natural and human systems. 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]	Thanks. The distinction between the (dominating) negative impacts and the potential benefits of climatic impact drivers are now discussed as part of the risk framing, later in the chapter. Here, we focus on the observed changes and the ongoing responses.
55108	6	52	7	4	[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]	See response to 55106

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57806	6	52	7	4	This paragraph doesn't make sense to me. It starts by saying the context of AR6 is different - which I think is true - but the rest of the paragraph does not succeed in explaining why. The 2nd sentence was certainly true in AR5, and the third sentence sounds like a platitude. This paragraph should strongly summarize why, actually, the context is different: a sense of urgency within the scientific community, that the window for action is rapidly closing, or even - for many ecosystems and Earth processes - may have already irreversibly closed. This paragraph is in a key position within the entire AR6 report and should be considered very carefully. [Peter Kalmus, United States of America]	The paragraph starts now with the sense of urgency (with reference of SR 1.5) and the commitment from international frameworks, governments and societies to take actions to minimize risks posed by climate change and to limit GHGs.
6327	6	52	8	15	What validating mechanisms were used to authentiicate various assessment of climate variables across regions? [Isaac Sarfo, Ghana]	This is discussed in the subsequent chapters of the report. We summarize here, and give reference to the full assessment.
43026	6	53	7	5	This paragraph isn't clear. The first two sentences invite the reader to make the mistaken inference that AR6 is different from other ARs because "substantial changes have been observed across the physical climate system, many of which can be attributed to anthropogenic influences, with impacts on natural and human systems". But this would be a mistaken inference because all those things were also part of AR5, for instance. The next sentence is also problematic because it doesn't obviously belong in a WGI report. (Neither is that stuff a new feature of this AR cycle, either.) I'm not sure what you're trying to say here. [David Frame, New Zealand]	The paragraph starts now with the sense of urgency (with reference of SR 1.5) and the committeemen from international frameworks, governments and societies to take actions to minimize risks posed by climate change and to limit GHG. The Paris agreement sets the context of a renewed global accord on mitigation and a stronger sense of urgency from SR1.5, SROCC, etc..
36634	7	1			The use of "can" implies a conditional where I think the authors wished to say that they do attribute the changes to physical influences. Lots of things can happen, most of them don't. [Paul Copland, New Zealand]	Editorial. Disagree with reviewer's interpretation of "can be"; in this context it means that some changes are attributable to climate change.
54598	7	2	7	6	Could you also provide broad figures of losing mass from other components of the cryosphere like the Greenland Ice Sheet whose contribution to sea level rise is expecting to be more pronounced in the future (Aschwanden etl. 2019: Contribution of the Greenland Ice Sheet to sea level over the next millennium) [KENEL DELUSCA, Canada]	Rejected, comment refers to an earlier internal draft of the chapter and is not applicable to the FOD
27072	7	6	7	9	The sentence structure need to be rechecked. [Nyein Chan NIL, Myanmar]	Rephrased
35218	7	6		7	The statement that the rates of increase are consistent with known emissions when taking into account the observed and inferred uptake of oceans and biosphere gives the misleading impression that we know these uptakes more precisely than we do, especially the rates. Also, it is unclear why "respectively" is used in this sentence (editorial). [Ko Barrett, United States of America]	Accept - but the comment is actually about p 7 lines 42-44. Omitted "respectively" (unnecessary). Revised statement about rates.
6459	7	7	7	7	Mention ocean heat gain below 2000 meters [Hugh Lefcort, United States of America]	Accepted. We do mention this in the revised version.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
55114	7	9		10	[pt 1 of 2] The sentence says, "The global mean sea level is rising at the rate of [XX] mm/year over [19XX-20XX] 10 (Figure 1.1, wedge f), and this rate has itself increased, from [XX] mm/yr over [19XX-19XX]." That is untrue. The best long sea-level measurement records show no statistically significant acceleration in rate of sea-level rise since the 1920s. E.g., https://sealevel.info/1612340_Honolulu_Wismar_Stockholm_vs_CO2_annot3.png The only way to find significant acceleration in the rate of sea-level rise is to use short measurement records, or to do apples-to-oranges comparisons of measurements at different locations and/or by different means. [cont'd] [David Burton, United States of America]	Rejected. Please see the recently released Special Report on Ocean and Cryosphere, which we now refer to for this statement.
55116	7	9		10	[pt 2 of 2[I suggest that the sentence be replaced with the following: "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 is 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]	see response to 55116
31522	7	11	7	12	"(1.2.4)" should appear at the very end of the sentence. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. Due to reorganizing of contents, the sentence has been removed.
35222	7	11		16	This paragraph is hard to follow. It seems to be a jumble of information, not all of which makes sense. On one hand we offer a very specific number for interannual variability and on the other we say observed changes extend beyond this range. Then we discuss (again) anthropogenic influence and end with other factors. Please revisit to tell a coherent story. [Ko Barrett, United States of America]	Rejected, comment refers to an earlier internal draft of the chapter and is not applicable to the FOD
35220	7	11			Is quasi-random a well understood term? [Ko Barrett, United States of America]	The phrase does not appear in section 1.2 but 1.4
44890	7	15	9	24	This section on the changing state of the climate system based on paleo observations could benefit from closer synchronization with and reference to CH2, which assesses observational evidence for large-scale changes in each of these spheres. [Darrell Kaufman, United States of America]	Taken into account.
43292	7	17			The sentence begning from line 17 should be shortened and splitted. [Onema Adojoh, United States of America]	Text revised.
31524	7	20	7	20	"many" should be "that many" ? [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Text revised.
26330	7	22	7	22	Acceleration since 2013 is unsubstantiated. Given the recent public debate about hiatuses and surges, any treatment needs to be thorough. [Jochem Marotzke, Germany]	Text revised.
53094	7	23	7	23	Since you use material form other chapters I think you should make it more clear that these are presented in a more integrated way here. Therefore I suggest inserting "integrated and" before "illustrated" [Jan Fuglestvedt, Norway]	Text revised.
35224	7	23		24	What is meant by "geographic pattern that is different to surface warming"? Are we meaning that precip and temperature change in different ways? Please clarify [Ko Barrett, United States of America]	Text revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
35226	7	24		25	The increase in extreme precip is larger the more extreme the event? I'm not sure what is worth telling with this statement. Is this like saying "In general the total rainfall is larger the longer and harder it rains." [Ko Barrett, United States of America]	Text revised.
31526	7	31	7	31	In Figure 1, it would be good if the labels match the language in the text exactly, so e.g. "Land surface" instead of "Land". [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Thanks. The figure has been extensively revised.
51752	7	33	7	34	The mean was not defined in caption of figure 1.1. [Anson Cheung, United States of America]	Thanks. The figure has been extensively revised.
39452	7	34	7	34	I like the rosette. Although it is not clear what the precipitation wedge describes. More detailed description should be included in the caption, as well as the data source and the reference period considered to compute the mean values [Carolina Vera, Argentina]	Thanks. The figure has been extensively revised.
51754	7	34	7	35	I don't think figure 1.1 presents any strong evidence that "many components of the climate system have noew been altered outside of their natural range of interannual variability [Anson Cheung, United States of America]	Thanks. The figure has been extensively revised.
8064	7	41	7	44	Comment : "These observed changes are consistent with known anthropogenic emissions, when accounting for observed and inferred uptake by the oceans and biosphere respectively." This sentence suggests that no debate exists on new increasing sources of methane from permafrost or seabed. Moreover, this contradicts what is written on p. 36 (line 11-12). To the cited references (0'Connor 2010 and Ruppel and Kessler 2017), I suggest to add the articles by Bruhwiler et al 2017 ; Turner et al 2017 and Sparrow et al 2018 showing that there is a debate on the possibility of increasing sources from the ocean floor and permafrost related to global warming. [Anne Coudrain, France]	Not applicable; the text has been substantially altered.
51756	7	41	8	10	This can be more concise because all the paragraphs are saying realm X (e.g. atmosphere) is changing rapidly at a rate Y. Presenting the data as part of the figure or another table might work better. [Anson Cheung, United States of America]	Not applicable; the text has been substantially altered.
28752	7	41	8	15	Hard numbers on current trendds seem better suited to other chapters [Piers Piers Forster, United Kingdom (of Great Britain and Northern Ireland)]	Text revised.
7996	7	42	7	43	While methane is increasing, there is a very lively debate about why that's the case. A consensus has not emerged. To say that methane increases are consistent with known emissions isn't reflecting this debate. Please rephrase. [Olaf Morgenstern, New Zealand]	Text revised.
43688	7	42	7	44	It would be better to say "these global observed changes are consistent with known anthropogenic emissions" of CO2, CH4, and N2O. Regional changes are influenced by SLCFs as discussed in chapter 6 [Vaishali Naik, United States of America]	Noted. No change warranted; "global" is clear from the context.
53096	7	43	7	43	You mention uptake by ocean and biosphere, but some important gases are also removed by chemical destruction in the atmosphere. Thus, I suggest inserting "chemical removal in the atmosphere" after "inferred" [Jan Fuglestvedt, Norway]	Text revised.
27640	7	44	1	44	the data is missing [Poot Delgado Carlos Antonio, Mexico]	The data has been added, or clearly marked as 'placeholder'.
43376	7	45	7	45	Perhaps this is just a function of the placeholders, but Figure 1.1b and caption alternately refers to a reference years of 1850 and 1880. [Kristina Pistone, United States of America]	Thanks. The figure has been extensively revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
27074	7	45	7	45	Based on NOAA, the global mean CO2 concentration is increasing by 2.2 ppm per year during the last decade. At Mauna Lao Atmospheric Baseline Observatory, the avarage for May peak at 414.7 ppm which is 3.5 ppm higher than the 411.2 ppm peak reached in May, 2018. (Ref: Eleanor Imster and Deborah Byrd (June 17, 2019) - Atmospheric CO2 hits record high in May 2019 in EARTH. https://earthsky.org/earth/atmospheric-co2-record-high-may-2019; https://research.noaa.gov/article/ArtMID/587/ArticleID/2461/Carbon-dioxide-levels-hit-record-peak-in-May). [Nyein Chan NIL, Myanmar]	Noted. The record high in May 2019 is remarkable but not something to mention in 1.2.1, where we're talking about annual and decadal, global averages.
27076	7	46	7	46	Is "Mauna Loa" a station for measuring the climate variables? If so, it had better add "Mauna Loa" Observatory, Hawaii, etc. When I checked the name, it seemed to be a volcano. [Nyein Chan NIL, Myanmar]	Text revised.
46098	7	48	7	48	"Both the atmosphere and the land surface are undergoing rapid changes." should include ocean? [Amy Featherstone, United Kingdom (of Great Britain and Northern Ireland)]	Text revised.
42832	7	48	7	50	This needs expansion. A key indicator is upper tropospheric temperature and specific humidity, as an indicator of the importance of the water vapor feedback. Reference to updated observations following Soden et al 2005 would be important to note. [Michael Evans, United States of America]	Thanks. There are many potential indicators, most of which are assessed in Chapter 2. Here we only wish to highlight the multiple, concurrent changes throughout the system.
37288	7	48	7	50	It would be better eventually to quote values from the latest datasets to be used in the SOD here. The period over which the trend is calculated should be specified. The trend estimates are creeping upwards. They are currently indicating 0.18ºC/decade for the 40-year period 1979-2018. Chapter 2 has trend maps for 1980-2018 in Fig. 2.11 which are due to be updated to new datasets and perhaps extended to 1980-2019 for the SOD. The centres providing these maps could be asked to provide the corresponding global average trends. Alternatively, as what "presently" is the trend is not the same as (and probably a bit higher than) the trend calculated over the last 40 years, one could close the praragraph less precisely: "is presently increasing at a rate of close to 0.2ºC/decade". [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	The text has been substantially revised, and we generally do not discuss trends.
43690	7	48	7	50	It would be interesting to see how land and ocean temperatures are varying individually. Is it possible that land temperatures may be changing more rapidly than oceans? [Vaishali Naik, United States of America]	We considered this, but in the end decided not to overload the figure. Land/sea is shown very clearly in Chapter 2.
55110	7	48		50	[pt 1 of 2] The paragraph says, "Both the atmosphere and the land surface are undergoing rapid changes. Most notably, the global mean surface temperature has increased by [XX] °C since [YYYY] and is presently increasing at a rate of 0.17 °C per decade [SR15]." In the first place, that's not "rapid," and in the 2nd place it appears to be a rate maximized by choosing time period endpoints to take advantage of ENSO cycles, AND by cherry-picking a "hot" temperature index. In other words it is deceptive. If you don't do tricks like that, you get lower rates of warming. [cont'd] [David Burton, United States of America]	Please see the assessment of surface temperature calculations in Chapter 2.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
55112	7	48		50	[pt 2 of 2] Here's a graph showing GISS (the highest) and UAH6+HadCRUT (the lowest) temperature trends, from 1960 to 2014. https://sealevel.info/GISS_vs_UAH_and_HadCRUT_1960-2014_woodfortrees_annot2.png = https://tinyurl.com/wft1960-2014 (1960 was near the beginning of an ENSO-neutral period, and 2014 was near the end of an ENSO-neutral period.) The warming trend for that 54 year period was about 0.15 °C / decade (GISS) or 0.07°C / decade (UAH6+HadCRUT). I suggest rewriting the paragraph to read, "Globally averaged temperatures have been slowly rising, at an average rate of about 0.11 ±0.05 °C / decade, which implies typically a poleward shift of isotherms of 6 to 24 km per decade." [Hansen et al 1988 doi:10.1029/JD093iD08p09341] ### [David Burton, United States of America]	Please see the assessment of surface temperature calculations in Chapter 2.
15980	7	49	7	49	"0.17oC" should read "0.2oC" (IPCC Special Report of 1.5C Global Warming, SPM, A1.1) [SAI MING LEE, China]	Text revised.
27078	7	49	7	49	The global mean surface temperature has increased by 0.8 degree Celsus (1.4 degree Fahrenheit) since 1880. (Ref: https://earthobservatory.nasa.gov/world-of-change/DecadalTemp) [Nyein Chan NIL, Myanmar]	Best available numbers will be used for the final report.
29918	7	49	7	49	I cannot believe that an instantaneous decadal rate of change, even for GMST, could be determined to such a high level of precision. [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	Text revised.
27642	7	49	7	54	the data is missing [Poot Delgado Carlos Antonio, Mexico]	Text revised.
7998	7	52	7	55	I agree with changing this discussion to pH. That would be much more straightforward to present than changes in precip which are complicated and difficult to represent in a pie chart. [Olaf Morgenstern, New Zealand]	Thanks. The figure has been extensively revised.
45960	7	52	7	55	It is being suggested that the time series of ocean surface pH presents "new knowledge" to lcountres with inadequate observation platforms; thus, this be iadded. [Lourdes Tibig, Philippines]	Thanks. The figure has been extensively revised.
37290	7	52	7	55	Wedge c of Fig 1.1 does not provide a very clear signal, or put more crudely is a bit of a mess. I would support changing to a different variable if a clearer precipitation signal cannot be shown. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Thanks. The figure has been extensively revised.
57218	7	53	7	54	The meaning of this part of the rossette (wedge c), I can not understand regarding the evolution of annual mean precipitation over land. For me, not understandable. [Sharl Noboa, Ecuador]	Thanks. The figure has been extensively revised.
29280	7	54	7	54	I think shifting to a wedge showing ocean pH is definitely better. [Fabio D'Andrea, France]	Thanks. The figure has been extensively revised.
55068	7	54	7	55	I support keeping the precip indicator in the figure [Trude Storelvmo, Norway]	Thanks. The figure has been extensively revised.
45122	7	54	7	55	Regarding the comment that the "precipitation" sector of Figure 1.1 might be changed to a pH sector: I don't think the rainfall sector should be removed, as it is of strong policy relevance as is the message that the regional pattern of change is different to that for temperature. However, a pH sctor could be added. [David Wratt, New Zealand]	Thanks. The figure has been extensively revised.
51822	7	54	7	55	Given tha Ocean pH is a mirror image of atmospheric CO2 having two wedges seems inadvisable and I would be tempted to suggest keeping the precipitation one. [Peter Thorne, Ireland]	Thanks. The figure has been extensively revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
14966	7	54	7	55	There is an italic note to consider changing the observations to a time series of pH rather than precipitation. I don't follow the rationale for making this change - the precipitation plots are clear. [Erin McClymont, United Kingdom (of Great Britain and Northern Ireland)]	Thanks. The figure has been extensively revised.
43694	7	54	7	55	Why are the authors planning to change the precip wedge in Figure 1.1 to show oceanic surface pH? I understand that oceanic acidition is a relevant climate change indicator, but precipitation would be more relevant [Vaishali Naik, United States of America]	Thanks. The figure has been extensively revised.
27080	7	54	7	55	Five series of observations, available for the period 1901-2010??? (AR5-Chapter 2, p.201-204) [Nyein Chan NIL, Myanmar]	Thanks. The figure has been extensively revised.
49400	7	54	7	55	The suggestion in italics ("consider changing this to a time series of ocean surface pH") is completely out of place here in this discussion of precipitation patterns. [Sonya Legg, United States of America]	Thanks. The figure has been extensively revised.
45626	7				It might be helful to have a brief mention in this section of the feedback question everyone gets asked" "will the warming feed the warming". [Euan Nisbet, United Kingdom (of Great Britain and Northern Ireland)]	Thanks. Feedbacks are indeed mentioned elsewhere in the chapter, but not explicitly at this point in the text.
42796	8	2	8	3	Cryosphere also includes freshwater ice (lake and river ice) and solid precipitation [Xiao Cunde, China]	Thanks. The figure has been extensively revised.
12596	8	2	8	5	The Arctic is also particularly threatened by greater-than-average warming due to Arctic amplification. Because the Arctic is warming at twice the rate as the global average and because Arctic sea ice is susceptible to this increased temperature, Arctic sea ice is being reduced, which contributes to a positive feedback within the climate system that can further amplify warming. Include that both the declining Arctic sea ice and thawing permafrost can contribute to positive feedbacks that will further affect the climate—the sea ice through reduced albedo and the permafrost through released terrestrially stored carbon. These feedbacks can further amplify warming that risks not meeting the goal of staying well below 2C/1.5C. Arctic Monitoring and Assessment Programme (AMAP) (2017) SNOW, WATER, ICE, AND PERMAFROST IN THE ARCTIC: SUMMARY FOR POLICYMAKERS, 8 (“The Arctic is still a cold place, but it is warming faster than any other region on Earth. Over the past 50 years, the Arctic’s temperature has risen by more than twice the global average. Increasing concentrations of greenhouse gases in the atmosphere are the primary underlying cause: the heat trapped by greenhouse gases triggers a cascade of feedbacks that collectively amplify Arctic warming.”). [Kristin Campbell, United States of America]	Noted. As readability is a key goal, we cannot be comprehensive in this section. A full assessment is done in chapter 9.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
12598	8	2	8	5	Permafrost thaw can also be a source of N2O, a greenhouse gas that can contribute additional warming. Wilkerson J., et al. (2019) Permafrost nitrous oxide emissions observed on a landscape scale using the airborne eddy-covariance method, ATMOS. CHEM. PHYS. 19:4257–4268, 4257 ("The microbial by-product nitrous oxide (N2O), a potent greenhouse gas and ozone depleting substance, has conventionally been assumed to have minimal emissions in permafrost regions. This assumption has been questioned by recent in situ studies which have demonstrated that some geologic features in permafrost may, in fact, have elevated emissions comparable to those of tropical soils. However, these recent studies, along with every known in situ study focused on permafrost N2O fluxes, have used chambers to examine small areas (< 50 m2). In late August 2013, we used the airborne eddy-covariance technique to make in situ N2O flux measurements over the North Slope of Alaska from a low-flying aircraft spanning a much larger area: around 310 km2. We observed large variability of N2O fluxes with many areas exhibiting negligible emissions. Still, the daily mean averaged over our flight campaign was 3.8 (2.2–4.7) mg N2O m−2 d−1 with the 90 % confidence interval shown in parentheses. If these measurements are representative of the whole month, then the permafrost areas we observed emitted a total of around 0.04–0.09 g m−2 for August, which is comparable to what is typically assumed to be the upper limit of yearly emissions for these regions."). [Kristin Campbell, United States of America]	Noted. As readability is a key goal, we cannot be comprehensive in this section. A full assessment is done in chapter 9.
14968	8	2	8	5	It isn't clear why the sea-level plot for Figure 1.1 is in shades of blue when those same shades are used elsewhere to present changes in temperature. The impression is that sea level is 'reducing' (if 'cooling = reducing = blue' in the rest of the diagram) [Erin McClymont, United Kingdom (of Great Britain and Northern Ireland)]	This comment has been considered during the preparation of the FGD. (In FGD) Unfortunately the colour scale for sea level was kept blue. We needed a one sided scale, and blue is the traditional ocean colour.
57982	8	2	8	5	Could the components of the ice be splitted in wedge d in Fig. 1.1? [Tomas Halenka, Czech Republic]	Rejected. This would overload the picture. Moreover, there are little or no data for cryospheric components other than glaciers before the satellite period.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
12746	8	2	8	5	The Arctic is also particularly threatened by greater-than-average warming due to Arctic amplification. Because the Arctic is warming at twice the rate as the global average and because Arctic sea ice is susceptible to this increased temperature, Arctic sea ice is being reduced, which contributes to a positive feedback within the climate system that can further amplify warming. Include that both the declining Arctic sea ice and thawing permafrost can contribute to positive feedbacks that will further affect the climate—the sea ice through reduced albedo and the permafrost through released terrestrially stored carbon. These feedbacks can further amplify warming that risks not meeting the goal of staying well below 2C/1.5C. Arctic Monitoring and Assessment Programme (AMAP) (2017) SNOW, WATER, ICE, AND PERMAFROST IN THE ARCTIC: SUMMARY FOR POLICYMAKERS, 8 ("The Arctic is still a cold place, but it is warming faster than any other region on Earth. Over the past 50 years, the Arctic's temperature has risen by more than twice the global average. Increasing concentrations of greenhouse gases in the atmosphere are the primary underlying cause: the heat trapped by greenhouse gases triggers a cascade of feedbacks that collectively amplify Arctic warming."). [Durwood Zaelke, United States of America]	Noted. As readability is a key goal, we cannot be comprehensive in this section. A full assessment is done in chapter 9.
12748	8	2	8	5	Note that these changes are accelerating. Add that permafrost thaw also is a source of N2O, with emissions based on low-level flights over Alaska at the upper limit of what is usually experienced in the region. Wilkerson J., et al. (2019) Permafrost nitrous oxide emissions observed on a landscape scale using the airborne eddy-covariance method, ATMOS. CHEM. PHYS. 19:4257–4268, 4257 ("The microbial by-product nitrous oxide (N2O), a potent greenhouse gas and ozone depleting substance, has conventionally been assumed to have minimal emissions in permafrost regions. This assumption has been questioned by recent in situ studies which have demonstrated that some geologic features in permafrost may, in fact, have elevated emissions comparable to those of tropical soils. However, these recent studies, along with every known in situ study focused on permafrost N2O fluxes, have used chambers to examine small areas (< 50 m2). In late August 2013, we used the airborne eddy-covariance technique to make in situ N2O flux measurements over the North Slope of Alaska from a low-flying aircraft spanning a much larger area: around 310 km2. We observed large variability of N2O fluxes with many areas exhibiting negligible emissions. Still, the daily mean averaged over our flight campaign was 3.8 (2.2–4.7) mg N2O m−2 d−1 with the 90 % confidence interval shown in parentheses. If these measurements are representative of the whole month, then the permafrost areas we observed emitted a total of around 0.04–0.09 g m−2 for August, which is comparable to what is typically assumed to be the upper limit of yearly emissions for these regions."). [Durwood Zaelke, United States of America]	As readability is a key goal, we cannot be comprehensive in this section. A full assessment is done in chapter 9.
6674	8	2	8	10	I like the presentation of figure 1.1. Please can we ensure that the datasets used in figure 1.1 are derived from chapter 9 and hence consistent with other chapters via the ocean and cryosphere tiger teams? [Helene Hewitt, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. This is made consistent with Chapter 9.
31528	8	3	8	3	remove "massive" ? [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. The ice sheets are by far the most massive components of the cryosphere, certainly by mass.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
15982	8	4	8	5	The ice loss of the Greenland Ice Sheet should also be highlighted given its significant loss in recent decades, e.g. Nonlinear rise in Greenland runoff in response to post-industrial Arctic warming (https://www.nature.com/articles/s41586-018-0752-4). [SAI MING LEE, China]	Rejected. This paragraph refers to a wedge in Fig. 1.1, now Fig. 1.2, which only shows glaciers. We have no data for the ice sheets prior to the satellite period. Adding more cryospheric components would also overload Fig. 1.2., and introduce empty spaces.
15628	8	4			"continuously losing mass for the last century" is too general. I would write "There is a clear trend of global mass loss since the mid 19th century with intermittent periods of slight mass re-gain at regional and decadal levels (Zemp et al. 2015). Zemp, M., Frey, H., Gärtner-Roer, I., Nussbaumer, S.U., Hoelzle, M., Paul, F., Haeberli, W., Denzinger, F., Ahlstroem, A.P., Anderson, B., Bajracharya, S., Baroni, C., Braun, L.N., Caceres, B.E., Casassa, G., Cobos, G., Davila, L.R., Delgado Granados, H., Demuth, M.N., Espizua, L., Fischer, A., Fujita, K., Gadek, B., Ghazanfar, A., Hagen, J.O., Holmlund, P., Karimi, N., Li, Z., Pelto, M., Pitte, P., Popovnin, V.V., Portocarrero, C.A., Prinz, R., Sangewar, C.V., Severskiy, I., Sigurdsson, O., Soruco, A., Usubaliev, R., and Vincent, C. (2015): Historically unprecedented global glacier decline in the early 21st century. Journal of Glaciology, 61 (228), p. 745-762. doi: 10.3189/2015JoG15J017 [Michael Zemp, Switzerland]	Taken into account. 'continuously' has been removed from the sentence. Text has to be short here.
27082	8	5	8	5	8 Gt/year during 2000 and 2016 (Ref: https://www.bbc.com/news/science-environment-48696023) [Nyein Chan NIL, Myanmar]	Taken into account. The exact number and the time period over which the mass balance of glaciers has been assessed has been added in accordance with Section 9.5: "for the period 2012-2016 they lost mass at a rate of 278 ± 113 Gt per year"
27644	8	5	8	10	the data is missing [Poot Delgado Carlos Antonio, Mexico]	Taken into account. The exact number and the time period over which the mass balance of glaciers has been assessed has been added in accordance with Section 9.5: "for the period 2012-2016 they lost mass at a rate of 278 ± 113 Gt per year"
35228	8	6		7	This report cannot do justice to an overarching statement about the biosphere in a few sentences. [Ko Barrett, United States of America]	This section has been removed / edited into other sections.
57894	8	7	8	10	GOHC and GMSL: coordination required with chapters 2 (3, 7 and 9). GMSL is also accelerating. Suggestion for Fig 1.1 variables order: GMST, OHC, GMSL, Glaciers. And, at least use same colorbar for GMST, OHC, GMSL. [Catia Domingues, Australia]	Coordination with other chapters is ongoing.
54600	8	7	8	10	Any number on observed Ocean acidification? [KENEL DELUSCA, Canada]	Numbers added.
51574	8	7	8	10	Simple encouragement - this is the kind of clear writing that helps policy makers communicate with their decision makers. [Lindsey Cook, Germany]	Thanks!
8000	8	12	8	13	There's a mangled sentence here. Please fix. [Olaf Morgenstern, New Zealand]	Text revised.
45124	8	12	8	13	I don't understand this sentence. Do you mean: "This figure demonstates there are marked, ongoing and concurrent changes to many components of the physical climate system"? [David Wratt, New Zealand]	Text revised.
53100	8	12	8	13	something strange with the language here.... [Jan Fuglestvedt, Norway]	Text revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
43380	8	12	8	13	With this sentence, it's not clear what is trying to be said, beyond what I think copyediting would address. I'd recommend something like "Fig 1.1 presents examples of recent changes in multiple datasets. These datasets overall show marked, ongoing, and concurrent changes to many components of the physical climate system." [Kristina Pistone, United States of America]	Text revised.
50700	8	13	8	13	Typo in "that s one". [Hernan Edgardo Sala, Argentina]	Thank you for the suggestion. The term has been fixed.
31530	8	13	8	13	"that s one of" should be "that there are" ? [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Text revised.
53098	8	20	8	20	A nice figure and a good example of the type of presentations that ch1 can do. I wonder if the left hand side could have more info about what is happening on land (See SRCCL) [Jan Fuglestvedt, Norway]	Thanks. The figure has been extensively revised.
44182	8	20	8	23	Caption needs to describe what the sub-wedges for precipitation represent. [Christian Reuten, Canada]	Thanks. The figure has been extensively revised.
57284	8	20	8	25	Pie-chart is nice, but policy prescriptive, because area of segments increases over time, giving more visual weight to recent years. Similar problem with "spiral diagrams." I'm surprised people don't make more of a fuss about this. [Myles Allen, United Kingdom (of Great Britain and Northern Ireland)]	Thanks. The figure has been extensively revised.
32914	8	20			fig 1.1. & associated text: would be best to use global mean SL time series from CH9 for cross-report consistency - contact Kopp/Slangen [Aimee Slangen, Netherlands]	Thanks. The figure has been extensively revised.
29636	8	22	8	22	In Fig 1 (Right) the center indicates the year 1880, but in the legend 1850 is indicated. Which of the two years is the correct one? [luisa Sturiale, Italy]	Thanks. The figure has been extensively revised.
43028	8	28	9	42	Section 1.2.1.2 seems too big on paleo and too light on other timescales to me. I would add more on reanalyses datasets and their general agreement, on SAT records and their general agreement, more on D&A, and so on. Perhaps that material is yet to come, and perhaps it requires negotiation with other chapters (whereas there is no paleo chapter this time round). [David Frame, New Zealand]	Noted. The subsection's motivation is guided by the availability of direct data on GHG which are the dominant drivers of anthropogenic climate change, hence the focus on the last 800,000 years. We did change the title of the subsection to make this clear.
31532	8	30	8	30	Maybe give some examples for "paleoclimate archives", e.g. ice cores, ocean sedimanets, lake sediments, tree rings etc. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Text revised. Added "such as "ice cores, corals, marine and lake sediments, speleothems, tree rings"
7776	8	30	8	31	Please revise the sentence. It is hard to understand how information from paleoclimate archives provides an essential long-term context for the projected changes in the 21st century and beyond. [Merja Tölle, Germany]	Accepted. Text revised: "Paleoclimate archives (e.g. ice cores, corals, marine and lake sediments, speleothems, tree rings) register environmental information and permit the reconstruction of climatic conditions before the instrumental era. Thus they provide an essential long-term context for the anthropogenic climate change of the past 150 years and the projected changes in the 21st century and beyond (Masson-Delmotte et al., 2013; Stocker et al., 2013b)"
55070	8	30	8	41	The discussion of Fig. 1.2 needs to make it very clear that the glacial/interglacial cycles are driven by orbital forcing [Trude Storelvmo, Norway]	Accepted. Text revised: " … largely driven by millennial-scale orbital cycles and related feedbacks (Berger, 1978; Laskar et al., 1993). "

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
42834	8	30	9	35	These paragraphs need more structure. First there is the record of greenhouse gas concentrations and temperature estimates from ice core records, but there are also the seasonal to centennial timescale reconstructions of regional, hemispheric and global mean temperature for the past 400-2000 years. Together with realistically forced climate simulations for the pre-anthropogenic past millennium (850-1850; also possibly 0-2000 from PMIP4) these provide a highly detailed, possibly spatially resolved reconstructions of forced and unforced climate variation that also suggest the most recent decades show unprecedented warming over the past few centuries to millennia. These results are not entirely new but are based on many more data, more thorough uncertainty quantification, and therefore provide more confidence in conclusions drawn from the results. Since AR5, see for example: McGregor et al 2015; Tierney et al 2015; Hakim et al 2016; Abram et al 2016; Emile-Geay et al 2017; Steiger et al 2018; Steiger et al 2019; Neukom et al 2019. Also, note that realistically forced paleoclimatic simulations (detection and attribution studies; PMIP3, PMIP4) are an important part of diagnosing the likely processes by which reconstructed climate has varied. --> This comment is largely addressed at p 35 l 23ff. [Michael Evans, United States of America]	Taken into account. We essentially agree with this. A new para covering the last 2k years has been added See also response to comment 43028.
33290	8	30	9	43	It's great that paleoclimate is right upfront in Chapter 1. Paleoclimate archives are never defined here, though - that comes much later in the chapter. Only ice cores are mentioned by name. It would be good to provide at least a short parenthetical definition / explanation here. [Erika Wise, United States of America]	Accepted. Text revised. Added "such as "ice cores, marine and lake sediments, speleothems, tree rings"
14970	8	36	8	37	The Snyder (2016) publication has received a lot of criticism for it's approach. Just because it has the possibility of showing multiple glacial-interglacial cycles of temperature is not a reason to include it here. Snyder did not use all available data sets, and the compilation calculates a different set of temperature anomalies than compared to the LGM-Holocene transition (which was calculated using a much more spatially and temporally comprehensive data set than Snyder - see Shakun et al. 2012 at https://www.nature.com/articles/nature10915). If the compilation by Snyder is unable to reproduce LGM-Holocene then there must be increased uncertainty pushing back through geological time as the spatial/temporal detail becomes less. It would be better to present the ice core temperature data if you want a robust indicator of temperature change, even if it is effectively a 'polar' temperature (you could also plot a low latuitude ocean temperature record for comparison e.g. Lawrence et al. 2006: Evolution of the eastern tropical Pacific through the Plio-Pleistocene glaciation, Science 312, 79-83). My concern is that by using the Snyder (2016) paper you are opening this up to a lot of criticism about relying on a record which has been challenged on several fronts. [Erin McClymont, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. We appreciate this detailed comment. Snyder has 6.5°C for LGM-Holocene global mean temperature difference, whereas Shakun has 3.5°C! The Lawrence et al 2006 temperature reconstruction is not suitable here because it does not offer the required resolution over the past 800 kyr. Coordinated with Chapters 2 and 9: replace Fig. 1.2c Bintanja and van de Wal by Spratt and Lisiecki, also add uncertainty bar. Also mention uncertainty of 5 m (Spratt and Lisiecki) for MIS5 in caption. Figure SOD 1.3 serves as an illustration of the evolution of these indicators over the past 800kyr. Comprehensive assessment of the available literature happens in subsequent chapters. Figure SOD 1.3 now includes the assessed ranges for a number of paleoperiods and links to the Chapters 2, 5, 9 and the relevant Annex.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
8474	8	36	8	38	Review for consistency with chapter 2 and chapter 9. Temperature ranges are contested. [Robert Kopp, United States of America]	Taken into account: coordinated with Chapters 2 and 9: replace Fig. 1.2c Bintanja and van de Wal by Spratt and Lisiecki, also add uncertainty bar. Also mention uncertainty of 5 m (Spratt and Lisiecki) for MIS5 in caption.
50702	8	37	8	37	Insert space in "about-126". [Hernan Edgardo Sala, Argentina]	Accepted. Done
31534	8	37	8	37	Space needed after "about". [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Done
57896	8	38	8	38	Note: Global changes and large scale changes for ocean variabiles will be assessed jointly across chapters 2 and 9, and including other relevant chapters when relevant (eg, Chapter 7, GOHC). [Catia Domingues, Australia]	Noted, thanks
48246	8	44	8	44	On figure 1.2 it would be good to have error bars on the observations if these are available. [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account: error bars are now mentioned in the caption.
32916	8	46			fig 1.2. & associated text: would be best to use global mean SL time series from CH9 for cross-report consistency (paleo, 20th C and projections) - contact Kopp/Slangen [Aimee Slangen, Netherlands]	Taken into account. Assessed numbers/ranges from Ch2/9 and Annex II have been added to the figure.
24442	8	48	8	50	In the text: “a) Measurements of CO2 in air enclosed in Antarctic ice cores (Lüthi et al., 2008; MacFarling Meure et al., 2006) and direct air measurements (Dlugokenky and Tans, 2019) (Keeling et al., 1976)” Comment: As in the previous reference, compact in only one parenthesis, the following ones: (Dlugokenky and Tans, 2019; Keeling et al., 1976). [Rubén D Piacentini, Argentina]	Accepted. Done.
57986	8	48	9	5	No b), c) in the caption [Tomas Halenka, Czech Republic]	Accepted. Done.
50704	8	50	8	55	The Figure caption 1.2 has several acronyms (RCPs, PMIP, CMIP5, etc.) that have not been defined previously, I suggest to include the full names in order to make it understandable to a wider audience. [Hernan Edgardo Sala, Argentina]	Noted. Acronyms are be introduced and provided in an Annex of entire report
24444	8	52	8	52	In the text:”2013b) Sea level changes reconstructed from oxygen isotope measurements on several ocean sediment”. Comment: Include a point between “2003b)” and “Sea level changes…..”. [Rubén D Piacentini, Argentina]	Accepted. Done.
37292	8	53			The HadCRUT4 dataset does not quite show observed temperature changes since 1850 as it comprises gappy, processed data. Its area-mean values should be regarded as estimates based on observations, not observations. It would be more correct to write "Temperature changes since 1850 are from the observationally-based HadCRUT4 dataset" rather than "Observed temperature changes since 1980 are from the HadCRUT4 dataset". [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Noted. No change. While correct, we fear this level of detail might confuse readers.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
35230	9	6		20	These statements are inaccurate. International response to risks from climate change has not occurred only after 2015. We are not in a substantially different context for IPCC reports: we are in a progressively evolving context. The difference is important. All Parties signed onto the UNFCCC in 1992, A subset agreed to targets in 1997. Adaptation took on more emphasis in 2001, Paris was agreed in 2015, Global Stocktakes will change things further...this is a progression, not a sea change. The IPCC mandate remains the same - to provide the best periodic assessment of climate knowledge. I do not support the selection and highlighting of a small subset of UN actions in this section. 2015 was not an overly important year in the grand scheme of things and these selections invite accusations of bias. [Ko Barrett, United States of America]	Comments fits with text from Ch1 Internal Draft but not FOD text. The text has been revised to focus on UNFCCC and Paris Agreement and SDG
41238	9	9			P 9 line.9 Insert summary of arctic hazards [Leonard Berry, United States of America]	Rejected, no action: hazard is not a topic in this subsection
12600	9	10	9	15	More to add here about warming locking in SLR and concerns about SLR should extend beyond 2100 because SLR will continue to occur even after warming has slowed. Also the uncertainty of SLR projections and non-linearity associated with ice sheet collapse and massive SLR that exceeds the bounds of the linear relationship (and these should be highlighted in the revised Figure 1.2 in the SOD). Good P., et al. (2016) Large differences in regional precipitation change between a first and second 2 K of global warming, NATURE COMMUNICATIONS 7(13667):1–8; and Solomon S., et al. (2009) Irreversible climate change due to carbon dioxide emissions, PROC. NATL. ACAD. SCI. USA 106(6):1704-1709, 1707. [Kristin Campbell, United States of America]	Noted. No action: the level of detail asked for here is not appropriate for this introductory section and figure. This new information needs to be assessed in the subsequent chapters of the WGI contribution the AR6.
42310	9	10	9	15	Commitment to sea level rise due to ice mass loss should note not only commitment to level of SLR committed, but rate of potential change. See for example WWW.ICCINET.ORG/THRESHOLDS and references therein, such as Joughin, I., Smith, B.E., and Medley, B. (2014). Marine ice sheet collapse potentially under way for the Thwaites Glacier Basin, West Antarctica. Science, 344(6185), 735–738. [Gabrielle Dreyfus, United States of America]	Taken into account. "Such persistent warm conditions in the atmosphere represent a multi-century commitment to long-term sea level rise, summer sea ice reduction in the Arctic, substantial ice sheet melting, potential ice sheet collapse, and many other impacts in all components of the climate system (Clark et al., 2016; Fischer et al., 2018; Pfister and Stocker, 2016; see Chapter 9.4) (Figure 1.3).
15984	9	10	9	15	Please consider including the results of this study: Mid-Pleistocene transition in glacial cycles explained by declining CO2 and regolith removal (https://advances.sciencemag.org/content/5/4/eaav7337) - More CO2 than ever before in 3 million years. [SAI MING LEE, China]	Rejected. No action: considered time window in Fig 1.2 does not include MPT
50478	9	10	9	35	A readability analysis was conducted on an arbitrary selection of test. A variety of algorithms were applied, and things like references were removed to eliminate noisy text that might skew readability results. To be considered consumable by a broad readership, the target scores for each of the following indices should be in the range of 8 to 10. [Anton Holland, Canada]	Noted. We appreciate the comment about readability, but no action taken. Accessibility for broader audience is mostly relevant for the SPM and SPM headline statements. Here, this is a scientific assessment with many technical details.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
51576	9	11	9	13	This could do with BOLDing, being a critical point to hear: The records presented in Figure 1.2 show that sustained changes in global mean temperature of a few degrees Celsius cause increases in sea level by several tens of meters, rising rapidly over several millennia at the end of ice ages [Lindsey Cook, Germany]	Rejected. Bolding or other formatting is so far not a style at this level. But the statement could be considered for the executive summary of this chapter.
55118	9	11		14	[pt 1 of 6] The paragraph says, "...sustained changes in global mean temperature of a few degrees Celsius cause increases in sea level by several tens of meters, rising rapidly over several millennia at the end of ice ages... Seen against this background, ongoing present-day warming represents a commitment to long-term sea level rise". That's a confused mess of unscientific nonsense. [cont'd] [David Burton, United States of America]	Rejected. Comment not relevant. All statements are based on published, science peer-reviewed literature and supported by multiple lines of independent evidence.
55120	9	11		14	[pt 2 of 6] The author writes "ice ages" but means glaciations. He's talking about when the great Laurentide, Fennoscandian, Cordilleran & Patagonian ice sheets receded, and that did, indeed, raise the oceans by many meters. But those ice sheets no longer exist, so they cannot melt, now. There are only two places left on Earth with enough ice to produce that kind of sea-level rise: Antarctica and Greenland. But most of Antarctica averages more than 40 degrees below zero, so a few degrees of warming obviously won't melt it. That leaves only Greenland as an even remotely plausible source for large amounts of meltwater. But we know that during the MWP Greenland was substantially warmer than it is now, without causing a remarkable increase in global sea-level. [cont'd] [David Burton, United States of America]	Rejected. The reviewer is incorrect: multiple independent satellite measurements demonstrate that both Greenland and Antarctica are melting and losing mass already now, and this mass loss is accelerating.
55122	9	11		14	pt 3 of 6] Moreover, the author has confused cause with effect. To a large extent, during glaciations it was the great ice sheets that kept the Earth's albedo high and temperature low. When Milinkovich cycles caused an increase in seasonal temperature swings, the warmer summers increased melting, and the colder winters decreased snowfall, causing the ice sheets to lose ice; over millenia the retreat of the ice sheets reduced the Earth's albedo, and icreased atmospheric CO2, which increased the rate of summer melting. The "sustained changes in global mean temperature of a few degrees Celsius" were the RESULT of that process, not the cause of it. [cont'd] [David Burton, United States of America]	Taken into account. Text revised: "Paleoclimate reconstructions also shed light on the causes of these variations, revealing processes that need to be considered when projecting climate change. The records presented in Figure 1.3 show that sustained changes in global mean temperature of a few degrees Celsius are associated with increases in sea level by several tens of metres. During two extended warm periods (interglacials) of the last 800,000 years, sea level is estimated to have been several metres, up to over 15 m, higher than today. During the last interglacial, about 130,000 years ago, sustained warmer temperatures in Greenland preceded the peak of sea level rise (Masson-Delmotte et al., 2013; IPCC AR5 WGI Ch5, Fig 5.15).

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
55124	9	11		14	[pt 4 of 6] Moreover, those changes in sea-level took many thousands of years, compared to an anthropogenic warming pulse which resource constraints ensure will last a few hundred years, at most. The negative feedbacks which limit CO2 increases are already removing the equivalent of about 2.5 ppmv of CO2 per year, even though CO2 levels are only elevated by about 130 ppmv. When mankind transitions away from fossil fuels, CO2 levels will plummet, and if anthropogenic CO2 emissions were to cease completely, half the anthropogenic increase would be removed in under forty years. [cont'd] [David Burton, United States of America]	Rejected. The reviewer is incorrect: CO2 concentration in the atmosphere will remain increased for many millennia after a stop of emissions.
55126	9	11		14	[pt 5 of 6] Moreover, the author is ignoring the modern sea-level measuremnt records, which tell us quite precisely what sort of effect temperature changes have on sea-level trends, with the Earth's CURRENT ice sheet configuration. We have many excellent sea-level measurement records extending back more than a century, and some go back two centuries. What they tell us is that GHG emissions and the consequent modest temperature increases have very little effect on sea-level trends. Despite a 100 ppmv increase in CO2, plus substantial increases in several other GHGs, and a significant increase in average global temperatures (between about 0.5 and 0.8°C) the best long sea-level measurement records show no detectable acceleration in the rate of sea-level rise since the 1920s or before. [cont'd] [David Burton, United States of America]	Rejected. The reviewer is incorrect: current SLR is due to thermal expansion of warming ocean waters, melting of glaciers and mass loss from Greenland and Antarctica.
55128	9	11		14	[pt 6 of 6] Some sites did record a slight acceleration in sea-level trend between the mid-1850s and about 1930, as the LIA ended. The LARGEST acceleration was at Brest, France, where the sea-level trend was flat (+0.0 ±0.2 mm/yr) in the 1800s, but +1.5 ±0.2 mm/yr since 1900. http://sealevel.info/190-091_Brest_1807-1900_vs_1900-2016.png ### [David Burton, United States of America]	Rejected. The reviewer is incorrect: acceleration of SLR demonstrated based on global data sets, see Nerem et al., 2018, PNAS.
31538	9	12	9	12	"are associated with" rather than "cause" [although I agree that sea level changes are caused by temperature change, the graph does not show this, it just shows that they happen at the same time]. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Text revised: "Paleoclimate reconstructions also shed light on the causes of these variations, revealing processes that need to be considered when projecting climate change. The records presented in Figure 1.3 show that sustained changes in global mean temperature of a few degrees Celsius are associated with increases in sea level by several tens of metres. During two extended warm periods (interglacials) of the last 800,000 years, sea level is estimated to have been several metres, up to over 15 m, higher than today. During the last interglacial, about 130,000 years ago, sustained warmer temperatures in Greenland preceded the peak of sea level rise (Masson-Delmotte et al., 2013; IPCC AR5 WGI Ch5, Fig 5.15).
26332	9	12	9	12	"long-term" must be inserted before "increases in sea level". [Jochem Marotzke, Germany]	Taken into account. Not relevant, text revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
42798	9	12	9	15	Discuss and keep consistency with chapter-9 [Xiao Cunde, China]	Noted. Consistency ensured: replace SOD Fig. 1.3c Bintanja and van de Wal by Spratt and Lisiecki, also added uncertainty bars for paleoperiods. Also mention uncertainty of 5 m (Spratt and Lisiecki) for MIS5 in caption.
8476	9	13	9	15	Cross reference to sea-level commitment figure in chapter 9. [Robert Kopp, United States of America]	Accepted. Reference to Section 9.4 added
51824	9	13	9	15	There is a risk here of being seen as over simplistic an assessment? Glacial cycles include melt of two ice sheets that are no longer present. It seems a buit unduly definitive to make this statement in this current manner although there is little doubt that it is true. I just worry it may be a hostage to fortune statement as written. [Peter Thorne, Ireland]	Taken into account. The comment has been addressed by the revised text.
44068	9	17	9	19	There is centennial scale variation in late Holocene (2.5 Ka - 0 Ka) sea level as well, and modern sea level rise is outside the range of this natural variability (Kopp, Dutton, and Carlson 2015: https://par.nsf.gov/servlets/purl/10058372). [Sara Kahanamoku, United States of America]	Taken into account. The sea level variations over the past 2 kyr is now be included in a new para on the last 2kyr to be inserted at FOD page 9, line 36
12602	9	17	9	24	Note the proximity to these tipping points/critical thresholds as warming has already reached 1C, and there exist many tipping points between 1.5 and 2C. Drijfhout S., et al. (2015) Catalogue of abrupt shifts in Intergovernmental Panel on Climate Change climate models, PROC. NAT'L. ACAD. SCI. 112(43):E5777–E5786; and 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]	Accepted. Sentence citing Drijfhout et al. 2015 was added.
46526	9	17	9	24	This paragraph present new literature very briefly and makes conclusions, without first going through a thorough assessment [WGI TSU, France]	Noted. However, the conclusions here are not different from AR5. We add a pre-AR5 ref and a reference to Chapter 2, where this is assessed in AR6.
12750	9	17	9	24	More to add here about warming locking in SLR and concerns about SLR should extend beyond 2100 because SLR will continue to occur even after warming has slowed. Also the uncertainty of SLR projections and non-linearity associated with ice sheet collapse and massive SLR that exceeds the bounds of the linear relationship (and these should be highlighted in the revised Figure 1.2 in the SOD). Good P., et al. (2016) Large differences in regional precipitation change between a first and second 2 K of global warming, NATURE COMMUNICATIONS 7(13667):1–8; and Solomon S., et al. (2009) Irreversible climate change due to carbon dioxide emissions, PROC. NATL. ACAD. SCI. USA 106(6):1704-1709, 1707. [Durwood Zaelke, United States of America]	Noted. No action: the level of detail asked for here is not appropriate for this introductory section and figure. This new information needs to be assessed in the subsequent chapters of the WGI contribution the AR6.
12752	9	17	9	24	Explain the proximity to these tipping points/critical thresholds as warming has already reached 1C, and there exist many tipping points between 1.5 and 2C. Drijfhout S., et al. (2015) Catalogue of abrupt shifts in Intergovernmental Panel on Climate Change climate models, PROC. NAT'L. ACAD. SCI. 112(43):E5777–E5786; and Steffen W., et al. (2018) Trajectories of the Earth System in the Anthropocene, PROC. NAT'L. ACAD. SCI. 115(33):8252–8259. [Durwood Zaelke, United States of America]	Accepted. Sentence citing Drijfhout et al. 2015 was added.
45378	9	17	9	35	A reference to relefant sections of Chp 9 would help here. [Baylor Fox-Kemper, United States of America]	Accepted. References to Chapter 9 added
50706	9	18	9	18	Typo in "occurance". [Hernan Edgardo Sala, Argentina]	Accepted. Done
29298	9	18	9	18	occurrence [Fabio D'Andrea, France]	Accepted. Done

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
27508	9	18	9	19	explain in simple terms what you mean by 'bipolar seesaw' [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Text revised.
6563	9	18	9	19	Clarify: …and the occurance of a bipolar seesaw, “indicating out-of-phase temperature changes in both hemispheres” [Tim Christiane Thys, Belgium]	Accepted. Revised to opposite-phase instead
33096	9	18			I think "indicate" is too strong a word given the fact that we have little direct evidence for the AMOC changes over most of the abrupt events (Please see recent review paper--Lynch-Stieglitz, J., 2017, Annual Reviews of Marine Science, 9, 83-104). Also, I would avoid the use of the phrase "bipolar see-saw" which will not hold meaning for most climate scientists. Maybe "The records also show centennial- to millennial-scale variations, particularly during the ice ages, at least some of which are clearly associated with changes of the Atlantic Meridional Overturning Circulation and a redistribution of heat between the northern and southern hemispheres" [Jean Lynch-Stieglitz, United States of America]	Accepted. Reference added
50480	9	19	9	35	Flesch-Kincaid Grade Level -- 14.3 [Anton Holland, Canada]	Noted. Thank you for calculating these readability scores. However, this is more relevant for the SPM and the headline statements therein. Would be helpful to have this once the SPM draft is available for review.
50482	9	19	9	35	Gunning Fog Index -- 16.4 [Anton Holland, Canada]	Noted. Thank you for calculating these readability scores. However, this is more relevant for the SPM and the headline statements therein. Would be helpful to have this once the SPM draft is available for review.
50484	9	19	9	35	Coleman-Liau Index -- 14.9 [Anton Holland, Canada]	Noted. Thank you for calculating these readability scores. However, this is more relevant for the SPM and the headline statements therein. Would be helpful to have this once the SPM draft is available for review.
50486	9	19	9	35	SMOG Index -- 15.6 [Anton Holland, Canada]	Noted. Thank you for calculating these readability scores. However, this is more relevant for the SPM and the headline statements therein. Would be helpful to have this once the SPM draft is available for review.
50488	9	19	9	35	Automated Readability Index -- 14.7 [Anton Holland, Canada]	Noted. Thank you for calculating these readability scores. However, this is more relevant for the SPM and the headline statements therein. Would be helpful to have this once the SPM draft is available for review.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
50490	9	19	9	35	FORCAST Grade Level -- 12.1 [Anton Holland, Canada]	Noted. Thank you for calculating these readability scores. However, this is more relevant for the SPM and the headline statements therein. Would be helpful to have this once the SPM draft is available for review.
50492	9	19	9	35	Powers Sumner Kearl Grade -- 6.9 [Anton Holland, Canada]	Noted. Thank you for calculating these readability scores. However, this is more relevant for the SPM and the headline statements therein. Would be helpful to have this once the SPM draft is available for review.
50494	9	19	9	35	Rix Readability -- 12 [Anton Holland, Canada]	Noted. Thank you for calculating these readability scores. However, this is more relevant for the SPM and the headline statements therein. Would be helpful to have this once the SPM draft is available for review.
50496	9	19	9	35	What's clear is the text is far off that target readability score if we are aiming for a broad audience. The Powers Sumner Kearl Grade index was applied, but it should be noted that it is not appropriate for texts of this nature. This index is suited for elementary texts and isn't suited to texts above fourth-grade level. [Anton Holland, Canada]	Rejected. We disagree as this is an introduction to a comprehensive and thorough scientific assessment. We do agree, however, with the importance of readability for high-level documents and text elements such as the SPM and headline statements.
50498	9	19	9	35	If we add references back in, the visual disctraction of the reference coding further diminishes the readability of the text. [Anton Holland, Canada]	Rejected. We disagree as this is an introduction to a comprehensive and thorough scientific assessment. We do agree, however, with the importance of readability for high-level documents and text elements such as the SPM and headline statements.
50500	9	19	9	35	Similar analyses were conducted throughout the entire report with similar results. Work needs to be done to ensure that the average reader finds the report to be accessible and useful overall. [Anton Holland, Canada]	Rejected. We disagree as this is an introduction to a comprehensive and thorough scientific assessment. We do agree, however, with the importance of readability for high-level documents and text elements such as the SPM and headline statements.
36636	9	20			Irreversible? Certainly in practice (by us), but not in principle I suspect. Could be clearer. [Paul Copland, New Zealand]	Noted. The term "irreversibility" is defined in the Glossary of AR6 and has been used in AR5 already in this context of "on a human timescale"
49328	9	21	9	21	Suggest "close relationship" rather than "synchronicity," given the close but complex temporal relationships between GHGs and temperatures over time on this timescale [Yarrow Axford, United States of America]	Noted. But we prefer to use terminology that is based on the assessed scientific literature. Added relevant ref Shakun et al. 2012

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
33116	9	21	9	24	The statement that "...greenhouse gases as one driver of climate change in the past" is not entirely accurate; actually the authors got this backwards. Atmospheric CO2 changes lag global temperature changes (by ~9 months) "at all measured time scales" (MacRae, 2019) [William Call, United States of America]	Rejected. The reviewer is incorrect. Changes in GHG concentrations modify the Earth's radiative balance, GHGs _are_ one of the several drivers of climate change in the past. For the paleoclimate record: CO2 and temperature change synchronous (Shakun et al, 2012). BTW, a blog entry cannot be cited in IPCC assessments.
55130	9	21		24	[pt 1 of 4] The text 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 gases as one driver of climate change in the past." That is dead wrong. [cont'd] [David Burton, United States of America]	Rejected. The reviewer does not provide any evidence for his claim.
55132	9	21		24	[pt 2 of 4] Since, in the paleoclimate record, the changes in GHG concentrations follow, rather than preceed, 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. 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. [cont'd] [David Burton, United States of America]	Noted. Changes in GHG concentrations modify the Earth's radiative balance, GHGs _are_ one of the several drivers of climate change in the past.
55134	9	21		24	[pt 3 of 4] 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]	Noted. Not clear what the reviewer would like to see changed.
55136	9	21		24	[pt 4 of 4] 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]	Noted. Not clear what the reviewer would like to see changed.
14972	9	22	9	23	These are better references for the greenhouse gas - temperature links than the Snyder (2016) paper which was cited previously [Erin McClymont, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. No change. We agree that these are in principle "better references", but these do not cover the past 800 kyr.
51758	9	23	9	23	Bereiter et al. 2018 also shows synchroneity (doi: https://doi.org/10.1038/nature25152) [Anson Cheung, United States of America]	Accepted. Reference added
6559	9	23	9	23	I wonder if reference "Parrenin et al., 2013" is the correct one? [Tim Christiane Thys, Belgium]	Rejected. Yes, it is correct.
57988	9	23	9	24	the synchronicity from the data cannot be used as argument for causality within the systém, by the way, if still within the discussion of Fig. 1.2 (as continuing in next paragraph) from the plots real synchronicity can hardly be assessed due to resolution [Tomas Halenka, Czech Republic]	Accepted. We agree, based on limited evidence shown in SOD Fig 1.3. Sentence modified.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
24216	9	23	9	24	This subsection is headed "Change across multiple timescales" but only mentions palaeoclimate records of the past 800,000 years. This omits longer-scale Cenozoic records of the 'greenhouse world' prior to 34 Ma, which was characterised by significantly higher concentrations of greenhouse gases, much warmer global mean temperatures, and poles with little or no ice (Zachos, J.C., Dickens, G.R. and Zeebe, R.E., 2008. An early Cenozoic perspective on greenhouse warming and carbon-cycle dynamics. Nature, 451(7176), p.279; Royer, D. L. CO2-forced climate thresholds during the Phanerozoic. Geochim. Cosmochim. Acta 70, 5665–5675 (2006); Zachos, J., Pagani, M., Sloan, L., Thomas, E. & Billups, K. Trends, rhythms, and aberrations in global climate 65 Ma to present. Science 292, 686–693 (2001).) This aspect is discussed in Chapter 7 but missing here. [Natasha Barbolini, Sweden]	Noted. We have added a sentence in the starting para with a reference to WGI AR6, Chapter 7 and to AR5 Ch5.
24218	9	23	9	24	This underlines the important role of greenhouse gases as one a major driver of climate change in the recent and geological past. [Natasha Barbolini, Sweden]	Noted. Text revised, but different that suggested by the reviewer
6561	9	23	9	24	rephrase: greenhouse gases as "a significant driver" [Tim Christiane Thys, Belgium]	Accepted. Text revised. We now refer to "characteristic" rather than "driver"
29920	9	23	9	24	Since the interglacial cycles are driven by orbital variations, the GHG changes are arising in response to the climate changes. There is a feedback to be sure, but the synchronicity does not by itself imply a temperature response to GHG changes. [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. We agree, based on limited evidence shown in SOD Fig 1.3. Sentence modified.
53102	9	26	9	26	Explain CE [Jan Fuglestvedt, Norway]	Taken into account. We have replaced "CE" by "year 1850"
32416	9	26	9	28	There is a word missing between already and outside (presumably 'moved'). However, there is a problem with this bold statement altogether. It is probably false to make such a statemen, as it means that the CO2-concentrations can be read out of the ice-cores, which is probably and presumable completely wrong, as has been pointed out by many reports and scientific works. This statement is of an alarmist nature and should be modified and be much more carefully and less boldly made. It only serves to lower the credibility of the work of WG1 of the IPCC. [Martin Hovland, Norway]	Rejected. We have added the missing word "moved". But we disagree with rest of comment. No action.
51578	9	26	9	34	his is such a critical sentence, but it is too technical for most policy makers - can you write more simply, also remind them what RCP 2.6 is (so few know this) and what consequence to human siffering (for instance) you mean by 'rapidly moving beyind their long term nature range' [Lindsey Cook, Germany]	Noted. We agree that this needs to be less technical in the higher level documents of the report. Here, we prepare a technical assessment, where technical language is needed.
46100	9	27	9	28	"CO2 concentrations had already 'expanded' outside the reconstructed range of natural variation over the past 800,000 years." Missed word from the sentence. I have added a placeholder suggestion, so you can see where I mean. [Amy Featherstone, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Missing word "moved" added
45126	9	27	9	28	Do you mean: "...CO2 concentrations WERE already outside …" ? [David Wratt, New Zealand]	Taken into account. Missing word "moved" added
33118	9	27	9	29	Actually, our current Holocene interglacial is a full 2-3°C lower than three (3) past interglacials in last 300,000 years (i.e, 125,000, 275,000 and 325,000 years before present) which indicate a strong cyclicity of ~23,000 years (i.e, Milankovitch cycles); NOAA, Glacial-Interglacial Cycles, https://www.ncdc.noaa.gov/abrupt-climate-change/Glacial-Interglacial%20Cycles [William Call, United States of America]	Noted. We don't think this is relevant here -- the 23 kyr cyclicity is not relevant for the next 100 years.
55060	9	28	9	28	grammatically incorrect [Trude Storelvmo, Norway]	Taken into account. Missing word "moved" added

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31540	9	28	9	28	"had already moved outside" instead of "had already outside" [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Missing word "moved" added
19156	9	28	9	28	had "risen" already [Baerbel Hoenisch, United States of America]	Taken into account. Missing word "moved" added
35232	9	28		30	Inaccurate to say that the GFCS, agreed in 2009, was in response to ideas contained in AR5 (2013-14). [Ko Barrett, United States of America]	Not applicable -- text not in Ch1 FOD… Comments fits with text from Ch1 Internal Draft
8478	9	29	9	29	Check for consistency with chapter 2. Glacial/interglacial temperatures are contested. For instance, it is unclear whether LIG global mean surface temperature was higher than today. [Robert Kopp, United States of America]	Taken into account. The assessed estimates/ranges for paleo temperature and sea level from Ch2/9, Annex II are included in SOD Figure 1.3.
46102	9	30	9	32	Separate this into two sentences [Amy Featherstone, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Done.
33120	9	30	9	32	Define "long term natural range." The statement that, "these global-scale indicators will rapidly move out of their long-term natural range within the next few decade" is speculative; no empiral data / observations cited to support this statement. [William Call, United States of America]	Accepted. The sentence has been revised
27510	9	32	9	32	delete 'Detection and' [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Done.
33122	9	32	9	35	Statement that "...increase of greenhouse gas concentrations is the dominant cause for" global mean temperature and sea level changes is highly improbable and likely completey inaccurate. Our Sun (Sol) is the primary driver of energy received by the Earth (i.e., visible light, IR, UV, microwave radiation, etc.). This is not only intuitively obvious, but even recent research using the SABER instrument onboard NASA's TIMED satellite; M. Mlynczak, NASA Langley Research Center, February 2018; ""We see a cooling trend..."High above Earth's surface, near the edge of space, our atmosphere is losing heat energy. If current trends continue, it could soon set a Space Age record for cold." [William Call, United States of America]	Rejected. What we consider here are _changes_ of the Earth's energy budget, not the budget per se. No action needed.
43696	9	32	9	35	And what about SLCFs? [Vaishali Naik, United States of America]	Noted. WGI AR6 has an entire chapter on SLCF (Ch 6). According to SOD Chapter 7, CO2 is the dominant forcer.
6543	9	34	9	34	"is the dominant cause" - I suggest to quantify that. [Tim Christiane Thys, Belgium]	Taken into account. We now refer to the relevant section SOD Ch7
57898	9	35	9	35	There are new references submitted or published. Eg: https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2019GL082015. There are D&A references on glaciers as well (eg, Marzeoin). [Catia Domingues, Australia]	Accepted. Reference added
46104	9	37	9	40	Separate this into two sentences at 'in other words', just for ease of reading [Amy Featherstone, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Done.
6565	9	37	9	40	Add reference, e.g. Lewis, S.L. and Maslin, M. A.(2015): Defining the Anthropocene. [Tim Christiane Thys, Belgium]	Noted. The term is defined in the AR6 Glossary
31542	9	39	9	39	"magnitude" instead of "magtude". [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Done.
8002	9	39	9	39	So far no-one has found another planet just like ours, so I think there is only one "Earth System". [Olaf Morgenstern, New Zealand]	Noted. The text has been revised and clarified
29300	9	39	9	39	magnitude [Fabio D'Andrea, France]	Accepted. Done.
57990	9	39	9	39	magnitude [Tomas Halenka, Czech Republic]	Accepted. Done.
6545	9	39	9	39	correct magtude in "magnitude" [Tim Christiane Thys, Belgium]	Accepted. Done.
19158	9	39	9	39	magtude should be magnitude [Baerbel Hoenisch, United States of America]	Accepted. Done.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
51580	9	40	9	42	Again, please BOLD. This is life changing information and clearly stated, but easily missed if not drawn out for the 'busy reader'. [Lindsey Cook, Germany]	Rejected. Bolding or other formatting is so far not a style at this level. But the statement could be considered for the executive summary of this chapter.
24214	9	40	9	43	Include a recent paper on the sixth mass extinction: 1) Ceballos, G., Ehrlich, P.R., Barnosky, A.D., García, A., Pringle, R.M. and Palmer, T.M., 2015. Accelerated modern human–induced species losses: Entering the sixth mass extinction. Science advances, 1(5), p.e1400253. (2) Ceballos, G., Ehrlich, P.R. and Dirzo, R., 2017. Biological annihilation via the ongoing sixth mass extinction signaled by vertebrate population losses and declines. Proceedings of the National Academy of Sciences, 114(30), pp.E6089-E6096. (3) Ceballos, G. and Ehrlich, P.R., 2018. The misunderstood sixth mass extinction. Science, 360(6393), pp.1080-1081. [Natasha Barbolini, Sweden]	Accepted. We have added a reference to Ceballos et al. 2017, PNAS. IPBES is now also referenced.
37294	9	40	9	43	The sentence that spans these lines implies that ocean acidification is something separate from climate change. But ocean acidifcation is a change in the state of the ocean. And the ocean is part of the climate system. If climate change is interpreted as change to the climate system (rather than change to the statistics of weather) then ocean acidification is itself part of climate change. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Point taken, sentence revised
43698	9	40	9	43	This statement should be caveated by uncertainty levels in these phenomena as some of these can be questioned. For example, recent satellite measurements suggest greening in China and India over the past decade (Chen et al., 2019) DOI: 10.1038/s41893-019-0220-7. [Vaishali Naik, United States of America]	Noted. The overall statement here aims at pointing to the different changes occurring in the Anthropocene. No action.
55138	9	40		42	[pt 1 of 4] The text says, "...Such changes include not only climate change itself, but also a sixth mass extinction of species, rapid ocean acidification due to uptake of anthropogenic carbon dioxide, and massive destruction of tropical forests..." Good grief, that's a lot of crackpottery to cram into just one sentence fragment! [cont'd] [David Burton, United States of America]	Noted. We agree, the sentence is quite comprehensive but anthropogenic interference with the Earth System is as well.
55140	9	40		42	[pt 2 of 4] There is no sixth max extinction of species. https://www.theatlantic.com/science/archive/2017/06/the-ends-of-the-world/529545/ [cont'd] [David Burton, United States of America]	Rejected. The scientific evidence is clear. See e.g. assessment reports by IPBES
55142	9	40		42	[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. The purpose of the sentence is to give a view of the changes occurring in the Anthropocene caused by human activity.
55144	9	40		42	[pt 4 of 4] Oean acidification is a red herring. It is minuscule, and harmless, and dwarfed by natural spacial and temporal variations in ocean pH. It does not and cannot make the oceans acidic, only slightly less caustic. Its 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 overwhelming scientific evidence, based on observations and measurements, does not support this reviewer statement. No action.
55062	9	41	9	41	magtude… [Trude Storelvmo, Norway]	Accepted. Done.
55072	9	41	9	41	Statement about 6th mass extinction must be backed by multiple references [Trude Storelvmo, Norway]	Noted. The WGII assessment report and the assessment reports by IPBES are referenced now.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
7778	9	41	9	41	"sixth"? I don't understand this. I suggest to ever write down why "sixth" is mentioned or leave it out. [Merja Tölle, Germany]	Noted. This is a standing expression; a reference is given. No action.
6547	9	41	9	41	insert: also "the by the end of the last Ice Age started" sixth mass extinction of species [Tim Christiane Thys, Belgium]	Accepted. Sentence revised
54974	9	41	9	43	Other references may also be integrated into this statement. Given the existing references with a span from 2000 to 2018, Barnosky et al. (2011) Nature 471, pages 51–57 that has received 1,151 citations may also be considered. [Kilkis Siir, Turkey]	Noted. This statement is not an assessment but should highlight the further consequences of anthropogenic interference and point the reader to additional information.
29650	9	43	43	9	The year of the reference Steffen et al. is 2017, but in final references is 2018!!! What's the exact year? [luisa Sturiale, Italy]	Taken into account. The reference has been removed.
35234	9	45		49	Delete" that could be considered as innovative governance mechanism compared to business as usual" Avoid conjecture. Also, statements about conditional action and adaptation, particularly by developing countries, is focusing on only a few of the many issues in NDCs and misses the main point about what an NDC is (flexible, self-determined, etc.) [Ko Barrett, United States of America]	Accepted. This has been deleted.
39454	9	46	9	46	Consider if the "Talanoa Dialog" should be also included in this section. [Carolina Vera, Argentina]	Talanoa is now mentioned.
27162	9	46	10	15	The reference to a political agenda is confusing and suggests the question: does the AR6 report is scientific or driven by a political agenda? [François GERVAIS, France]	We refer to the international agenda of the United Nations, the FCCC, and similar organizations and agreements (many of which contain the term "Agenda" in their titles) to highlight the broader context of AR6 report and various governance processes addressing climate change. No reference is made to a "political agenda" in the sense of partisan politics.
32608	9	46	11	42	This section needs to first be focused on the objective of the UNFCCC that is the underlying document for the Paris Accord; the Paris Accord is just a subsidiary agreement and it needs to be evaluated and critiqued relative to whether it will lead to meeting the objective of the UNFCCC--not just accepted as this is what is the truth and guidance from above. The IPCC needs to make clear how flimsy the cloth is that makes up the Paris Accord--it sounds great, but the world would not be happy were they to really understand the changes that it would make inevitable. I just do not think the international scientific community can simply accept what has been agreed to without making very clear what its implications are. [Michael MacCracken, United States of America]	Thanks for this important comment. The text has been revised to introduce UNFCCC goals. We have also assessed the ability of the Paris NDCs to meet the Paris goals, and included several sentences on their relative weakness at various points.
43700	9	46	11	42	I think the information in section 1.2.2 can be shortened. I understand that it provides information on the various governance processes that are designed to address impacts of climate change- background material for the reason why AR6 is adopting a risk and solution-oriented framing. I think reducing this to two paragraphs would be sufficient to make the point that cross-disciplinary and cross-working group approach is needed so that WG1 can provide relevant information for WGII and WGII [Vaishali Naik, United States of America]	The text has been shortened and the focus to governance processes are on UNFCCC-Paris agreement and SDGs.
49252	9	53	9	53	Would suggest to add in a subsection 1.2.2.1 Paris Agreement [EE LING LEE, Malaysia]	The text has been shortened. Too many subsections interferes with readability.
48248	9	54	9	54	Suggest "drawn up" instead of "agreed to". [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. The sentence has been rewritten.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
31544	9	54	9	55	remove "was" and put commas around "agreed…..(UNFCC, 2015)" [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. The sentence has been rewritten.
54602	9	54	10	6	There is a key feature of the Paris Agreement that needs to be mentioned in the context of a new international climate change governance structure: its applicability to all Parties. On another note, it is important the importance of its enhanced transparency framework as the Paris agreement is not a legally-biding instrument in genereal. [KENEL DELUSCA, Canada]	This comment has been considered during the preparation of the FGD. (In FGD) Taken into account. It has been introduce through the NDC: "Each Party to the PA is required to submit a Nationally 40 Determined Contribution (NDC) and pursue, on a voluntary basis, domestic mitigation measures with the 41 aim of achieving the objectives of its NDC (Article 4)."
30422	9	55	9	55	an "and" seems to be missing. [Joeri Rogelj, Austria]	Not applicable. The sentence has been rewritten.
35236	9	55	10	1	Delete. Not agreed by IPCC to synchronize to the Global Stocktake. [Ko Barrett, United States of America]	Rejected, comment refers to an earlier internal draft of the chapter and is not applicable to the FOD
43030	9	56			Again, the text uses "aim" and not "goal" [David Frame, New Zealand]	Unclear what the reviewer is referring to. There is no line 56 on p. 9. The verb "aims" is used, correctly, at p 9 line 55. Paris "goals" are mentioned in subsequent sentences.
26880	9				This IPCC Report should focus on the facts. The information on the international governance to address challenges posed by climate change is important and interesting. However, this topic should be discussed under separate cover. [Thomas Ackermann, Germany]	This section has been shortened. Introducing the governance context is part of the AR6 mandate, and the presentation here already focuses on the facts about that context.
50708	10	1	10	1	Replace "Paris agreement" by "Paris Agreement". [Hernan Edgardo Sala, Argentina]	Accepted. The text has been revised.
13106	10	1	10	1	Rather than saying "efforts to eradicate poverty" it might be worth rephrasing this to emphasize that "poorer countries and people of a lower socio-economic class will be disproportionately impacted by climate change". [Nora Richter, United States of America]	Out of scope. Here we present briefly the Paris Agreement. The proposition is better suited to WG II.
35238	10	3		5	Why highlight this one specific report? [Ko Barrett, United States of America]	Rejected, comment refers to an earlier internal draft of the chapter and is not applicable to the FOD
13618	10	4	10	5	The text should include the (important) instruction in Article 2(2) of the Paris Agreement regarding its implementation, ie, the sentence should read: "The Paris Agreement is to be implemented, from 2020 onwards, 'to reflect equity and the principle of common but differentiated responsibilities and respective capabilities, in the light of different national circumstances' (article 2)." [Stephen Humphreys, United Kingdom (of Great Britain and Northern Ireland)]	This comment has been considered during the preparation of the FGD. (In FGD) Noted. In the x-chapter Box 1.1. we have preferred to mention "in the light of equity and best available science in the (article 14)". The question of equity and the principle "of common but differentiated responsibilities" are dealt in WG II

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
53104	10	4	10	5	The sentence regarding implementation of PA needs some more nuances, in my view [Jan Fuglestvedt, Norway]	More details added.
43032	10	4			The Paris Agreement is scheduled to be implemented from 2020. The "will" comes across as a bit authoritarian. [David Frame, New Zealand]	Sentence no longer appears.
10024	10	5	10	5	implemented after 2020 onwards. [Tibor Farago, Hungary]	Now says "PA came into effect in 2020," since report will be issued in 2021.
10026	10	5	10	6	it also addresses international cooperative mechanisms (e.g. international emission trading) [Tibor Farago, Hungary]	It's covered in following sentences and for the sake of brevity we cannot detail the cooperative mechanisms
35240	10	7		13	Agree with author's note that this may have been transformed by 2021 [Ko Barrett, United States of America]	This note no longer appears in the FOD text
43416	10	8	10	8	NDC processes have already begun in many nations, and many nations are expected to declare more NDCs this year (2019). "Near term (2031-2050) is therefore a mischaracterization of when these processes begin [Saad Amer, United States of America]	see comment 30424
57248	10	8	10	8	unclear why the NDC system should only be valid in the first half of the century (2031-2050). Where does the Paris Agreement say that there won't be NDCs after 2050? [Oliver Geden, Germany]	Sentence no longer appears.
30424	10	8	10	8	Not sure "near term" is an adequate term to describe the 2031-2050 period. The Paris Agreement also calls for NDCs for 2025. It would be unclear how that would be called if 2031-2050 is already "near term". [Joeri Rogelj, Austria]	Phrase no longer appears.
10028	10	8	10	9	Paris Agreement does not call for emission reduction pledges for all Parties through NDCs! It is a rather sensitive question. In fact: According to the P.A., the developed countries should undertake emission reduction targets, while the developing countries should enhance their mitigation efforts and over time to move towards emission reduction or limitation targets in their NDCs. (Personal remark: These NDCs and their overall or aggregate effects are extensively analysed by some international organisations, like UNFCCC/COP Secretariat and the UNEP, and by many authors including myself: Farago T., 2016: The anthropogenic climate change hazard: role of precedents and the increasing science-policy gap. Időjárás, 120:1, pp. 1-40 ISSN 0324-6329. http://real.mtak.hu/60726) [Tibor Farago, Hungary]	Text has been revised and clarified.
13620	10	13	10	15	It would seem relevant to note, following this sentence, that Article 4 also asks states to ensure each new NDC represents progress on the previous -- states are not permitted to backtrack! So I suggest you insert: "Article 4 also specifies that each 'successive' NDC will represent a 'progression beyond' the 'then current' NDC and reflect the 'highest possible ambition'. " [Stephen Humphreys, United Kingdom (of Great Britain and Northern Ireland)]	This comment has been considered during the preparation of the FGD. (In FGD) Taken into account. the proposed text is introduced farther inn the paragraph when introducing the "ratcheting mechanism"

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
13230	10	13	10	15	The section "1.2.2 International governance to address challenges posed by climate change", notably "The Paris Agreement" (line 54 onwards) fails to note the role of non-state actors in climate action. After "(Kato and Ellis, 2016)." INSERT: "There is also a role for non-state actors, including the private sector in taking climate action, and Article 6.4 (b) refers explictly to the 'participation in the mitigation of greenhouse gas emissions by public and private entities' (Glynn et al, 2017; UNFCC 2017: 7)." References: Glynn, P., Cadman, T. and Maraseni, T.N., 2017. Business, organized labour and climate policy: Forging a role at the negotiating table. Edward Elgar Publishing; UNFCCC. (2015). Conference of the Parties serving as the meeting of the Parties to the Paris Agreement (CMA). Retrieved from http://unfccc.int/bodies/body/9968.php. [Timothy Cadman, Australia]	We did not succeed in introducing this change in time for the SOD so this comment has been considered for the FGD. In the FGD, this comment is Not Applicable. The section has been extensively revised and the text referring to non-state actors is no longer in the section. Role of non-state actors is assessed in WG II
27512	10	14	10	14	An important aspect of the Paris agreement is article 8 on Loss and Damage, which the global stocktake should inform as well (as far as I understand) and even if that is difficult it would be good to mention L&D when introducing the paris Agreement. Also given it's part of the following box. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Loss and damage briefly mentioned.
42836	10	17	22	15	Just a comment - this seems to me very well done, I really like the plan for the structure of the report. [Michael Evans, United States of America]	Noted, thanks
45128	10	18	10	19	Do you mean: "...with its outcomes expected to contribute TO the global stocktaking process …"? [David Wratt, New Zealand]	Not applicable. The sentence has been rewritten.
37296	10	18	10	19	This sentence works for AR6 and the 2023 stocktake, but begs the question "What next?" in the mind of the reader. The IPCC's assessment reports have had a six or seven-year frequency, and it is hard to see how this can be shortened given the demands of climate-model improvement and the running of new CMIPs. But the global stocktake is expected to have five-year frequency. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	This sentence now mentions the five-yearly cycle of global stock-taking under the Paris accord. Comment on timing of IPCC vs. stocktake is an issue for leadership and PA implementation, not Ch. 1.
41304	10	19	10	19	Insert 'to' after 'contribute' [Debra Roberts, South Africa]	Not applicable. The sentence has been rewritten.
49254	10	21	10	21	Would suggest to add in a subsection 1.2.2.2 The 2030 Agenda for Sustainable Development 'Transforming our World' [EE LING LEE, Malaysia]	Additional subsections interfere with readability
43034	10	21		29	Reads a bit like an ad. Suggest deletion. We should be at arms length from these documents and declarations - we shouldn't be endorsing this stuff: that would be prescriptive, which is not part of our mandate. Similar comments apply to some of the other UN docs discussed here. [David Frame, New Zealand]	The focus has been put on UNFCCC +Paris agreement and SDG. Also the language has been revised to avoid policy prescription.
48250	10	22	10	24	The meaning of this sentence is not clear to me. [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	Editorial error corrected
10030	10	28	10	30	It is much more relevant to refer not only to Goal 13 (for well-known reasons, its targets do not deal with mitigation). I propose alternative text: The 2030 Agenda recognizes that “climate change is one of the greatest challenges of our time and its adverse impacts undermine the ability of all countries to achieve sustainable development. .. .. The global nature of climate change calls for the widest possible international cooperation aimed at accelerating the reduction of global greenhouse gas emissions and addressing adaptation to the adverse impacts of climate change.” Goal 13 deals explicitly with climate change, establishing several targets on adaptation, awareness-raising and finance. [Tibor Farago, Hungary]	the text suggested has been added
13622	10	30	10	30	For accuracy, it may be better to say 'Most other SDGs are highly relevant [rather than 'tightly linked'] to climate and climate change.'? [Stephen Humphreys, United Kingdom (of Great Britain and Northern Ireland)]	Thanks for the suggestion. Accepted

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
13624	10	30	10	30	After this sentence, perhaps reference SR15, which lays this case out in detail (in chapter 1, cross-capter box 4, pages 73-75)? [Stephen Humphreys, United Kingdom (of Great Britain and Northern Ireland)]	thanks for the suggestion. Accepted
44184	10	33	10	35	"The IPCC Special Report on Global Warming of 1.5°C was prepared to strengthening the global response to the threat of climate change in the context of sustainable development and efforts to eradicate poverty." [Christian Reuten, Canada]	Not applicable. The sentence has been rewritten.
52452	10	37	10	43	Suggest to include a more complete list of SDGS related to the SRs [John Brian Robin Matthews, France]	For the sake of brevity we cannot add more text on SDG but reference to SR has been made
45380	10	40	10	40	SRCCL acronym is misspelled. [Baylor Fox-Kemper, United States of America]	Accepted. The term has been checked through the entire chapter.
53106	10	40	10	40	Insert full tittle of SRCCL (e.g in footnote). It helps to show how broad this is [Jan Fuglestvedt, Norway]	Noted. The full title has been mentioned in the text.
35242	10	43		44	No, the 1.5 report was not specially prepared to assess the feasibility of a 1.5 warming goal in the context of SDGs. 1.5 addressed sustainable development writ large, as well as impacts and emissions pathways. Please take care to present reference to 1.5 properly. [Ko Barrett, United States of America]	The reviewer is referring to the Internal draft not to the FOD
49256	10	44	10	44	Would suggest to add in a subsection 1.2.2.3 The New Urban Agenda [EE LING LEE, Malaysia]	We lack space to discuss the New Urban Agenda in detail.
35244	10	52	11	52	Delete these cherry-picked examples [Ko Barrett, United States of America]	The reviewer is referring to the Internal draft not to the FOD
57992	10	53	10	53	why not considering long-lived urban emission? [Tomas Halenka, Czech Republic]	Chapter 6 covers only short-lived climate forcers. "Long-lived urban emissions" join the global atmosphere, rather than staying in place over an urban area.
49258	10	54	10	54	Would suggest to add in a subsection 1.2.2.4 The Sendai Framework for Disaster Risk Reduction (SFDRR) [EE LING LEE, Malaysia]	Additional subsections interfere with readability. SFDRRR is covered in the text

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
43036	10	54	11	8	Similar comments as before. This does too much to prescribe approaches, and elevates some approaches above the level warranted to us as IPCC authors. I would change this section to something like: "The Sendai Framework for Disaster Risk Reduction (SFDRR) 2015-2030 (UNISDR, 2015) is a pathway to reduce risks associated with disasters of all scales, frequencies, and onset rates caused by natural or manmade hazards. Disaster risk reduction (DRR), climate change, and sustainable development are tightly linked (Forino et al., 2015; Kelman, 2015, 2017; McBean, 2012). Some have argued for a more integrated climate change adaptation with DRR integration (Forino et al., 2015) and of climate change mitigation with pollution prevention (Kelman, 2017). AR6 adopts a risk-oriented framing (see section 1.2.4.1, Risk Framing) based on a multidisciplinary approach and Cross-Working Group coordination in order to ensure integrative discussions of major scientific issues associated with integrative risk management and sustainable solutions (IPCC, 2017). " Quite a lot of prescriptive and normative language can (and should) be cut out. Just because Forino and Kelman have made arguments for integrating some dimensions of adaptation or mitigation policy does not imply that these approaches are now the new normal - it's up to nation states, rather than academics or IPCC, to decide which policies and issues to couple and which to leave uncoupled. Presuming for ourselves a mandate to make these decisions is bad form, and contravenes IPCC's own rules around prescription. By all means, choose AR frameworks that make risk management as easy as possible, but don't describe those frameworks as having special status. [David Frame, New Zealand]	This section has been heavily revised, omitting most of the parts criticized here. The risk framing is now almost entirely contained in a cross-WG box in section 1.4. Thanks for the useful comments.
28754	11	0	19	20	The Table on the stocktake came across as a desperate attempt by WGI to keep itself relevent. Should it be shorter and pick a few specific things? An omission are emisison metrics (GWPs) etc. used directly in carbon accounting and derived from the forcing chapters... [Piers Piers Forster, United Kingdom (of Great Britain and Northern Ireland)]	Noted. We shortened the table in places, and added emission metrics. We stick to the broad coverage. Picking very few individual examples is problematic. As the reviewer knows, WG1 information is crucially important in the context of the global stocktake for many aspects, i.e. long-term temperature goals, the remaining carbon budgets, the near-term climate projections (to assess adequacy of adaptation actions), the metrics etc . Some of the spread of the provided information is there in order to allow a wide range of stakeholders to pick from a menu, rather than to prescribe certain areas as the only ones that are relevant.
41300	11	1	11	1	Drop 'HFA' as this acronym was used only once in this chapter. [Debra Roberts, South Africa]	Accepted. The term has been removed.
13626	11	6	11	6	Perhaps it would make sense to say something about the Sendai Framework itself here? How about inserting between the two sentences in this line the following: "The Sendai Framework calls for substantial reductions in mortality, injury, infrastructural damage, and economic loss from disasters, through increases in the number of national and local disaster risk reduction strategies and multi-hazard early warning systems, and through 'substantially enhance international cooperation to developing countries'." [Stephen Humphreys, United Kingdom (of Great Britain and Northern Ireland)]	The section has been shortened and the Sendai Framework is just mentioned in the Risk framing but not any more as a paragraph

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
43418	11	7	11	8	CMA refers to Conference of the Parties serving as the meeting of the Parties to the Paris Agreement; the current acronym is defined incorrectly [Saad Amer, United States of America]	Taken into account. Text has been shortened substantially. Note that that the reviewer is referring to page 12, Cross-Chapter Box 1.1
29652	11	9	11	9	The references IPCC, 2017 there isn't in final references [luisa Sturiale, Italy]	Reference added.
49260	11	10	11	10	Would suggest to add in a subsection 1.2.2.5 The Global Framework for Climate Services (GFCS) [EE LING LEE, Malaysia]	Too many subsections interfere with the flow of the text.
48554	11	11	11	42	The mention of IPBES and GFCS seems a little misplaced here. The Paris Agreement, Sendai and SDGs are all government negotiated agreements/ goals. IPBES is an assessment. Why is this included but not other assessments such as the Global Environment Outlook? GFCS is mainly run by WMO. Why not mention inititaives by the EU or other UN agencies? The list could go on and on. I suggest taking out mention of IPBES and GFCS or adding a table that includes other relevant assessments and programs. [Zinta Zommers, United States of America]	IPBES and GFCS not any more highlighted as paragraphs, and other similar initiatives are mentioned
41302	11	19	11	19	Drop 'LDC' as this acronym was used only once in this chapter. [Debra Roberts, South Africa]	Accepted. The term has been removed.
49262	11	26	11	26	Would suggest to add in a subsection 1.2.2.6 The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) [EE LING LEE, Malaysia]	Too many subsections interfere with the flow of the text.
53108	11	36	11	36	need to update "will be assessed" [Jan Fuglestvedt, Norway]	Accepted. The term has been updated.
50710	11	40	11	40	I suggest to add "to the AR6" in this way: "For the WGI contribution to the AR6, this means..." [Hernan Edgardo Sala, Argentina]	Sentence no longer appears.
50712	11	42	11	42	I suggest to replace: "This challenge has translated into a change in the WGI structure compared to previous assessments, which will be further explained..." by: "This challenge has translated into a change in the structure of the WGI report compared to previous assessments, which will be further explained..." [Hernan Edgardo Sala, Argentina]	Sentence no longer appears.
10032	11	43	11	43	In this international governance listing, the Addis Ababa Action Agenda (AAAA) could also be mentioned briefly: it was also adopted in 2015 and it is the basis for the post-2015 international development cooperation (in harmony with the 2030 Agenda for sustainable development). This AAAA also refers to climate change in several aspects. [Tibor Farago, Hungary]	Addis Ababa Action Plan already mentioned. We lack space to expand further.
27514	11	45	11	55	What are the metrics used to do the stock-take? That is crucial and needs to be mentioned where in WG1 this is dicussed for what. I guess for Mitigation in chapter 7, but for adaptation & L&D? Given how central this is a good part of this box should be dedicated to metrics. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Metrics now have their own question within the new section 3 of the table on the near-term.
13108	11	47	11	47	What is "stocktake"? It would be owrth defining this term at the beginning of Box 1.1. [Nora Richter, United States of America]	Accepted. We now include a brief description of the global stocktake in general terms at the beginning of the box.
49402	11	47	11	47	This cross-chapter box 1.1. on the global stocktake needs to begin by defining what the "global stocktake" means for the nonspecialist. [Sonya Legg, United States of America]	Accepted. We now include a brief description of the global stocktake at the beginning of the box.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
45382	11	47	13	3	The initiation of the stocktake discussion isn't clear why WGI has a role at all, until the bullet list at the end comes into play. I'd recommend an earlier statement clarifying the WGI role in the stocktake in order to trim some of the language in this discussion to be more focused on WGI purview. [Baylor Fox-Kemper, United States of America]	Taken into account. We had to balance the reviewer suggestions to first clarify what the global stocktake process is, before emphasising WG1's role. We revised the language to more clearly emphasise WG1 role in the third and fourth paragraphs, starting with " The type of information sought by the global stocktake has been described by UNFCCC parties and the areas where the WGI assessment is particularly relevant are: [...]" and "The WGI assessment provides a wide range of potentially relevant information for the stocktake, complementary to IPCC Special Reports, the contributions from WGII and WGIII and the Synthesis Report. [...]", respectively.
50474	11	47	13	11	While the cross-chapter box is a good tool to help readers understand the architecture of the content and navigate, the introduction to the table is very dense, complicated, and difficult to follow. [Anton Holland, Canada]	We hope that the more simple introduction into what the global stocktake is, addresses this point sufficiently.
13628	11	47	13	11	This cross-chapter box is welcome. Although it does a good job of referring to CMA decisions on the global stocktake -- and Table 1 is impressively comprehensive -- the first section still feels quite rough and unfocused. For example, it does not quite capture the scope of the stocktake as outlined in the most authoritative source, the Paris Agreement itself. It could refer at a minimum to Articles 7(14), 9(6), 10(6) and 13 (5) and (6). This could be done with a single sentence as follows: "The Paris Agreement expects the global stocktake to 'recognise' and 'enhance the implemention of' adaptation actions in developing countries, and to 'take into account' information on climate finance 'efforts' by developed countries and on their 'support on technology development and transfer' for developing countries." Such a sentence could be inserted, for example, at page 12 line 11 or 48, or at page 13 line 12. [Stephen Humphreys, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. We now include a brief description of the global stocktake at the beginning of the box - slightly broader than suggested by the helpful reviewer comment.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
13630	11	47	13	11	The cross-chapter box correctly identifies the importance of 'equity' to the global stocktake, and references other relevant mentions of equity in the Paris Agreement. However there is no discussion of how equity is to be understood (the term is hardly transparent!). Given the relatively thorough discussion of the 'best available science' in table 1, there is presumably scope for a somewhat lengthier discussion of 'equity' also in this box. Fortunately, such a discussion has already been undertaken twive by the IPCC, in AR5 (WG3, chapter 4 [Fleurbaey et al]) and in SR15 (Chapter 1, section 1.1.1, pages 54-55). At a minimum, it would be good to mention these existing sources in this box at an appropriate juncture, and also to mention briefly what 'equity' has come to mean in evolving IPCC reports. For example: "By 'equity' is meant procedural and substantive fairness between and within countries and generations, as outlined in AR6 and SR15." An excellent places for such a line would be between the two sentences on page 12 line 5. This would then allow minimal clarity when the term arises (twice) again in the box. Moreover, numerous elements raised in section 2 of table 1 (along pages 15-19) themselves raise equity concerns (in terms of differential impacts) -- which might be gathered together under a single additional rubric. (Much of the relevant information is given in SR15 chapters 3 and 4.) This is also true of other sections of the report -- notably chapters 10, 12 and Atlas, and to a degree 4 and 11 -- all produce information pointing to the varying exposure of different groups to specific climate harms -- a point that might be made in this cross-chapter box. [Stephen Humphreys, United Kingdom (of Great Britain and Northern Ireland)]	Taken into consideration. Thank you for the very considerate comment. From WG1 perspective, we however will not venture into defining what was meant by equity in the Paris Agreement, or into discussing equity implications of differential impacts, as this is WG2 ad WG3 territory. We look forward to combining that information at the SYR stage.
57292	11	47	13	11	This box would be the ideal place to reproduce the key concepts box from the SPM of SR1.5. They are not, of course, set in stone, but they are government-approved, so any changes in usage from SR1.5 should be highlighted and justified. [Myles Allen, United Kingdom (of Great Britain and Northern Ireland)]	Noted. We agree with the general usefulness of such a box, although it might be better placed in either the SPM or the TS, not in Chapter 1 and not as part of another topic (the global stocktake). For some of the key variables, like global warming, AR6 proposes a different usage (i.e. consistent use of air surface temperatures) than SR1.5 (see e.g. Table 2.2 warming definition being GSAT).
33292	11	47	19	1	The table (Section 1: State of the Climate) in Cross-Chapter Box 1 is great & very informative. The text before the table (p.11-13) is confusing. I do not think the word "stocktake" is widely used, so starting with what that means would be very useful. [Erika Wise, United States of America]	Accepted. We now included a brief explanation of what the global stocktake process is right at the beginning.
10034	11	49	11	49	The IPCC AR6 will prominently inform the 2023 global stocktake of the Paris Agreement through .. [Tibor Farago, Hungary]	Noted. The particular text element is not part of the reworded and simplified language any more.
50714	11	51	11	51	Please, include the meaning of "SYR", because it has not been previously defined. [Hernan Edgardo Sala, Argentina]	Accepted. The respective text is shifted to paragraph 5 of the Box and "Synthesis Report" is there used instead of "SYR".
35246	11	54	12	1	Inaccurate in many ways. AR6 does not link climate services to the information needed for adaptation and mitigation. WGI does not choose "key provider" pathways for "developing regional messages". [Ko Barrett, United States of America]	Not applicable here. Text not in Ch1 FOD. Error in page reference of the reviewer comment? We note that the comments fits with text from Ch1 Internal Draft unrelated to this section.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
45624	11				Perhaps the UN WMO Global Atmosphere Watch could be mentioned in ths list? [Euan Nisbet, United Kingdom (of Great Britain and Northern Ireland)]	Noted. No text changes, as specific information is up to the individual chapters and the Technical Summary.
10036	12	1	12	1	The Paris Agreement (PA) is a legal instrument under the UNFCCC, so that the long-term goals of the PA should also be considered in the context of the objective of the UNFCCC. The IPCC had already a significant role for the formulation of that objective in early 1990s. A reminder of that objective would be essential in relation to the global stocktake. E.g.: The ultimate objective of the UNFCCC is to achieve stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. The Paris Agreement is a legal instrument for enhancing the implementation of the Convention, including its objective" and the Article 14 of this Agreement provides for a periodic global stocktake "of the implementation of this Agreement to assess the collective progress towards achieving the purpose of this Agreement and its long-term goals." This .. [Tibor Farago, Hungary]	Noted. We thank the reviewer for this comment. We however do not venture into the complex legal and target relationship between the Paris Agreement and the UNFCCC, as a discussion on the relationship between UNFCCC's "stabilised GHG concentrations" ultimate objective (Art. 2) and PA's temperature (Art. 2) and long-term emission (Art. 4.1) goals would warrant more space than we have.
47986	12	3	12	3	Avoid interprettion of the Paris Agreement. Stick to direct quotes to avoid comments in the SOD from Governments. [WGI TSU, France]	Noted. Comment unclear as this line is a direct quote from the Paris Agreement. The original text of Art 14 of the Paris Agreement says: "It shall do so in a comprehensive and facilitative manner, considering mitigation, adaptation and the means of implementation and support, and in the light of equity and the best available science." while the text here states " This stocktake should be done in a 'comprehensive and facilitative manner, considering mitigation, adaptation and the means of implementation and support, and in the light of equity and the best available science'. Thus, we presume that the reviewer asks us to change "This stocktake should be done " into the original "It shall do so". Instead, we now opted to make it clear that "shall do so" originates in the Paris Agreement, rather than as our interpretation of it... the new next hence reads "The Paris Agreement further specifies that the stocktake shall be undertaken in a ..." to avoid misunderstandings
35248	12	3		5	What is the reference here to the wide range of human impacts? A wide range of impacts was not addressed in the section. Further, What evidence do we have that "previously independent international agendas have become more closely integrated"? [Ko Barrett, United States of America]	Taken into account. Section has been heavily revised to address this. (We believe the reviewer meant to refer to p 9 lines 48-49, and not page 12, line 3).

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
44186	12	8	12	8	How is the acronym related to the sentence? [Christian Reuten, Canada]	Noted. The respective text has been deleted as part of the simplification of the box. FYI: CMA stands for "Conference of the Parties serving as the meeting of the Parties to the Paris Agreement". See e.g. https://unfccc.int/process-and-meetings/bodies/the-big-picture/what-are-governing-process-management-subsidiary-constituted-and-concluded-bodies
44188	12	9	12	10	The link is incorrect. [Christian Reuten, Canada]	Editorial. Link corrected. the printed link is correct, but the Adobe PDF seems to insert the line number "10" into the link, which renders the link as broken.
43038	12	16			end quote mark missing. [David Frame, New Zealand]	Editorial. Done
10038	12	19	12	20	The last part of this sentence ought to be deleted, because the Parties specified the purpose and long-term goals to the extent as it could be accepted by consensus: The purpose and long-term goals towards .. global stocktake are different across those thematic areas. and have not yet been specified by Parties. [Tibor Farago, Hungary]	Accepted. Reworded Box text does not contain the text in question any more.
55500	12	19	12	37	This paragraph is rather convoluted; could it be either simplified a little, or broken down into c.two sub-paragraphs? [Wesley Fraser, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Reworded box text is more clearly structured into subsections.
43040	12	20			Just quote PA Article 2 here. Editing it looks suspicious. [David Frame, New Zealand]	Accepted. We now include the text where 1.5C and 2C are mentioned as a direct quote.
43042	12	22			Use the fulle text of Article 4.1 "In order to achieve the long-term temperature goal set out in Article 2, parties..." That is the fuller context. Editing it looks like we are trying to frame the document to bring to the surface some interpretations, while limiting the scope for others. Fuller contexts are better, because then readers and parties can decide for themselves. [David Frame, New Zealand]	Noted. Rather than partial quotation, we now implemented the new and simplified and shortened text, which does not quote directly. We hope the shortening appropriately reflects Art. 4.1.
46528	12	34	12	34	"will likely include" - the word likely is reserved for IPCC uncertainty language. Also, great care needs to be taken when referring to the Paris Agreement, particularly when if interpretating it, and this language sounds speculative [WGI TSU, France]	Accepted. Text revised accordingly, i.e. "likely" is not used.
43046	12	48			I would also argue that IPCC SR1.5 has already pointed out that reporting against the usual measure of equivalance (GWP100) is ambiguous in terms of the temperature implications of a given emissions portfolio. Chapter 7 will also be making this point. We don't know whether the stocktake will or not, but IPCC has made and will be making this point, so it should probably go here for consistency. [David Frame, New Zealand]	Taken into account. We included a row on metrics - as suggested by other comments. We refrain here from pointing out a particular metric - as all come with specific shortcomings and strengths. The metric question is included in section 3 of the subsequent table.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
43044	12	49			I would delete "at a collective level" - yes it's in the UN doc, but it doesn't add anything here. [David Frame, New Zealand]	Rejected. The text is rephrased for clarity, but we disagree with the reviewer as "collective level" adds the important information that the stocktake will not examine individual's nations' NDCs , but rather consider - at the collective level - the consistency of actions and goals. Thus, the collective nature of the stocktake is emphasised throughout the text.
35250	13	5	34	4	I question whether this historical information is 1) universally agreed as written and 2) necessary to this repor - it is not an assessment, as sucht. A call for this information is not contained in the outline. [Ko Barrett, United States of America]	Rejected. Historical section is shortened considerably for SOD.
43048	13	6			Missing subject of sentence. I presume it's "parties" between "allows" and "to put". [David Frame, New Zealand]	Taken into account. Text slightly shortened to avoid a "missing noun" interpretation. We however kept the phrasing more vague as "parties" is slightly too restrictive, and "parties, civil society and the public in general" is slightly too long.
48552	13	10	13	13	I welcome the mention of loss and damage in several places in this chapter. However, it is not clear if WG1 is relevant to loss and damage, as stated here. Wouldn't WG2 be more relevant to loss and damage? While no common definition of loss and damage exists, it is often stated that loss and damage occurs when adaptation is insufficient or not possible. Thus it seems loss and damage should be covered by WG2. What specific aspect of loss and damage is WG1 covering? Trends in extreme events? This is only a tiny element of loss and damage as articulated in WIM while other areas include non-economic loss and damage, slow onset events, etc.Perhaps this could be clarified somewhere or the relationship explored in a box. [Zinta Zommers, United States of America]	Taken into account. Text amended by stating: "cognizant of the important contribution of WGII on this matter"
15350	13	14	19	3	The idea is very good and useful, the Potential Relevances are scientifically correct, and at the same time they are too general and weak to attract attansion of decision makers and practicioniers. Please condence the statements and add figures, if it is possible [Oksana Lipka, Russian Federation]	Taken into account. We condensed and revised as much as possible. The reviewer is reminded that this Table is only a pointer with general references to the various issues covered in the chapters.
45962	13	14	19	4	Cross-chapter Box 1.1, Table 1.1 is a very welcome innovation in this Chapter. It makes for easy reading and reference for readers., [Lourdes Tibig, Philippines]	Noted. Thanks.
57994	13	14	19	4	too busy Table, especially with the relevance description, but with missing simple answers to the questions, which would provide introductory summary [Tomas Halenka, Czech Republic]	Taken into account. The reviewer is reminded that this Table is only a pointer with general references to the various issues covered in the chapters. The more precise numbers and findings will be compiled in the Technical Summary.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
31548	13	16	13	16	The chapters/sections are not always formatted consistently, and some have commas and others don't. Does "9" imply the whole of chapter 9? This is not particularly informative. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Editorial. Most chapter references now refer to subsections or subsubsections. In the two instances where whole chapter numbers are provided, they refer to the whole chapter. Chapter references will be updated in final draft based on final chapter ordering.
31550	13	16	13	16	It would be helpful for the Second-Order Draft if the Tables had line numbers so they can be reviewed more readily. There are seveal typos etc, in the tables. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Editorial
31552	13	16	13	16	"The Earth's energy budget, climate feedbacks, and climate sensitivity". It would be good to iterate on this with the LAs of Chapter 7. e.g., in Chapter 7, TCR is defined as "The TCR (units: °C) is defined as the change in the global mean near surface air temperature, averaged over a 20-year period, centred at the time of atmospheric CO2 doubling (year 70), in a climate model simulation in which CO2 increases at 1% yr-1 from pre-industrial and compared to the same time period within a preindustrial control simulation. It is a measure of transient warming accounting for the strength of climate feedbacks and ocean heat uptake.". However, in this Table it is defined as "The transient climate response is a is a measure of the strength of climate feedbacks and the timescale of ocean heat uptake". It would be good to use a consistent definition. e.g. change in the Table to "The transient climate response is a measure of transient warming accounting for the strength of climate feedbacks and ocean heat uptake". Similarly for ECS: "The higher the ECS, the lower are the greenhouse gas emissions...". Strictly speaking this should be "The higher the ECS, the lower are the greenhouse gas concentrations...". Also, "An energy imbalance indicates that one can expect additional warming..." should strictly be "An energy imbalance indicates that one can expect additional temperature change..." (or add "positive" to "energy inbalance"). In summary; maybe ask Trude and/or Piers (CLAs Chapter 7) to check this section of the Table. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. The reviewer's suggestions are welcome. As the reviewer suggests, the actual wordings should be consistent in their substance, but do not need to be verbatim the same, as this box is kept at a slightly more general level and succinct level. The new description, not definition, of ECS and TCR are "Equilibrium Climate Sensitivity (ECS) measures the long-term climatic response to CO2 doubling from pre-industrial concentrations. Transient Climate Response (TCR) measures the near-term response to increasing CO2 concentrations. "
51696	13	16	13	29	Cross-Chapter Box 1.1, Table 1. Column 2 Question. Suggest that the title "Question" be change to "Topic" or "Issue" or other title, since not all of the items listed in the column are questions. [Zelina Zaiton Ibrahim, Malaysia]	Noted. Rather than changing the column header we now rephrased all items in this column in the form of questions.
53110	13	16	19	5	I find the questions here relevant but it would be useful if you make it more clear where these questions are coming from and how they have been established - in addition to the right hand column you have explaining relevance. And it is very useful that you show the links to the various sections in the report adressing the topics. [Jan Fuglestvedt, Norway]	Noted. The questions arise from a cross-Chapter consideration of the potentially relevant issues by Chapter 1 and other chapter authors - given it is a cross-chapter box. The chapter references have been expanded and updated.
43050	13	25			Sorry - I meant to contribute to this box before FOD deadline. Chapter 7 thinks that TCR and ECS values are relevant, and that room should be found in the stocktake for parties to report separately emissions and removals of all GHGs with lifetimes longer than and shorter than 100 years. i.e., if you can report the LLCF and SLCF shares of the emissions profile, you can fairly easily how much warming is implied. If you smear together SLCFs and LLCFs, then you can't. [David Frame, New Zealand]	Noted. Our existing reference to the metrics discussion in Chapter 7.7 (page 18 FOD) has been emphasised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
53112	13	26	13	27	the last sentence in the caption is unclear (about the synthesis) [Jan Fuglestvedt, Norway]	Noted. The last sentence should read "The overarching synthesis that comprises contributions from all three Working Groups to the Global Stocktake will be part of the Synthesis Report". We apologize for this edit not having made it to the SOD version. The text was deleted for the FGD.
57900	13	29	13	29	Table 1.1. Section 2.3.3.1 Please replace "thermosteric" with "thermal" expansion. Undertanding of heat uptake can help constrain projections of warming and sea level. [Catia Domingues, Australia]	Accepted. Text change not made for the SOD, but was implemented for the FGD. We apologize for the oversight of not having changed it this time.
57902	13	29	13	29	Most variables listed in Tabl2 1.1 for Chapter 2 is for the ocean. Is there a need to balance with other indicatiors? [Catia Domingues, Australia]	Noted. The selection of variables is not comprehensive and reflects the potential relevance for the global stocktake. However, adding more variables would make the table even longer, which is not an option in our view.
43382	13	29	13	29	Potential relevance for changes in sea ice extent (Question 3), I'd add ice albedo effects, e.g.: "…influences the flux of heat into the earth system, and the heat exchange between the atmosphere and oceans." [Kristina Pistone, United States of America]	Noted. Thanks for the suggestions to amend the potential relevance. In the overall quest for brevity, we did not include additional items this time.
7582	13	29	13	29	« How did sea -ice... potential relevance» : sea ice also afects albedo and thus the balance of energy between the Earth system and space [Christophe Genthon, France]	Noted. Thanks for the suggestions to amend the potential relevance. In the overall quest for brevity, we did not include additional items this time.
7584	13	29	13	29	« Are mountain glaciers… » Potential relevance : glacier naturally integrate though time and translate in readily visible images (shrinking glaciers) the cumulative impact of surface radiation imbalance due to increasing GHG. [Christophe Genthon, France]	Noted. Thanks for the suggestions to amend the potential relevance. In the overall quest for brevity, we did not include additional items this time.
26334	13	29	13	29	The first four entries seem to derive their relevance entirely from impacts (WGII material). I'm sure physical relevance can be found on every one of them. For example, ocean warming directly accumulates the anthropogenic greenhouse effect. And the retreating mountain glaciers are one of the few examples where an anthropogenic change can both be robustly attributed (because almost all glaciers retreat, worldwide) and be communicated easily. [Jochem Marotzke, Germany]	Noted. The suggestions to revise the potential relevance with a WG1 lens have been generally pursued. However, this table focusses on WG1 ISSUES, which can be relevant because subsequent IMPACTS can be particularly policy-relevant. Thus, the authors would argue that the ISSUE/QUESTON column should focus on WG1 issues, the POTENTIAL RELEVANCE column should however provide the general reader a broader perspective and also pointers to WG2 and WG3 material.
43702	13	29	13	50	Box1.1 Table 1 (line numbers are ficitious). Replace "can be" with "are" in "Mountain glaciers often feed downstream river systems during the melting period, can be an important source for freshwater". [Vaishali Naik, United States of America]	Noted. We opted however for the more cautious formulation "can be" as some mountain glaciers might not be "important" in the freshwater balance of some regions.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
50476	13	29	19	1	The cross-chapter box 1.1, Table 1 is a good attempt to situate a wide variety of readers. The relatively simple questions posed are ones that many readers would have, and the explanations of relevance are well done. Perhaps these descriptions of relevance can form the basis for development of information tools like infographics that are targeted at a broad audience. They would certainly engage policy makers. [Anton Holland, Canada]	Noted. Thank you for the suggestion regarding information graphics, which is relevant for a later stage - when considering outreach material.
37298	13	29	19	1	This comment refers to the right-hand-column entry in Table 1 of Box 1.1 that runs from the foot of page 1.15 to the top of page 1.16. The first sentence is incorrect. WMO did not develop the Essential Climate Variables (ECVs). They were developed by GCOS. WCRP also does not merit a mention in this context. WMO is a sponsor of GCOS, but so also are IOC, the International Science Council (ICSU at the time the ECVs were first developed) and UNEP. The reference for this should be Bojinski et al. (2014, doi: 10.1175/BAMS-D-13-00047.1). Williams and Eggleston (2017) should also be referenced as it deals with a selection of six of the ECVs that are particularly suited for use as indicators of climate change, and it this selection that may be attributed to WMO, not the whole set of ECVs. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Thanks for the comment. As the box has been defined to focus directly on the IPCC and WG1 contributions, the respective text to which this comment refers to has been deleted.
57290	13	29	19	1	Human influence on the climate system box in table: this defines "global warming" as the increase in GSAT. This is inconsistent with the agreed definition in SR1.5 and inconsistent with all definitions of "observed warming" in AR5 and in the Structured Expert Dialogue being used to inform the Paris Agreement. This is highly policy prescriptive, as is made clear by the following question: if GSAT were lower and increasing slower than GMST, would there still be a strong push to switch from GMST to GSAT in the definition of "global warming"? I fear this change being driven by a desire to adapt the definition of "global warming" to fit a desired scenario-classification in WG3. It will be very serious for the reputation of IPCC if WG1 science is seen to be re-defining things in response to perceived policy imperatives. [Myles Allen, United Kingdom (of Great Britain and Northern Ireland)]	Noted. We disagree, given that some of the main policy-relevant results from SR1.5, i.e. the remaining carbon budget in Table 2.2 is based on GSAT, not on GMST as the reviewer suggests to be the case for basically all SR1.5 findings. Also, we do not agree to the allegation of re-defining issues in response to perceived policy imperatives. The WG3 scenario classification for AR6 has not been performed yet - partly because the WG3 emission database does not even exist yet. It is the onus of any IPCC report to assess the available science and literature at its time.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
57294	13	29	19	1	The material on greenhouse gas metrics in Chapter 7 is highly relevant to the global stocktake, and merits a row for itself below the Carbon Cycle and SLCF rows, with a title like "aggregating emissions". For many mitigation decisions, the key piece of information is that peak warming is determined by current plus future warming (obviously enough), and future warming is determined by cumulative aggregate CO2-equivalent emissions of cumulative pollutants (Ctot: primarily CO2 and nitrous oxide, expressed as CO2-e using GWP100) between now and the time of peak warming, plus a term proportional to the change ΔS in aggregate SLCF emission rate (also expressed as CO2-e) between now and the decade prior to peak warming, plus a small contribution from cumulative CO2-e SLCF emissions Stot between now and peak warming, all added together and multiplied by the TCRE: ΔT=TCRE × [Ctot + alpha Stot + (1-alpha) x H x ΔS] where H is the GWP time-horizon (100 years). The value of alpha depends on how fast radiative forcing needs to decline to maintain stable tempertures: following a 1% ramp-up this is given by (ECS-TCR)/(d2 x TCR), where d2 is the slow thermal adjustment time, or about 0.3%/year. So alpha/(1-alpha)=0.003 x H and alpha=0.25. The relevant information is in Allen et al (2016,2018) and Cain et al (2019) GWP* papers, and I'd be happy to provide it directly. I appreciate that this observation will get push-back as "policy prescriptive" because it implicitly refers to greenhouse gas metrics, but if the IPCC cannot inform the UNFCCC of a simple relationship between quantities that they have decided to report (aggregate CO2-e emissions using GWP100) and progress towards their long-term temperature goal, then it is questionable whether IPCC should be informing the stocktake at all. [Myles Allen, United Kingdom (of Great Britain and Northern Ireland)]	Noted. A question and pointer to the metrics discussion in Chapter 7 was already included in the Table (page 18 FOD) and is now emphasised again. We note that the IPCC has the obligation to assess the scientific literature and not be policy-prescriptive. There are many approaches to metrics, and pros and cons to the various options depending on the objective.
38130	13	29	19	1	It is not always clear the relationship between Question, Potential Relevance and Global Stocktake in this table, particularly between Potential Relevance and Global Stocktake. Probably the Potential Relevance here is too qualitative. I think IPCC has been required to offer relevant information to Global Stocktake, but does this table match the information? There are three areas indicated in lines 4-11 in page 13 for which the WGI assessment is particularly relevant, and it should be shown to which area each topic or question in this table belongs. [Hiroaki Kondo, Japan]	Noted. In the absence of very clear guidelines by the global stocktake process, there is an advantage of keeping some vagueness and avoid over-classification. We will await government review comments to consider the classification.
49404	13	29	19	1	In cross-chapter box 1, table 1, I like the framing with "question" followed by "potential relevance". However, care needs to be taken to make sure items in the "question" column are phrased as questions, and every item needs to have a "potential relevance" statement. [Sonya Legg, United States of America]	Taken into account. Text is now streamlined with questions.
33396	13	29	19	2	Cross-Chapter Box 1.1, Table 1: It seems like in many cases, the callouts to the Paris agreement weakened the point of the box, or felt forced. For example, for the 4.6 question - why not just say that the results of different emission scenarios can inform adaptation and impacts analyses? For 3.3.1, attribution is a generally important topic - we didn't start estimating attribution in order to monitor progress towards Paris. Etc. [Marcus Sarofim, United States of America]	Taken into account. This box is not about the relevance of WG1 in general, but specifically related to the global stocktake process, which is a process under the Paris Agreement. We take on board the reviewer's suggestion to point to the finding's relevance also in other text passages.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
27516	13	29	19	4	As it stands this table is very confusing. At the beginning there are questions which seem rather random, why did you chose these questions? Why did you then change to buzz-words? Again, why these? I suggest to reorganise the table around the three aspects of the stocktake introduced above, a,b,c give broad catergorise of relevant information & in which chapter they can be found & give one or two explicit examples, clearly labled as examples in each of the three subareas. At the moment there is no link to chapter 12 where information of hot spots of increased hazards, vulnerability and exposure will hopefully be given which seems to be very relevant to adaptation and L&D. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. We restructured the table - following however the tentative outline of the Synthesis Report. We will consider the structure of the box in response to the government review comments. Also, we added elements for Chapter 12.
45872	13	30			Answers to the questions are somewhat tilted and draw from WGII assessment in many cases. When looking at the questions one would expect an answer to those questions first and then a potential emphasis why such change is important. The "importance" element should be written in a more general way in order not to conflict and remain coherent with the respective WGII assessment. Reference should be to AR5 WGII. Statements in the table conflict with the notion that "We include here only information covered in the WGI contribution to the AR6." Reference to WGII AR5 would thus be legitimate. Boxes do not have numbers unfortunately. One observation to share: Isnt CO2 a long lived greenhouse gas? [Katja Mintenbeck, Germany]	Noted. We only include the geophysical aspects that are covered by WG1, but the "potential relevance" is chosen to make the issues accessible to a wider audience. Thus, the "potential relevance" column is designed to make cross-references to WG2 and WG3. The actual findings will then however only be pulled together by the Synthesis Report across all three working groups.
6676	13		13		Please can we update the cross-references to chapter 9 in this cross-chapter box 1.1? Should ice sheets be part of the box? [Helene Hewitt, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. References updated. Ice sheets are mentioned both in the sea level related question and tipping point related question (third last and last row of the table).
44190	13		13		Last column in table, second row, in "...and the related increase of the greenhouse gas CO2 concentrations" remove "the greenhouse gas". [Christian Reuten, Canada]	Accepted. Text revised accordingly.
44192	13		13		Last column in table, fifth row, the last words "by Chapter 5" don't seem to make sense. [Christian Reuten, Canada]	Accepted. Text revised accordingly.
55146	14	1			[pt 1 of 2] In Cross-Chapter Box 1.1, Table 1, the text for section 2.3.3.3 / 9 says: "Sea level rise is a comparatively slow consequence of a warming world with potential multi-meter increases over hundreds of years. The current sea level change (both rising and lowering) around the coastlines of the world can have strong impacts on storm surge flooding, coastal erosion etc., posing coastal adaptation challenges." 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. Text is based on the Chapter 9 assessment.
55148	14	1			[pt 2 of 2] That's why at about 20% of the best sea-level measurement sites, measurements show 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]	Noted. We do not disagree with the notion that locally sea level can be falling. In fact, the original text did exactly state that. We thank the reviewer for the specific example.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
43704	14	5	14	10	Box1.1 Table 1 Why assess increases in CO2 only? Why not methane, N2O, SLCFs, which chapter 2 and chapter 6 do. I think this question should be reframed to - how much have WMGHGs and SLCF concentrations increased since the preindustrial period? [Vaishali Naik, United States of America]	Accepted. We now included other GHG concentrations. The reason that a focus CO2 is warranted is that it constitutes the dominant human contribution.
26336	14	12	14	12	"in line" --> "compatible" [Jochem Marotzke, Germany]	Accepted. Text revised accordingly.
8332	14	22	14	25	The passage "Ocean acidification is affecting marine life, especially organisms that build calciferous shells and structures (e.g. coral reefs) as they can disintegrate/dissolve in too acidic waters." incorrectly characterizes the state of knowledge on how OA impacts calcifying organisms. Yes, direct dissolution has been observed, but more common is retardation of growth and recruitment/reproduction failure. Rephrase and reconcile with WGII content. [Sarah Cooley, United States of America]	Accepted. Text revised accordingly.
52454	14	25	14	25	"as they disintegrate/dissolve in too acidic waters" - suggest to drop this last part as calcerous organisms don't have to be actually dissolving to be impacted (biological impacts already occur at saturation states above 1). Also, it might create confusion whether ocean waters are acidic (pH < 7) or not (they are not). [John Brian Robin Matthews, France]	Accepted. Text revised accordingly.
43706	14	30	14	40	Box1.1 Table 1 Biogeochemical feedbacks from climate driven changes in natural SLCFs are being covered in chapter 7 [Vaishali Naik, United States of America]	Accepted. During the revision of the Box, the general reference to biogeochemical cycles has been dropped, so that the issue noted by the reviewer does not arise any more.
44620	14	31	14	31	There have two "since", should delete a since. [Liang Zhao, China]	Accepted. Text revised accordingly.
46530	14	35	14	35	"AGREED early industrial period" - makes it sound like the period has COP approval [WGI TSU, France]	The word "agreed" should be deleted. We agree. Text refers to this assessment, not the COP. Unfortunately it slipped through our radars in this revision. Text was adapted for the FGD.
13110	14		14		Summary for 2.3.4.3 - emphasize that ocean acidification has significant consequences for both coastal upwelling regions and polar regions. [Nora Richter, United States of America]	Taken into account. Considered suggestion. Balance needed between comprehensiveness and brevity.
51582	14		14		This is written so blandly as to numb readers from the consequences of insufficient action to loss of human life. Without brief indication of human-related, species-related consequences (as the SR1.5C does), this leaves the reader cold to the human impact, or general species impact as in connecting what we know relating to past ocean acidification and mass species extinctions - far more than just damaged coral reefs. A reader would not absorb this, in the current choice of language. [Lindsey Cook, Germany]	Noted. Not clear what exactly is suggested by the reviewer. Much detail on follow-on impacts is WG2 material, best covered there. The table is intended only to provide relatively brief pointers.
33454	14				In Cross-chapter box 1.1 Table 1, under topic "How much did the oceans acidify already?" 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 "How much did ocean acidity increase already?" and "disintegrate/dissolve in waters with increased 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. Text revised accordingly, as the text segment that used "acidic" has been dropped.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
56184	15	1	15	1	(Table Stocktake): Entry for weather and climate extremes should be expanded as follows: "Robust assessments of past and projected changes in weather and climate extremes for different warming levels (up to present, for 1.5°C of global warming, 2°C, 3°C, 4°C) and of the contribution of human influence to their occurrence". [Sonia Seneviratne, Switzerland]	Taken into account. We revised the text into thematic questions, not directly following the chapter structure any more. The reference to Chapter 11 content is now more prominent, although we did not use the specific suggested formulation.
43708	15	5	15	10	Box1.1 Table 1 : Trends in SLCF emissions are being covered in chapter 6. [Vaishali Naik, United States of America]	Taken into consideration. The table now emphasises SLCF Chapter 6 findings in its third subsection. Among other considerations, historical trends of SLCF have less of an impact on the future (due to the short-lived nature). We hence considered SLCF best covered in the "near-term section".
15630	15	6			You might want to add the following references to GCOS and the ECV concept: Bojinski, S., Verstraete, M., Peterson, T.C., Richter, C., Simmons, A. and Zemp, M. (2014): The concept of Essential Climate Variables in support of climate research, applications, and policy. Bulletin of the American Meteorological Society, 95, 9: p. 1431-1443. e-View: doi: http://dx.doi.org/10.1175/BAMS-D-13-00047.1 [Michael Zemp, Switzerland]	Noted. The revision of the table re-focused the material on WG1 chapter material pointers. Thus, the text section to which this comment referred to is not existent any more.
38132	15	14	15	44	Isn't it OK that the question is not interrogative sentence? [Hiroaki Kondo, Japan]	Noted. Unclear question/comment. No action.
52456	15	50	15	50	There are many more ECVs than those listed, so this should say "The indicators include" rather than "The indicators are" [John Brian Robin Matthews, France]	Noted. The revision of the table re-focused the material on WG1 chapter material pointers. Thus, the text section to which this comment referred to is not existent any more.
26338	15		15		In the Ch10 entry, should it not consistently read "climate change", not just "climate"? [Jochem Marotzke, Germany]	Noted. The specific text element was deleted.
29338	16		16		Please check if this is the correct use of SSPs. Is it consistent regarding the description of SSPs and warming in W/m2. [Minal Pathak, India]	Noted. The correct reference to the newest scenario generation is under discussion. SSPX-Y is however the WG1 terminology with Y being the 2100 approximate/nameplate radiative forcing level in W/m2.
29340	16		16		Last row. Paris agreement's long term goals of 2C or 1.5C. Might be good to stay consistent with the text in the Paris Agreement. Pasting text but authors can edit as appropriate: 'keeping a global temperature rise this century well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius' [Minal Pathak, India]	In the interest of brevity - and given that the verbatim Paris Agreement target section is given in the box's text above - we here refer to 1.5C and 2.0C succinctly.
45130	16				I suggest you change the question for the first topic in Section 2 of Table for Cross-Seection Box 1.1 to : "What are THE projected CHANGES IN key climate indices under low, medium and high emission scenarios ..." [David Wratt, New Zealand]	Taken into consideration. The new subtitle for the 2nd subsection now reads "WGI science to inform how long-term climate change could unfold depending on chosen emission futures".

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
25568	17	1	17	1	The text states: "The concept of the transient climate response to cumulative emissions of carbon-dioxide (TCRE) indicates that one tonne of carbon-dioxide has the same incremental effect on global warming irrespective of whether it is emitted in the past, today or in the future." This simply cannot be. I paste in here my comment pertinent to Chapter 5, pages 61-68: "The TCRE concept, increase in global temperature ΔT proportional to integrated emissions, or constant ratio of ΔT to Integrated emissions, would seem to be an artifact of emissions increasing approximately exponentially, typically characterized as 1% per year increase in emissions. It cannot be expected to hold for a different emissions trajectory or if the emissions trajectory substantially changes. Consider an emission of a pulse of CO2 of short duration followed by zero emissions. ΔT will gradually increase and then, as CO2 decreases, ΔT will ultimately decrease. As integrated emissions is a constant, TCRE will likewise first increase, then decrease. So TCRE cannot be considered a constant. QED. The non-constancy of TCRE was demonstrated, for example by Zickfeld et al (ERL, 2016) in which they examined varioius profiles of emissions including cessation and negative emissions (the latter decreasing the integrated emissions). In the cessation case ΔT continues to increase for a time; ultimately ΔT would start to decrease once CO2 is taken up by sinks. But the abscissa, the total emissions is a constant. So temp response cannot be a function solely of total prior emissions. Figure 1 d of Zickfeld shows TCRE varying by as much as a factor of 2 for the scenarios examined. So the concept has no foundation in science and has no utility for any planning of climate futures in a reduction scenario. Zickfeld, K., MacDougall, A. H., and Matthews, H. D. (2016). On the proportionality between global temperature change and cumulative CO 2 emissions during periods of net negative CO 2 emissions.	Taken into account. The "proof" of the reviewer is not a scientific "proof" warranting a "QED", e.g. it ignores the Earth system's inertia in some statements... For example, the reviewer seems to assume that a pulse emission of CO2 will lead to CO2 concentration to return towards their pre-pulse levels. Thus, the statement holds that, in first approximation, TCRE is constant - despite some small non-linearities. Text builds on Chapter 5 assessment.
55150	17	1			[pt 1 of 2] In Cross-Chapter Box 1.1, Table 1, the text for "Global carbon and other biogeochemical cycles and feedbacks (Chapter 5)" says "What is the remaining carbon budget that is consistent with the Paris Agreement's long-term objectives?" and "5.5; 5.5.1, TCRE; 5.5.2, remaining carbon budget." and "The remaining carbon budget provides an estimate of how much CO2 can still be emitted into the atmosphere by human activities while keeping global warming to a specific temperature limit. It thus provides key geophysical information about emissions limits consistent with limiting global warming to well below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C. Remaining carbon budgets should be seen in context of historical CO2 emissions to date. The concept of the transient climate response to cumulative emissions of carbon-dioxide (TCRE) indicates that one tonne of carbon-dioxide has..." [cont'd] [David Burton, United States of America]	Noted. Comment with no suggestions for changes, just quoting the FOD text. No action taken.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
55152	17	1			[pt 2 of 2] "...the same incremental effect on global warming irrespective of whether it is emitted in the past, today or in the future." This "carbon budget" nonsense needs to be removed from the Report. The amount of CO2 taken up by the terrestrial biosphere and oceans is a function primarily of the atmospheric CO2 level. Currently, the removal rate of CO2 from the atmosphere is the equivalent of about 2.5 ppmv CO2 per year, and increasing. https://www.nature.com/articles/ncomms13428 AR5 estimates that CO2 removal by greening & the oceans current removes CO2 about 55% as fast as mankind emits it, leaving the "airborne fraction" as about 45%. So, if CO2 emissions were merely halved, then CO2 levels would cease rising, entirely. That's why the flurry of "carbon budget" papers and articles are all wildly unscientific. ### [David Burton, United States of America]	Rejected. Comment claim is inconsistent with the scientific information available. Refer to Chapter 5 in this report and to the series of past IPCC reports for comprehensive assessments of the global carbon cycle, its perturbation and related issues.
55154	17	1			[pt 1 of 4] In Cross-Chapter Box 1.1, Table 1, the text for "Short-lived climate forcers (Chapter 6)" and "What are the cobenefits of and co-challenges of climate mitigation?" 6.1.4 says, "The reduction of fossil-fuel related emissions often goes hand in hand with a reduction of air pollutants, like aerosols. Those reductions in air pollutants can accrue co-benefits 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 suggestions, no action.
55156	17	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. No suggestions, no action.
55158	17	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. No suggestions, no action.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
55160	17	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. No suggestions, no action.
16148	17		17		This note concerns the first question refferred to Chapter 6: "How important are reductios in short lived..." In my opinion the relevance box should provide an answer to the question, not simply underline again the issue. the Report 1.5 has already some answers to the question, and so does Chapter 6. This issue is also important to reiterate, starting with Chapter 1 that is the first one to be read, that reducing short-lived climate forcers emission is not an alternativ to CO2 mitigation. [Sandro Fuzzi, Italy]	Rejected. This box only provides pointers to other chapters, where the comprehensive assessment is being provided.
7780	17		17		Please formulate a question out of "Equilibrium Climate Sensitivity". [Merja Tölle, Germany]	Accepted. Suggestion adopted.
47980	17		17		Under SLCF box 6.1.4: IPCC reports are policy neutral and relevant but not prescriptive. Please avoid using emotive language or value based statements or using terms like should, must, need in the text when referencing actions or decisions. [WGI TSU, France]	Noted. We adapted the text to avoid the term "need to " and suggest to use a slightly more factual formulation "requires a mix of mitigation strategies" - simply because not a single gas alone causes 100% of human-induced climate change. We consider revising this segment again depending on government review comments.
43052	18	4			Suggest altering: "To compare the relative climate effects of different gases, CO2-equivalence based on global warming potentials with a timescale of 100 years have customarily been used. New innovations in the scientific literature have the potential to provide less ambiguous ways of making this comparison." [David Frame, New Zealand]	Taken into account. The pointer to metrics is covered with a specific reference to Chapter 7.7. We refrain however from providing a single recommendation.
43710	18	5	18	10	Box1.1 Table 1: I believe chapter 7 is considering metrics for not only greenhouse gases but also aerosols. [Vaishali Naik, United States of America]	Noted. The Paris Agreement and NDCs are however not currently formulated to include aerosols, so the GHG related metrics are the policy-relevant ones in the global stocktake context.
15632	18	7			With regard to the influence of mountain glaciers on freshwater, I suggest to mention that glacier runoff plays a role during dry and warm seasons, mainly in Central Asia and the Peruvian Andes (Kaser et al. 20 , Huss & Hock, 2018). Kaser, G., Großhauser, M., & Marzeion, B. (2010). Contribution potential of glaciers to water availability in different climate regimes. Proceedings of the National Academy of Sciences, 107(47), 20223-20227. Huss, M., & Hock, R. (2018). Global-scale hydrological response to future glacier mass loss. Nature Climate Change, 8(2), 135. [Michael Zemp, Switzerland]	Noted. We thank the reviewer for this suggestion and the references. However, we opted to not include more regional detail in this overview table (for brevity). Also, we stress that this table is merely pointing to relevant section of the IPCC report with the Technical Summary providing a compilation of the results.
13112	18		18		Summary for 7.7 - Rephrase the question: "How can mitigation action in relation to different greenhouse gases be compared in relation to their effect of Earth's climate?" [Nora Richter, United States of America]	Taken into consideration. The new formulation is hopefully addressing the reviewer's concerns: "How can the climate benefit of mitigating emissions of different greenhouse gases be compared? "

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
13114	18		18		For the summary on "Large-scale changes in P-E and surface salinity," briefly mention what the consequences are of changes in ocean surface salinity. [Nora Richter, United States of America]	Noted. In the interest of brevity, we however do not explicitly cover ocean salinity changes any more in this table.
13116	18		18		For the summary on "What are the expected sea level changes in a changing climate?" consider rephrasing the summary. The second sentence show be rephrased to emphasize that "ocean heat uptake, glacier melt, solid ice discharge and surface mass balances of ice sheets" respond to changes in temperature but these responses can be "non-linear" as result of feedback loops and critical thresholds. [Nora Richter, United States of America]	Rejected. We appreciate the reviewer's input. The reviewer suggestion is one option. The current text version stresses the non-linearity already.
7782	18		18		Please formulate a question out of "Earth's energy imbalance" [Merja Tölle, Germany]	Accepted. Suggestion adopted.
7784	18		18		Please formulate a question out of "Total atmospheric moisture" [Merja Tölle, Germany]	Accepted. We focus the question on regional precipitation and runoff changes, which is arguably closer related to the end-user interests and hence the policy-relevance under the global stocktake.
24446	18		18		In the text: “P-E over oceans is closely related to ocean surface salinity, while P-E over land is closely related to surface water availabilit and to drought occurrence.” Comment: correct the word: “availability” [Rubén D Piacentini, Argentina]	Accepted. Text revised accordingly.
44194	18		18		Last column in table, second last row, should the word "which" be added so that it reads "That is because of the long-time scales with which ocean heat uptake…"? [Christian Reuten, Canada]	Accepted. We however used the wording "on which".
51698	18		18		Observation on sequence of questions and topics for each Chapter: for example: Row: Ocean, cryosphere, and sea level change (Chapter 9). What are the expected sea level changes in a changing climate? This is the first question for the chapter, but in the chapter itself, this topic is treated much later in the chapter. Suggest to list the questions or topics in accordance with the chapter layout. Sea-level rise is related to ice and glacial melt (second question) and temperature (expansion). Or ask another question on water mass and sea ice. [Zelina Zaiton Ibrahim, Malaysia]	Noted. We thank the reviewer for the suggestion. We re-structured the questions logically by the draft sequence of Synthesis Report structure. The individual questions however are not meant to follow a particular order.
13118	18		19		For the summary "How are the mountain glacier melt rates expected to develop in regions that are currently dependent on this seasonal freshwater supply?" the question is not answered in the summary. Include a short sentence or phrase explaining how glacier melt rates are expected to develop and what are the implications of this. [Nora Richter, United States of America]	Noted. The table is not meant to come up with answers. Instead, answers are provided in the chapters or in the Technical Summary.
7786	18		19		Please formulate a question out of "Large-scale changes in P-E…" and out of the other boxes on the following page [Merja Tölle, Germany]	Accepted. Suggestion adopted.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
29654	19	4	19	18	It is advisable to insert the following bibliography on the topics provided in this paragraph: Adger, W.N., Quinn, T., Lorenzoni, I., Murphy, C., Sweeney, J. Changing social contracts in climate-change adaptation. Nature Climate Change, 2013, 3(4), pp. 330–333. Baird, J, Plummer, R, Haug, C, Huitema, D. Learning effects of interactive decision-making processes for climate change adaptation. Global Environmental Change, 2014, 27, pp. 51-63 Brink, E., Wamsler, C. Collaborative Governance for Climate Change Adaptation: Mapping citizen–municipality interactions. Environmental Policy and Governance, 2018, n. 28, pp. 82-97. Butt, N, Shanahan, DF, Shumway, N, et al. Opportunities for biodiversity conservation as cities adapt to climate change. Geo: Geography and Environment. 2018; e00052. https://doi.org/10.1002/geo2.52 Hoff, J, Gausset, Q. Community Governance and Citizen-Driven Initiatives in Climate Change Mitigation. Routledge: London, 2015 Sturiale L, Scuderi A. (2018) The evaluation of green investments in urban areas: A proposal of an eco-social-green model of the city. Sustainability, 10 (12), 4541 [luisa Sturiale, Italy]	This section has been heavily revised with the inclusion of numerous contributing authors in a cross-chapter group. The bibliography listed here is useful, but it is more relevant to public action on adaptation than to public understanding of climate hazards.
28756	20	0	25	0	The intro to this section didn't really led anywhere. In my mind it should justify the risk framing. The section reads as if there are lots of possible framing and then, bang, introduces the risk framing without justifying its user over another. [Piers Piers Forster, United Kingdom (of Great Britain and Northern Ireland)]	Section has been heavily revised and parts of it moved elsewhere in Ch 1.
27518	20	1	21	34	A discussion on implicitly value driven choices (where do we study, how do we design the experiment etc. ..) is missing. Also important other aspects influencing and biasing our knowledge, e.g. that no climate model is desinged in Africa e.g. https://journals.ametsoc.org/doi/10.1175/BAMS-D-16-0090.1 would be important to discuss here. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	A new discussion of values in science, with contributing authors from several other chapters, has been introduced into this section. Suggested reference was added. Thanks for the important comment.
43712	20	1	21	34	As I mentioned above, I am not sure for the need for this section (or some parts of it). To me, it is trying to defend the need for scientific process needed to support climate-related decisions. Who is the audience of this section? [Vaishali Naik, United States of America]	AR6 differs from previous ARs in its structure and focus. Acknowledgement of the role of values in science, and relation of science to society, has been requested by WG1 leadership. A new discussion of values in science, with contributing authors from several other chapters, has been introduced into this section.
49406	20	1			Section 1.2.3, Climate, science, and society: perceptions, values, and ethics. I agree that it is important to touch on these issues, even in a report concerned primarily with the physical basis. However, I would like to see this subsection more connected with the other subsections of this overall section 1.2 on the global context of the current assessment. For example, why at the current time, is it important to discuss this? What are the take-away messages from this discussion for the rest of the report? [Sonya Legg, United States of America]	AR6 differs from previous ARs in its structure and focus. Acknowledgement of the role of values in science, and relation of science to society, has been requested by WG1 leadership. A new discussion of values in science, with contributing authors from several other chapters, has been introduced into this section.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
6373	20	2	21	33	I could not find where the context of this subchapter is highlighted/detailed in the other chapters of SR6 [Baruch Rinkevich, Israel]	AR6 differs from previous ARs in its structure and focus. Acknowledgement of the role of values in science, and relation of science to society, has been requested by WG1 leadership. A new discussion of values in science, with contributing authors from several other chapters, has been introduced into this section, along with references to other chapters that address these issues.
15116	20	2	21	34	This entire section has no place in a scientific assessment. It's nothing but one-sided political spin as evidenced by both the text and the references, for example, the McCright and Dunlop paper which is highly prejudicial and has absolutely nothing to do with climate science. Politics has no place in science and the reason that climate science is so intractably broken and controversial is because politics chose sides. To be balanced would require mentioning that the far left blindly accepts the Catastrophic Anthropogenic Global Warming meme because the proposed mitigation policy is in line with their Socialist agenda of destroying free market capitalism and Democracy, which are the consequences, intended or not, of the UNFCCC's stated policy goals. The far left leans this way because of the public comments made by people like Christiana Figueres inferring that these consequences are intended. [George White, United States of America]	Subsection (or rather topic) mandated by WGI leadership. Reviewer presents no evidence that climate science is "broken." Comment reflects a highly partisan political viewpoint. No scientific literature cited or suggested.
54620	20	2	21	34	I do not see the point or relevance to section 1.2.3 (and it is actually bit confussing). Section 1.3.1 and 1.3.2 should either dissapear or make it considerably shorter [Ruth Cerezo, Mexico]	AR6 differs from previous ARs in its structure and focus. Acknowledgement of the role of values in science, and relation of science to society, has been requested by WG1 leadership. A new discussion of values in science, with contributing authors from several other chapters, has been introduced into this section.
53114	20	2	21	34	Section 1.2.3 is important and should be kept. But it may need some edits in reponse to review comments. You may add links to some other chapters, but also to other WGs. (See outlines of WGII and WGIII reports. E.g. ethics is included in both). [Jan Fuglestvedt, Norway]	This section has been heavily revised with the inclusion of numerous contributing authors in a cross-chapter group.
26340	20	2	21	34	The entire subsection strikes me as a very interesting and erudite essay, but I couldn't see the consequences of these insights for the WGI AR6. All told, it comes across more as a review than an assessment. [Jochem Marotzke, Germany]	AR6 differs from previous ARs in its structure and focus. Acknowledgement of the role of values in science, and relation of science to society, has been requested by WG1 leadership. A new discussion of values in science, with contributing authors from several other chapters, has been introduced into this section. The nature of literature about values and ethics, in particular, does not lend itself to assessment in the same way as natural science.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
52692	20	2			There is a discussion about values in science in Chapter 10 Section 5 as well. I am wondering whether it makes sense to move at least part of the discussion there to this section here, or whether the overlap is justified. This should be discussed across the two chapters. [Douglas Maraun, Austria]	This section has been heavily revised with the inclusion of numerous contributing authors in a cross-chapter group, including this reviewer.
6549	20	4	20	4	"Values and ethics play critical….understanding": suggest to change to: "Understanding climate may be biased by differing values and ethics". [Tim Christiane Thys, Belgium]	Sentence no longer appears.
12604	20	4	20	12	This point needs to be included in the SPM to illustrate that the actions that must be taken may vary from place to place and encompass different sectors that best serve the needs of the country implementing them while also addressing climate change to the maximum amount possible. [Kristin Campbell, United States of America]	We have suggested this for the SPM
12754	20	4	20	12	This point needs to be included in the SPM to illustrate that the actions that must be taken may vary from place to place and encompass different sectors that best serve the needs of the country implementing them while also addressing climate change to the maximum amount possible. Note the efforts to create an alliance among science, policy, religion, and education to elicit public support for climate mitigation. 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 (“Build an alliance among science, religion, health care, and policy to change behavior and garner public support for drastic mitigation actions.”). [Durwood Zaelke, United States of America]	We have suggested this for the SPM

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
13636	20	4	20	30	The welcome discussion in these two paragraphs (esp para. 1) introduces a higher level of value relativism that is warranted. While there is certainly disagreement on the optimal policies, there is rather broad agreement on the *values* that should underpin those policies, notably, for example, the values of human life, subsistence, and stability, and on the need for the costs and benefits of climate impacts and policies to be distributed 'equitably'. The latter point is clear from the UNFCCC and Paris texts themselves. AR5 and SR15 further point out that the language of 'human rights' provides a means of identifying core values relevant to climate impacts and policy objectives that are broadly agreed and that are, moreover, already enshrined in international law. See (a) Fleurbaey et al (2015) and (b) Allen et al (2018). (It is notable that the references in this section are all somewhat older than the latter texts.) Full refs: (a) Fleurbaey, M. et al., 2014: Sustainable Development and Equity. In: Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Edenhofer, O., Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, P.E. K. Seyboth, A. Adler, I. Baum, S. Brunner, and T.Z.J.C.M. B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow (eds.)]. Cambridge University Press, Cambridge, Cambridge, United Kingdom and New York, NY, USA, pp. 283–350; (b) Allen, M.R., O.P. Dube, W. Solecki, F. Aragón-Durand, W. Cramer, S. Humphreys, M. Kainuma, J. Kala, N. Mahowald, Y. Mulugetta, R. Perez, M. Wairiu, and K. Zickfeld, 2018: Framing and Context. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)] [Stephen Humphreys, United Kingdom (of Great Britain and Northern Ireland)]	A new discussion of values in science, with contributing authors from several other chapters, has been introduced into this section. We added two sentences based on this important comment; thank you.
50502	20	4	21	34	For this selection of text, the analysis provides results that are even farther from 8 to target score. In addition to this, 73% of the sentences in this selection of paragraphs are over 30 syllables. 95% of the sentences are over 20 syllables. Large syllable counts like these are generally indicative of a plain language problem with the text. This is especially concerning in this case because the text is describing "Climate, science, and societies: perceptions, values, and ethics" areas that would be of interest to a wide variety of readers. [Anton Holland, Canada]	Noted
54976	20	4	21	34	All sections will benefit from more recent references, including this section that appears to have relatively less recent references than other sections although it may have received new or additional emphasis in AR6. [Kilkis Siir, Turkey]	The call for recent references is appropriate for some aspects of this section, but not others. Philosophical ethics and history/philosophy of science do not change as quickly as physical science; older literature, especially books, is still highly relevant. We have incorporated several more recent references.
43294	20	4			Same as lines 16 and 17. [Onema Adojoh, United States of America]	Rejected. The sentences are not identical and make different points.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
29656	20	6	20	15	It is advisable to insert the following bibliography on the topics provided in this paragraph. 31. Stauskis, G.: Development of methods and practices of virtual reality as a tool for partici-patory urban planning: a case study of Vilnius City as an example for improving environ-mental, social and energy sustainability. Energy, Sustainability and Society, 4 (7), 1-13 (2014). Scuderi A, Sturiale L. (2019) Evaluations of social media strategy for green urban planning in metropolitan cities. Smart Innovation, Systems and Technologies 100, pp. 76-84 [luisa Sturiale, Italy]	Thanks. These references are narrower in scope than what is appropriate for this section.
13632	20	7	20	7	Surely science 'cannot offer definitive responses' rather than 'can offer no response' to questions of value or importance? [Stephen Humphreys, United Kingdom (of Great Britain and Northern Ireland)]	Sentence no longer appears.
51584	20	7	20	8	While the IPCC cannot be policy perscriptive, it does have a role to point out what actions would be 'a high priority' for policy makers to protect life on earth. This is a kind of ethical spacethe IPCC can and should take that clearly states the 'importance' or 'value' of an option in relating to saving life forms while clearly stating the compromises to life forms that another option would create. This is not 'policy perscrptive' but it is ensuring policy makers take an informed decision when humanity is facing an existential situation. [Lindsey Cook, Germany]	WGI does not suggest policy actions or priorities. Comment more appropriate for WG2 and WG3.
10040	20	7	20	14	Please, no such statement: “By contrast, science can offer no response to questions of value ..” Actually, social science deals with various value systems and also with various issues of ethics, social norms !!! However, it is true, that some values are widely shared, but others vary considerably across .. etc. [Tibor Farago, Hungary]	Sentence no longer appears
57996	20	7	20	18	a bit artifitial, moreover, there are social-economic sciences, psychology, legal aspects of climate justice analysing the mentioned items, maybe better distinguish the objective and subjective aspects [Tomas Halenka, Czech Republic]	Sentence no longer appears
43054	20	8		10	I would cut the example after the semicolon, or broaden the references considerably to include other key references - especially since neither of the references are from the ethics literature narrowly defined. But as it is, I don't think WGI has any business focusing on this specific, narrow issue and then citing only one highly prescriptive citation (however influential) and then one other STS piece which basically nods in approval. There are lots of other approaches, sufficientarian, utilitarian, liberal, etc, which interpret CBDRRC (on which unequal GHG use bears) differently. It's a can of worms, and we should just steer clear of it here. If we want to refer to ethical arguments, rather than just how values interact with climate change, we should point across to the relevant bits in WGIII. [David Frame, New Zealand]	Example no longer appears.
13634	20	9	20	12	This sentence raises the important distinction between 'subsistence' and 'luxury' emissions. However it does so in a way that is odd or incorrect, implying (apparently) that these represent different 'values' with regard to emissions, about which people disagree. With respect, Agarwak and Narain's point was essentially the opposite: that the distinction between 'subsistence' and 'luxury' emissions provides a means of evaluating different emissions within the *same* value frame. This is because everyone can agree that emissions needed for subsistence are more essential, and so have more value, than emissions used for 'luxury' purposes (ie non-essential by definition). And that therefore luxury emissions should be targetted for cuts rather than 'subsistence emissions' -- or they should be assigned diiferent values in any CBA. The sentence needs to be rewritten. [Stephen Humphreys, United Kingdom (of Great Britain and Northern Ireland)]	Example no longer appears.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
43056	20	13		16	Suggested alternative: "...political rhetoric, and decision-making, and also have powerful effects on perceptions of climate change." I don't think the points about education and climate literacy fit here. They also dog whistle to the view that educated people are morally superior, and we should strongly avoid doing that. So I would delete the last two sentences of the paragraph. [David Frame, New Zealand]	This section has been heavily revised with the inclusion of numerous contributing authors in a cross-chapter group.
46524	20	14	20	18	Compliments for the few sentences about climate literacy, however, I think this material should be expanded. A good source of studies is the Journal of Geoscience Education: https://www.tandfonline.com/action/doSearch?AllField=climate&SeriesKey=ujge20. A high-profile paper on this topic is: http://science.sciencemag.org/content/351/6274/664 [WGI TSU, France]	This section has been heavily revised with the inclusion of numerous contributing authors in a cross-chapter group.
53906	20	16	20	18	This is too parochial - there are 200+ other countries in which values certainly have an influence too. [Timothy Carter, Finland]	Taken into account. Newer transnational polling and literature covering other countries has been introduced. Lit. on these issues for all 200+ countries does not exist, but we can do a better job of choosing representative samples from around the world. However, page limits preclude much expansion of this section.
48556	20	16	20	18	Please add more recent references. For example, "Citizens' Acceptance of Climate Change Adaptation and Mitigation: A Survey in China, Germany, and the U.S." by Claudia Schwirplies, Ecological Economics (2018). It shows factors beyond education are important as well: https://www.sciencedirect.com/science/article/pii/S0921800917300599 [Zinta Zommers, United States of America]	Accepted. Excellent revision.
7654	20	16	20	18	Comment : in the sentence "However, values are also … "; I suggest to take off the words "strong ifluences"; the new sentence becames "However, values are also in some cases (e.g. the USA and UK) dominating education and knowledge as predictors of attitudes (McCright and Dunlap, 2011; Whitmarsh, 2011)." [Anne Coudrain, France]	Accepted. Excellent revision.
10042	20	17	20	17	“in some cases (e.g. the USA and UK) dominating education ..”: it would be useful to omit the reference to 2 developed countries, because it is a sensitive point, while in quite many other countries, incl. developing countries perhaps other values also have a key role in education. [Tibor Farago, Hungary]	Revised: "However, values are also in some cases (e.g. the USA and UK) dominating education and knowledge as predictors of attitudes (McCright and Dunlap, 2011; Whitmarsh, 2011)."

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
13232	20	18	20	20	The section "1.2.3 Climate, science, and societies: perceptions, values, and ethics" fails to note that the 'thickness' of governance values adopted in the climate regime can impact on the legitimacy and effectiveness of climate action if the range of values are not sufficiently comprehensive. After "Whitmarsh, 2011)." INSERT: "Consequently, the legitimacy and effectiveness of climate action depends not only on science and technology, but also on the comprehsiveness of the governing values and institutional arrangements adopted (Breakey et al. 2017; Dooley et al 2017)." References: Breakey, H., Cadman, T. and Sampford, C., 2017. Governance values and institutional integrity. Governing the Climate Regime: Instituional Integrity and Integrity Systems; Cadman, T., Maguire, R., Sampford, C., Eds. (pp. 16-44); Dooley, K. and Parihar, G., 2016. Human rights and equity: governing values for the international climate regime. In Governing the Climate Change Regime (pp. 154-172). Routledge. [Timothy Cadman, Australia]	This comment has been considered during the preparation of the FGD. (In FGD) Taken into account. While we did not incorporate the proposed sentence, we believe that we have captured much of the commenter's intent in the following paragraph: "As noted above, values — fundamental attitudes about what is important, good, and right — play critical roles in all human endeavours, including climate science. In AR5, Chapters 3 and 4 of the WGIII assessment addressed the role of cultural, social, and ethical values in climate change mitigation and sustainable development (Kolstad et al., 2014; Fleurbaey et al., 2014). These values include widely accepted concepts of human rights, enshrined in international law, that are relevant to climate impacts and policy objectives (Hall and Weiss, 2012; Peel and Osofsky, 2018; Setzer and Vanhala, 2019). Specific values – human life, subsistence, stability, and equitable distribution of the costs and benefits of climate impacts and policies – are explicit in the texts of the UNFCCC and the Paris Agreement (Breakey
43058	20	18			I don't think "necessitates" is the right word. Could have something more like "International efforts to manage climate change are facilitated if leaders, policymakers, and the broader public have literacy in the causes…" [David Frame, New Zealand]	Taken into account. The sentences has been rewritten together with other comments.
26342	20	20	20	21	The language borders on the prescriptive - "leaders must have (acquire?) literacy" [Jochem Marotzke, Germany]	Revised to read "International efforts to manage climate change are facilitated if leaders, policymakers, and the broader public have literacy in the causes…"

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
6904	20	20	20	22	"The international governance efforts and strengthening the response to climate change necessitates that leaders, policymakers, and the broader public have literacy in the causes, effects, and possible future course of climate change." Speaking about the causes of climate change is a priority. As the anthropologist Jason Hickel (2019, [1]) said in Real-World Economics Review : "economic growth is projected to drive energy demand up at a rate that outpaces the rollout of clean energy capacity". A lot of academic papers have shown the link between economic growth, energy demand increase and global warming, Global decoupling of fossil energy use and economic growth has never been demonstrated according to Eloi Laurent (Revue de l'OFCE - Débats et politiques, 2011, [2]). So we know the causes of global warming and the main transition hurdles to ecological pathways. 1 : http://www.paecon.net/PAEReview/issue87/Hickel87.pdf 2 : https://www.ofce.sciences-po.fr/pdf/revue/120/r120-9.pdf [Olivier Raguenes, France]	Great comment considered in revision. However, energy demand is more of a Working Group 2 and 3 issue.
57250	20	20	20	41	These paragraphs should contain more on how party leaders, public officials, lawmakers in Parliaments or ministers perceive climate knowledge and deal with it. This is of course a bit delicate to write about but there's literature, and it's relevant, e.g. Rickards et al in WIREs CC 2014 on senior government and business decision-makers, Munck af Rösenschöld et al im WIREs CC 2014 on institutional inertia or Geden in Nature Geoscience 2018 on politically informed advice [Oliver Geden, Germany]	This is an excellent suggestion. We have not yet incorporated it into this section, but will do so in the next round of revision. This section has been heavily revised with the inclusion of numerous contributing authors in a cross-chapter group. (In FGD) Noted. We were unable to introduce this subject into the discussion of media coverage and values.
10044	20	21	20	21	literacy in the causes, effects, possible future course and options of response policies .. [Tibor Farago, Hungary]	Now reads: "Governance responses to climate change are facilitated when leaders, policymakers, and the broader public share some degree of literacy in the causes, effects, and possible future course of climate change."
44070	20	22	20	23	Example of integrating scientific knowledge with cultural understanding of weather/climate in Hawai'i: Delevaux et al. 2018 (https://www.mdpi.com/2071-1050/10/9/3147) [Sara Kahanamoku, United States of America]	We did not succeed in introducing this reference in time for the SOD, but we will do so in the next draft.
43060	20	23		25	See also earlier references which made many of these points, like Rayner and Malone 1998. [David Frame, New Zealand]	This comment has been considered during the preparation of the FGD. (In FGD) Accepted. This reference and other older ones were added.
12606	20	25	20	30	Provide short examples of the regional impacts, like that the Arctic is warming twice the global average. Along that line, warming is accelerating, which can impact internal variability and underlying trends. [Kristin Campbell, United States of America]	Regional examples and variability are discussed in detail in Section 1.3.6.
12756	20	25	20	30	Provide examples of the regional impacts, like that the Arctic is warming more than twice the global average. Note also that warming is accelerating, which can impact internal variability and underlying trends. [Durwood Zaelke, United States of America]	Regional examples and variability are discussed in detail in Section 1.3.6.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
43062	20	25		26	Adds little. Could delete. [David Frame, New Zealand]	Disagree that sentence adds little.
52694	20	27	20	30	I experienced a similar but distinct situation in Austria. A drying trend in winter over several decades caused people to believe this was climate change and would continue in the future. But all projections (and physical understanding) suggest this was only internal variability. It is very difficult to convince people (in particular farmers and water managers) that strong observed trends may not be an expression of climate change. Is there literature about such issues? I find them important as well. [Douglas Maraun, Austria]	Now reads: "climate change itself is not uniform: some regions face steady, readily observable change, while others experience high variability that masks underlying trends (Section 1.4.1); this non-uniformity may lead to wide variation in perceptions of the urgency of addressing climate threats, creating a complex patchwork of climate literacy at all scales (Howe et al., 2015)."
43064	20	30		31	Not sure tying the uncertainty language to ethical behaviour is compelling. [David Frame, New Zealand]	Discussion has been revised to focus on values rather than ethics.
6567	20	32	20	42	Rephrase paragraph - my suggestion: Against this background, scientists should take special care when communicating findings and uncertainties that are used to make high-stakes decisions. In some cases ample evidence is present to assign a precise probability to a conclusion, but often uncertainty is deeper and could be more accurately characterized in alternative ways (Kandlikar et al., 2005). As a result, the IPCC uses standardised calibrated language of 'likelihood' and 'confidence' to communicate the outcome of the assessment (see Box 1.1). However, even with calibrated language, the choice of a specific category (e.g. likely vs. very likely) may itself be prone to uncertainties. Moreover, this calibrated language does not necessarily prevent confusion or misunderstandings. Studies show that lay readers, even when confronted with the IPCC uncertainty guidance, systematically underestimate the intended level of certainty. The quantification of a numerical range, alongside likelihood terminology, and allowing for narrower (more precise) bandwidth when appropriate, could help to reduce confusion in public communication (Budescu et al., 2014). [Tim Christiane Thys, Belgium]	This section has been heavily revised with the inclusion of numerous contributing authors in a cross-chapter group. Revisions similar to those suggested here were adopted.
29922	20	34	20	34	Can you provide a single example of where a precise probability can be provided? I suggest deleting "precise". [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	Revised as suggested.
51826	20	35	20	41	Does inclusion of this text not implicitly undermine much of the assessment performed by later chapters? Could it be mis-used? I would consider carefully whether to retain this text. [Peter Thorne, Ireland]	Taken into account. Point considered in revision of this section, but intellectual honesty requires that this sort of limitation be discussed openly. Section on values in science in Ch 1 has been coordinated with Ch 10, 11, 12, and Atlas.
43066	20	36		38	This section probably needs some fine-tuning. [David Frame, New Zealand]	No direct suggestion.
6906	20	38	20	39	"Studies show that even when shown IPCC uncertainty guidance, lay readers systematically underestimate the intended level of certainty." The uncertainty is rarely strong and often overestimated. This study published in BioScience (S. Herrando-Perez et al., 2019, [1]) shows how conservative the IPCC assessments are and how it should evolve, especially with a new working group in charge of transmission. Raising climate awareness cannot be achieved with conservative statements. 1 : https://academic.oup.com/bioscience/article/69/3/209/5382637 [Olivier Raguenes, France]	Revised: "One study of 25 samples in 24 countries found that even when shown IPCC uncertainty guidance, lay readers systematically misunderstood IPCC likelihood statements, interpreting both higher and lower likelihood statements as conveying probabilities closer to 50 percent than intended (Budescu et al., 2014)."

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
57220	20	39	20	41	This sentence is very large, could explain in two sentences, maybe. Not so clear for me, some confuse. [Sharl Noboa, Ecuador]	Sentence revised and clarified.
29924	20	40	20	41	Løhre et al. 2019 (WCAS doi: 0.1175/WCAS-D-18-0136.1) show further that people often confuse objective with subjective uncertainty in the interpretation of the width of confidence intervals. [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	this suggestion has been incorporated in the FGD. Thanks.
26344	20	41	20	41	"Could help to reduce" - what are the consequences for WGI AR6? [Jochem Marotzke, Germany]	Phrase no longer appears.
43068	20	42	21	13	Not sure I see the point or value of these two paragraphs in a WGI report. [David Frame, New Zealand]	These paragraphs have been placed in a separate sub-subsection. The intent of Section 1.2.3 is to convey a sense of how the pipeline from scientific work to public understanding is changing.
45384	20	43	21	3	This discussion is very important, but is framed here using too much jargon. I do not understand what "explicit risk" is from this presentation, nor even what it's ontological or philosophical nature is. This paragraph needs rewriting for a less well-informed audience. [Baylor Fox-Kemper, United States of America]	Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.
53908	20	43	21	3	An interesting example of how the media is adapting its reporting of climate change sceince concerns the terminology that it chosses to emply. The Guardian newspaper recently redefined some terminology to emphasise the gravity of climate change and urgency for action. It also redefined global warming as global heating, purportedly at the advice of a climate scientist. https://www.theguardian.com/environment/2019/may/17/why-the-guardian-is-changing-the-language-it-uses-about-the-environment. This is an interesting development, but it has the danger of straying too far into political advocacy. This is acceptable for a newspaper with a political standpoint to follow, but not defensible for a body like IPCC, which should, in my view, attempt at all times to use as neutral, balanced and objective language as possible. Even if some climate scientists and authors use these more emotive terms in their dealings with the media (which is their prerogative), use of these terms in the IPCC reports may undermine the objectivity of the IPCC. This may be worth raising as a more general issue at lead author meetings - what is IPCC policy nowadays for the evolution of the climate change lexicon? [Timothy Carter, Finland]	Section now includes the sentence "Recently, a selection of media has begun actively using stronger terms, such as climate crisis and climate emergency, favouring them over climate change or global warming."
7656	20	45	20	48	Comment : it is not the climate change that fails but the news; so I suggest "In the USA, analyses of television network news show that climate change receives minimal attention, is most often framed in a political context, and that news largely fail to draw appropriate linkages between climate change and some types of extreme weather events are failing (Hassol et al., 2016)." [Anne Coudrain, France]	Reviewer seems to have misread the sentence, which already says what she wants it to say.
46182	20	50	20	50	Need to be cautious that the WG II risk framework is truly applied right across the three WGs, Vulnerabiity/exposure/hazard does not work in WG III. [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	Section has been heavily revised and parts of it moved elsewhere in Ch 1. Discussion with WGII and III reps at LAM3 revealed limited support for a unified risk framework across the WGs, esp. WGIII.
6569	20	52	20	52	delete: "d" behind the reference (Dewulf, 2013) [Tim Christiane Thys, Belgium]	Accepted. The character has been removed.
35252	20				Table 1.1: Don't see strong value in presenting this information or doing it in tabular form. [Ko Barrett, United States of America]	Rejected, comment refers to an earlier internal draft of the chapter and is not applicable to the FOD

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
53116	21	2	21	3	This last sentence seems a bit disconnected and as far as I can see, not needed. [Jan Fuglestvedt, Norway]	Sentence has been moved elsewhere. Section has been heavily revised and parts of it moved elsewhere in Ch 1.
45386	21	6	21	15	How exactly is social media of impact to this report? I think the target of this paragraph is to note that non-expert judgement plays a role in societal opinion, while this is an expert document that needs mirroring in the media (including social media). However, the discussion here is insufficiently direct. What is a facebook or twitter user to take away from this paragraph? How does the IPCC role or purpose differ? What are the relevant standards of truth, consensus, etc.? [Baylor Fox-Kemper, United States of America]	Good point. Section has been heavily revised and parts of it moved elsewhere in Ch 1.
43420	21	6	21	15	Social media further serves as a catalyst for nontraditional actors, like youth, to voice opinions and take action in climate discussions [Saad Amer, United States of America]	Good point. Section has been heavily revised and parts of it moved elsewhere in Ch 1.
6375	21	17	21	22	Suggest to delete this paragraph as not adding to the text [Baruch Rinkevich, Israel]	Rejected. If we're discussing values, we *must* discuss how those affect the practice of science itself. Section has been heavily revised.
43070	21	22			I don't think this sentence is a good idea. Taken out of context by swivel-eyed loons, it is likely to be used as IPCC arguing that the science should fit the UN agenda. I'm not sure the material in this section will land where it was intended to land. [David Frame, New Zealand]	This section has been heavily revised with numerous contributing authors. Values discussion mandated by leadership.
27520	21	24	21	24	We are humans, so our values cannot not influence sciene. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	This section has been heavily revised with numerous contributing authors.
29926	21	24	21	34	I have recently argued (Shepherd 2019 PRSA doi: 10.1098/rspa.2019.0013) that in the construction of climate information there is an inevitable tension between reliability and informativeness, related to the decision to address type 1 vs type 2 errors, which implicitly imposes values and hence has ethical implications. I illustrated this with quotations from AR5. [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	We included a discussion of this, citing the reference mentioned.
44072	21	25	21	27	Citation that provides another example of ethical communication with sensitive stakeholder communities: Kearns 2015 (https://drive.google.com/file/d/1AddqPfY9cl6RZd1CxutiWl_yMphQ_hLb/view) [Sara Kahanamoku, United States of America]	Reference considered
54232	21	40	21	42	Why is the WG1 report said to be focused on the global stocktake, adaptation, mitigation, and impacts? It would seem more appropriate to be focused on climate science, with the other two WG reports focused on adaptation/impacts, and mitigation. [Brian O'Neill, United States of America]	Taken into account. Considered with 39456. The intention was "focused on climate science relevant to GS etc." This text is moved to Section 1.8.
39456	21	41	21	41	Notice that the WG1 report outline approved by 46th session of IPCC does not say that the report is focused on results relevant to the Global Stocktake. Instead the Chapter 1 outline talks about "Framing of the physical science information relevant for mitigation, adaptation, and risk assessment in the context of the Global Stocktake" [Carolina Vera, Argentina]	Accepted. The intention was "focused on climate science relevant to GS etc." Revised accordingly. This text is moved to Section 1.8.
6571	21	41	21	41	Insert after global stocktake, "as required by the Paris agreement". [Tim Christiane Thys, Belgium]	Accepted. Phrase inserted. This text is moved to Section 1.8.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
31736	21	42	99	38	The discussion of “regional scales” is rather unclear. If the term is not defined there is little hope of providing a clear assessment. On Page 75, line 4, the Pacific Ocean is given as an example of a “region”: this is a very different scale to some of the regions used in the Atlas, such as “Central Europe”. There is also some variation in the meaning of “global”, it can mean either (1) “at a large spatial scale”, as in “The signal of climate change is most obvious at the global scale” (page 65, line 54) or (2) “covering the globe”, as in “global stocktake”, “observing systems on a global scale” (page 34, line 17), “Global Climate Observing System”, etc. [Martin Juckes, United Kingdom (of Great Britain and Northern Ireland)]	Some flexibility in the usage of both terms is required in varying contexts, including referencing past IPCC reports and scientific articles which do not conform to the regions as defined in the AR6 Atlas.
43072	21	44			been, not ben. [David Frame, New Zealand]	Accepted. The sentence has been rewritten.
8480	21	46	21	46	"been" [Robert Kopp, United States of America]	Accepted. The sentence has been rewritten.
41306	21	46	21	46	Replace 'ben' with 'been' [Debra Roberts, South Africa]	Accepted. The sentence has been rewritten.
6551	21	46	21	46	"ben" change to "been" [Tim Christiane Thys, Belgium]	Accepted. The sentence has been rewritten.
26422	21	46	21	54	The breakdown into global and process chapters could be motivated much more strongly. The rationale expressed at the scoping meeting was that COP21 represents universal acknowledgement of the anthropogenic cause of the observed climate change, implying for the AR6 that one should not wait until Chapter 10 before this is stated. Instead, the anthropogenic origin should come very early on, for the WGI report to be better able to focus on the consequences, risks, etc. [Jochem Marotzke, Germany]	Noted. Could not mention it for brevity of the text.
35254	21		22		Table 1.2: Don't see strong value in presenting this information or doing it in tabular form. [Ko Barrett, United States of America]	Rejected, comment refers to an earlier internal draft of the chapter and is not applicable to the FOD
27524	22	2	22	6	add that this integration in particular allows for stakeholder needs requesting localised information across timescales to be addressed, e.g. https://www.climatecentre.org/downloads/files/RCCC%20IPCC%20Nairobi%20Report%202018-4%20V5.pdf [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Revised accordingly. This text is moved to Section 1.8.
14974	22	3	22	3	I commend this approach of bringing the palaeoclimate information into the text. Harder for reviewers but much easier for the reader to see the integrated information. [Erin McClymont, United Kingdom (of Great Britain and Northern Ireland)]	Noted. No action called for.
27522	22	4	22	4	delete 'Detection and' [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Revised accordingly. This text is moved to Section 1.8.
39458	22	8	22	8	The assessment of the regional climate change knowledge is enhanced in this report with chapters 10-12 [Carolina Vera, Argentina]	Taken into account. Reflected in the text which is now moved to Section 1.8.
14976	22	8	22	8	Emphasising the regional is very valuable [Erin McClymont, United Kingdom (of Great Britain and Northern Ireland)]	Noted. No action called for.
6573	22	8	22	8	delete "provision" (readibility) [Tim Christiane Thys, Belgium]	Not applicable. The sentence has been rewritten.
6575	22	9	22	10	insert "was" after "extreme events" and delete comma [Tim Christiane Thys, Belgium]	Not applicable. The sentence has been rewritten.
44196	22	10	22	10	"…events was distributed…" [Christian Reuten, Canada]	Not applicable. The sentence has been rewritten.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
15204	22	11	22	11	The word "instead" here does not seem appropriate, as a content choice is being contrasted to a structural choice. [Claudia Tebaldi, United States of America]	Section on "New Approaches" moved; sentence revised.
48252	22	12	22	12	Suggest adding "and approaches to communicating regional climate information" after "regional climate change". [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. The text was deleted for brevity.
6577	22	13	22	13	replace "product" by "tool" [Tim Christiane Thys, Belgium]	Not applicable. The text was deleted for brevity.
15206	22	18	24	15	This whole section on the risk framework needs to be rewritten. It is confused and confusing, there are factual errors, and reads like a grab bag of concepts/definitions/references often incorrect, or at least not making up a coherent narrative. Parts of this are also going to be rewritten necessarily as Chapter 16 of WG2 evolves, but it is not the main problem. It is so difficult to correct that I almost think it should be greatly reduced and limited to a short introduction of the box, where the various terms are defined. Sorry to be so critical but I don't even know where to start to make more concrete suggestions. A whole rewrite I think is the best way to go. [Claudia Tebaldi, United States of America]	Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.
43590	22	18	26	2	The presentation of the risk framework is inconsistent. The risk framework developed for the AR6, starting with the revised definition of risk, makes it clear that risk can arise from both climate change impacts and responses to climate change. The text acknowledges this in some places, but in other places makes statements such as "in the IPCC risk framework, the dynamic interaction between hazards, exposure and vulnerability determines risk" - which applies to risks from climate change im,pacts only but not necessarily to risks from responses to climate change. Equally the Figure cross-chapter Box 1, Figure 1 relates only to the hazard-exposure-vulnerability dimension, which is only half of the risk framework. The discussion also needs to make clearer that given that risks in the IPCC use apply only for potential impacts on human or ecosystems, WGI on its own does not assess risks but provides information necessary for the assessment of risks. It would also be useful to point out somewhere that SRM is a key example of risks arising from responses to climate change (and WGI has an important role to play in assessing those risks). So overall I suggest a major re-write of these pages to ensure the risks framework is presented properly and consistently. [Andy Reisinger, New Zealand]	Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.
53120	22	18	26	4	This needs close coordination across WGs. Please consult WGII and WGIII authors, as well as bureau members involved in the coordination of this topic. [Jan Fuglestvedt, Norway]	Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.
32014	22	18	28	4	These sections discuss Risk framing but they do not yet address the central need which is to explain clearly what is the specific contribution of WGI to meeting policy maker needs for risk assessment, and how will these needs be addressed in AR6. The cross-chapter box 1.2 discusses only a definition of risk and related quantities. It does not explain what are the roles of the different working groups, or how the findings from different working groups will be brought together into a coherent risk assessment. The only lines I could find on the specific contribution of WGI are lines 10 and 11 on page 24, which state that the WGI contribution focuses primarily on the assessment of hazards. This is a much too limited conception. Comments continue in next row. [Rowan Sutton, United Kingdom (of Great Britain and Northern Ireland)]	Very important comment, well stated. Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
32016	22	18	28	4	I would direct the authors to study the Principles of Risk Assessment discussed in the landmark climate change risk assessment of King et al, 2015: see https://unfccc.int/news/climate-change-a-risk-assessment and specific recommendatios for WGI in Sutton, 2019, Climate science needs to take risk assessment much more seriously, https://journals.ametsoc.org/doi/abs/10.1175/BAMS-D-18-0280.1 Comments continue in next row. [Rowan Sutton, United Kingdom (of Great Britain and Northern Ireland)]	Very important comment, well stated. Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.
32018	22	18	28	4	A basic requirement for risk assessment is the need to consider both likelihood and impact together. The impacts in scope for WGI are primarily physical impacts, but it should be stated clearly that a central task of the WGI assessment is to provide quantitative information about these physical impacts, conditioned where appropriate on specific scenarios for future climate (spanning the uncertainty in climate response as well as SSPs). The value for risk assessment of qualitative information about likelihood combined with quantitative information about impacts should be explicitly discussed. Comments continue in the next row. [Rowan Sutton, United Kingdom (of Great Britain and Northern Ireland)]	Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.
32020	22	18	28	4	One of the key principles of risk assessment is the need to pay systematic attention to high impact events even if their likelihood is assessed to be low (e.g. Sutton, ESD, 2018). This principle should be applied systematically (not limited to aburpt changes) to all chapters that discuss future projections, and the intention to do this (and the reasons for doing it) should be stated clearly in Chapter 1. Note that it requires a clear departure from previous WGI reports where the focus has been placed overwhelmingly on assessment of the likely range only. [Rowan Sutton, United Kingdom (of Great Britain and Northern Ireland)]	Important comment that has been taken into account in Ch 1, but not necessarily communicated to the rest of the report. Please continue to emphasize this in comments on the SOD.
54242	22	18			I started out making specific comments on this section, but then found it easier to make just this general one. There are quite a few problems throughout the section, and it also has many redundancies with the cross chapter box on risk. My recommendation would be to eliminate this section and just use the box. At most there could be a paragraph or two in addition to the box that indicates that the focus of the WG1 assessment is on hazards as a component of the risk framework. The types of problems in the section include a description of the relation between risk in SREX and AR5 that is partly inaccurate and misses the main points, not distinguishing impacts from risk, a somewhat confused description of adaptation and co-benefits, out of place reference to climate services and to SSPs, and several redundancies within the section. [Brian O'Neill, United States of America]	Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.
32610	22	20	22	26	While the UNFCCC objective does acknowledge risk, this presentation of it fails to accept the objective as the underpinning aim of all the efforts being purused. The Paris Accord, as was the propose Kyoto Accord, are subservient to the UNFCCC objective--that is what we need to accomplish. The status of meeting the UNFCCC objective defines the core role of the IPCC--not just accepting Paris as anything other than a political milestone along the way--and actually a quite defiicient one. [Michael MacCracken, United States of America]	Very important comment, well stated. This applies to section 1.2.2 as well. Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.
39460	22	25	22	25	a common risk framework across the reports of the three WGs. [Carolina Vera, Argentina]	Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
43592	22	27			At present there are two pages talking about the risk framework without telling the reader what risk actually is. I suggest you bring in early the key definitional sentence of risk: "Risk is the potential for adverse consequences for human or ecological systems". You could then unpick this definition to make clear that intrinsic to the definition of risk is the notion of uncertainty or more broadly, incomplete knowledge (hence POTENTIAL for adverse consequences), and that in IPCC usage the concept of risk is applied only where consequences affect human or ecological systems (which excludes what parts of the literature might call "flood risk" - that's a hazard, but not a risk). If you start with this, it will help readers better understand the concept (I think) and the specific role that WGI plays in this assessment. [Andy Reisinger, New Zealand]	Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.
43594	22	28	22	45	This para is unbalanced - it spends most of its time talking about risks related to climate change impacts and only at the end, coming across as an afterthought, it says "oh, yes, risk can also arise from responses". The main innovation in the AR6 across the three WGs is that this or should be now on a much more symmetrical basis. [Andy Reisinger, New Zealand]	Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.
6553	22	29	22	29	delete "and climate events" (repetition with "climate-related hazard") [Tim Christiane Thys, Belgium]	accept
46190	22	32	22	33	The risk from responses is not only to ecosystems and third parties. Those undertaking repsonses also face risk because they lose out when the outcomes are nor what they expect (technical risk: stuff does nor work; economic risk: prices or markets do not evolve as expected; political risk: government policies change). Also existing assets may become stranded for economic or political reasons (referred to as "transition risk" by practitioners in the finance sector). WG III is largely concerned with this latter type of risk. There is therefore a need for further x-WG discussion on this if any franewok is to be truly comprehensive. [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	Very important comment, well stated. This applies to section 1.2.2 as well. Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.
27526	22	35	23	4	This is a summary of what has been done but without highlighting how this changes anything. A shorter summary but adding instead examples of what new statements are now possible to make would be much more useful. It is also very repetitive when reading the next section. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.
53118	22	47	22	47	I think "should" is a bit too strong here. [Jan Fuglestvedt, Norway]	Agree, revised
43596	22	47	22	53	I'm "virtually certain" that it is a misrepresentation of WGII AR5 to say that adaptation SHOULD include actions with co-benefits, because (a) this is policy prescriptive and (b) there's nothing wrong with adapting to climate change without co-benefits if it is an efficient response. Of course it's useful and often essential to look for co-benefits, but it is not a prescriptive requirement and I'm pretty sure the AR5 doesn't say it is. [Andy Reisinger, New Zealand]	Agree, revised
43598	23	8	22	9	This sentence is correct but most of the text that follows then deals with the hazard-exposure-vulnerability dimension only, making the presentation of the risk framework confusing and inconsistent. [Andy Reisinger, New Zealand]	Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.
39462	23	8	23	38	Considering that the cross-chapter Box 1.2 describes the Risk Framing in IPCC AR6, the purpose of this subsection called "Risk concept in AR6" is not evident or clear. [Carolina Vera, Argentina]	Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
27528	23	8	24	15	As above this section can be considerably shortened with respect to the historic element, integrated with the section above but enhanced with examples what it actually means. The RCFs might provide examples where the fact that very different lines of evidence need to be combined to assess risk can be highlighted as well. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.
46184	23	11	23	12	The x-WG process has resulted in a common definition which is not quite the same as a framework whch I don't think has been achieved. [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.
46128	23	12	23	12	The phrase "direct handshake" is too colloquial and could be misinterpreted. Consider rephrasing. [Cynthia Randles, United States of America]	Rephrased.
39464	23	14	23	22	The paragraph repeats many of the concepts discussed in the previous subsection about the evolution of the risk concept in previous IPCC reports. [Carolina Vera, Argentina]	Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.
43074	23	16	24	1	Generally like this section. [David Frame, New Zealand]	Rejected, comment refers to an earlier internal draft of the chapter and is not applicable to the FOD
43600	23	19	23	22	This sentence is in direct conflict with the risk definition, which makes clear that risk can arise from both climate change impacts (where the hazard-exposure-vulnerability framework is useful) and climate change responses (where it is not). Even for the hazard-exposure-vulerability framework it would be useful to better recognise the fact that all these things change over time, and some of them change as a result of deliberate or accidental human interventions. I.e. risks are the result of dynamic interactions, not static. Which means e.g. that risks can change without any change in climate if e.g. more people build houses in flood plains. This is really important to help put climate change induced risks in context. [Andy Reisinger, New Zealand]	Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.
31554	23	19	26	2	Some of the definitons use inconsistent language. For example, the definition of Risk includes "lives, livelihoods, health and wellbeing, economic, social and cultural assets and investments, infrastructure, services (including ecosystem services), ecosystems and species.", whereas the definition of Risk Management includes "people, livelihoods, species or ecosystems, environmental functions, services, and resources, infrastructure, or economic, social, or cultural assets". It may be that these are very deliberately slightly different, in which case this is fine, but if not then these shoud be made consistent. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.
43076	23	21			Suggest deleting "in line with the Paris Agreement and SDGs" because the point is much more general than SDGs and PA. We shouldn't be peddling specific governance frameworks and structures. [David Frame, New Zealand]	Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.
39466	23	24	23	32	There is again a reference to the WG2 AR5 risk frame. The introduction of the SSPs here is not clear, considering that section 1.6 does that. [Carolina Vera, Argentina]	Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
43602	23	24	23	32	Somewhere in this para, if not earlier, the authors should make clear that risks as defined in the IPCC apply only to human or ecological systems - i.e. there has to be something of value that is being impacted. This helps clarify where the contribution from WGI to risk assessment begins and where it ends - WGI has a critical role to play in assessing changes in hazards, and to some extent exposure (e.g. changing extent of hazards and extremes), but WGI by and large does not assess the consequences for human or ecological systems which is done in WGII. Meaning that WGI assesses changes in flood frequencies and magnitudes and extent, but not the RISK posed by flooding as this requires an assessment of economic or other consequences. But it also means that WGI can and must play an important role in understanding risks arising from some responses to climate change, most notably SRM but also changes in land-surface and climate interactions arising from large-scale land-use change (as assessed e.g. in the SRCCL). [Andy Reisinger, New Zealand]	Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.
50716	23	28	23	28	In order to find the reference easily, the exact section should be indicated as "section 1.6.2.1" (instead of simply 1.6). [Hernan Edgardo Sala, Argentina]	Editorial.
8482	23	34	23	34	Arven and Renn (2015) isn't in bbliography [Robert Kopp, United States of America]	Accepted. The reference has been changed to Aven and Renn and added into the bibliography.
26346	23	34	23	34	Arven and Renn (2015) not in bibliography [Jochem Marotzke, Germany]	Accepted. The reference has been changed to Aven and Renn and added into the bibliography.
51700	23	34	23	34	Wrong reference is given. There is no Arven and Renn (2015) listed in the reference list. A check on Google Scholar indicates that there is no such reference. The correct reference is Aven and Renn, 2015, Risk Analysis 35. [Zelina Zaiton Ibrahim, Malaysia]	Changed to read: Aven and Renn
32022	23	34	23	38	This paragraph notes some criticisms and identifies some changes to terminology but does not address the central issue of how the IPCC, and WGI in particular, are going to meet policy maker needs for risk assessment. The reference to Sutton (2018) gives no explantion of the reason for the proposal and offers no opinion (justified or otherwise) on whether the authors agree with the recommendation, or whether it will be adopted for AR6. This is not just a question of academic interest - it is a key issue for meeting policy maker needs, so WGI should take a clear, considered, position and justify it. [Rowan Sutton, United Kingdom (of Great Britain and Northern Ireland)]	Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1. Sutton (2018) is now discussed in the section on storylines, not here. LAM3 held a general discussion on risk frameworks, including reps from WG2. The risk framework is now presented in a cross-WG box, but due to time lag with WG2 and WG3, has not been fully developed yet. Please keep raising this issue.
47984	23	34	23	38	Sentence repeated in CCB 1.2 on the need to move from probability-based to risk framework [WGI TSU, France]	Accepted. Duplicate sentences have been removed.
29928	23	35	23	35	The criticism of probabilities is not new, e.g. Dessai & Hulme (2004 Clim. Policy doi: 10.1080/14693062.2004.9685515), and some acknowledgement of this literature should probably be made. [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.
29932	23	35	23	35	I have recently argued (Shepherd 2019 PRSA doi: 10.1098/rspa.2019.0013) that since there is no objective way to characterize epistemic (systematic) uncertainty probabilistically, storylines provide an alternative (discrete) way of representing this uncertainty in risk analysis. [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	Reference added, and incorporated a statement along these lines.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
39468	23	38	23	38	Where does Sutton (2018) propose to include "unlikely but high-impact risk"? The purpose of including Figure 1.3 is not evident in that sentence as it is. [Carolina Vera, Argentina]	Sutton (2018) is now discussed in the section on storylines, not here. Fig 1.3 is now Fig 1.12.
42710	23	38	23	38	Figure 1.3 and sparse Sutton (2018) references are confusing and distracting. I would suggest either dedicating a paragraph to this approach, justifying its utility, or not having this additional risk model. [Stephanie Courtney, United States of America]	Sutton (2018) is now discussed in the section on storylines, not here. Fig 1.3 is now Fig 1.12.
51702	23	38	23	38	Mssing reference to Surtton, 2018. Since this reference is quoted for a figure (Figure 1.3), the missing listing is considered as substance. [Zelina Zaiton Ibrahim, Malaysia]	Sutton (2018) is now discussed in the section on storylines, not here. Fig 1.3 is now Fig 1.12.
48558	23	40	23	55	Please note that additional publications on Reasons for Concern are expected as a result of the Special report on land and oceans. Please update this section next year when the publications become available or invite the authors from the Special reports to contribute to this section. For example, the Special Report on Land added innovations to burning embers by using SSP literature and exploring the impact of socio-economic changes along with temperature rise. They also changed methods to improve traceabiltiy and reliabiltiy of results. [Zinta Zommers, United States of America]	Taken into account. RFCs are addressed in 1.2.2.1, XC Box 1.1, and Figure 1.15. Zommers et al. 2020 is cited, and SR1.5, SROCC, and SRCCL are briefly summarized.
39470	23	42	23	42	Check the RFCs definition. RFCs illustrate the impacts and risks for people, economies and ecosystems across sectors and regions. What does "Key risks have potentially severe impacts.." mean? [Carolina Vera, Argentina]	Not clear what is being suggested. RFC paragraph has been shortened.
55074	23	47	23	49	Incomprehensible sentence [Trude Storelvmo, Norway]	Taken into account. Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.
45132	24	1	24	3	I suggest it would be helpful to list the four "reasons for concern" for which the levels of risk have increased since the AR5 - rather than just state the risk has gone up for four out of five. [David Wratt, New Zealand]	RFC paragraph has been shortened.
44198	24	7	24	8	Is it meant to read "socio-economic vulnerabilities"? [Christian Reuten, Canada]	Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.
32024	24	10	24	15	This section should conclude with a much clearer set of statements about what specifically AR6 is going to do differently to better meet policy makers' needs for risk assessments. These needs have significant consequences for each of chapters 4-12, and it should be explained here what specific relevant assessments these chapters will be making. In particular, will the focus remain entirely on the likely range for key parameters, or will potential high impact scenarios also be explicitly assessed? [Rowan Sutton, United Kingdom (of Great Britain and Northern Ireland)]	Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1. LAM3 held a general discussion on risk frameworks, including reps from WG2. The risk framework is now presented in a cross-WG box, but due to time lag with WG2 and WG3, has not been fully developed yet. Please keep raising this issue.
53854	24	17	26	4	The risk framing is essential for AR6. But I wonder if we can shorten the texts we have on this in Ch1. We have section 1.2.4.1 and the Box 1.2. I suggest the authors look for possibilities for some shortening here. [Jan Fuglestvedt, Norway]	Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
10046	24	19	24	19	What is the reason that Resilience in not part of this Risk framing? [Tibor Farago, Hungary]	Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.
46188	24	19	24	19	The financial literature that WG III assesses uses the terms "physical risk" and "transition risk" which are not congruent with terminology in the IPCC world. As WG III progresses we need to consider this [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.
51586	24	19	24	54	I appreciate that the IPCC adoption of the term 'risk' has a thorough history, yet the word can be met by the reader with different psychological responses. We ask our students in schools to be 'risk takers', and many cultures promote 'take the risk'. This box is very helpful, but as the reader goes through the many chapters, the brain may not always absorb 'risk' as you wish to emphasise it. This subconsious challenge could be met by the IPCC authors with extra efforts to be sure the consequences of 'taking that risk' are aboslutely clear to the reader. [Lindsey Cook, Germany]	Excellent point. Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.
49408	24	19	26	2	Cross-chapter box 1.2: Risk framing. Much of this seems repetitive of the section 1.2.4.1 "Risk framing" which precedes it. Eliminate overlap. [Sonya Legg, United States of America]	Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.
26874	24	19			The definition of Risk = likelyhood x impact is fundamental. This definition is given only in Chapter 4 (page 67, line 22). By interpreting this definition you can show that risk can be mitigated by either reducing the likelyhood or the impact. [Thomas Ackermann, Germany]	Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.
30426	24	21	24	23	Stronger evidence for this is probably found in Princinple 3 of Article 3 of the United Nations Framework Convention on Climate Change (UNFCCC) which reads: "3. The Parties should take precautionary measures to anticipate, prevent or minimize the causes of climate change and mitigate its adverse effects. Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing such measures, [...]" [Joeri Rogelj, Austria]	We did not succeed in introducing this excellent point into the SOD, but we will do so in the next round of revision. (In FGD) Rejected. The previous language from the preamble to the UNFCCC was retained.
28468	24	25	24	25	What is meant by "the physical climate change"? [David Schoeman, Australia]	Take into account. The section has been revised and moved to Cross-Chapter box 1.3.
46186	24	27	24	27	I would prefer common definition to commin framework. Risk concepts do not frsme WG III (SD does) but risk concepts are applied which is an improatnt distincton. There is no issue wioth the text in this box overall, which states well the outcome of the risk discussions [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
51706	24	32	25	42	The description of impact here is confusing; physical impacts are mentioned but not other types. This is then followed by a description of risks, which is partly repeating the text on page 24, lines 38 to 42; while on line 34, page 25, the word consequence is used (which also means impact). More worrying is that on line 38, page 25, a codicil is given that "risk only applies if an explicit assessment to humans is included (exposure or vulnerability)", negagting the definition on pag 24, line 32 that Risk is "The potential for adverse consequences for human or ecological systems". Here also the word consequence (alternative to impact?) is also used. There needs to be distinction in the different nuances of these terms to clarify, technically how they will be used in the report. At present interchangeability in the use of terms seems to allows for some circularity in definitions. [Zelina Zaiton Ibrahim, Malaysia]	Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.
46192	24	44	24	48	These lines capture adequately the WG III perspective on risk [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	No action required.
44894	24	45	26	46	There is no reference/citation to the assertion here or elsewhere in CH1 about the rate of past changes compared with present or future changes. In CH2, we are trying to assess rates of change in large-scale climate indicators during paleo periods. It's not easy and rather controversial. Certainly sea level has risen at higher rates in the past than it is now, and I suspect that there were centuries during deglaciation when it warmed as rapidly at the 20th century. In any case, I suggest that this statement be rewritten in a way that agrees with the more formal and complete assessment in CH2, once it has passed review. [Darrell Kaufman, United States of America]	Not clear to what this refers - nothing in the indicated page range of the FOD corresponds to the comment.
43604	24	54			It is not clear why this box only draws attention to exposure, vulnerability, hazard, and impacts, and not to adaptation or mitigation (or SRM) which as responses to climate change are equally important sources of risk. I understand that the former are more relevant from a WGI perspective, but WGI also has important contributions to make to understand the risk from climate change responses. And more fundamentally, this box purports to present the AR6 risk framework, not just the WGI view of it, and it should therefore give a balanced and equal treatment to risks relating to climate change responses. [Andy Reisinger, New Zealand]	Potential risks of responses to climate change are now mentioned at several points.
45720	25	5	25	9	The definition of vulnerability is much more lengthy than included in the SR15 and SROCC glossaries. Such keep to the glossary definitions [Katja Mintenbeck, Germany]	Section has been heavily revised and parts of it moved elsewhere in Ch 1. Cross-WG discussion has produced the definitions now given in the SOD. Glossary definitions are good, but it is not clear why the referee thinks terms should not be discussed more fully.
50888	25	5	25	9	The text reads as if "vulnerability" applies only to humans, but it can apply also to ecosystems, plants, animals, etc. [Petra Seibert, Austria]	This has been clarified.
43078	25	5			suggest deleting "such as wealth, social status, and gender" since there's no particular justification for focusing on these. Lots of things may affect vulnerability. [David Frame, New Zealand]	No action taken; definitions here are composed by a cross-WG group.
52458	25	7	25	8	"It also includes structural…" - this suggests exposure is being considered as coming under vulnerability, rather than as a separate concept as in the risk propeller diagram [John Brian Robin Matthews, France]	Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
43422	25	8	25	8	Youth are also particularly vulnerable; age isn essential factor Currie, Janet, and Olivier Deschênes. “Children and Climate Change: Introducing the Issue.” The Future of Children, vol. 26, no. 1, 2016, pp. 3–9. JSTOR, www.jstor.org/stable/43755227. [Saad Amer, United States of America]	Excellent point. Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.
44200	25	14	25	17	The sentence is either grammatically wrong or just too long and confusing. Maybe try to rewrite it into two sentences. [Christian Reuten, Canada]	Accepted. The sentence has been removed.
38134	25	14	25	17	This sentence is unclear and not easy to understand. [Hiroaki Kondo, Japan]	Accepted. The sentence has been removed.
51704	25	14	25	17	This sentence is confusing. It is unclear if there is a grammer issue or confused logic in the definition. It appears to define hazards as "both trends and extreme events,' impact' for AR6 in general, is a specific intersection of hazard, vulnerability, and exposure within a sector". If there is intended to be a full stop, instead of a comma, after "extreme events", so that the text will read as a new sentence: ' Impact' for AR6 in general, is a specific intersection of hazard, vulnerability, and exposure within a sector", then the question is, what is the difference between "risk" and "impact"? Figure 1 Cross-Chapter Box 1.2 shows risk as the intersection of hazard, exposure and vulnerability. In addition, the following section gives a definition of Impact. [Zelina Zaiton Ibrahim, Malaysia]	Accepted. The sentence has been removed.
54234	25	16	25	17	impacts should not be defined here within the definition of hazard, especially since it has its own entry immediately following these lines. [Brian O'Neill, United States of America]	Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.
45722	25	19	25	25	The definition of impacts differs from that included in the SR15 and SROCC glossaries. Such keep to the glossary definitions [Katja Mintenbeck, Germany]	Section has been heavily revised and parts of it moved elsewhere in Ch 1. Cross-WG discussion has produced the definitions now given in the SOD. Glossary definitions are good, but it is not clear why the referee thinks terms should not be discussed more fully.
54236	25	19	25	34	This definition of impacts is mostly redundant with the risk definition, but also somewhat inconsistent since it is an old definition and the risk definition has been updated. It would be better to give a much shorter definition of impacts directly after defining risk, which would indicate that impacts are a specific manifestation (in reality or in a model) of the potential for harm that defines risk. [Brian O'Neill, United States of America]	Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.
52462	25	24	25	24	Given that floods are not considered of themselves as risks (only hazards), I don't think you should refer to "physical impacts" in the report or to these in the definition of impacts. They are simply physical hazards. [John Brian Robin Matthews, France]	Section has been heavily revised and parts of it moved elsewhere in Ch 1. Cross-WG discussion has produced the definitions now given in the SOD.
45724	25	24	25	25	please avoid physical impacts and instead use hazards, to be consistent with the risk framing [Katja Mintenbeck, Germany]	Section has been heavily revised and parts of it moved elsewhere in Ch 1. As per the cross-WG group discussion, the terms "climatic impact drivers" and hazards have been used consistently in the SOD.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
45726	25	27	25	34	Impacts are realised risks....see SROCC glossary definition and cross chapter box 2 in SROCC Chp 1 [Katja Mintenbeck, Germany]	Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.
45752	25	27	25	34	This paragraph is a repetition of what is already said above, p 24, lines 38-48. Remove. [Katja Mintenbeck, Germany]	Removed.
52460	25	33	25	33	"(e.g. risk of heat-related deaths)" should go after lives [John Brian Robin Matthews, France]	Accepted. The sentences has been revised.
48254	25	34	25	34	Maybe instead of "risk of wind turbines harming birds" include a broader and more human-related example e.g. "loss of farmland and degraded ecosystems to meet the demand for biofuels". [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.
45728	25	36	25	39	evaluating changing hazards not impacts [Katja Mintenbeck, Germany]	Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.
8484	25	37	25	38	Could it be said that such studies "assess the flood hazard"? [Robert Kopp, United States of America]	Accepted. The sentences has been revised.
45730	25	38	25	38	relative to human and / or ecosystems [Katja Mintenbeck, Germany]	Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.
54238	25	38	25	39	the text "risk only applies if an explicit assessment to humans is included (exposure or vulnerability)" is awkward and not completely correct. I would suggest "risk only applies if an explicit assessment of consequences for human or ecological systems is included." [Brian O'Neill, United States of America]	Sentence no longer appears. Section has been heavily revised and parts of it moved elsewhere in Ch 1.
51710	25	41	25	42	"since its beginning, the IPCC has developed a consistent treatment and communication of scientific uncertainty" and reference is made to Box 1.1. However, Box 1.1 and Figure 1.1 is from AR5, and the reference quoted, that Mach et 2017, briefly explains the development from the first IPCC report and actually proposes an amended process for consideration of future IPCC reports, in part with reference to the criticism from Aven and Renn, 2015, which has been highlighted in the Chapter, pg 23 line 34 and pg 25 line 44. In addition on page 38, line 22-28, the differences/evolution in uncertainty assessment approach is noted. [Zelina Zaiton Ibrahim, Malaysia]	Sentence no longer appears. Section has been heavily revised and parts of it moved elsewhere in Ch 1.
47982	25	44	25	47	Sentence repeated on pages 23 lin 34 on the need to move from probability-based to risk framework [WGI TSU, France]	Accepted. Duplicate sentences have been removed.
54240	25	44	25	47	If there is going to be a discussion of critiques of the IPCC risk framework, it should be based on more than one citation, and it should also consider whether those critiques still apply to the AR6 framework (since at least the citation provided was a reaction to some specific aspects of the framework used in AR5). [Brian O'Neill, United States of America]	Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.
51708	25	49	25	55	Figure 1 Cross-Chapter Box 1.2 does not include the term "Impact", although there is some amount of explanation of impacts in the context of risks, hazards, exposure and vulnerability. [Zelina Zaiton Ibrahim, Malaysia]	Risk framing XC box now includes a definition of impacts.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
45964	25	49	26	4	Will there be an improvement on the propeller diagram of the Risk Framework? It is being pointed out that in Chapter 6 of the SROCC, this propeller diagram has been adopted but improved to reflect compound events and cascading impacts. It is suggested that thw writing teams consider this. [Lourdes Tibig, Philippines]	Propeller diagram has been revised, and probably will be further revised after the SOD.
45732	25	53	25	53	including socio-ecoonomic, there are other processes driving vulnerability and exposure eg physiological mechanisms and limits to performance and evolutionary adaptation [Katja Mintenbeck, Germany]	Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.
43606	26	2			Cross-chapter box 1.2, Figure 1: this figure is inadequate since it represents only the risks from climate change impactsw, not climate change responses. It should also be updated to better capture the dynamic nature of risk (relating to both changes in hazards and changes in exposure and vulnerability). Coordinate with WGII on this please but more importantly, don't present the hazard-exposure-vulnerability picture as representing the treatment of risk in the AR6, as this is far too narrow. [Andy Reisinger, New Zealand]	In the SOD we have included those revisions to the risk framework that were available at the time of writing. The cross-WG risk discussion group needs to provide WG1 with materials in time for our deadlines.
43080	26	4		51	Discussion should occur in light of the model predictions, and be consistent with the rest of the report. At present it singles out only evidence (model or paleo) for tipping points, and is too uncritical. It should also include the literature critiquing tipping points, and recognise the fact that the near-linear TCRE relationship probably limits the global scope for tipping effects in temperature (at least) out to a few degrees above pre-industrial. Discussion should also reflect the fact that the uncertainty around tipping points/etc becomes greater as temperatures go higher. [David Frame, New Zealand]	Noted. However, this section is designed to explain the concepts of tipping points etc., rather than to assess their probabilities (that comes elsewhere in the AR6). It does not seem appropriate to us to "critique" the general notion of bifurcations and tipping points here (as these concepts are well-established in the wider literature). However, we do now mention the linearity of TCRE as an indication that ESMs do not suggest strong non-linearities in global warming over the next 100 years.
10048	26	7	26	7	Tipping points also exist in policymaking and analysed by various experts. At least, it could be mentioned somewhere in this subsection in relation to the international climate governance. (Personal remark: there are several memorable examples of such “turning” points in the course of climate negotiations.) [Tibor Farago, Hungary]	Noted. In social sciences and history, the concepts of path dependence and network effects have some similarity to "tipping points," but I don't see a good place to discuss this in Ch 1. Turning points in negotiations certainly happen, but can't be modelled in the same way as those in physical systems.
53122	26	7	26	55	I think a reference to figure 1.3 is missing in this section [Jan Fuglestvedt, Norway]	Accepted. Figure has been moved to SOD Figure 1.12. Instead an illustrative SOD Figure 1.13 on the concepts of Tipping Points has been added.
27530	26	7	26	55	What do we know about the timescales of tipping points as well as their predictability? What are concrete examples of consequences of tipping points? (at the moment it just says severe local impacts…). A reference to chapter 11 where examples of how tipping points affect extreme events are discussed might be useful, but there'll be other examples. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Text revised based on discussion. Chapter references added.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
26348	26	7	26	55	Isn't it worth also introducing the AR5 definition of irreversibility, which if I remember right was not technical/mechanistic but related to timescales relevant to societies? [Jochem Marotzke, Germany]	Noted, and we have clarified the definition of irreversibility. However, we have deliberately avoided defining irreversibility in terms of human timescales , as strict irreversibility implies hysteresis even in the limit of very slowly varying forcing.
31718	26	7	69	23	It would be useful to have a clear explanation of the distinction between “tipping points” and “thresholds” in section 1.2.4.2. The usage in this chapter varies between “threshold” referring to a policy target or a level set for diagnostic purposeses (e.g. page 69, line 23) and a the boundary of a behavioural change in a dynamic system (e.g. page 37, line 25). When used with the dynamic systems meaning, it is not clear whether there is intended to be a distinction between “thresholds” and “tipping points”. On the one hand, the fact that the term “threshold”, unlike “tipping point”, recognises that more than one dimension is typically involved would be welcome. On the other hand, it may help clarity across the whole report to reserve the term “threshold” for policy targets and levels set for diagnostic purposes. [Martin Juckes, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. We plan to define both terms with reference to the scientific literature and stick to the chosen definitions.
57998	26	9	26	9	A key risk is ….. I would not say that potential for abrupt CC is just aspect of risk [Tomas Halenka, Czech Republic]	Accepted. Done.
31716	26	9	26	12	Is a “tipping point” defined by (1) the onset of an instability and hence irreversible change or (2) abruptness? Defining the term in such a way that it eliminates discussion of slow instabilities (as might be typical in the cryosphere and parts of the bio-sphere) is not a good idea. On closer examination, the meaning of “abrupt” appears vague here .. is it intended to include phenomena such as the “abrupt” disappearance of an ice sheet over 2-5 centuries, or an abrupt transition from forest to desert in the S. American tropics? If this is the case, it would be helpful to explain that “abrupt” needs to be interpreted on a sliding scale, with different time-scales implied for different parts of the climate system. Is it intended that the term “tipping point” should refer to global scale events, or should the term also apply to abrupt changes at a regional scale (this distinction is relevant to Chapter 5 … but it looks as though the definition should come here in chapter 1). [Martin Juckes, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Using the definition from AR4 for "abrupt change". Be sure our definition includes discussion of time scales.
8486	26	9	26	55	See discussion of "tipping points", and the problems with this terminology, in Kopp et al. (2016, doi:10.1002/2016EF000362). This section also does not discuss the concepts of commiment or irreversibility, which are highly relevant to his literature. [Robert Kopp, United States of America]	Noted. We aim here to clarify the definition of "tipping points" to avoid many of these issues. We have however clarified the issue of "irreversibility" and "effective irreversibility". See response to 26348.
58000	26	12	26	12	I would say, and even the reference is rather saying as my understanding, the tipping points reffer to the limit or threshold, just point of state, beyond it the abrupt climate change occurs. [Tomas Halenka, Czech Republic]	Accepted. The tipping point itself is not the abrupt change, and vice versa.
6579	26	12	26	12	insert after change "as" [Tim Christiane Thys, Belgium]	Accepted. Sentence revised.
8640	26	12	26	12	Lenton 2008 quite specifically defined tipping points/elements in such a way as to include slow changes, not limiting it to those which are abrupt (AR5 also did not use the abrupt qualifier).. [James Annan, United Kingdom (of Great Britain and Northern Ireland)]	Noted.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
55162	26	13			[pt 1 of 2] Re: "1.2.4.2 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 (410 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. The reviewer presents no scientific literature in support of this claim. In any case, the mere fact that plants thrived in the Cretaceous does not imply that present-day plants, which have evolved under the much different conditions of the last million years or so (when CO2 levels were below present levels), would also thrive under Cretaceous conditions. Pollen production is sensitive to small changes in temps. Recent satellite evidence shows that a third or more of the "global greening" cited elsewhere this reviewer's comments as a CO2 sink is due to large tree-planting programs and intensified agriculture in China and India, not uptake of anthropogenic CO2 by wild plants, though that is also occurring in some regions. https://www.nature.com/articles/s41893-019-0220-7
55164	26	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. The reviewer presents no scientific literature in support of this claim. In any case, the mere fact that plants thrived in the Cretaceous does not imply that present-day plants, which have evolved under the much different conditions of the last million years or so (when CO2 levels were below present levels), would also thrive under Cretaceous conditions. Pollen production is sensitive to small changes in temps. Recent satellite evidence shows that a third or more of the "global greening" cited elsewhere this reviewer's comments as a CO2 sink is due to large tree-planting programs and intensified agriculture in China and India, not uptake of anthropogenic CO2 by wild plants, though that is also occurring in some regions. https://www.nature.com/articles/s41893-019-0220-7
19160	26	14	26	14	typo: Earth System Model (ESM) projections [Baerbel Hoenisch, United States of America]	Accepted. Sentence revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
45388	26	14	26	15	The existence of "tipping points" in ESMs is a wide-ranging topic that deserves many more than one reference, including some that are skeptical of their existence. Some are below, but the topic goes back at least to Budyko in the 1960s, so a wider perspective is probably warranted here. The Dijkstra series of papers mapping the bifurcations of increasingly realistic ESMs is probably also worth adding here. [Baylor Fox-Kemper, United States of America]	Accepted. This is being further discussed in those chapters where the ESMs are being used
32026	26	14	26	21	This paragraph incorrectly assumes that the only relevant scientific issue is to assess the probability of crossing a tipping point. This is wrong (and arguably ill-posed): where likelihoods are inherently uncertain it is much more useful for risk assessment to make a quantiative assessment of impacts. See Sutton (2019, BAMS) and references therein. [Rowan Sutton, United Kingdom (of Great Britain and Northern Ireland)]	Noted. However, this section is designed to explain the concepts of tipping points etc., rather than to assess their impacts (that comes elsewhere in the AR6). A new conceptual figure SOD 1.13 has been included to make this clearer.
6581	26	14	26	31	This paragraph is confusing to read: my suggestion: keep phrase 14-15. Than cut and paste paragraph 23-31 as from line 15. Cut and paste current phrases 15-26 after the current phrase 31. [Tim Christiane Thys, Belgium]	Taken into account. Text revised to make it better understandable.
52702	26	20			Is “resilience” the correct word? Seems to ring the wrong bell, as the discussion is about the physical system here. [Douglas Maraun, Austria]	Taken into account. Changed "reduced resilience" to "increased sensitivity".
7788	26	21	26	21	Full stop is missing [Merja Tölle, Germany]	Accepted. Sentence revised.
24220	26	23	26	25	Cite: Beisner, B.E., Haydon, D.T. and Cuddington, K., 2003. Alternative stable states in ecology. Frontiers in Ecology and the Environment, 1(7), pp.376-382.; Scheffer, M. and Carpenter, S.R., 2003. Catastrophic regime shifts in ecosystems: linking theory to observation. Trends in ecology & evolution, 18(12), pp.648-656. [Natasha Barbolini, Sweden]	Taken into account. Added the Scheffer et al. citation.
46116	26	23	26	31	This is a great paragraph, however there is a lot of scientific jargon that can be quite hard to understand if not in this field of expertise. I suggest a rewording with more layman's terms or definitions of these scientific terms in a table close by. [Amy Featherstone, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Edit for readability.
8824	26	27			Thermohaline hysteresis was first demonstrated in Stocker, T.F., and D.G. Wright, Rapid transitions of the ocean's deep circulation induced by changes in surface water fluxes, Nature, 351, 729-732, 1991. Please cite accordingly. [Thomas Stocker, Switzerland]	Taken into account. Added suggested citation.
12608	26	33	26	38	Tipping points should be explained in a way that the public and policy makers understand the risk they present. It also is important to note the proximity to these tipping points/critical thresholds as warming has already reached 1C, and there exist many tipping points between 1.5 and 2C. Drijfhout S., et al. (2015) Catalogue of abrupt shifts in Intergovernmental Panel on Climate Change climate models, PROC. NAT’L. ACAD. SCI. 112(43):E5777–E5786; and Steffen W., et al. (2018) Trajectories of the Earth System in the Anthropocene, PROC. NAT’L. ACAD. SCI. 115(33):8252–8259; 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; Xu and Ramanathan (2017) Well below 2 °C: Mitigation strategies for avoiding dangerous to catastrophic climate changes, Proc. Natl. Acad. Sciences; Xu Y., et al. (2018) Global warming will happen faster than we think, NATURE, Comment 564:30–32. [Kristin Campbell, United States of America]	Taken into account. Similar/identical to 12758.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
42312	26	33	26	38	In discussion of tipping points, include reference to committed impacts (such as loss of ice mass) and rates -- e.g., while we may be committed to loss of Thwaites Glacier, the rate of loss depends on melt rates. See for example WWW.ICCINET.ORG/THRESHOLDS and references therein, such as Joughin, I., Smith, B.E., and Medley, B. (2014). Marine ice sheet collapse potentially under way for the Thwaites Glacier Basin, West Antarctica. Science, 344(6185), 735–738. Note also the proximity of some of these tipping points, given that warming has already reached 1C, and there exist many tipping points between 1.5 and 2C. Drijfhout S., et al. (2015) Catalogue of abrupt shifts in Intergovernmental Panel on Climate Change climate models, PROC. NAT'L. ACAD. SCI. 112(43):E5777–E5786; and Steffen W., et al. (2018) Trajectories of the Earth System in the Anthropocene, PROC. NAT'L. ACAD. SCI. 115(33):8252–8259; 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; Xu and Ramanathan (2017) Well below 2 °C: Mitigation strategies for avoiding dangerous to catastrophic climate changes, Proc. Natl. Acad. Sciences; Xu Y., et al. (2018) Global warming will happen faster than we think, NATURE, Comment 564:30–32. [Gabrielle Dreyfus, United States of America]	Taken into account. Text in all of section 1.2 has been revised to stress committed climate change and related impacts more prominently, e.g. Section 1.2.1.2
12758	26	33	26	38	Tipping points should be explained in a way that the public and policy makers understand the risk they present. It also is important to note the proximity to these tipping points/critical thresholds as warming has already reached 1C, and there exist many tipping points between 1.5 and 2C. Drijfhout S., et al. (2015) Catalogue of abrupt shifts in Intergovernmental Panel on Climate Change climate models, PROC. NAT'L. ACAD. SCI. 112(43):E5777–E5786; and Steffen W., et al. (2018) Trajectories of the Earth System in the Anthropocene, PROC. NAT'L. ACAD. SCI. 115(33):8252–8259; 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; Xu and Ramanathan (2017) Well below 2 °C: Mitigation strategies for avoiding dangerous to catastrophic climate changes, Proc. Natl. Acad. Sciences; Xu Y., et al. (2018) Global warming will happen faster than we think, NATURE, Comment 564:30–32. The role of clouds also should be noted, as any major shift can have profound effect on climate. Bender F. A.-M., et al. (2012). Changes in extratropical storm track cloudiness 1983–2008: observational support for a poleward shift. Climate Dynamics 38:2037–2053; Norris J. R., et al. (2016). Evidence for climate change in the satellite cloud record. Nature 536:72–75; 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, 9 ("Though clouds enhance the greenhouse effect by trapping heat, they also reflect an enormous amount of solar radiation and nearly double the albedo of the planet. Their albedo effect dominates over their greenhouse effect, balancing out to a net cooling of about –25 Wm–2 (compared with the 1.6 Wm–2 forcing from CO2 and total current forcing of 3 Wm–2) (IPCC, 2013). More than two-thirds of this cooling is from the extensive extratropical cloud systems, which are found poleward of about 40° and are associated with jet streams and storm tracks (IPCC, 2013). Satellite data reveal that these cloud systems are retreating poleward in both hemispheres, which has led to an increase in the solar radiation reaching the	Taken into account. Text has been revised. A conceptual Figure 1.13 has been added to better illustrate the tipping points concept.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
32612	26	33	26	46	A really key tipping point is likely the degree of warming that will lead eventually to the loss of substantial mass from the ice sheets. I'd suggest using this as an example to give a sense of the challenges, time constants, etc. that are involved. I also think in this regard to make justifying the 2 C and 1.5 C values based on a tippping point to nonlinear behavior is only credible on a very limited basis--even though this seems to have been how the Paris values were chosen. I would also suggest making the point that this hypothesized runaway heating tipping point would allow so much warming that there will be many, many impacts of various types. The scientific community needs to offer its thoughts on all of this--evaluate and critique how the Paris numbers were involved, and so on. [Michael MacCracken, United States of America]	Taken into account. Text has been revised.
15208	26	35	26	35	"systems with inertia struggle to keep up with rapidly increasing forcings"??? What does that mean, what is the evidence? Sorry but as evocative as this may sound, it is not a scientific assessment. [Claudia Tebaldi, United States of America]	Accepted. Sentence revised.
8826	26	36			rate-induced tipping is an important process first demonstrated by Stocker and Schmittner in 1997 for the AMOC. Please cite accordingly: Stocker, T.F., and A. Schmittner, Influence of CO2 emission rates on the stability of the thermohaline circulation, Nature, 388, 862-865, 1997. [Thomas Stocker, Switzerland]	Taken into account. Suggested reference added.
44074	26	37	26	38	Additional example of "bifurcation point overshoot" & review of Anthropocene tipping points: Steffen et al. 2018 (https://www.pnas.org/content/115/33/8252.short) [Sara Kahanamoku, United States of America]	Taken into account. Suggested reference added.
8828	26	37			further to comment above: (e.g., AMOC, Stocker and Schmittner, 1997; "compost bomb", Wieczorek et al., 2011) [Thomas Stocker, Switzerland]	Taken into account. Suggested reference added.
6583	26	40	26	41	rephrase: "would have severe local impacts relevant to the concept of dangerous climate change" into: "would have severe local climate change impacts". [Tim Christiane Thys, Belgium]	Accepted. Text revised.
8830	26	42			an important review article that should be cited here is Clement, A.C., and L.C. Peterson, Mechanisms of abrupt climate change of the last glacial period, Rev. Geophys., 46, RG4002, 2008. [Thomas Stocker, Switzerland]	Taken into account. Suggested reference added.
51760	26	43	26	44	Bowen et al. 2015 only talks about PETM, but not deglaciation in the Quaternary -- another citation is needed. [Anson Cheung, United States of America]	Taken into account. Additional reference added.
44892	26	43	26	45	I think it's a mischaracterization to imply that deglaciations during the Quaternary were tipping events that changed climate for 10's to 100's of thousands of years. They are part of orbitally driven glacial-interglacial cycles. Maybe more to the point is that non-linear feedbacks in the climate system are known to have occurred during transitions from glacial to interglacial periods, causing climate to change faster than the underlying orbital forcing. [Darrell Kaufman, United States of America]	Rejected. Tipping points are almost invariably a response to some change in external forcing (as are the ice-age cycle cycles). Ice-cores also show clear critical slowing-down before deglaciation events (Dakos et al., 2010). We have clarified this point.
51712	26	48	26	55	Suggest that the three types of surprises categorised by Aven and Krohn, 2014, (https://doi.org/10.1016/j.ress.2013.07.005) should be listed. [Zelina Zaiton Ibrahim, Malaysia]	Noted.
26930	26	48	26	55	The PBB outbreak in Northern America is no good example for an "unknown unknown". The potential of insect pests to infest large areas is known for centuries, and factors alleviating the risk levels are known, too. [Joachim Rock, Germany]	Noted.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
55166	26	48		55	I suggest adding another paragraph after this one (i.e., at the end), to read as follows: "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 [David Burton, United States of America]	Noted.
45734	26	51	26	53	epidemic refers to disease, rather say unexpected ecological changes or biological infestations [Katja Mintenbeck, Germany]	Rejected. The term "epidemic" also has a broader meaning: "a sudden, widespread occurrence of a particular undesirable phenomenon," e.g. "an epidemic of violent crime." (dictionary)
32028	26	54	26	54	The proposal of Sutton (2018) is not limited to surprises as defined here. The authors also need to make clear whether they agree that this proposal should be adopted for AR6 WGI or not (with reasons). More generally this section should conclude with clear recommendations for the assessment of tipping points/surprises in AR6 WGI. [Rowan Sutton, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Text was deleted. The Sutton figure (or a version of it) is now discussed in SOD Section 1.4.4 Storylines
31556	26	54	26	55	It is stated that "In this context Sutton (2018) proposes to include unlikely but high impact risks as an integral part of the WGI assessment.", but it would be good to also state whether this reccommendation is actually implemented in AR6, and a call-out to relevant sections. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Text was deleted. The Sutton figure (or a version of it) is now discussed in SOD Section 1.4.4 Storylines
8832	26	54			Sutton (2008) missing in ref list [Thomas Stocker, Switzerland]	Noted. Text was deleted. The Sutton figure (or a version of it) is now discussed in SOD Section 1.4.4 Storylines
51588	27	5	27	5	I don't understand what equilibrium climate sensitivity means. Have I missed a simple definition? It is later defined on p.33 yet remains quite technical to the non-scientist. [Lindsey Cook, Germany]	Not applicable. The figure and corresponding text have been moved to Section 1.4.4 in the SOD. The definition is being introduced in Section 1.3.
48256	27	18	27	18	Suggest including somewhere in this section a reference to Jack et al., 2019, Climate Risk Narratives: An iterative reflective co-production process for producing and integrating climate knowledge (Climatic Change, submitted) available from Chris Jack <cjack@csag.uct.ac.za>.I64 [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. This section was rewritten, in order to bring a coherent definition and usage across the working group
51714	27	18	27	54	The use of the term narratives and/or storylines within the AR6 reports should be clarified. Are they interchangeable words (this should be discouraged); are they to be used in compound manner (narrative storyline) are do they mean different things? This should be irrespective of if other authors are using the terms in a looser colloquial sense in the literature. [Zelina Zaiton Ibrahim, Malaysia]	Accepted. This section was rewritten
32030	27	18	28	4	It would be very valuable if this section could conclude with clear recommendations for the use of narratives and storylines throughout the rest of the report. [Rowan Sutton, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. The new text includes a paragraph where in the report the concept of storyline is used and how it is used. It is also included table1.1 now.
13120	27	18	28	4	This section is confusing. It is unclear to me how "storylines" and "narratives" are meant to better inform communities and policymakers. Is this supposed to be a method of "breaking down" scientific information? Or is this just meant to make scientific conclusions more "useful" to the public? [Nora Richter, United States of America]	Taken into account. This section was rewritten for clarification.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
46194	27	18	28	4	This discursive section is quite long and bascailly tells policymakers that terms are applied variously across different literatures. Making this tighter and getting the word "Qualitative" (line 35) in earlier to distinguish storylines from quantitative model outputs would be good. Also to make the point that storylines are generally the starting point for generating model inputs (or ever structure) and are not add-ons. I note that the relevant bullet point in the agreed outline is "Framing of the physical science information relevant for mitigation, adaptation, and risk assessment in the context of the Global Stocktake". This goes beyond "framing of physical science information". [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	Accept. the text has been deeply revised : the definitions of terms across different literature shortened and the distinction between storylines made consistent
56186	27	18	28	4	To be considered in overall AR6 report: Could we develop narratives for worlds at 1.5°C, 2°C, 3°C and 4°C which would be internally consistent and would illustrate how climate change would unfold under these different scenarios? The idea would be to look at the sum / conccurent occurrence of different changes in the climate system, rather than at each single element. [Sonia Seneviratne, Switzerland]	Taken into account. Temperature levels are introduced in Chapter 1 and developed in the technical summary.
53128	27	18	28	4	I think you also need to make the spatial and temporal dimensions more clear in the way the storyline concept is used. And how they are related. [Jan Fuglestvedt, Norway]	taken into account. This topic will be addressed through a WG wide writing team
53130	27	18	28	4	This is a topic that needs to be coorindinated across WGs. Will be followed up by TSU/Bureau [Jan Fuglestvedt, Norway]	taken into account. This topic will be addressed through a WG wide writing team
45966	27	18	28	4	The emergence of narratives and storylines that moves beyond presentation of data is hoped to bridge thegap between the scientists and the users (e.g., policymakers, pactitioners, etc.) [Lourdes Tibig, Philippines]	Taken into account. This section was rewritten, in order to bring a coherent definition and usage across the working group
38948	27	18			Narratives/storylines are one of the new approaches highlighted in AR6, but descriptions tend to be a bit abstract and the concept and merits of the approach are not easy to understand (talking about "event" storyline). Please make definition of the approach a bit more clear here. A simple, illustrrative example would be appreciated. The reviewer cannot help wondering how probable is the "story" he has just been told compared with other possibilities. Is it OK to understand that we do not know much about how the "drivers" (as in Zappa and Shepherd 2017 example) will change? [Masahide Kimoto, Japan]	Accepted. the text has been deeply revised to shorten the definitions of terms across different literature ; a larger team has been set to clarify the concepts related to different uses of storylines and narratives in AR6,
6585	27	21	27	25	insert after "communicate", "research" information and replace "insufficient" by "too complex" (because it often IS sufficient, but complicated) [Tim Christiane Thys, Belgium]	Accept. The text has been revised.
15210	27	24	27	30	I do not agree with this presentation. What does "insufficient" on line 24 mean? And it sounds as if storylines are going to be the solution, addressing all the shortcomings of traditional information, right?I don't think so. They are just a different approach to communication, far from resolving exhaustively the need of actionable information.They are not moving "beyond", they are just going at it in a different way. [Claudia Tebaldi, United States of America]	Accept. The word "insufficient" has been changed to the word "complex". See comment 6585
53124	27	24			I think it would be useful if you say more about why this is "insufficient for the purpose of decision making". What is the problem with the trad way of communicating findings? [Jan Fuglestvedt, Norway]	The word "insufficient" has been changed to the word "complex". See comment 6585

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
54244	27	25	27	38	This sentence characterizes the storylines in SR1.5 Ch 3 Box 8 (Seneviratne et al) as "event storylines" consisting of a "physically self consistent unfolding of past events, or of plausible future events or pathways," in contrast to storylines for socio-econonomic scenarios. But I don't see a clear distinction between the two, since the SR1.5 storylines are not just about physical climate events but also about socioeconomic factors like mitigation and adapation measures as well. I think the difference is that the SR1.5 storylines are about the outcomes of integrated climate-society scenarios, whereas socio-economic storylines used to support emissions scenarios and impact assessments contain socio-economic and environmental factors only, but not climate outcomes or climate policies. [Brian O'Neill, United States of America]	a team has been set within WG 1 and coordinating with others WGs to clarify the concepts related to different uses of storylines and narratives in AR6,
53126	27	27	27	27	When you write "these limitations" you take it for granted that that this is obvious to the reader. Please explain more. [Jan Fuglestvedt, Norway]	The text has been revised to be more explicit
27532	27	29	27	30	Rephrase to say that both terms have been used interchangeble but there is also literature where 'storyline' has a very precise definition. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Text has been revised to address the comment
27534	27	32	27	45	Add that storylines often pick up on past events & thus people's experience & storyline approaches are thus often linked to event attribution. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Text has been revised to address the comment
29930	27	35	27	35	In the sense used here, storylines are quantitative, not qualitative. They are not probabilistic, but are still quantitative. [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	text revised
52704	27	36			The Shepherd et al (2018) paper goes beyond event storylines. E.g., the Zappa & Shepherd (2017) approach mentioned further below is not about events but physically consistent plausible evolutions of the climate system. Event storylines are therefore only a sub-category of the Shepherd et al. (2018) storylines. This should be corrected. [Douglas Maraun, Austria]	Text revised
29938	27	38	27	41	The term 'storyline' was first introduced in an event-based sense in Shepherd (2016 CCCR doi: 10.1007/s40641-016-0033-y) in the context of extreme-event attribution. [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	Reference added
43296	27	43	28	44	These lines should be moved to line 5 page 1-28. [Onema Adojoh, United States of America]	The reviewer proposition is not understandable
15212	27	45	27	45	Where is the evidence assessed for claiming that narratives and storylines are "more effective"? Isn't it a bit early to claim that? [Claudia Tebaldi, United States of America]	Text revised to provide more nuance
52706	27	45			Again, it is not only about events, but also about pathways/evolutions of the climate system as in Zappa & Shepherd. [Douglas Maraun, Austria]	Text revised
29934	27	48	27	48	Event-based storylines are not qualitative, they are quantitative. They are just not probabilistic, but that is different. [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	Text revised
29936	27	52	27	54	Since event-based storylines are not qualitative, the definition in the IPCC Glossary will need to be revised. [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	coordination with Glossary team has been started to update definitions related to storylines and narratives
52708	28	1	28	2	Chapter 10 discusses storylines also as a means to explore uncertainties. [Douglas Maraun, Austria]	Chapter 10 rather discusses the complementarity between narrative/storylines and Ensemble mean /probabilistic projections

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43714	28	6	33	17	This historical review of climate science is too long and probably not necessary in such detail. I think this information should go in a review paper, rather than an assessment. I would also refer the authors to papers coming out in the AMS Monographs centennial anniversary edition where many of the points covered here are reviewed. [Vaishali Naik, United States of America]	Section 1.3 has been heavily revised and reorganized in the framework of "lines of evidence" rather than chronological periods. The historical elements have been reduced and more AR5 conclusions added.
26350	28	6	33	33	I still struggle trying to identify the strategic role in the WGI AR6 assessment of this very extensive historical review. And given that the entire historical review takes around 10% of the chapter text length, it seems to me that its purpose in the overall report needs to be articulated more explicitly and more comprehensively. [Jochem Marotzke, Germany]	Section 1.3 has been heavily revised and reorganized in the framework of "lines of evidence" rather than chronological periods. The historical elements have been reduced and more AR5 conclusions added.
51716	28	6	37	25	I am unclear on the value of having the history of climate understanding within the chapter. It may be a box or supplement. Section 1.3.4 is more valuable. [Zelina Zaiton Ibrahim, Malaysia]	Section 1.3 has been heavily revised and reorganized in the framework of "lines of evidence" rather than chronological periods. The historical elements have been reduced and more AR5 conclusions added.
53910	28	6	37	25	This is a very interesting historical account and worthy of publication somewhere, but is it really necessary in this Chapter? I thought that IPCC was trying to reduce the length of its reports, and to reduce their text-book like characteristics, focusing on the key elements of an assessment instead. I really appreciate the thought that has gone into this account, but I don't think this is the appropriate outlet for it. Try a review journal like WIREs Climate Change - that would be a great place to publish something like this. [Timothy Carter, Finland]	Section 1.3 has been heavily revised and reorganized in the framework of "lines of evidence" rather than chronological periods. The historical elements have been reduced and more AR5 conclusions added.
57296	28	6	37	25	This is tough, but the golden rule is propose cuts if you propose additions, particularly if the chapter is too long. This is great and fascinating material, but is it needed, and does it just put up hostages to fortune? Could all this material not be moved to a nice review paper, which I am sure would be very highly cited. Hope you can forgive this suggestion, and I reiterate, it is interesting stuff and will get lots of positive comments -- but do we need it? [Myles Allen, United Kingdom (of Great Britain and Northern Ireland)]	Section 1.3 has been heavily revised and reorganized in the framework of "lines of evidence" rather than chronological periods. The historical elements have been reduced and more AR5 conclusions added.
30428	28	6	37	25	An excellent section - that I have read with great interest and pleasure. I particularly appreciate the effort made to highlight climatological knowledge from multiple perspectives, not only the Western scientific perspective. Maybe this could be elaborated slightly further if more evidence is available. [Joeri Rogelj, Austria]	Noted, with thanks. Section 1.3 has been heavily revised and reorganized in the framework of "lines of evidence" rather than chronological periods. The historical elements have been reduced and more AR5 conclusions added.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
28758	28	6	43	0	As much as I enjoyed 1.3, I thought a lot of the historical side is in books eg (Weart) and it could have been much shorter. Also, I think repeating such long statements from past IPCC reports at such length is problematic. I think they and their evolution could be summarised in a much shorter paragraph. Mistakes will creap in, E.g. Eunice Foote did not look at heat trapping, her experiments looked at solar absorption (not thermal IR) and it is not that clear that they even worked. There are several papers on her work now to refer to. She was the first to propose that increases in CO2 raised the Earth's temperature. I'm sure there are lots of small errors/opinons in the historical narrative on balance and geographic representation ,so I would solve these by being short and to the point. For example radiative transfer, forcing and drivers is under representated given its major role in development of the field. Is CO2 going up is this caused by coal burning, does it absorb radiation, how much effect does this have on warming.... These are central themes that are missed. How can you have a history that mentions stacks of papers but not Keeling (1960), Manabe and Wetherald (1968), Hansen (1981). Also IPCC very much grew out of the stratospheric ozone community and work by Bert Bolin and others [Piers Piers Forster, United Kingdom (of Great Britain and Northern Ireland)]	Information on Foote is useful; thanks. Some of the references mentioned have been included. RF has been treated more explicitly and more extensively. Coal burning was already treated. Section 1.3 has been heavily revised and reorganized in the framework of "lines of evidence" rather than chronological periods. The historical elements have been reduced and more AR5 conclusions added.
55502	28	6	44	28	This is a really nice section on the history of climate science; very accessible, and I can see great value of this section particularly for students approaching the IPCC reports for the first time. [Wesley Fraser, United Kingdom (of Great Britain and Northern Ireland)]	Section 1.3 has been heavily revised and reorganized in the framework of "lines of evidence" rather than chronological periods. The historical elements have been reduced and more AR5 conclusions added.
54978	28	6	44	30	Although useful to underline the robust history of climate science, the relatively lenghtly historical perspective may be augmented with a timeline based figure with the main milestones from the start, including the use of satellite observing systems in the 1960s. The same timeline can be superimposed to the increasing temperature trends since pre-industrial levels, which could strengthen the message. The timeline can be used to also emphasize the catching-up of scientific knowledge to the realization of increases in surface temperatures, possibly with multiple layers based on surface-based instrumental measurements, aircraft observations, satellite-based retrievals, in-situ measurements and palaeoclimatic records as indicated on page 44 that could possibly provide additional support to Figure 1.7 on page 45. [Kilkis Siir, Turkey]	We also like the idea of a timeline, and we discussed it repeatedly, but the number of significant developments across a 150-year period makes it impractical within the constraints of a printed IPCC page. We may attempt it for an online supplementary graphic. Section 1.3 has been heavily revised and reorganized in the framework of "lines of evidence" rather than chronological periods. The historical elements have been reduced and more AR5 conclusions added.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
27502	28	6	64	49	This is a big comment, with comments following below within the same pages are linked to this suggestion, which I think would improve the IPCC report - real world connection a lot. The two sections 1.3 and 1.4 are content-wise very interesting and a lot of it is necessary in this chapter, but due to the structure there is also a lot of repition and in particular the chapter 1.3 lacks motivation on why it is here and a reader of AR6 interested in our current understanding and how to interpret it will wonder why the historical perspective is relevant. I would suggest to reframe chapter 1.3 as 'Lines of evidence' and discuss, very similar to 1.4 the different lines of evidence we have and how they have evolved over time. Having subsections on physical process understadning, oberservations, modelling etc. A lot of the material from the current section 1.3 & 1.4 can get in this framing but it could be very much streamlined. What is currently missing in these chapters is how different strands of evidence are combined and synthesised. This is something that is in AR6 necessary in every chapter, wheras in AR5 it was mainly done for the SPM, thus it deserves space. There is a little bit of literature on how to do this quantitatively coming from e.g. the event attribution multi-method approaches, e.g. van Oldenborgh et al., 2019. But this is only one example and more discussion would be important. A new chapter 1.4 could than be framed around key pillars of understanding and discuss within one section how they evolve from AR5 with SR1.5 to AR6 WG1. This is currently in 1.3.4 and the following but, identifying common pillars of understanding across reports would make this information better applicable. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	This was a very important suggestion for us, which we have implemented. Section 1.3 has been heavily revised and reorganized in the framework of "lines of evidence" rather than chronological periods. The historical elements have been reduced and more AR5 conclusions added.
53856	28	6			I enjoyed reading section 1.3 - very good to have this in the report. Given the amount of topics and material the chapter has to cover I wonder if some tightening is possile in order to shorten the text, without losing substance. [Jan Fuglestvedt, Norway]	Section 1.3 has been heavily revised and reorganized in the framework of "lines of evidence" rather than chronological periods. The historical elements have been reduced and more AR5 conclusions added.
45134	28	17	34	4	I question whether the long and detailed history of climate change science pre-IPCC in subsections 1.3.1 and 1.3.2 is appropriate or needed in an IPCC assessment. While this material is nicely written, it is more suited to a text book. It could be dropped from this chapter with the added benefit of shortening the chapter by several pages. [David Wratt, New Zealand]	Section 1.3 has been heavily revised and reorganized in the framework of "lines of evidence" rather than chronological periods. The historical elements have been reduced and more AR5 conclusions added.
45390	28	17	39	25	This is really a lovely section. Please don't remove it! [Baylor Fox-Kemper, United States of America]	Thanks! Unfortunately, we had to make some cuts. Section 1.3 has been heavily revised and reorganized in the framework of "lines of evidence" rather than chronological periods. The historical elements have been reduced and more AR5 conclusions added.
49410	28	19	28	20	Include "physics" in the list of disciplines conbined into climate science. This is especially important since some physicists are vocal climate denialists and think that climate scientists ignore physics (I am a physicist by training myself). [Sonya Legg, United States of America]	Included in the text
55076	28	19	28	20	Seems odd to leave out "physics" here, given that early findings related to e.g. radiative transefr are absolutely essential for our current understanding of the climate system [Trude Storelvmo, Norway]	Added this.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
32418	28	19	28	23	The important work by Bjerknes and the 'Bergen School' (including Bergeron, Godske, and several other essential meteorologists), who developed the basis for dynamic meteorology, including the Polar front, etc., and the basis for modern weather forecasting has not been mentioned. Also the work by Sverre Pettersen, is also left out. Reference to the over 1000 page book by Godske et al, 1955, needs to be referred to here. [Martin Hovland, Norway]	Section 1.3 has been heavily revised and reorganized in the framework of "lines of evidence" rather than chronological periods. The historical elements have been reduced and more AR5 conclusions added. Bjerknes is mentioned but the focus in this section is on climate rather than on weather forecasting. The cited book Edwards (2010) covers their relationship.
32614	28	21	28	21	Within our field, we can have many hypotheses, but really only one theory (in the field of nuclear physics, they do sometimes talk about multiple theories). For our field, in my view, a theory represents a well developed explanation that has no plausible alternatives; one can have lots of hypotheses, but only one theory. Also, I'd note, was not Arrhenius the only scientist positing a human influence in the 19th century, at least on a global scale? I would actually have thought this would have said that scientists put forth a number of hypotheses to explain the natural factors causing climate change over Earth history in the 19th century and these only really started to get looked at critically in the 1960s or so (and my 1968 dissertation was one of the first climate model tests of a couple of the hypotheses). On human influences, there were only a very few up until the mid-20th century when Manabe and Wetherald's 1-D radiative-convective model could confirm the findings of Arrhenius that the altitude of saturation of the CO2 bands makes a difference (due to the lapse rate) and when Craig and Revelle's study of ocean uptake of bomb-generated radionuclides made clear the ocean was not uniformly mixed and had an upper mixed layer with a short time constant and a deep ocean with a very long one (which is what allows the CO2 concentration to build up, as Arrhenius suggested and critics rejected). [Michael MacCracken, United States of America]	Högbom (Arrhenius's colleague and friend) also posited human influence from coal combustion in the 19th c. and calculated that it was already offsetting all the CO2 naturally absorbed by rock weathering; also Ekholm. The word "theories" no longer appears in the usage discussed here.
31560	28	22	28	22	"until after World War II". Maybe instead "until the late-1940's". Similarly throughout these sections, WW1 and WW2 are used as "benchmarks" of time, but no other historical events are. I think it is better to use the decades rather than historical events, unless the historical events unambiguously and directly led to the development discussed. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	WWI and WWII no longer appear as temporal markers.
54422	28	25	28	39	This section should include reference to Robert FitzRoy, founder of the Met Office and inventor of several types of barometers as well as the term "weather forecasts". See FitzRoy, R. 1863. The Weather Book: A manual of practical Meteorology. Longman, Green, Longman, Roberts & Green, London, UK. [Annika Herbert, South Africa]	Section 1.3 has been heavily revised and reorganized in the framework of "lines of evidence" rather than chronological periods. The historical elements have been reduced and more AR5 conclusions added. FitzRoy was an important figure, but in this reduced treatment is not useful as a reference.
8488	28	25	28	49	If sea-level science is part of climate science, then the tide-gauge record (beginning in northern Europe in the eighteenth century) should be mentioned here. [Robert Kopp, United States of America]	Good point - thanks. Tide gauge record is discussed.
50718	28	28	28	28	Add "in" in "...century Eurasia." [Hernan Edgardo Sala, Argentina]	Sentence no longer appears.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
57222	28	36	28	37	Regarding the peruvian fishermen, must to write more details in the sentence. I think is wrong to say El Niño Phenomenon, the peruvian fishermen noticed a warm current, that is not the same as The El Niño Phenomenon. Of course, these first observations of the warming sea surface temperatures contibuted to the knowledge of El NIño Phenomenon. [Sharl Noboa, Ecuador]	Wording adjusted. Those fishermen named the observed Christmastime warm current off Peru "El Niño," so we think this is accurate. ENSO and its teleconnections are a more recent concept.
7722	28	37	37	25	Section 1.3. Congratulations to the author(s) of this nicely written historical section. Due to the poor performance of models, the water vapour problem identified by NVAP-M and the incomplete understanding of aerosols and clouds, I have concerns about the history after these pages. [Forrest Mims, United States of America]	No revision suggested; no action taken.
31562	28	51	28	51	"With the gradual acceptance of “deep time”". Not sure that this is clear. Maybe "With the gradual acceptance that the world was older than a few thousand years" or similar ? [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	"Deep time" is a widely used phrase for long geological time scales. We added a clarifying phrase.
57906	28	51	29		What are the paleoclimate perspectives for ocean variables? Temperature, salinity, sea level, pH etc. [Catia Domingues, Australia]	Important. We have added this to the extent possible. Section 1.3 has been heavily revised and reorganized in the framework of "lines of evidence" rather than chronological periods. The historical elements have been reduced and more AR5 conclusions added.
48560	28		30		This is very interesting reading for the novice/ uninformed reader. However if it has already been covered in AR4 or other reports, this section on the hisotry of climate science could perhaps be cut.Unless is presents something new? [Zinta Zommers, United States of America]	Section 1.3 has been heavily revised and reorganized in the framework of "lines of evidence" rather than chronological periods. The historical elements have been reduced and more AR5 conclusions added.
28172	29	2	29	3	Berger(1977, Nature) and Berger(1978, Journal of Atmospheric Physics) are suggested to be cited, since all the spectral components of long term variations of eccentricity, obliquity (axial tilt) and climatic precession were first calculated by him, and the “Berger astronomical solution” is most widely used in paleoclimate community until now. [Feng SHI, China]	Added these references - thanks.
51762	29	2	29	3	Another citation for linkages between Milankovitch cycle and Ice ages -- Hays et al. 1976 doi: DOI: 10.1126/science.194.4270.1121 [Anson Cheung, United States of America]	Added this reference - thanks.
46774	29	6	29	6	You cannot “measure” precipitation from tree-ring data: it should be replaced with “reconstructed”. [Charpentier Ljungqvist Fredrik, Sweden]	Thanks for the suggestion, the term was changed
31564	29	19	29	20	Good to have a reference for: "19th-century scientists also established the main physical principles governing Earth’s temperature" [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Fleming 1998 (referenced in next sentence) covers this.
7586	29	29	29	29	I think this was actually a 1-dimensional model, probably worth mnetioning, actually a « 1-dimensional energy balance model » [Christophe Genthon, France]	2-D model - zonal and vertical, though vertical model mainly used to parameterize 1-D zonal EBM.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
37300	29	33	29	34	The sentence spanning these lines tells only part of the story. The other part is that Richardson's approach was simply not practical prior to the advent of electronic computers. This would have been the case even if his sample calculation had worked well. The first numerical weather prediction carried out by Charney and colleagues in 1950 required both the availability of an electronic computer and a substantial simplification of the equations set out by Richardson. See, e.g., ftp://ftp.library.noaa.gov/docs.lib/htdocs/rescue/JNWP/50th_Symp_2004_CD.PDF/JNWPU_2004_All/1003.pdf [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Section 1.3 has been heavily revised and reorganized in the framework of "lines of evidence" rather than chronological periods. The historical elements have been reduced and more AR5 conclusions added. References (Edwards 2010 and Nebeker 1995) both discuss everything mentioned here.
28760	29	36	29	37	Eunice Foote did not look at heat trapping, her experiments looked at solar absorption and it is not that clear that they even worked. She was the first to propose that increases in CO2 raised the Earth's temperature. [Piers Piers Forster, United Kingdom (of Great Britain and Northern Ireland)]	We dropped the mention of Foote.
52464	29	37	29	37	"was ignored until very recently". "Overlooked" would be a better word than ignored, since it seems Foote's pioneering work was forgotten and recently rediscovered rather than ignored. [John Brian Robin Matthews, France]	With respect to published research, there is no meaningful difference between "forgotten" and "ignored," and the studies of her work show that her gender probably played a role in her work not being followed up. In any case, reference to her work has been dropped.
29516	29	44	29	45	This is a weird reference! Here is a suggestion for other papers: 1) Hines, C., 1974. A possible mechanism for the production of Sun-weather correlations. J. Atmos. Sci., 31, 589-591.2) Eddy, J., 1976. The Maunder Minimum. Science, 192, 1189-1202. 3) Pittock, A., 1978. A critical look at long-term Sun-weather relationships. Rev. Geophys. Space Phys., 16, 400-420. [Katja Matthes, Germany]	Added reference to Eddy; cuts to this section have eliminated the original sentence as well as the "weird" reference to Weart (which is an important scholarly book that is expanded and kept up to date by means of a website).
51590	29	50	31	5	This is all fascinating, I appreciate you taking time to explain the historical developments. [Lindsey Cook, Germany]	Thanks very much
55168	29	50		54	[pt 1 of 2] The text states that, "Arrhenius (1896) found that a doubling of carbon dioxide would produce a 5-6°C warming, but in 1900 new measurements seemed to rule out CO2 as a greenhouse gas due to overlap with the absorption bands of water vapor (Angström, 1900; Anonymous, 1901). Nonetheless, as coal combustion reached 900 megatonnes per annum, 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: "Arrhenius (1896) was the first scientist to..." [cont'd] [David Burton, United States of America]	Section 1.3 has been heavily revised and reorganized in the framework of "lines of evidence" rather than chronological periods. The historical elements have been reduced and more AR5 conclusions added, leaving no room for this longer discussion of Arrhenius.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
55170	29	50		54	[pt 2 of 2] "...quantify the warming effect of mankind's CO2 emissions. He reported that a doubling of carbon dioxide would produce a 5-6°C warming, though he later revised that downward to 1.6°C. In 1900 new measurements seemed to rule out CO2 as a greenhouse gas due to overlap with the absorption bands of water vapor (Angström, 1900; Anonymous, 1901). Nonetheless, as coal combustion reached 900 megatonnes per annum, Arrhenius wrote that anthropogenic carbon dioxide would eventually warm the planet, and that it would be highly beneficial. He also predicted the benefits of "CO2 fertilization," and even predicted what is now called 'polar amplification.' 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]	Section 1.3 has been heavily revised and reorganized in the framework of "lines of evidence" rather than chronological periods. The historical elements have been reduced and more AR5 conclusions added, leaving no room for this longer discussion of Arrhenius.
8490	29	52	29	52	Fix anonymous ref. [Robert Kopp, United States of America]	The Anonymous reference is to an article published without an author that explains Angstrom's result in English. We are supposed to provide English wherever possible.
29940	30	2	30	3	Since the claim of "saturated bands" still comes up occasionally from climate skeptics, a reference for this sentence would be useful. [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	Added reference to Fowle (1917).
42842	30	17	31	40	This section needs a better description of the advances that came about in numerical modeling of weather and the extension of those models into climate studies, improvements in resolution, process incorporation, coupling of atmosphere, ocean, land processes; but still challenges like drift and lack of ensembles, coarse representation of key climatological features. Also: development of more sophisticated means of analyzing gridded data and merging simulations and observations (e.g. data assimilation, historical and paleoclimatic reanalysis); identifying observational needs (tropical and southern oceans from which would emerge TOGA-TAO, PIRATA, profiling floats, other observing programs); development of the first experimental and operational numerical seasonal and interannual climate predictions, for instance of ENSO. --> largely addressed in section 1.3.3, section 1.4.2 [Michael Evans, United States of America]	Section 1.3 has been heavily revised and reorganized in the framework of "lines of evidence" rather than chronological periods. The historical elements have been reduced and more AR5 conclusions added. There is not room for a detailed discussion of these issues, but many are discussed in Section 1.5.
29942	30	17	33	17	The linear 'arrow of progress' presented in this section is challenged by Martin-Nielsen (2015 WCC doi: 10.1002/wcc.349). This point relates back to the discussion of epistemic values earier in the chapter. [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	The discussion in this section does not proclaim linear progress in all areas; we have made this more explicit. Martin-Nielsen's article focuses solely on HH Lamb and his ideas, without taking into account both similar work by LeRoy Ladurie and others on historical climatology, nor on the fact that Lamb turned out to be wrong about the long-term effect of climate modelling on the subfields of historical climatology and paleoclimate, which have flourished since his time.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
32616	30	19	30	19	Given all the other detail, I would think some elucidation is needed here, particularly mention of Manabe and Wetherald's 1967 paper. [Michael MacCracken, United States of America]	Section 1.3 has been heavily revised and reorganized in the framework of "lines of evidence" rather than chronological periods. The historical elements have been reduced and more AR5 conclusions added. This reference was included.
10050	30	19	30	21	Like the summaries of previous historical stages, it would be fair to refer e.g. to such scientists, whose publications, presentations significantly contributed to that “public uptake” and already in 1972 the concern for this hazard was reflected in the outcomes of the UNCHE (Stockholm). More concretely: .. an interdisciplinary field. According to Keeling (1970), the increasing human population in the 21th century "along with their other troubles, may also face the threat of climatic change brought about by an uncontrolled increase in atmospheric CO2 from fossil fuels." Bolin and Bischof (1970) have derived estimates of the atmospheric CO2 for the forthcoming decades. This hazard was already addressed in the outcome document of 1972 UN Conference on the Human Environment. Consistent projections of substantial anthropogenic climate change led to growing concern .. [Tibor Farago, Hungary]	Section 1.3 has been reduced in length and reorganized, leaving less space for this discussion. Section 1.3.5 now mentions and cites some of the early 1970s work that brought climate change into the UNCHE discussions, as well as the UNCHE itself.
10052	30	21	30	23	Actually: Preparations for negotiating the UNFCCC began in 1990 in accordance with a UN General Assembly resolution (A/RES/45/212), which formulation was to a large extent catalysed by the first IPCC assessment (1990) and the declaration approved by the Second World Climate Conference (1990). (Personal remark: these and other key milestones of this process were also described in: Farago T., 2016: The anthropogenic climate change hazard: role of precedents and the increasing science-policy gap. Időjárás, 120:1, pp. 1-40 ISSN 0324-6329. http://real.mtak.hu/60726) [Tibor Farago, Hungary]	The word "negotiations" was intended to capture both formal and informal discussions leading to UNFCCC. Informal discussions began in the mid-1980s. Revised to read "discussions" instead.
31566	30	44	30	44	14C needs 14 as a superscript ? [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Editorial
37302	30	47			It would be more correct to write that radiosonde networks emerged in "the late 1940s and 1950s". The majority of the sonde-launching ocean weather ships were on station before the 1950s began. ECMWF's archive of data for reanalysis has about 400 500hPa temperature observations per day for January 1950, rising to a little under 1100 per day by January 1959. Roughly a third of the network was established in the post-WW2 1940s, and about two thirds in the 1950s. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Revised, thanks.
51828	30	49	30	50	The statement that satellites can observe the globe twice daily globally isn't really correct. Particularly in the tropical regions it requires a period of several days. I wonder whether this statement is needed. If it is it should be nuanced appropriately to avoid being easy pickings for vested interests. [Peter Thorne, Ireland]	Revised to delete "twice daily."
52466	30	50	30	50	Can "infrared radiometers" measure solar radiation? [John Brian Robin Matthews, France]	Changed to "radiometers."
57904	31	1	31	14	This paragraph nees to be revisited to summarise how collection marine observations moved from individual projects to large scale (with culmination of the Argo floats array) with the start of the World Ocean Circulation Experiment (WOCE era). https://www.sciencedirect.com/science/article/pii/B9780123918512000039?via%3Dihub [Catia Domingues, Australia]	WOCE now included.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
37304	31	4			The network of drifting ocean buoys should be mentioned as well as ships in the context of SST measurement. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Added.
51830	31	8	31	8	Should reference Freeman et al. which is the most recent ICOADS paper? [Peter Thorne, Ireland]	Reference included.
55172	31	8		11	[pt 1 of 4] The current text says, "Sea level was historically measured by onshore tide gauges, but due to numerous sources of error and limited spatial distribution, these are valuable mainly for measuring long-term change. Satellite radar altimetry can measure sea level and ocean circulation from space at much higher spatial and temporal resolutions,..." That is an astonishing inversion of realty. Anyone who thinks the satellite altimetry data is superior to the tide-gauge data is hopelessly confused or wildly bised. I suggest the following replacement: "Sea level has been measured precisely by onshore tide gauges for over a century at many measurement sites, and over two centuries at some. They measure sea-level where it matters for coastal planning: at the shoreline. [cont'd] [David Burton, United States of America]	Very useful comment, thanks. Text has been revised. The links in this case are useful, but please, in future comments give references to published peer-reviewed literature. IPCC assessments cannot use or cite websites or blog posts, no matter their quality.
55174	31	8		11	[pt 2 of 4] Those measurements comprise the highest-quality long-term climate-related dataset in existance. 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. [cont'd] [David Burton, United States of America]	Very useful comment, thanks. Text has been revised. The links in this case are useful, but please, in future comments give references to published peer-reviewed literature. IPCC assessments cannot use or cite websites or blog posts, no matter their quality.
55176	31	8		11	[pt 3 of 4] Satellite radar altimetry, in contrast, measures sea-level only in the open ocean. 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]	Very useful comment, thanks. Text has been revised. The links in this case are useful, but please, in future comments give references to published peer-reviewed literature. IPCC assessments cannot use or cite websites or blog posts, no matter their quality.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
55178	31	8		11	[pt 4 of 4] Refs: https://www.aviso.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%9Ccal-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]	Very useful comment, thanks. Text has been revised. The links in this case are useful, but please, in future comments give references to published peer-reviewed literature. IPCC assessments cannot use or cite websites or blog posts, no matter their quality.
31568	31	11	31	11	remove comma after 1978. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Fixed by inserting "it" after comma instead.
52468	31	13	31	14	Drifting buoys also became a major part of the in situ SST observing system in the 1980s [John Brian Robin Matthews, France]	Discussion of WOCE and Argo added.
32618	31	16	31	49	It seems to me essential to not just discuss the pale perspective on changes in global average temperature, but to also do so for sea level, providing a clear indication of the magnitude of sea level change associated with the various changes in global average temperature. To my mind, the sea level consequences of the changes in global average temperature that are projected will be far more costly and problematic to adapt to than the temperature consequences, for which there is at least a technological counter-measure (air-conditioning) that humans can take advantage of. For sea level, costly relocation of many/most of the world's most populated cities is seeming inevitable--and background for that needs to be provided here. [Michael MacCracken, United States of America]	Very important comment. We have added more on both paleo and present-day SLR. Section 1.3 has been heavily revised and reorganized in the framework of "lines of evidence" rather than chronological periods. The historical elements have been reduced and more AR5 conclusions added.
19168	31	16	31	49	this section completely forgets about the paleoclimate information prior to 800 ka, inlcluding reconstructions of atm. CO2, temperature nd ocean acidification millions of years back in time and information that informed the studies listed in Table 1.1. At least a brief sentence with citation of some key papers seems appropriate (e.g. Foster et al. 2017, Zachos et al. 2001, Hönisch et al. 2012) [Baerbel Hoenisch, United States of America]	Section 1.3 has been heavily revised and reorganized in the framework of "lines of evidence" rather than chronological periods. The historical elements have been reduced and more AR5 conclusions added, leaving little room for additions. Paleo prior to 800ka is discussed very briefly in sections 1.2 and 1.5. We focused on the background to AR5. Other chapters of AR6 discuss pre-800ka records in more detail.
46776	31	19	31	19	This formulation – climate-related events as frosts, flowers, harvests, droughts, famines, and grain prices – is problematic. Famines are, in most cases, not “climate-related events” although they can be in certain cases. Moreover, grain prices only to a limited extent reflecting climate or related to climate. This is even true back to medieval times at least in Europe. [Charpentier Ljungqvist Fredrik, Sweden]	We deleted famines and prices as indicators. Yes, such data are problematic if used alone, but the sentence is describing the significant contributions of historical climatology, which does use these data in combination with others to attempt to reconstruct local and regional climates of the historical (recorded) past.
19162	31	27	31	27	add methane to CO2 [Baerbel Hoenisch, United States of America]	Added.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
31570	31	28	31	28	It would be good to have some consistency in the report on how isotopes are represented. Elsewhere the superscipt 18 is used. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Editorial
19164	31	31	31	32	I would suggest to specify that Antarctic ice cores are more reliable in reflecting CO2 (due to contamination of Greenland ice). Also, not all CO2 records are from Dome C butalso Vostok. I wuld suggest to simply drop "Dome C" nd leave this statement with "East Antarctica" [Baerbel Hoenisch, United States of America]	Length considerations forced us to leave out discussion of Greenland vs. Antarctic CO2. We dropped reference to particular Antarctic locations.
33098	31	35	31	41	Another major contribution from paleoclimate in this era is the recognition that the Atlantic Ocean circulation has not been stable over glacial-interglacial climate changes, and that these changes are associated with abrupt transitions in climate in the North Atlantic region (Boyle & Keigwin 1987) (Ruddiman & McIntyre 1981) (Manabe & Stouffer 1988) (Broecker et al. 1985). [Jean Lynch-Stieglitz, United States of America]	We included a sentence on this - thanks.
42838	31	35	31	41	This should be more specific and complete - we learned from these studies that the roughly 20k, 40k and 100k cycles of variation in global ice volume we observed from deep sea sediment based observations were consistent with those expected from the Milankovitch hypothesis. In the last sentence, this is a good place to mention the development of global general circulation modeling and the search for "out of sample" tests for them - including the seasonal and annual mean sea surface temperature reconstructions that were being developed by CLIMAP and others as cited. [Michael Evans, United States of America]	Section 1.3 has been heavily revised and reorganized in the framework of "lines of evidence" rather than chronological periods. The historical elements have been reduced and more AR5 conclusions added. Length constraints prohibit more detailed discussion.
31572	31	36	31	37	We now think there are only 8 or 9 glacial-interglacial cycles over this period; maybe worth noting this? I can't access the Shackleton and Opdyke paper, but the abstract says "The boundaries of 22 stages representing alternating times of high and low Northern Hemisphere ice volume are recognized and dated.". This is only 11 glacial-intergalcial cycles at most, becasue there is typically 1 stage for a glacial and one stage for an interglacial. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	We modified the text to say that 22 NH ice highs and lows were found by Shackleton and Opdyke (1973).
58002	31	38	31	38	Milankovitch theory of orbital cycles (recalculated and introduced to modern paleoclimate analyses by Berger (1978, 1988) Berger, A., 1978. Long-term variations of daily insolation and Quaternary Climatic Changes. Journal of the Atmospheric Sciences, 35(12), 2362-2367. Berger, A., 1988. Milankovitch Theory and Climate. Reviews of Geophysics, 26(4), pp. 624-657. [Tomas Halenka, Czech Republic]	We added these references.
46778	31	43	31	43	The very largest volcanic eruptions may have a more long-lasting cooling effect due to feedback mechanisms. It may also be mentioned that clusters of large eruptions can have a more long-lasting cooling effect. [Charpentier Ljungqvist Fredrik, Sweden]	Changed "1-3 years" to "several years."
42840	31	43	31	49	Note also the beginning of the transition from global qualitative to spatially resolved and semiquantitative reconstructions, for evaluation, for instance, of changes in large scale patterns of climate variation, e.g. ENSO and North Atlantic Oscillation, monsoon circulation, drought patterns. --> largely addressed at p 35 l. 23ff but should note/cite/reference also the substantial contributions from terrestrial archives - mainly analysis of tree ring widths and densities for gridded drought index reconstructions. [Michael Evans, United States of America]	Section 1.3 has been heavily revised and reorganized in the framework of "lines of evidence" rather than chronological periods. The historical elements have been reduced and more AR5 conclusions added. If this comment has not been addressed to your satisfaction, please repeat in next round.
37306	31	43			"global cooling" should be replaced by "global tropospheric cooling and stratospheric warming". [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	This formulation would be more precise, but the substantial shortening of this section requires minimal detail.
19166	31	45	31	45	10 in 10Be should be superscript [Baerbel Hoenisch, United States of America]	Editorial

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
46106	31	46	31	49	Need to included bivlave shells and otoliths in this list, especially as bivalves can do daily reconstructions (with arguments for tidal instead). Bivalves: Schöne et al. 2002. Reconstructing daily temperatures from growth rates of the intertidal bivalve mollusk Chione cortezi (northern Gulf of California, Mexico). Paleo, paleo, paleo. vol184, pp. 131-146 [Amy Featherstone, United Kingdom (of Great Britain and Northern Ireland)]	Wish we could add it, but the shortening of this section requires minimal detail. Section 1.3 has been heavily revised and reorganized in the framework of "lines of evidence" rather than chronological periods. The historical elements have been reduced and more AR5 conclusions added.
31574	31	48	31	48	remove comma after monthly. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Thanks for the suggestion, we modified the text
10054	31	51	31	51	The major anthropogenic driver of climate change is the emission of greenhouse gases, [Tibor Farago, Hungary]	Text was revised accordingly.
31576	31	51	31	52	Need a reference (e.g. AR5, or this report) for "The major anthropogenic driver of climate change is greenhouse gases, with aerosols and land use change playing significant secondary roles" [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	This sentence no longer appears, but other sentences make this point. Section 1.3 has been heavily revised and reorganized in the framework of "lines of evidence" rather than chronological periods. The historical elements have been reduced and more AR5 conclusions added.
7724	31	51	31	55	While water vapour is universally acknowledged as the leading greenhouse gas, it receives little attention in this entire draft (and in AR5). This section should include a statement to the effect that warming caused by increases in anthropogenic CO2 increases evaporation of water, the leading natural greenhouse gas (i.e. a positive feedback statement). While the atmospheric lifetime of an H2O molecule is 7-10 days, the cumulative magnitude of the atmosphere's water vapour load is not. Indeed, as many others and I have written, water vapour forms a reservoir in the atmosphere. [Forrest Mims, United States of America]	We introduced the CO2-water vapor link briefly. We may develop it further in the TOD.
28820	31	51	32	18	This section is less developed than the rest and given that radaitive transfer and forcing was central to the development of climate science makes the whole unbalanced. Is CO2 going up is this caused by coal burning, does it absorb radiation, how much effect does this have on warming.... These are central themes that are missed. How can you have a history that mentions stacks of papers but not Keeling (1960), Manabe and Wetherald (1968), Hansen (1981). Also IPCC very much grew out of the stratospheric ozone community and work by Bert Bolin and others. There are important papers on the observing systems for greenhouse gases, radaitive forcing by Ramanathan and Fels,... and lots of atmospheric chemistry - especially realted to stratospheric ozone.. [Piers Piers Forster, United Kingdom (of Great Britain and Northern Ireland)]	Section 1.3 has been heavily revised and reorganized in the framework of "lines of evidence" rather than chronological periods. The historical elements have been reduced and more AR5 conclusions added. We have added more on radiative transfer. Keeling was already mentioned. Manabe & Wetherald 1967 (I assume, not 1968) is now cited. RF has been treated somewhat more fully. Historical works cited by Weart, Edwards, and Fleming cover all of what you mention in detail.
26352	31	53	31	53	"Studies established" -- which ones? References needed. [Jochem Marotzke, Germany]	Added refs to Suess, Revelle & Suess.
41308	32	5	32	5	Write 'ICSU' in full [Debra Roberts, South Africa]	Sentence containing ICSU no longer appears.
50720	32	5	32	6	Delete space before the dot. [Hernan Edgardo Sala, Argentina]	Space was deleted

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
10056	32	6	32	9	The stratospheric supersonic transport aircrafts (SST) were named as possible anthropogenic causes of the ozone depletion as those released nitrogen oxides at that altitude (Johnston, 1971). According to an another hypothesis, the NASA's space shuttle operations using solid rocket boosters of the Space Transportation Systems (STS) caused high amount of hydrogen chloride emissions in the stratosphere that might also contribute to the ozone destruction (Stolarski and Cicerone, 1974). [Tibor Farago, Hungary]	Space precludes much discussion of these important events, but note discussion of the SST and the Climatic Impact Assessment Program (responding to the SST). Scientists sometimes know of CIAP (the largest climate impact assessment conducted to date at that time) only through papers by the individual authors involved; citation here is to the multi-volume final report.
19234	32	15	32	15	what is IGY? [Baerbel Hoenisch, United States of America]	Acronym is already spelled out at its first occurrence on FOD p. 30 line 31. International Geophysical Year
55078	32	29	32	30	The text needs to be more explicit on how simple 0, 1 or 2-dimensional models can "provide constraints" on GCMs [Trude Storelvmo, Norway]	Revised "constrain" to read "test." If a GCM were to give a result outside the range of a simple 1-D EBM using the same observational parameters, this contradiction would certainly serve to indicate problems with the GCM result (the meaning of "constrain" here). This view of simple models as a test of complex ones was taken for granted in the 1970s and 1980s. The reviewer is referring to a more recent development in which simple models are derived from, or tuned to match, the statistics of complex ones and then used to emulate their behaviour - but in that case the simple model is dependent on the complex one, so it cannot be used to test it. For more details see S. Weart, https://history.aip.org/climate/simple.htm#L_0820

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
26354	32	29	32	30	I cannot see that simple models can constrain complex ones -- on the contrary, as the chapter later states, simple models are often used as emulators of the complex-model behaviour. [Jochem Marotzke, Germany]	Revised "constrain" to read "test." If a GCM were to give a result outside the range of a simple 1-D EBM using the same observational parameters, this contradiction would certainly serve to indicate problems with the GCM result (the meaning of "constrain" here). This view of simple models as a test of complex ones was taken for granted in the 1970s and 1980s. The reviewer is referring to a more recent development in which simple models are derived from, or tuned to match, the statistics of complex ones and then used to emulate their behaviour - but in that case the simple model is dependent on the complex one, so it cannot be used to test it. For more details see S. Weart, https://history.aip.org/climate/simple.htm#L_0820
49414	32	33	32	33	Has "equilibrium climate sensitivity" been defined earlier? If not, a definition is needed here. (or refer to definition in table 1.1) [Sonya Legg, United States of America]	ECS and TCR are now defined in the text, instead of in the caption of Table 1.1.
7726	32	33	32	33	“Carbon emissions” is a misnomer commonly used in the media and used here and at least 24 other times in this chapter. You are not referring to pure carbon, as in aerosolized diamonds or black carbon soot (which does indeed have a climate impact). You mean CO2, the compound carbon dioxide. A Google search gives 21.1 million hits for the misnomer “carbon emissions” and 31.5 million hits for CO2, the correct term. CO2 is properly used 158 times in this chapter. please be both accurate and consistent and replace all uses of “carbon emissions” with “carbon dioxide emissions” or “CO2 emissions.” [Forrest Mims, United States of America]	"Carbon emissions" is shorthand for a number of different things, including black carbon, CO2, CH4, and halocarbons. CO2 is the most important, but not the only anthropogenic carbon emission. Nonetheless, we have checked for instances where naming CO2 specifically is important.
31578	32	33	32	34	"most estimates of equilibrium climate sensitivity fell into the 2-4°C range (see Edwards, 2010, p. 182)". In the Edwards table, 5 estimates are not in the range 2-4, and 6 are in this range, so what is written is strictly correct, but somewhat misleading in my opinion. A range of 1.5 to 4.0 would capture 8 of the 11 estimates, and be more clearly "most". [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Revised as suggested, thanks.
26356	32	34	32	34	References needed on detection. [Jochem Marotzke, Germany]	References added.
49412	32	34	32	37	These two sentences appear to contradict one another. The first statement, that climate change signal was detected, is then followed by one beginning "nonetheless", implying that this is despite the detection of the signal, whereas it may have been motivated by that signal. Or maybe I just don't understand what is intended here? [Sonya Legg, United States of America]	Sentence revised. Thanks.
53132	32	35	32	35	A referene after "1990s" could be useful. [Jan Fuglestvedt, Norway]	Reference added.
26358	32	35	32	35	Which juxtaposition is expressed by "nonetheles"? [Jochem Marotzke, Germany]	Sentence revised. Thanks.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
30430	32	42	33	17	Another interesting piece of historical information in this broader context could be the following report of 1978: Williams J (1978). Carbon Dioxide, Climate and Society: Proceedings of an IIASA Workshop, February 21-24, 1978. Oxford: Pergamon Press. ISBN 9781483159355 http://pure.iiasa.ac.at/id/eprint/821/1/XB-78-502.pdf [Joeri Rogelj, Austria]	Reference added.
6267	32	45	32	45	Energy is one of the main climate change drivers. Energy balance and energy consumption pattern is also needed to be considered in all modeling practices, in local, national and global levels (Jafari, M. and Smith, P., (2018). Climate Change as a Driving Force on Urban Energy Consumption Patterns. In Encyclopedia of Information Science and Technology (4th ed., pp. 7815-7830). IGI Global. https://doi.org/10.4018/978-1-5225-2255-3.ch680) [Mostafa Jafari, Iran]	Energy consumption is taken into account in IPCC scenarios (section 1.6 of this chapter), and assessed in WG2 and WG3.
10058	33	10	33	11	“As negotiations toward the UN Framework Convention on Climate Change (FCCC) proceeded in the latter half of the 1980s, ..” Actually, negotiations proceeded from 1991 .. The idea to develop such a treaty was raised in 1987 in the Brundtland report (WCED, 1987: Our common future) and in the 1988 UNGA resolution on the protection of the global climate, however, the negotiations toward the UNFCCC were launched only after another UNGA resolution in 1990. (Personal remark: These “details” were important that time also for myself, as I was the national negotiator from early 1991 ..) [Tibor Farago, Hungary]	Changed the word "negotiations" to "discussions," since that was the intent.
50722	33	14	33	14	The equilibrium climate sensitivity (ECS) is mentioned in several figures and tables of the Chapter 1 (Cross-Chapter Box 1.1, Table 1, Figure 1.3, etc.), but it is only very shortly defined in the caption of the Table 1.1. For the sake of understanding of this concept (ECS) along this chapter (Ch.1), I suggest to include a short but compresive definition of it (and/or a brief explanation or discussion) in the main text. It might be placed previously to Figure 1.3 (page 27). A similar suggestion can be done regarding the transient climate response (TCR) concept. [Hernan Edgardo Sala, Argentina]	Section 1.3 has been heavily revised and reorganized in the framework of "lines of evidence" rather than chronological periods. The historical elements have been reduced and more AR5 conclusions added. ECS and TCR are now defined in the body text, but there is not space in Chapter 1 for a more extensive discussion.
53134	33	14	33	17	This comes a bit abruptly. Even if ECS has been mentioned before, I wonder if a brief explantion could be useful. (Sorry if I missed something here) [Jan Fuglestvedt, Norway]	Section 1.3 has been heavily revised and reorganized in the framework of "lines of evidence" rather than chronological periods. The historical elements have been reduced and more AR5 conclusions added. ECS and TCR are now defined in the body text, but there is not space in Chapter 1 for a more extensive discussion.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
26360	33	14	33	33	This part of the historical account deserves more depth than is given. For example, the nearly unchanging ECS likely range might be interpreted such that no progress has been made at all -- but there has been. And AR6 Ch7 states in its FOD on p. 89 lines 36-37 that "The direct use of the raw ECS estimated from models is shifting from being the main source of information in early reports to instead playing a more supportive role in the present assessment", implying a changing role of the AR6 GCM entry in Table 1.1. [Jochem Marotzke, Germany]	ECS and TCR are now defined in the body text, but there is not space in Chapter 1 for a more extensive discussion. The second half of this comment is addressed as follows: "The more recent assessments emphasize additional ways of estimating climate responses, including transient response and paleoclimate reconstructions of ECS (see Chapter 7)." In the table of ECS and TCR estimates, we also mentioned AR6 Ch 7's shift away from raw ECS estimates from GCMs
38138	33	16	33	17	People expect that the likely range of climate sensitivity becomes narrower in AR6 than that in past reports as science has progressed. [Hiroaki Kondo, Japan]	The assessment will determine the range, and at the FOD stage this assessment had not been completed.
31580	33	22	33	22	Maybe use "best estimate" rather than "best guess" ? "Guess" suggests a somewhat arbitrary process. And "best estimate" is consistent with the guidance in the Box titled "Treatment of uncertainty and calibrated uncertainty language used in IPCC reports" in this Chapter. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Thanks for the suggestion. We revised to read "estimated range" and "best estimate".
53136	33	22	33	22	I think you need to also explain TCR before listing this in table 1.1. As far as I can see, this is the first mention. [Jan Fuglestvedt, Norway]	ECS and TCR are now defined in the body text.
16124	33	22	33	32	Similar to that before: the Table caption is too long, 11 lines of text. [Branko Grisogono, Croatia]	We have moved the definitions of ECS and TCR into the body text, reducing the length of the caption. In past reports, many IPCC figures have had extremely long captions since they are often re-used outside the IPCC context.
30432	33	22	34	1	An earlier overview study of 1978 is available in: Williams J (1978). Carbon Dioxide, Climate and Society: Proceedings of an IIASA Workshop, February 21-24, 1978. Oxford: Pergamon Press. ISBN 9781483159355 http://pure.iiasa.ac.at/id/eprint/821/1/XB-78-502.pdf These on page 144-145 of this report, an overview of more than 10 studies is provided in "Table 2" and a consolidated range of 1.5-3.0K is given for climate sensitivity (there defined as a the temperature increase from doubling atmospheric CO2 concentrations from 300 to 600ppm). The report states explicitly: "Summarizing Table 2, it appears that present models estimate a surface temperature increase of 1.5 to 3 K with large amplifications near polar regions for a doubling of the CO2 concentration from 300 to 600 ppm." [Joeri Rogelj, Austria]	Reference added. Thanks for this comment.
15214	33	22	34	2	Could this Table become a graph with lines spanning intervals, set on the same axis reference? [Claudia Tebaldi, United States of America]	A figure in section 1.3.6 now presents some of these studies, along with more recent ones, in the format suggested here. We think they are complementary.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
26362	33	24	33	24	AR5 glossary does not say "modeled" climate in definition of ECS. [Jochem Marotzke, Germany]	The definitions of ECS and TCR were adjusted to be consistent with Chapter 7 of AR6. Note that the AR6 definitions use "near-surface air temperature, " while AR5 and previous reports used "surface air temperature."
26424	33	25	33	26	AR5 glossary of TCR refers to 20-year period centred on the time of CO2 doubling. [Jochem Marotzke, Germany]	The definitions of ECS and TCR were adjusted to be consistent with Chapter 7 of AR6. Note that the AR6 definitions use "near-surface air temperature, " while AR5 and previous reports used "surface air temperature."
31582	33	25	33	26	Definition of TCR should be consistent with that in Chapter 7 (and with previous table in this Chapter). Same with definition of ECS, which should include the words "global mean near-surface air temperature". [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	The definitions of ECS and TCR were adjusted to be consistent with Chapter 7 of AR6. Note that the AR6 definitions use "near-surface air temperature, " while AR5 and previous reports used "surface air temperature."
55080	33	29	33	30	The view that TCR represents a "more realistic measure" of near-term response has been challenged by Grose et al. (GRL, 2018) [Trude Storelvmo, Norway]	Revised to read: "Transient response was long seen as a more realistic measure of the actual climate system's near-term response to gradually increasing CO2, but this view has recently been questioned (Grose et al., 2018 doi: 10.1002/2017gl075742). 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 climate sensitivity has changed very little since 1979. The more recent assessments, including this one, emphasize additional ways of estimating climate responses, including transient response to emissions (TCRE) and paleoclimate reconstructions of ECS (see Box 7.1 of Chapter 7). The quality of past projections is discussed in Section 1.3.6."

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
26364	33	31	33	32	This sentence glosses over a major uncertainty. Whether transient estimates of ECS are the same as the true ECS is highly nontrivial and is closely related to time- and state-dependence of feedbacks. Please ensure consistency with Ch7, [Jochem Marotzke, Germany]	Revised to read: "Transient response was long seen as a more realistic measure of the actual climate system's near-term response to gradually increasing CO2, but this view has recently been questioned (Grose et al., 2018 doi: 10.1002/2017gl075742). 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 climate sensitivity has changed very little since 1979. The more recent assessments, including this one, emphasize additional ways of estimating climate responses, including transient response to emissions (TCRE) and paleoclimate reconstructions of ECS (see Box 7.1 of Chapter 7). The quality of past projections is discussed in Section 1.3.6."
14978	33	33	33	33	I don't think the use of the term "best guess" is the most appropriate given past criticisms of scientists acting "inappropriately" with data (see Climategate). Would something less informal be better? "Highest probability" or "Most likely" (or something else?) [Erin McClymont, United Kingdom (of Great Britain and Northern Ireland)]	We have changed it to 'best estimate' to avoid confusion with IPCC uncertainty language, which was not used in reports prior to 1995.
52470	33	33	33	33	"Best guess ECS" might be better described as "Central estimate ECS" [John Brian Robin Matthews, France]	We have changed it to 'best estimate' to avoid confusion with IPCC uncertainty language, which was not used in reports prior to 1995.
38136	33	33	33	33	Why Estimated range of TCR will not be shown in AR6? [Hiroaki Kondo, Japan]	Accepted. TCR range is now included in Table 1.1.
27536	33	33			Definitely interesting table but it needs to be motivated why climate sensitivity is so crucial [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	ECS etc. have been defined and explained more fully, and TCR and other measures also described and compared.
40896	33	49	33	50	This definition of adaptation limits from AR5 was confined to physical or socio-economic barriers that impede taking adaptive actions. This misses the psychological limitations of addressing unprecedented conditions where significant cognitive effort is needed to imagine both climate related problems and their adaptive solutions. This failure of imagination can limit even beginning adaptation, so that adaptation action are not undertaken in countries such as Australia and Canada, despite access to resources and technology. The importance of psychological factors limiting adaptation is supported by reference to Evans et al., 2016 on p34 and these two additonal references: Coulter, L. (2018). "The Limits of Imagination," in Limits to Climate Change Adaptation, eds. W. Leal Filho & J. Nalau. (Cham: Springer), 211-226. Coulter, L., Serrao-Neumann, S., and Coiacetto, E. (2019). Climate Change Adaptation Narratives: Linking climate knowledge and future thinking. Futures 111, 57-70. [Liese Coulter, Canada]	The point is well taken, but we cannot determine what this comment refers to. P 33 lines 49-50 is the middle of Table 1.1, which is unrelated to the comment. Evans et al. is referenced, but on p. 98, not p. 34. The phrase "adaptation limits" only appears once, on p. 23 line 43 of the FOD, in the context of the Reasons for Concern Framework. This discussion has been shortened and moved to Section 1.4.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
52474	34	5	34	5	This section covers more than the IPCC era [John Brian Robin Matthews, France]	Section 1.3 has been heavily revised and reorganized in the framework of "lines of evidence" rather than chronological periods. The historical elements have been reduced and more AR5 conclusions added.
43716	34	5	37	25	I think this section can be shortened as it reads more like a review than an assessment. Or even removed because the key points regarding scientific findings in IPCC reports is covered in section 1.3.4. To me section 1.3.4 appears more relevant than a historical review of the scientific process [Vaishali Naik, United States of America]	Section 1.3 has been heavily revised and reorganized in the framework of "lines of evidence" rather than chronological periods. The historical elements have been reduced and more AR5 conclusions added.
44896	34	5			One important development during the IPCC era is the advancement of informatics and a trend toward data sharing, either as required by funders or as motivated by shifting scientific culture. I suggest mentioning open data and the cyber infrastructure that underlies them as a major development that has led to advancements across climate sciences (as it has all of science and engineering). [Darrell Kaufman, United States of America]	We incorporated this point into our new cross-chapter box on "values, science, and the IPCC assessment process.
53138	34	10	34	10	I don't think the word "consider" is enough here. You may replace this or add "assess". [Jan Fuglestvedt, Norway]	Changed to "evaluate"
53140	34	13	34	13	More references could be useful here, since this is a growing topic. [Jan Fuglestvedt, Norway]	Added two additional references.
6587	34	15	34	15	insert after unprecedented "rapid" [Tim Christiane Thys, Belgium]	Since "unprecedented" means "has never occurred before," adding "rapid" provides no new information.
51832	34	19	34	19	GHCN is a dataset maintained by NOAA NCEI and it is inappropriate to include in this list. Strongly suggest you remove it from this list which otherwise is of organisations and coordination mechanisms. [Peter Thorne, Ireland]	Removed.
51836	34	23	34	28	This is not an up to date assessment of surface temperatures and excludes important innovations such as use of reanalyses to perform estimates and the analysis of Cowtn and Way as well as the new analyses by Chinese research groups for example. It feels like it falls between two stools of general and specific. Also, many of the papers will be superceded by time of SOD so some coordination with chapter 2 is required on this segment. [Peter Thorne, Ireland]	This section has been heavily revised. The context here is historical, up to and including AR5, and space is very limited. We added references to Cowtan and Way, and JMA. We do not have space to include every relevant reference, and the goal of this "how we got here" section is not to bring everything up to the most recent developments. More recent developments are covered in later sections.
6589	34	24	34	24	replace "groups" by "research institutes" [Tim Christiane Thys, Belgium]	Replaced with "research organizations."
37308	34	24			It is a bit misleading to refer to NASA and NOAA as "independent groups" developing land/ocean datasets. This is because the NASA group uses a NOAA SST analysis and uses a NOAA database of surface air temperature over land. NASA is dependent on NOAA for its ability to produce its dataset. None of these datasets are truly independent - they do not use completely different sets of observations - but some datasets are more independent than others. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	The word "independent" was dropped.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
6591	34	25	34	25	insert after adjustment "for non-climatic changes" [Tim Christiane Thys, Belgium]	Phrase no longer appears. Section heavily revised.
37310	34	26	34	28	In a similar vein to the preceding comment, whilst the land dataset referred to here is an independent production, it is used with a Hadley Centre SST dataset to form the Berkeley Earth merged land-sea dataset. So this GMST dataset is not independent of HadCRUT4. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	The word "independent" was dropped.
6593	34	26	34	28	By which institute this new surface data set was develloped? If you name the previous 3, it is consistent to name this as well. [Tim Christiane Thys, Belgium]	Added Berkeley Earth citation.
51834	34	30	34	38	This paragraph needs additional work in several respects. Firstly, for radiosondes it is not appropriate to call out just the Haimberger analysis and not e.g. the work of Steve Sherwood or the work on thermal winds. Secondly, not all satellite data use radiosondes for cal/val / dataset construction. Third, the paragraph currently does not mention GNSS-RO which is an absolutely calibrated technique. Given that the section has already mentioned GCOS it feels odd, also, not to therefore mention GRUAN? [Peter Thorne, Ireland]	Thanks - useful. Section has been reduced in length. Reference to GCOS was dropped, so GRUAN not mentioned either. This now reads: "New methods for spatial and temporal homogenization of radiosonde records were introduced in the 2000s (Sherwood et al., 2008; Sherwood et al., 2015; Haimberger et al., 2012). Radio occultation using signals from Global Navigation System satellites emerged as an independent, absolutely calibrated source of high-resolution atmospheric measurements at altitude (Kuo et al., 2005; Foelsche et al., 2008)."
6595	34	36	34	37	rephrase - I suggest: "However, despite repeated adjustments, differences in the temperature trends from surface, radiosonde, and satellite observations still are present." [Tim Christiane Thys, Belgium]	Sentence now reads: "However, despite repeated adjustments, significant differences remain in the temperature trends from surface, radiosonde, and satellite observations; between the results from three research groups (UAH, RSS, and NOAA) that analyse satellite data; and between modelled and satellite-derived tropospheric warming trends (Santer et al., 2017; Thorne et al., 2011). These differences are the subject of ongoing research. "
7728	34	36	34	38	Where are citations to the well-known, long-time satellite work by Christy and Spencer of the Univ. of Alabama? [Forrest Mims, United States of America]	The Christy/Spencer group is known as UAH (Univ Alabama Huntsville), and is mentioned in this paragraph. Length considerations preclude adding more references. The cited references provide discussions of UAH, RSS, and NOAA satellite datasets.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
7774	34	36	38		Some differences are so significant that the sentence should read: "…diffeences, some significvant, remain in the temperature trends…." [Forrest Mims, United States of America]	Now reads: "However, despite repeated adjustments, significant differences remain in the temperature trends from surface, radiosonde, and satellite observations; between the results from three research groups (UAH, RSS, and NOAA) that analyse satellite data; and between modelled and satellite-derived tropospheric warming trends (Santer et al., 2017; Thorne et al., 2011). These differences are the subject of ongoing research."
51838	34	40	34	51	Again, this feels like a very partial lift of information. There is no allusion to the work on HadSST or ERSST products despite the fact that these are the marine basis for all existing global mean surface air temperature products. That buoys are biased relative to ships also needs to come out more clearly. [Peter Thorne, Ireland]	Section 1.3 has been heavily revised and reorganized in the framework of "lines of evidence" rather than chronological periods. The historical elements have been reduced and more AR5 conclusions added. It is impossible to discuss everything in the detail it deserves.
6678	34	40	35	13	Please can we cross-reference ocean and cryosphere observational progress to chapter 9 to ensure consistency? [Helene Hewitt, United Kingdom (of Great Britain and Northern Ireland)]	Thanks. This may need further work after the SOD. Much of the cross-referencing to Ch 9 appears later in the chapter, in Sections 1.4 and 1.5. Section 1.3 has been heavily revised and reorganized in the framework of "lines of evidence" rather than chronological periods. The historical elements have been reduced and more AR5 conclusions added.
6597	34	41	34	44	rephrase - I suggest: "In the2000s, bias introduced by differences in measurement methods (from buckets to engine intake thermometers), was adjusted, resulting in a major improvement of SST data from the period around World War II. (Kent et al., 2007)." [Tim Christiane Thys, Belgium]	Now reads: "In the 2000s, adjustments for bias introduced by different measurement methods (buckets vs. engine intake thermometers) resulted in a major improvement of SST data, especially for the 1940s (Thompson et al. 2008). "
52472	34	44	34	44	The Thompson et al. (2008) paper (10.1038/nature06982) would be a better citation for this than Kent et al., 2007 [John Brian Robin Matthews, France]	Changed the reference as suggested.
6599	34	53	34	54	Rephrase - I suggest: As from 1992, global sea level measurements from TOPEX/POSEIDON satellite altimetry were added to the sparse data from coastal tide gauges (Fu et al., 1994). [Tim Christiane Thys, Belgium]	Now reads: "Satellite radar altimetry, introduced operationally in the 1990s (Katsaros and Brown, 1991; Fu et al., 1994), complements the tide gauge record with absolute measurements of global mean sea level (GMSL) at much higher spatial resolutions."
6601	34	55	34	55	clarify "subsequent missions" or give reference [Tim Christiane Thys, Belgium]	Sentence no longer appears.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
7588	35	2	35	16	Recently, World Meteorological Organization established the Global Cryospher Watch (GCW), and its observation system, Cryonet, to monitor the various components of the cryodphere at global scale : https://globalcryospherewatch.org/ [Christophe Genthon, France]	Not applicable. Section 1.3 has been heavily revised and reorganized in the framework of "lines of evidence" rather than chronological periods. The historical elements have been reduced and more AR5 conclusions added.
8492	35	2	35	17	Cross-check with ch 9 [Robert Kopp, United States of America]	Noted.
36686	35	2	35	17	Should mention GRACE satellite contributions [William Lorenz, Australia]	Taken into account. GRACE and is successor GRACE-FO are mentioned later in the chapter in Section 1.5.1.1.
17886	35	2	35	17	Notoriously difficult mass balance estimates for glaciers is a missing comment. For instance, Monin-Obukhov slimilarity theory often does not work for inclined surfaces. Prandtl model for katabatic flows may work better, but that is not included in most of models. [Branko Grisogono, Croatia]	Rejected. There are already enough references for this section.
6603	35	3	35	3	"sign" means "signal"? [Tim Christiane Thys, Belgium]	Noted. It means "sign" (pos/neg).
8494	35	23	35	48	If sea-level science is part of climate science, then the paleo sea level record should be mentioned here. Cross check with ch 9 [Robert Kopp, United States of America]	Accepted. Now included in this section, if briefly, as well as in Section 1.5.1.1.
51764	35	23	35	48	There has also been a big push on generate mechanistic models to quantify processes that control proxies (e.g. Evans et al. 2013 QSR: https://doi.org/10.1016/j.quascirev.2013.05.024), and combining proxy system models with data assimilation work (e.g. Dee et al. 2016, doi:10.1002/2016MS000677; Steiger et al. 2015, doi: 10.1002/2016JD026011 [Anson Cheung, United States of America]	Taken into account; while such tools are extremely useful in furthering the tools of paleoclimate, they are beyond the scope of the "Lines of evidence" section here, which focuses on "How we got here".
44898	35	23	35	48	Given the tight space limitations, it's difficult to know which recent paleoclimate science advances to highlight. The current selection is good, but it would be better if it related more directly to information featured most prominently in the report. This section could be updated once we see which key datasets end up in the PaleoData Annex II. Maybe some of the new geochemical/biomarker techniques, or new technologies in ice-core research, will be considered in the report – they are major advances in the field. I'm not sure that the isotope enabled models or data assimilation will get much attention outside CH1. [Darrell Kaufman, United States of America]	Taken into account. As the report progresses, there will be further opportunities to achieve better coordination with those key elements from other chapters.
33100	35	26	35	27	I would add ocean chemistry to this list. It might also be good to mention the records related to precipitation (in particular the speleothem records on this time scale). I would also suggest that all of these records have lead to an increased undertanding of the causes glacial-interglacial CO2 , and a better understanding of the sensitivity of tropical precipitatioon 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) [Jean Lynch-Stieglitz, United States of America]	This comment has been considered during the preparation of the FGD. (In FGD) Taken into account. More treatment of ocean chemistry is included in Section 1.5.1 - Oceans - as well as in the respective Paleoclimate section. Speleothem constraints on regional to global-scale hydrology are now included in 1.5.1.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
14980	35	28	35	29	Paleoclimate archives also provide valuable but often qualitative information on other processes including changes to rainfall, dust, productivity and ecological change (give references). I note this here because the text is very focussed on temperature, but translating temperature into other (regional/local) impacts is part of the challenge for IPCC - but the Paleoclimate record can be informative for this (e.g. Fischer et al. 2018 Nature Geoscience). [Erin McClymont, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account; given the space constraints, this material was not included in this section. It should be highlighted in individual chapters and in the Technical Annex.
44900	35	29	35	32	It really wasn't the improvement in dating methods that led to progress in development of seasonally-annually resolved reconstruction. The studies cited here are primarily based on layer-counted archives for which dating wasn't a major issue previously. Four of the five studies are PAGES (Note: actually, Emile-Geay et al., 2017, should be cited as "PAGES 2k Consortium, 2017"); the advancement that underlies these was the trend toward data sharing that enabled the development of global data syntheses. [Darrell Kaufman, United States of America]	Accepted.
46780	35	31	35	32	I would also recommend to cite: Cook, E.R., Seager, R., Kushnir, Y., Briffa, K.R., Büntgen, U., Frank, D., Krusic, P.J., Tegel, W., van der Schrier, G., Andreu-Hayles, L., Baillie, M., Baittinger, C., Bleicher, N., Bonde, N., Brown, D., Carrer, M., Cooper, R., Čufar, K., Dittmar, C., Esper, J., Griggs, C., Gunnarson, B., Günther, B., Gutierrez, E., Haneca, K., Helama, S., Herzig, F., Heussner, K.-U., Hofmann, J., Janda, P., Kontic, R., Köse, N., Kyncl, T., Levanič, T., Linderholm, H., Manning, S., Melvin, T.M., Miles, D., Neuwirth, B., Nicolussi, K., Nola, P., Panayotov, M., Popa, I., Rothe, A., Seftigen, K., Seim, A., Svarva, H., Svoboda, M., Thun, T., Timonen, M., Touchan, R., Trotsiuk, V., Trouet, V., Walder, F., Ważny, T., Wilson, R., Zang, C. 2015. Old World megadroughts and pluvials during the Common Era. Sci. Adv. 1, e1500561. https://doi.org/10.1126/sciadv.1500561. Esper, J., Krusic, P.J., Ljungqvist, F.C., Luterbacher, J., Carrer, M., Cook, E., Davi, N.K., Hartl-Meier, C., Kirdyanov, A., Konter, O., Myglan, V., Timonen, M., Treydte, K., Trouet, V., Villalba, R., Yang, B., Büntgen, U., 2016. Ranking of tree-ring based temperature reconstructions of the past millennium. Quat. Sci. Rev. 145, 134–151. https://doi.org/10.1016/j.quascirev.2016.05.009. [Charpentier Ljungqvist Fredrik, Sweden]	Accepted; such references are included in the Section 1.5.1.1.
9832	35	38	35	40	Add four 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. 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 [Sebastian Luening, Portugal]	Taken into account; adding regional papers to this section is beyond the scope of the section, given length restrictions.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
9834	35	42	35	46	Claim: “Paleoclimate modeling advanced significantly during this period“. This is a bit of an exaggeration. The models still struggle greatly with the hindcast of pre-industrial regional and global climate of the past 2000 and 10,000 years. In the interest of transparency, these remaining significant deficiencies need to be mentioned. Much of the chapter reads a bit like an advertisement text, focusing mostly on the positive aspects, neglecting many of the remaining issues. [Sebastian Luening, Portugal]	Taken into account; the statement reflects a significant advancement in the number and types of paleoclimate modelling studies, the accuracy of the models via improved physics, and the incorporation of water isotopologues and land carbon modules, both of which enable more rigorous comparison to paleoclimate datasets.
31584	35	42	35	48	This is a paragraph on paleoclimate-specific modelling advances. In addition to the those listed, it could be added that knowledge of boundary conditions has improved (in particular in the pre-Quaternary). Also, PMIP has extended the number of time periods it addresses (originally it was just the mid-Holocene and LGM). [it might also be worth noting that paleoclimate modelling has also advanced because the models themselves have improved as part of general model development]. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	This comment has been considered during the preparation of the FGD. (In FGD) Rejected. Inclusion of advances in modelling per se is beyond the scope of the current section focused on observations. There is mention of modelling advances in the FGD section 1.5.2, for paleo-reanalyses, and 1.5.3, for PMIP, albeit only in passing.
44902	35	44	35	45	I don’t think that data assimilation is an “improvement on paleoclimate modelling.” It’s a blending of paleo observations and model physics. Also, this approach in general, and Hakim et al.’s paper in particular, seems to have gotten a lot of attention in CH1. I’m excited about paleo DA, but believe that we are in the early “honeymoon” phase prior the full appreciation of its weakness. For example, the new PAGES 2k multi-method GMST reconstruction (due to be published soon) shows that the DA-based temperature reconstruction is untenably flat compared with the other six more established methods. This is because DA assigns values of zero change where it extrapolates far beyond data. I suggest taking a more conservative stance when considering developments that are based on only a few studies. [Darrell Kaufman, United States of America]	This section has been heavily revised and shortened. The paragraph on paleo modelling that discussed DA has been removed.
50760	35	45	35	45	The acronym AOGCMs has not been previously defined in this chapter, I suggest to add the complete name. [Hernan Edgardo Sala, Argentina]	Accepted.
28470	35	50	36	4	Indigenous Knowledge and Traditional Knowledge should be separated and capitalised. At least that was the lesson from SROCC. [David Schoeman, Australia]	Editorial. The text will undergo professional copy-editing before publication.
44076	36	3	36	4	Indigenous knowledge incorporated with scientific knowledge for adaptation in Hawai'i: Delevaux et al. 2018 (https://www.mdpi.com/2071-1050/10/9/3147), Morishige et al. 2018 (https://www.mdpi.com/2071-1050/10/10/3368), Kurashima et al. 2018 (https://www.mdpi.com/2071-1050/10/11/3975), Gon et al. 2018 (https://www.mdpi.com/2071-1050/10/10/3420), Winter et al. 2018 (https://www.mdpi.com/2071-1050/10/10/3554), etc. [Sara Kahanamoku, United States of America]	These references are more appropriate for WG2, which addresses adaptation. Section 1.3 has been heavily revised and reorganized in the framework of "lines of evidence" rather than chronological periods. The historical elements have been reduced and more AR5 conclusions added.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
9836	36	6	36	7	Claim: “Changes in solar irradiance, a natural climate forcing, 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. [Sebastian Luening, Portugal]	The references cited in this comment document solar activity along other metrics than TSI, and the Solanki et al. paper states that "we stress that solar variability is unlikely to be the prime cause of the strong warming during the last three decades" (which at time of publication was 1975-2004). We lack space in Chapter 1 to discuss all aspects of solar activity and its influence on climate. Chapter 2 contains a 2-page section on solar influences on climate over the last 9000 years - please direct further comment to Ch 2. Please provide peer-reviewed, published references for the non-linear links you mention.
53142	36	6	36	7	Seems strange to have only one ref for this statement. I also suggest adding a ref to IPCC AR5 even if this is a bit old now. [Jan Fuglestvedt, Norway]	Section 1.3 has been heavily revised and reorganized in the framework of "lines of evidence" rather than chronological periods. The historical elements have been reduced and more AR5 conclusions added.
42844	36	7	36	7	and elsewhere: define radiative forcing and "drivers" of climate change at first use. I think drivers are being used as a more general descrption of why aspects of the climate vary, and can include internal forcing (e.g response in locales in temperature or moisture arising from ENSO activity); with external radiative forcing being defined as it was in AR5; maybe worth a box? [Michael Evans, United States of America]	Section 1.3 has been heavily revised and reorganized in the framework of "lines of evidence" rather than chronological periods. The historical elements have been reduced and more AR5 conclusions added.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
28762	36	7	36	28	This drivers section is unblalanced (shorter) and not very accurate in comparison to the rest. It misses the fact that early IPCC reports are based around radiative forcing and these reports cacluated forcing accurately, as well as GWP metrics in tandem WMO reports on ozone depletion. More and more forcings were calulated over this period, especially by the Hansen, Ramaswamy and Shine Groups.. Since 1990s observing systems have grown massivly for the greenhouse gases, and these are not mentioned, whereas temperture observing systems are discussed a lot. The huge growth in understanding aerosol forcing and all the work on this isn't mentioned. There was a clear evolution in understanding of radiative forcing, introducing stratospheric adjustment, effiacy with Hansen et al. (1999,2005)/Shine (2003) and effective radaitive forcing in AR5. This section is wrong about AR5, it did both concentration and emission based radiative forcings, and AR6 will do the same. Both are relevant. More importantly AR5 introduced effective radiative forcing - a defintion which is used in AR6, and was an evolution form AR4. Rather than expand this section, I would be inclined to shorten the others though. Dust probably has more effect on ice melting than soot...and I'm not sure I would highlight this here anyway. If you are being wholisitc for IPCC, metrics such as global warming potential connect to Paris agreement and would warrent mention. The carbon cycle could be discussed. Atmospheric chemistry is almost entiretly missed. Early climate feedback analysis such as Cess (1990) seems important to cover somewhere? [Piers Piers Forster, United Kingdom (of Great Britain and Northern Ireland)]	Thanks for this important comment. Section 1.3 has been heavily revised and reorganized in the framework of "lines of evidence" rather than chronological periods. The historical elements have been reduced and more AR5 conclusions added. The drivers section has been considerably expanded, with more discussion of RF and aerosols and more references, and GHG monitoring has been added to the observations section. GWP is also discussed. The sentence about emission-based forcing has been revised for clarity. However, it is impossible to discuss all relevant aspects of climate science in the few pages allotted to this section.
6605	36	8	36	8	write FAR in full [Tim Christiane Thys, Belgium]	FAR (First Assessment Report) was defined in section 1.1 of this Chapter
45628	36	12			Could also mention that methane sinks are becoming a lttle better understood, though possible changes to methane sinks are still poorly quantified. [Euan Nisbet, United Kingdom (of Great Britain and Northern Ireland)]	Section 1.3 has been heavily revised and reorganized in the framework of "lines of evidence" rather than chronological periods. The historical elements have been reduced and more AR5 conclusions added.
45630	36	13			Could mention up to date methane reference: Nisbet, E. G., M. R. Manning, E. J. Dlugokencky, R. E. Fisher, D. Lowry, S. E. Michel, C. Lund Myhre et al. "Very strong atmospheric methane growth in the 4 years 2014–2017: Implications for the Paris Agreement." Global Biogeochemical Cycles 33, no. 3 (2019): 318-342 [Euan Nisbet, United Kingdom (of Great Britain and Northern Ireland)]	Thanks for the suggestion, we included it in the Second Order Draft.
8496	36	14	36	14	Cross-check placeholder for ocean circulation with ch 9 [Robert Kopp, United States of America]	Sentence no longer appears.
53144	36	16	36	17	AR5 WGI Ch8 did assess RF in terms of both emission changes and concentration changes. But the former perspective was introduced as a new approach in AR5. [Jan Fuglestvedt, Norway]	Thanks, this was clarified.
43718	36	16	36	28	A thorough historical review of the concept of radiative forcing coming out in the AMS centennial monograph can be cited here with key points from the paper to shorten the text. [Vaishali Naik, United States of America]	Excellent reference - thanks. We were unable to integrate the reference into the SOD, but we will do so for the next draft.
31586	36	20	36	21	"Overall, concentration-based and emissions-based forcings are identical, but the latter does a better job of accounting for anthropogenic effects". This sounds a little vague…why does it do a better job and how? Maybe liaise with Chapter 7 ? [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	We removed this paragraph.
43720	36	21	36	23	N2O is not a short-lived gas. Sentence needs to be revised if included. [Vaishali Naik, United States of America]	This sentence no longer appears.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
8004	36	22	36	23	It's worth noting that CO and NOx are "indirect" GHGs whose global warming impact stems from their role in tropospheric ozone production. That's a subtle difference versus proper "short-lived GHGs" like methane that actually trap heat. [Olaf Morgenstern, New Zealand]	This sentence no longer appears.
53146	36	24	36	24	You may mention the effects of aersols on clouds, since this is an important ERF mechanism (if you have space) [Jan Fuglestvedt, Norway]	Aerosols' role in cloud nucleation is now briefly discussed.
53148	36	30	36	39	You could (if space) give a couple of the main conclusions from previous assessments) [Jan Fuglestvedt, Norway]	In reorganizing the section we have added many more AR5 conclusions and some from previous assessments.
9838	36	32	36	34	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. [Sebastian Luening, Portugal]	20th c attribution has been achieved to an "extremely likely" level of certainty across numerous dimensions of the climate system, attributing approximately all of the observed warming since 1750 (± 20 percent) to human activities. Replication of the MCA by models might strengthen that conclusion, but is not necessary to achieve it. Please see Chapter 3 of this assessment.
9840	36	32	36	39	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. [Sebastian Luening, Portugal]	The tropospheric tropical hotspot was never alleged to be a fingerprint of anthropogenic warming — just a sign of global warming for any reason. Tropical stratospheric cooling is the fingerprint, because it would be expected if CO2 were the cause but not if solar heating were the cause. This has been observed, but has slowed in recent years, possibly due to recovery of the ozone layer.
26366	36	41	36	41	"dramatically" is an exaggeration and, at a minimum, disputed. Some argue that too little of the increased compute power has gone into resolution and too much into complexity (e.g., Jakob, Nature Climate Change, 2014). Toning the statement down would be appropriate. [Jochem Marotzke, Germany]	We toned it down.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
55180	36	41		47	[pt 1 of 4] The first three sentences say, "Although climate models remain imperfect, their spatial resolution has increased dramatically while including ever more physical processes..In the 1990s, coupled 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. By 2000, some major modeling centers had deployed “unified” models for both weather prediction and climate modeling, with the goal of a “seamless” modeling approach that uses the same dynamics, physics, and parameterizations at multiple scales of time and space (WMO, 2015)." What's lacking is an explanation of the motivation for building unified models. So I suggest replacing those three sentences with the following 3 paragraphs: [cont'd] [David Burton, United States of America]	Sentence rewritten as follows, incorporating some of this language (thanks): "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; WMO, 2015). Because weather models make short-term predictions that can be frequently verified, this approach allows major portions of the climate models to be validated as weather models."
55182	36	41		47	[pt 2 of 4] "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. [cont'd] [David Burton, United States of America]	Sentence rewritten as follows, incorporating some of this language (thanks): "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; WMO, 2015). Because weather models make short-term predictions that can be frequently verified, this approach allows major portions of the climate models to be validated as weather models."
55184	36	41		47	[pt 3 of 4] 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. [cont'd] [David Burton, United States of America]	Sentence rewritten as follows, incorporating some of this language (thanks): "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; WMO, 2015). Because weather models make short-term predictions that can be frequently verified, this approach allows major portions of the climate models to be validated as weather models."

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
55186	36	41		47	[pt 4 of 4] 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. To partially address this problem, by 2000, some major modeling centers had deployed 'unified' models for both weather prediction and climate modeling, with the goal of a 'seamless' modeling approach that uses the same dynamics, physics, and parameterizations at multiple scales of time and space (WMO, 2015), so that major portions of the climate models can be validated as weather models." ### [David Burton, United States of America]	Sentence rewritten as follows, incorporating some of this language (thanks): "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; WMO, 2015). Because weather models make short-term predictions that can be frequently verified, this approach allows major portions of the climate models to be validated as weather models."
10060	36	42	36	42	ever more physical processes. The modelling started with very simple global climate models in 1960s (Manabe and Wetherald, 1967; Budyko, 1969, Sellers, 1969). In the 1990s already coupled AOGCMs were state of the art; .. [Tibor Farago, Hungary]	Section 1.3 has been heavily revised and reorganized in the framework of "lines of evidence" rather than chronological periods. The historical elements have been reduced and more AR5 conclusions added.
43722	36	44	36	47	I am not sure if seamless modeling was implemented "by 2000". Could you please provide an explicit example? [Vaishali Naik, United States of America]	The UK Met Office started developing its unified model around 1990. Cullen 1993, Met. Magazine 122, 81-93. "The Unified Forecast/Climate Model." Reference added.
55082	36	47	36	47	What exactly do you mean by "aerosol indirect feedback" here? Indirect aerosol effects induce an effective radiative forcing, so is not considered a feedback. If you do in fact have some feedback mechanism in mind here you need to be more specific [Trude Storelvmo, Norway]	Section 1.3 has been heavily revised and reorganized in the framework of "lines of evidence" rather than chronological periods. The historical elements have been reduced and more AR5 conclusions added.
15216	36	47	36	51	This sentence is at odds with that in the executive summary claiming success in constraining feedbacks and sensitivity. [Claudia Tebaldi, United States of America]	Exec summary does not claim "success," but rather improvement.
48562	36	48	36	51	I suggest spending more time highlighting recent advances in cliamte science or current gaps that continue to undermine understanding. This is done slightly later in the chapter but could perhaps be brought upfront? It could help articulate to governments and the policy audience, why continued investments in climate science and research are still needed. [Zinta Zommers, United States of America]	Section 1.3 has been heavily revised and reorganized in the framework of "lines of evidence" rather than chronological periods. The historical elements have been reduced and more AR5 conclusions added.
26368	36	50	36	50	Compared to other seasonal-prediction challenges, predicting ENSO is easy. [Jochem Marotzke, Germany]	Section 1.3 has been heavily revised and reorganized in the framework of "lines of evidence" rather than chronological periods. The historical elements have been reduced and more AR5 conclusions added.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
46662	36	50	36	51	Assessment on modes of variability occurs in Section 1.3.3; Section 2.4; Section 3.7; Section 4.4.3, 4.5.3; Section 6.2.2.5.1; Section 7.1.1/2 ; Section 8.3.1.3.2, 8.3.2.2, 8.3.2.4.1, 8.3.2.9.1, 8.4.2.5,8.5.2.2.1, 8.3.2.9.2, 8.4.2.5, 8.3.2.9.3, 8.4.2.5, 8.3.2.9.4, 8.4.2.5, Figure 8.43, 8.5.2.2.1, 8.5.2.2.1; Section 9.2.2.1, 9.2.2.3, Section 9.4.3.2, BOX 9.2, 9.2.3.1, Table 9.1, Section 9.2.1, Cross-Chapter Box 9.1, BOX 9.2, 9.6.2.1.1, 9.6.2.1.2, 9.5.4.7, 9.2.5; Section 10.1.4.2, 10.4.2.2, 10.6.3.3; Section 11.3.1, 11.7.1.1, 11.6.2, 11.1.5,11.4.1, 11.6.1, Table 11.4; Section 12.4.1, 12.4.4.3, 12.5.2.3; Section Atlas.5.2.1.2, Atlas.5.3.1.1, Atlas.5.3.2.1, Atlas.5.5.1.1, Atlas.5.5.2.1, Atlas.5.6.2.1, Atlas.5.6.3.1, Atlas.5.10.2.1, Atlas.5.10.2.2. This topic is addressed in ES of Chapter 2, 3, 4, 7, 11, addressed in box in chapter 9, and broadly addressed in above-mentioned subsections in chapter 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12. [WGI TSU, France]	Modes of variability are no longer discussed in Section 1.3. They are mentioned and cross-referenced to other chapters in Section 1.8.
7980	36	51	36	51	ADD SENTENCE: In addition other not resolved small-scale processes are a source of model bias and uncertainty, like the represenation of stable boundary layers over land and ice during nighttime and wintertime conditions (e.g., Holtslag et al., 2013, see https://journals.ametsoc.org/doi/full/10.1175/BAMS-D-11-00187.1) [Bert Holtslag, Netherlands]	The sentence was included
27538	36	53	37	8	The development of attribution is missing here as is regionalisation and sizes of model ensembles. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	History of attribution is now discussed, though very briefly, and there is now a long cross-chapter box on attribution. (In FGD) History of attribution is now discussed in 1.3.4 and XC Box 1.4. Multi-model ensembles are discussed in 1.3.4, but emphasis is not placed on sizes of ensembles. However, multi-model ensembles are reviewed more extensively in Section 1.5.3. Regionalization is discussed in 1.4.5.2.
15218	37	3	37	8	CMIP6 is going to create interesting challenges for this type of qualitative D&A. Plans to include a similar statement for AR6 should be cognissant of that challenge. [Claudia Tebaldi, United States of America]	Section 1.3 has been heavily revised and reorganized in the framework of "lines of evidence" rather than chronological periods. The historical elements have been reduced and more AR5 conclusions added.
46782	37	7	37	10	Compared to other lines of strong evidence and theoretical understanding of anthropogenic warming, this is not the strongest argument in the light of that most model simulations also are unable to fully simulate the reconstructed amplitude of past warm periods from external forcing. [Charpentier Ljungqvist Fredrik, Sweden]	Section 1.3 has been heavily revised and reorganized in the framework of "lines of evidence" rather than chronological periods. The historical elements have been reduced and more AR5 conclusions added.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
15220	37	10	37	11	The fact that future climate changes would not be precisely predictable is true because of internal variability alone, even if forcings were fixed. [Claudia Tebaldi, United States of America]	This comment has been considered during the preparation of the FGD. (In FGD) Taken into account. Internal variability is discussed extensively in Section 1.4. The sentence to which the reviewer refers does not mention internal variability, but addresses predictability in the context of AR6 emission scenarios: "AR6 emission scenarios are detailed in Section 1.6. While these estimates have remained consistent across a period of over 40 years, future climate change cannot be precisely predicted because greenhouse gas and aerosol emissions, land use, energy use, and other human activities may change in numerous ways."
53150	37	10	37	11	I think you also need to mention uncertainties in the climate response - not only in the drivers [Jan Fuglestvedt, Norway]	This comment has been considered during the preparation of the FGD. (In FGD) Noted. Internal variability is not mentioned in this section on projections, but is addressed at length in section 1.4.2.
15222	37	19	37	22	These statements are unsubstantiated. How do you measure quality and are you sure about increased confidence? Probably true for some limited, specific aspects, but these statements are too sweeping. [Claudia Tebaldi, United States of America]	These sentences no longer appear.
19170	37	27	37	27	this should be Box 1.3, not 1.1, please check throughout Box [Baerbel Hoenisch, United States of America]	Rejected. The numbering is correct. The other boxes are Cross-chapter boxes and therefore have a separate number order. Anyway, the Box on the calibrated uncertainty language was moved to SOD Section 1.2.
32032	37	29	39	21	Sutton (ESD, 2018) discusses how the IPCC uncertainty guidance can be applied to risk assessment. I suggest it would be useful to include explicit consideration of this issue, given the importance of risk framing to the chapter. [Rowan Sutton, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. This is now being discussed as part of SOD sections 1.2.3 and more importantly 1.4.4
45754	37	51	37	51	refer to SROCC Cross-Chapter Box 5 in Chapter 1 for deep uncertainty [Katja Mintenbeck, Germany]	Accepted. Reference added. The SROCC definition of deep uncertainty has been included.
6607	38	2	38	2	replace "certainty" by "uncertainty" [Tim Christiane Thys, Belgium]	Rejected. Text taken from IPCC Guidance on Treatment of Uncertainty in the IPCC AR6. See Mastrandrea et al. 2010, IPCC.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
35152	38	5	38	7	Apologies. This is a substantive comment which I think you will find it almost impossible to implement at this late stage. Perhaps you can use it in future or maybe share the idea between other lead authors. I find the quantification of 'confidence' in almost all the findings listed throughout the draft report to be inadequate. We currently face a crisis of replication in science, which as far as I can see has not really hit climate science yet to the level that it has hit e.g. psychology. We also have (finally) a backlash against the much used, especially in climate science, p-value less than 0.05 scientific paradigm. In 2016, the American Statistical Association published 6 recommendations (https://www.amstat.org/asa/files/pdfs/P-ValueStatement.pdf), one of which is 'A p-value, or statistical significance, does not measure the size of an effect or the importance of a result.'. My belief is that many of the results based on statistical analysis of climate data have made it into this report based on the false idea that 'significant' p-values are important findings. Of course this does not invalidate many of the results in the report, nor does it invalidate the use of the term 'likelihood' throughout the document. I am aware that people have looked at replication in climate science, and mostly reported positive results. My view is that these kind of replicability tests should be included as part of a confidence score. I would strongly advise that the current use of the term 'confidence' in a purely qualitative manor should be changed to include new ideas (some of which are vaguely mentioned in the report) such as the aforementioned replicability and open data/code. My guess is that currently 'high confidence' has been used in places because the p-value for that study was small. I really hope that's not the case. I recommend a slightly more robust confidence score based on the degree to which the findings are replicable. Here's one possible structure: * Low confidence. A single study using only a single source of data	Rejected. While we appreciate these constructive thoughts on the issue, the Guidance on Treatment of Uncertainty in the IPCC AR6 has been decided on. See Mastrandrea et al. 2010, IPCC.
52476	38	8	38	9	Suggest to clarify that "and expert judgement" can either be quantitative studies that do expert elicitation or a expert judgement made the authors. [John Brian Robin Matthews, France]	Taken into account. Text revised: "and expert judgement by the author team or from a formal quantitative survey of expert views, or both."
6609	38	17	38	17	"executive summary": is that the Summary for Policy Makers? [Tim Christiane Thys, Belgium]	Noted. No, it is the Chapter Executive Summary.
45756	38	18	38	18	likelihood if applicable [Katja Mintenbeck, Germany]	Accepted. Text revised accordingly.
27540	38	19	38	20	I don't understand the sentence. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Text has been revised to improve readability.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
43608	38	50	38	51	The evaluation of confidence is optional - authors may simply state the evidence/agreement and leave it at that. Confidence expressions are generally used only if there is enough literature to do that, i.e. confidence implies another level of judgement reached by the authors. This should be brought out more clearly. It would also be helpful to clarify the meaning of "low confidence" statements - i.e. that a low-confidence statement does NOT mean that the opposite statement has high confidence. A lot of people are confused by this. In my understanding, "low confidence" still means this is the best explanation we can give but it's not very credible - but everything else would be even less credible. This is very different to likelihood statements: if statement A is very unlikely, then by definition statement NOT-A is very likely. Whereas if statement A has low-confidence, it does NOT mean that statement NOT-A has high confidence. I think this would be useful to get across since it is critical for issues with deep uncertainty that cannot be assessed probabilistically but only in confidence terms (e.g. large-scale and rapid changes in polar ice sheets). [Andy Reisinger, New Zealand]	Taken into account. Text revised and added: "When confidence in a finding is assessed to be low (high), this does not necessarily mean that confidence in the opposite finding is high (low). "
27542	39	16			why 90%? Allmost all literature I read has 95%. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Decision was taken for the AR6 to report the 90% confidence interval (i.e., 5-95% range) as a standard and unless otherwise indicated.
26370	39	26	39	26	It strikes me as odd that the key findings of previous assessments come after the new approaches have been introduced in 1.2.4. This contributes to my uneasiness about the logical flow in the earlier parts of the chapter. [Jochem Marotzke, Germany]	Taken into account. The chapter structure has been revised. The history and the key findings from previous assessments now come before the new approaches etc.
10062	39	26	39	26	This section is devoted to development of climate understanding and key findings of IPCC assessments (however, almost no such info on SAR, TAR, AR4), but the history of those findings would also be of high interest and very much policy-relevant which assess the mitigation targets for stabilization of atmospheric concentration or for limiting warming below 2°C or 1.5°C. I understand: it is “cross-WG”. FAR: stabilization of the atmospheric concentrations; SAR: stabilization of global CO2-emissions within several decades followed by substantial reductions; TAR: stabilization of global emissions within few decades; AR4: stabilization of global emissions within 10–15 years, reduction at least by 50% by 2050; AR5: 40-70% global emission reductions by 2050. (Personal remark: such assessments are compared to the targets in climate agreements in Farago, 2016: The anthropogenic climate change hazard: .. the increasing science-policy gap. Időjárás, 120:1, pp. 1-40 ISSN 0324-6329. http://real.mtak.hu/60726) [Tibor Farago, Hungary]	Taken into account. Please note that Appendix 1 does provide the history of key statements from past IPCC assessment report SPMs. Unfortunately, we missed to refer to it anywhere in the FOD.
45392	39	26	42	50	Since the section headers here are direct quotations from the earlier reports, I think this would be clearer if quotation marks were used. [Baylor Fox-Kemper, United States of America]	Taken into account. We refrain from adding quotation marks for all the statements taken from the AR5 and the AR6 Special Reports to not hamper readability. However we have revised the text and add references where needed to make it very clear we refer to approved text from earlier reports.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
27544	39	26	44	32	This would follow much better from a reframed section about lines of evidence as these findings are based on combining different lines of evidence. It would be more useful to combine key pillars of knowledge emerged from and after AR5 and combine them under broader headings. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account: lines of evidence approach and key pillars of knowledge emerged has been implemented.
53152	39	30	39	30	You may insert "a broad set of" before "climate models" [Jan Fuglestvedt, Norway]	Not applicable. Text removed.
52478	39	36	39	36	Suggest to be careful in this section else it can read like these are the conclusions of this report. [John Brian Robin Matthews, France]	Noted. Not convinced that this is a real danger as each para starts with "AR5 concluded, AR5 assessed.
45736	39	38	39	38	WGII thought they had this honour - Do you mean AR5 WGI was the comprehensive WGI assessment? Or AR5 is the most comprehensive assessment so far [Katja Mintenbeck, Germany]	Not applicable. Text removed.
31588	39	38	39	39	This will need to be put in the past tense, because AR6 will likely have more review comments! [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. Text removed.
8834	39	38	39	42	a key advance of AR5 was Chapter 13 Sea Level Change which, for the first time, provided a comprehensive assessment of past, current and future sea level change. Two important achievements were made in AR5: 1. the closure of the observational sea level budget since 1993 within the uncertainties; 2. a model-based projection of sea level rise including all components. It is suggested that the progress in assessing sea level rise in AR5 be highlighted based on the AR5 WGI SPM statement: "Global mean sea level will continue to rise during the 21st century" (IPCC AR5 WGI SPM headline statement). This could lead to a new numered para on page 1-41, from line 16 onwards. [Thomas Stocker, Switzerland]	Taken into account. Sea level budget is now explicitly addressed in new Section SOD 1.3.4. SL projections are part of SOD 1.3.5.
29944	39	39	39	39	I always cringe when I read this number because a very large fraction of those were pointing out typographical errors. Is it possible to give an estimate of the number of substantive comments? [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. Text removed.
48258	39	51	39	51	Suggest changing "decades" to "centuries". [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. The text is approved wording from SPM WGI AR5.
13122	39	51	39	53	Include changes in the hydrologic cycle in this sentence. [Nora Richter, United States of America]	Noted. Unchanged to ensure consistency with SPM WGI AR5
53154	39	54	39	54	the wording ' "the other side of the CO2 problem" ' is a bit sloppy, in my view. I think you could write "another impact of CO2" or something like that. [Jan Fuglestvedt, Norway]	Accepted. Revised to match original paper by Doney et al. 2009
33456	39	54			The correct quote for Doney et al. 2009 is "the other CO2 problem" [Adrienne Sutton, United States of America]	Accepted. Revised to match original paper by Doney et al. 2009
26112	40	3	40	10	It is widely believed the sea level has fluctuated over the past 2 millennia by 0.3 to 0.5 metre or so (see below).So while your statement reagrding mean rate is technically true, it does not proviode an honest picture, because the widely differing averaging times confuse the comparison. [Stephen Taylor, United Kingdom (of Great Britain and Northern Ireland)]	Noted. We disagree about the "not provide an honest picture". This is approved wording from SPM WGI AR5 which relies on the most comprehensive assessment of sea level changes by the IPCC.
29952	40	13	40	14	The fact that atmospheric warming accounts for only 1% of the energy accumulation in the climate system explains why pauses in atmospheric warming are not inconsistent with climate warming. It would seem worth making this point here. [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. This is indeed an important point. Text revised accordingly and sentence added..

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
37312	40	24	40	25	"the pre-industrial period" would be better than "pre-industrial times". The text is referring to a specific period up to around 1750 with a more-or-less stable level of carbon dioxide. Pre-industrial times could refer to any epoch prior to 1750. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Text revised accordingly.
53156	40	26	40	26	Delete "change in" since radiative forcing by definition contains change. [Jan Fuglestvedt, Norway]	Accepted. Text revised accordingly. Now in SOD section 1.3.6
43724	40	29	40	29	Not just increases in well-mixed greenhouse gases but also short-lived greenhouse gases, such as ozone. [Vaishali Naik, United States of America]	Noted. Unchanged to ensure consistency with SPM WGI AR5
55188	40	39		54	[pt 1 of 3] It says, "A critical policy-relevant finding of WGI AR5 is the close, approximately linear relationship of cumulative total emissions of CO2 and global mean surface temperature response. ... it implies that continued emissions of greenhouse gases will cause further warming and changes in all components of the climate system, independent of any specific scenario or pathway. Further emissions and increase in atmospheric CO2 will also lead to further uptake of carbon by the ocean and increase ocean acidification. From the close link between cumulative emissions and warming it follows that any given level of warming (such as the 1.5°C and 2°C warming targets in the Paris agreement) 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." [cont'd] [David Burton, United States of America]	Noted. Comment with no suggestions for changes, just quoting the FOD text. No action taken.
55190	40	39		54	[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 over half the rate of anthropogenic emissions. So if CO2 emissions were merely halved, atmospheric CO2 levels would be declining (at a rate implying a residence time of about fifty years), rather than rising. 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. Comment claim is inconsistent with the scientific information available. Refer to Chapter 5 in this report and to the series of past IPCC reports for comprehensive assessments of the global carbon cycle, its perturbation and related issues.
55192	40	39		54	[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 obviosly absurd. The unscientific "carbon budget" nonsense needst to be purged entirely from this 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. Comment claim is inconsistent with the scientific information available. Refer to Chapter 5 in this report and to the series of past IPCC reports for comprehensive assessments of the global carbon cycle, its perturbation and related issues.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
7730	40	51	40	53	“…descend to zero”? Skeptics will quickly jump on this assertion to claim that people must stop breathing and climate scientists must cease flying to international conferences such as the major IPCC conference occurring while these comments are being written. Consider that the recent “pause” in warming was not correlated with the steadily increasing trend in CO2 (which I watch in real time being recorded by the Scripps and NOAA CO2 analyzers every time I calibrate my instruments while staying at the Mauna Loa Observatory during the past 27 summers). Before we endorse the ongoing impoverishment of millions of people in developing nations by attempts to drop CO2 emissions to zero, we must first develop a comprehensive, empirical understanding of the impact of tropospheric water vapour, cloud cover and aerosols on climate change based on global satellite observations. [Forrest Mims, United States of America]	Rejected. Sentence clearly states that "in the absence of a large net removal of CO2 from the atmosphere". Refer to Chapter 5 and the series of past IPCC reports for comprehensive assessments of these issues.
44202	40	52	40	52	"stabilizing warming" is the wrong term, rather "stopping warming" or "stabilizing temperatures". [Christian Reuten, Canada]	Noted. No change, decided to keep the wording.
53162	41	5	41	5	"the choice of" is not needed and can be deleted [Jan Fuglestvedt, Norway]	Noted. We leave the sentence as is. We believe it helps to understand the sentence and makes the link to Section 1.6 on scenarios.
41310	41	9	41	15	Perhaps consider referencing SR15 here as well. [Debra Roberts, South Africa]	Noted. Results from the three AR6 SRs are summarized in Box 1.2 of Chapter 1.
48382	41	9	41	15	This paragraph implies that no natural mechanisms remove CO2 from the biosphere. That is misleading. See Chapter 5 page 12 and also my comment starting on Chapte 5 page 17. [Stephen Parks, United States of America]	Noted. Text revised to clarify that, of course, natural sources and sinks are accounted for in this assessment from the WGI AR5. We note, however, that removal of the extra CO2 from anthropogenic activities is far too slow to remove the anthropogenic CO2 on a multi-century to millennial timescale. And many changes, e.g. sea level rise, ice melting etc. are committed to already.
55194	41	9		15	[pt 1 of 2] The text says, "Past, present and future emissions of CO2 thus commit the world to substantial multi-century climate change, and most aspects of climate change will thus 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 residence 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 calculated. [cont'd] [David Burton, United States of America]	Rejected. Comment claim is inconsistent with the scientific information available. Refer to past IPCC reports for comprehensive assessments of the issue of CO2 residence time.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
55196	41	9		15	[pt 2 of 2] So we know what would happen to CO2 level if CO2 emissions were stopped immediately: CO2 levels would decline immediately, on an approximately exponential decay curve toward slightly less than 300 ppmv, with a time constant (residence 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.drroyspencer.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 ### [David Burton, United States of America]	Rejected. Comment claim is inconsistent with the scientific information available. Refer to past IPCC reports for comprehensive assessments of the issue of CO2 residence time.
43084	41	16		17	Cite referenes and link to chapter 5. [David Frame, New Zealand]	Accepted. Text revised accordingly. We believe the comment was referring to FOD Chapter 1, p41, line 30?
46532	41	18	41	18	"post-AR5 Special Reports" -> "AR6 Special Reports" [WGI TSU, France]	Accepted. The term was changed to Special Reports in the Sixth IPCC Assessment Cycle' and is now Box 1.2
53160	41	18	42	49	You need to update this and include SROCC and SRCCL. [Jan Fuglestvedt, Norway]	Accepted. Key findings of SROCC and SRCCL are now discussed in Box 1.2.
56188	41	18	42	51	Very useful section. Would deserve to be presented more prominently in Chapter 1. [Sonia Seneviratne, Switzerland]	Noted. Thank you.
6377	41	18			Suggest to add key findings of SROCC on oceans ad cryosphere. They are not depicted here in a clear subsection [Baruch Rinkevich, Israel]	Accepted. Key findings of SROCC and SRCCL are now discussed in Box 1.2.
53158	41	20	41	26	When you refer to the three special reports (SR) you don't need to explain the backgournd (invitation from COP21, and decision in IPCC plenary). I suggest deleting this. [Jan Fuglestvedt, Norway]	Accepted. Revised as suggested.
10064	41	22	41	22	an invitation by the Parties to the United Nations Framework Convention on Climate Change (UNFCCC). [Tibor Farago, Hungary]	Accepted. The text was changed.
43082	41	25			Warming is not "unabated" because mitigation is occuring. This is the wrong word. Choose something like "Warming continues" or "warming continues at 0.2C /decade" or something. But not unabated. [David Frame, New Zealand]	Not applicable. The text was reorganized in a different way in Box 1.2.
37314	41	29	41	40	Related to the previous comment, it might be better to refer to the pre-industrial level, not levels, in two places here. The plural would be approriate if one were trying to distinguish among seasons, as each season has a different temperature level, even after global averaging, but that is not what is being discussed here. The term "pre-industrial baseline" is introduced later in the chapter, and could perhaps be deployed here also. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. Sentence was revised without mentioning 'levels' or 'level'
26114	41	39	41	41	Ambiguous. Suggest “The SR1.5 estimates with very high confidence that human activities between the pre-industrial period and 2017 have increased global temperature by 1 degc and that …… [Stephen Taylor, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. The text was revised.
57298	41	39	41	44	The finding that warming has reached 1C, increasing at 0.2C per decade, was a very widely quoted result from SR1.5, so I'd have thought this merits a key finding. Important to mention that these numbers refer to GMST, not GSAT, since in SR1.5 it was decided to define "global warming" as the increase in GMST. [Myles Allen, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. text was revised as suggested.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
51592	41	39	42	20	As an expert reviewer of the SR1.5C, I think the summary findings of the 1.5C as described here could be more effectively communicated. For example, clear and simple working that 1.5C is possible and GHG emissions to date would not reach 1.5C warming. Also, please detail 'imapcts' - the word alone is numbing, but if you list briefly the human and eco-system suffering and loss of life/extinction due to even 0.5C difference/overshoot, you capture attention/response. The short 'film' presented by IPCC at the COP24 was excellent in its summary messaging. [Lindsey Cook, Germany]	Not applicable. The sentences no longer appear.
6613	41	40	41	40	add "(GMST)" after "global mean surface temperatures" [Tim Christiane Thys, Belgium]	Accepted. The text was revised as suggested.
6611	41	41	41	42	clarify "warming to within +/- 20%" [Tim Christiane Thys, Belgium]	Rejected. This is the SR1.5 SPM wording. The sentence is unambiguous.
7732	41	52	41	55	Which SR1.5 models? Please insert (1) a brief comment to the effect it is expected that newer models should more accurately predict future temperature changes than the ~138 models used in AR5, and (2) a brief explanation of why the new models are expected to be better. Fig. 11-25 in AR5 illustrates my concerns. [Forrest Mims, United States of America]	Rejected. This specification adds too much detail, while the section has been written more tightly to save space.
45738	42	3	42	21	bring in WGII here, theme 2) impacts and risks central to WGII assessment [Katja Mintenbeck, Germany]	Rejected. The section intends to highlight issues relevant to WG1.
32624	42	4	42	45	And the IPCC 1.5 C report completely failed to really indicate that to meet the UNFCCC objective from 1992, what needed to happen was to get back to less than 0.5 C warming--not stay up at 1.5 to 2 C, which would fate the world to sea level rise of a few tens of METERS. [Michael MacCracken, United States of America]	Noted. Interesting insight but the section does not intend to criticise the SR1.5 report. Statements not highlighted in the SPM and/or discussed in the relevant chapter cannot be reproduced in this section.
32620	42	5	42	14	While the IPCC 1.5 report concluded the really trivially obvious, namely that a warming of 1.5 C would be less impactful of 2 C, the question that that report failed to address and really should have (despite apparent instructions to the contrary) is whether a warming by either of these amounts was consistent with the UNFCCC objective negotiated in 1992 and broadly accepted by the international community. I think this point needs to be made here--namely that no evaluation was carried out regarding the long-term implications of the Paris goals vis-vis the objective of the UNFCCC. [Michael MacCracken, United States of America]	Noted.
54980	42	12	42	14	Comparisons based on 1.5°C versus 2°C scenarios may be strenghted with referral to Table 5.1 of SR15 based on "Sustainable development implications of avoided impacts between 1.5°C and 2°C global warming" on page 453. [Kilkis Siir, Turkey]	Not applicable. The sentences no longer appear.
55198	42	13		14	[pt 1 of 3] The text says, "As a prominent example, warm-water coral reefs are projected to decline by a further 70-90% at 1.5°C and even by more than 99% at 2°C (very high confidence)." That claim is based on superstition (and Terry Hughes), not actual scientific evidence. Corals are very resliiant, and they thrive in warm water. Look at a map of coral reefs, and what do you see? https://aamboceanservice.blob.core.windows.net/oceanservice-prod/education/kits/corals/media/coralreefmap.jpg The coral reefs are clustered around the equator. Even the extremely warm southern Red Sea is dotted with thriving coral reefs. From 7:20 in this BBC video, hear how wonderfully healthy the coral are in the Red Sea, off Eritrea (at the southern end of the Red Sea), in that especially warm water: https://www.youtube.com/watch?v=P5URF1Bzbus [cont'd] [David Burton, United States of America]	Rejected. Claim not substantiated. The text sticks to the SR1.5 findings.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
55200	42	13		14	[pt 2 of 3] Then note that "1.5°C" really means only 0.5°C (and that 2°C means 1°C) relative to CURRENT temperatures, and then note that that tiny 0.5°C or 1°C increase is a global average which is expected to be mostly at high latitudes (due to Arctic amplification), with the tropics getting much less. So the Special Report was really claiming that about a quarter of a degree of warming in the tropics would devastate coral reefs, and that about a half degree of warming would kill 99% of corals. [cont'd] [David Burton, United States of America]	Rejected. Claim not substantiated. The text sticks to the SR1.5 findings.
55202	42	13		14	[pt 3 of 3] The Great Barrier Reef is believed to be about 20 million years old, so it has obviously survived much greater temperature changes than any in prospect now. In fact, extensive coral reefs are seen in the fossil record (on and off) as far back as over 400 million years. The Special Report's claim is utterly absurd, and in defiance of the evidence. It should be retracted, and appologized for, not repeated in AR6! Refs: https://www.thegwpf.com/peter-ridd-crying-wolf-over-the-great-barrier-reef/ https://cairnsdiveadventures.com.au/2017/11/coral-bleaching-cairns-reef-recovering-coral-spawning-2017-far-northern-dive-expeditions/ ### [David Burton, United States of America]	Rejected. Claim not substantiated. The text sticks to the SR1.5 findings.
55208	42	15		21	[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 substantiated. The text sticks to the SR1.5 findings.
32622	42	16	42	21	The whole treatment of sea level rise in the IPCC 1.5 C report was seriously flawed as there was, in effect, no real treatment of the potential SL contribution from the movement of ice streams, which is likely to become the dominant term in such analyses. And the finding that there would be roughly 0.1 m (really, as I recall, 0.06 m) less rise in 2100 from 1.5 C than from 2 C was not properly put in the context that the rate of sea level rise at that time would be on the order of 0.1 m per decade or more, and the effective value of delaying the sea level rise by less than a decade is likely very small. In any case, improved SL estimates roughly double the projected rise in 2100, so this acclaimed benefit was really hype and not of much significance. I would hope that this aassessment will be much more forthright on the dangers that we face. [Michael MacCracken, United States of America]	Noted. Sea-level is revisited in SROCC and AR6 Chapter 9.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
55204	42	16		21	[pt 1 of 3] The text says, "Importantly, 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 lower rate and a lower magnitude for a lower warming, enabling greater opportunities for adaptation in vulnerable environments such as small islands, low-lying coastal areas, and deltas." That's wrong. It 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 substantiated. The text sticks to the SR1.5 findings.
55206	42	16		21	[pt 2 of 3] Note that what the IPCC calls "1.5°C" really means only 0.5°C (and that 2°C means 1°C) relative to CURRENT temperatures, so those increases are very similar to the temperature increase we've already seen since the 1920s, which cased 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 substantiated. The text sticks to the SR1.5 findings.
27546	42	20	42	20	Is there qunatitative evidence for that or do we just assume it? I.e. do we have any confidence in this statement? [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Medium confidence added.
56190	42	23	42	23	"Rapid" sounds like an understatement. Would recommend changing to "immediate", and also mentioning somewhere in this title that the required efforts are "unprecedented" (actual wording of SR15). [Sonia Seneviratne, Switzerland]	Not applicable. The section was reorganised into Box 1.2. Sentence no longer appears.
55210	42	23		45	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 should 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 substantiated. The text sticks to the SR1.5 findings.
30412	42	25	42	42	This is inconsistent with SR1.5 as these are the wrong numbers. SR1.5 Chapter 2 ES and SR1.5 SPM report remaining carbon budgets from 2018 onward expressed in GSAT, consistent with AR5. These values are 420 GtCO2 and 580 GtCO2 for a 1-in-2 and 2-in-3 chance of limiting warming to 1.5°C. The reasoning here is thus entirely misguided. SR1.5 SPM says: "The choice of the measure of global temperature affects the estimated remaining carbon budget. Using global mean surface air temperature, as in AR5, gives an estimate of the remaining carbon budget of 580 GtCO2 for a 50% probability of limiting warming to 1.5°C, and 420 GtCO2 for a 66% probability (medium confidence). Alternatively, using GMST gives estimates of 770 and 570 GtCO2, for 50% and 66% probabilities, respectively (medium confidence)." Remaining carbon budget based on blended GMST is thus clearly communicated as an alternative not as the default option. SR1.5 Chapter 2 ES speaks about GSAT budgets only. I provide some suggested corrected wording in a separate comment. [Joeri Rogelj, Austria]	Accepted. Thanks for noticing this inconsistency.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
30414	42	25	42	45	Suggested corrected text: "Building upon the understanding from AR5 of the quasi-linear relationship between cumulative net anthropogenic CO2 emissions since the pre-industrial period and maximum global mean atmospheric temperature, the report assesses the remaining carbon budgets compatible with the 1.5°C or 2°C warming limits. The remaining carbon budget, starting from year 2018, for a one-in-two chance of limiting global warming to 1.5°C is about 580 GtCO2, and about 420 GtCO2 for a two-in-three chance (medium confidence), and are further reduced when taking into account permafrost and other less represented Earth-system feedbacks. At constant 2017 emissions, these budgets would be depleted by about the years 2032 and 2028, respectively. These estimates use a consistent definition of global mean surface air temperature as in AR5 because switching to a blended GMST metric would result in an arbitrary increase of carbon budgets compared to temperature targets that were set based on the AR5. (see section 1.5.3). It is concluded that all emission pathways with no or limited overshoot of 1.5°C imply global net anthropogenic CO2 emissions to 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. For limiting global warming to below 2°C, CO2 emissions decline by about 25% by 2030 and reach net zero around 2070. The report also highlights the use of carbon dioxide removal (CDR) techniques to compensate for residual emissions and achieve net negative emissions to return global warming to 1.5°C following a peak. The SR1.5 concludes that there is no single answer to the question of whether it is feasible to limit warming to 1.5°C and adapt to the consequences because feasibility has multiple dimensions that need to be considered simultaneously and systematically." [Joeri Rogelj, Austria]	Accepted. Text has been changed as suggested
47494	42	28	42	30	The amounts of 770 GtCO2, and 570 GtCO2 are inconsistent with SR1.5 and with chapter 5, table 5.7. The remaining carbon budget for a one-in-two chance of limiting global warming to 1.5°C is about 550 GtCO2, and about 420 GtCO2 for a two-in-three chance (medium confidence). At constant 2017 emissions, these budgets would be depleted by about the years 2035 and 2030, respectively [Birgit van Munster, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. See also comments 30412 and 30414.
53164	42	28	42	32	SR1.5 used both GSAT and GMST for remaining carbon budgets; see SPM section C.1.3 in SR1.5 [Jan Fuglestvedt, Norway]	Taken into account. See also comments 30412 and 30414.
13326	42	29			can not [Mansoureh Kouhi, Iran]	Rejected. Comment is unclear. There is no obvious connection with p 42 line 29
46370	42	29			can not [sadegh zeyaeyan, Iran]	Rejected. Comment is unclear. There is no obvious connection with p 42 line 29
57646	42	29			can not [Sahar Tajbakhsh Mosalman, Iran]	Rejected. Comment is unclear. There is no obvious connection with p 42 line 29
6615	42	30	42	30	insert after "emissions" the actual amount. [Tim Christiane Thys, Belgium]	Taken into account. The actual amount is given.
27548	42	30	42	32	why is GMST used now and why does that lead to larger budgets? I know this comes later but a brief 1-sentence explanation would be necessary here. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. These words no longer appear. See also comments 30412 and 30414.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
57300	42	30	42	32	The switch from GSAT to GMST (not entirely tidy, because in the end SR1.5 used a bit of a hybrid) is not the only reason budgets went up. Mostly it was because we had better estimates of warming to date and non-CO2 forcing. [Myles Allen, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. See also comments 30412 and 30414.
57252	42	31	42	32	shift to GMST is certainly not the only reason why budgets have increased between AR5 and SR15 [Oliver Geden, Germany]	Taken into account. See also comments 30412 and 30414.
13124	42	43	42	45	I would suggest re-phrasing this sentence in a more positive light. For example: That although it is unclear whether we can limit warming to 1.5C, in order to reach this goal and adapt to potential consequences, multiple dimensions need to be considered and global cooperation is required to implement solutions. [Nora Richter, United States of America]	Not applicable. The sentence was cut.
8836	42	43	42	45	This is beating around the bush and sounds rather academic. The important insight of the AR5 WGI notion of the limited carbon budget is that every year of emission makes subsequent mitigation efforts continually more ambitious until a time when a specific target is lost. The loss of an agreed climate target is unfortunately an every more likely possibility. relevant citation for losing climate target: Stocker, T.F., The closing door of climate targets, Science, 339, 280-282, 2013. [Thomas Stocker, Switzerland]	Not applicable. The sentence no longer appears.
53166	42	43	42	45	You are touching a huge and complex topic here. If you keep this, I suggest you add some more nuances; e.g., that past emisions alone are unlikley to cause warming of 1.5C, technological, dimension etc., [Jan Fuglestvedt, Norway]	Accepted. Sentence has been cut.
43086	42	44		45	See also Frame and Stone, 2013, Nature Climate Change volume 3, pages 357–359. Multiple lines and all that. [David Frame, New Zealand]	Not applicable. The sentence no longer appears.
6680	42	47			Can we ensure that chapter 1 and chapter 9 highlight the same key messages from the SROCC? [Helene Hewitt, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Coordinated with Ch 9.
32626	42	52	42	52	This subsection needs to summarize how well (or poorly) the models are doing in their simulations of SL rise. This is critical to be doing so evaluations can be made. My understanding is that the models significantly under simulate how much SL is occurring--but why? [Michael MacCracken, United States of America]	This should be done in the sea level chapter. This is about assessing past projections of GMST and the complications in doing this properly.
26372	42	52	44	30	The material in 1.3.5 is excellent, but we need a proper reference (not "in preparation"), in the ref. list. [Jochem Marotzke, Germany]	Hausfather et al has been submitted
36638	42	54			This section is important. It is however unclear how the claim is actually being assessed. It is insufficient to simply point to a selection of historical projections and discuss their subsequent accuracy. How were these particular projections chosen? Given the importance of this section it should not be necessary to go to the primary references to determine what the methodology was that was used to obtain the result. [Paul Copland, New Zealand]	Text revised. These projections are the most discussed past projections made over several decades.
27550	43	4	43	4	This is an important pillar of our confidence thus more detail on what 'realistic' means here would be very useful. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Text revised.
27648	43	16	43	17	replace with published article (Hausfther et al) [Poot Delgado Carlos Antonio, Mexico]	Hausfather et al has been submitted
45394	43	23	43	42	This comparison is a very nice one to include. The early studies versus observations since really help to frame the increasing accuracy of our field as well as the appropriate levels of present confidence. [Baylor Fox-Kemper, United States of America]	The subsection is retained.
37316	43	23			"global mean surface temperature" presumably here means GSAT not GMST. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Text revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
37318	43	33			"for observations" should be changed to "from observations" as the trend is computed from observationally-based analyses, not raw observations. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Text revised.
37320	43	38	43	39	See comments 25 and 26. In view of dataset interdependences, it should be explained how the datasets are combined into one. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Text revised.
37322	43	40			Change "observed" to "observationally based". [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Text was changed.
15224	43	46	43	46	I don't think anybody in the scenario community talks about their products as forecast. There is a precise terminology in place within that research community, and this section should be consistent with that. [Claudia Tebaldi, United States of America]	Text was revised to be consistent with terminology used in the community and cross-Chapter in WGI AR6
7734	43	46	43	50	"…past climate projections were quite successful…." Is followed with "…Hansen et al. (1988) projected around 50 percent more warming than has been observed…." However, the use of "quite successful" is simply inappropriate in view of Fig. 11-25 in AR5. In short, this section deserves a more realistic transition from Hansen's 50% overestimate to the overestimates by subsequent models all the way to AR5. Otherwise, the skeptics will be provided more ammunition. [Forrest Mims, United States of America]	The subsection describes why the Hansen et al projections overestimated by 50% - it was due to the forcings. The reviewer also does not explain why Fig. 11.25 in AR5 is relevant - that assessed forecast is accurate so far.
55212	43	47		51	[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, largely due to a misspecification of future radiative forcings. However, the observed change in temperature compared to the observed change in forcings is consistent with the model simulation (Hausfather et al 2019, in prep)." That's wrong, because scenario B is 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]	The terminology used by Hansen in testimony is irrelevant to correcting all the projections for the misspecified forcings.
55214	43	47		51	[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 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]	All the forcings have been corrected to the values that were observed. This is the correct way to do the comparison.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
55216	43	47		51	[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]	All the forcings have been corrected to the values that were observed. This is the correct way to do the comparison.
27650	43	51	43	51	replace with published article (Hausfther et al) [Poot Delgado Carlos Antonio, Mexico]	Hausfather et al has been submitted
45396	44	1	44	2	The decrease in the number of radiosondes probably should be mentioned here, as well as the diminished state of the TOGA moorings. Continuity in particular classes of satellites (particularly scatterometers) is really needed. It would not hurt to mention how difficult the Keeling measurements were in the early days (), because continuing to watch is less interesting than watching something new. [Baylor Fox-Kemper, United States of America]	Can't identify context for this comment - radiosondes not mentioned on p 44.
26374	44	4	44	4	I rather doubt it that any 1970s model "forecast" the 2017 CO2 concentration. Projected? Assumed? [Jochem Marotzke, Germany]	Text was revised to be consistent with terminology used in the community and cross-Chapter in WGI AR6
15226	44	4	44	4	Again the use of "forecasting" here is not correct [Claudia Tebaldi, United States of America]	Text was revised to be consistent with terminology used in the community and cross-Chapter in WGI AR6
27652	44	4	44	5	replace with published article (Hausfther et al) [Poot Delgado Carlos Antonio, Mexico]	Hausfather et al has been submitted
37324	44	7	44	8	Dataset interdependence is espcially an issue here. Results are shown for several land areas, and for some of these areas observational data coverage is good. So one would expect the HadCRUT4 and Cowtan and Way datasets to be very similar, as Cowtan and Way will have largely picked up the HadCRUT4 values. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Text revised.
17888	44	7	44	12	Were those climate projections based on coupled atmos.-ocean-… etc. models, or only on atmospheric models? [Branko Grisogono, Croatia]	Text revised. It varied - now discussed.
26376	44	24	44	24	"by 2030" would be essential after "1.8°C global warming". [Jochem Marotzke, Germany]	Thanks for the observation. We revised the text.
49416	44	33			This section (1.4 Development in observing systems, etc) needs a paragraph defining its scope. Are you discussing developments since the last AR5? Or developments that are ongoing at the current time? Each subsection seems to have a different idea of what is intended. [Sonya Legg, United States of America]	Accepted. The scope is now defined at the beginning of the section. The outline has been simplified for clarity.
52480	44	35	44	35	Suggest to combine 1.4.1 with section 1.3.3 as otherwise it's a bit repetitious [John Brian Robin Matthews, France]	Careful attention has been given to avoiding overlap between these sections.
53168	44	35	47	45	Section 1.4.1 needs a wrap-up, in my view [Jan Fuglestvedt, Norway]	Noted; this suggestion was considered in the revised draft.
45398	44	35	47	46	The importance of cross-calibration among different methods needs a paragraph and perhaps even a subsection. Bucket temperatures, XBT (bathythermograph) calibrations, and in situ vs. satellite SSTs are a nice case study of the importance in the PRL. [Baylor Fox-Kemper, United States of America]	Taken into account; this is likely the purview of Chapter 2 and is beyond the scope of this section.

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15634	44	45			Update the GCOS reference to the latest Implementation Plan: GCOS. 2016. “The Global Observing System for Climate: Implementation Needs.” WMO, GCOS-200. [Michael Zemp, Switzerland]	Accepted. Updated reference included.
55504	44	47	44	51	It may be worth highlighing where/when coverage/continuity is to be lost here. [Wesley Fraser, United Kingdom (of Great Britain and Northern Ireland)]	Noted; we have limited our discussion of observing system losses to documentary sources and paleoclimate sources.
39030	44		64		In section 9.4.1.3 of WGI AR5 the observation that " .. in most cases the multi-model mean agrees more favourably with observations than any individual model" is discussed. This is clearly seen in Fig. 9.7 (AR5). The reason for this phenomenon has now been understood and this has importance for the interpretation of the model mean. I suggest that a text like this is included somewhere in this chapter possible in section 1-4: It is a common observations in both weather forecasting and climate modeling that the ensemble mean often compares better to observations than most or all individual ensemble members. This can be explained by the surprising properties of high-dimensional spaces: almost all vectors are orthogonal and different vectors from the same distribution have almost the same length. The high-dimensional space enters when we consider a distance measure, e.g., the mean-square-error, over a long period or an extended spatial region. While non-intuitive, these properties strongly simplify the situation and allow us to derive analytical results for, e.g., the error of the ensemble mean and explain why the ensemble mean often has an error that is 30 % smaller than the median error of the individual ensemble members. In general the ensemble mean should be considered with care in high dimensional spaces as it has very different properties than the individual ensemble members. Christiansen, Ensemble Averaging and the Curse of Dimensionality J. Clim., 1587-1596, 31, 2019 doi:10.1175/JCLI-D-17-0197.1 Christiansen,	Thanks for this comment, which resulted in considerable cross-chapter discussion and introduction of new text addressing it.
37326	45	1			Where is the evidence that spatial coverage of surface temperature observations is generally decreasing? The GCOS (2015) report referred to in comment 14 came to the opposite conclusion for the WMO Regional Basic Synoptic Networks. The report also documented a rise over time in the number of monthly CLIMAT records. If a peer-reviewed reference that refutes the GCOS findings cannot be given the comment should be dropped. Note however that lines 18 and 19 of the same page state that the networks have improved, and refers to the GCOS report. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. A rigorous assessment of the spatial coverage of instrumental climate data was beyond the scope of the section, and as such we limited our assessment to documentary datasets and paleoclimate archives.
26378	45	4	45	5	"review" --> "assess" [Jochem Marotzke, Germany]	Accepted.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
37328	45	7	45	14	Again, the figure caption says "ground-based instrumental coverage is decreasing in recent years" which is contrary to the GCOS report and what is written in lines 18 and 19. What data are used as a basis for the "land surface T" line in the schematic, which suggests densest observational coverage around 1980? This is not what was diagnosed in preparing the GCOS report. Also "Land surface T" probably should read "Surface air T over land". "Land surface temperature" normally refers to the temperature of the land surface itself (mostly sensed from space) not the air temperature. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. The Figure in question has been substantially revised, along with its caption.
50724	45	12	45	12	I suggest to add "as a consequence of climate change" at the end of the figure caption in order to (briefly) include the reason of its vanishing. [Hernan Edgardo Sala, Argentina]	Noted; The Figure in question has been substantially revised, along with its caption.
14982	45	17	45	17	although palaeoclimate data is indicated in the opening paragraph, it then disappears from the discussion of variables by area/clmate system component, and instead emerges in a separate section. I can see the value of having these separate but the opening paragraph implies a synthesis which then isn't followed through. One change would be to embed the palaeoclimate data into each of these e.g. the tree ring data set expansion contributes to land and atmosphere; pages2k addresses mulitple sections here; ocean drilling links to ocean observations? [Erin McClymont, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account; Given the structure of the preceding "History" section in Chapter 1, we opted to keep the paleoclimate section separate.
7590	45	17	45	40	I wonder why here atmosphere and land are grouped. These are 2, admittely closely related but different components of the climate system, with distinctive observation approaches and techniques.. [Christophe Genthon, France]	Accepted. These were split into separate sections in the revised draft.
47426	45	17	45	42	Atmosphere has always the biggest data availability compared to other components of climate system. It doesn't make sense to only introduce the atmospheric data update a bit since AR5. It is suggested that some new released observations and datasets would need to be briefly introduced together with some new campaigns as well as new technology. [Hong-Li Ren, China]	Accepted. The 'Atmosphere' section has been significantly expanded in the revised draft.
48260	45	17	45	42	This whole section needs references and the final sentence should be expanded to include more information on relevant l44 [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Relevant references added.
51840	45	17	46	48	Several measurement techniques used in chapter 2 are missing here. This needs rectifying as chapter 2 is supposed to rely upon chapter 1 for these. [Peter Thorne, Ireland]	Taken into account; the scope and length of this section precludes a full treatment of all observational systems, which can presumably be found in the Technical Annex.
46112	45	18	45	42	It might be handy to add some information about statolith reconstructions, as well as tree-rings. Just as 'other techniques'. Reconstructions can be powerful tools for both looking at past change and checking the accuracy of model data. [Amy Featherstone, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account; the scope and length of this section precludes a full treatment of all paleoclimate archives, many of which may be found in the Technical Annex.
46130	45	24	45	24	Aura (not Auri) satellite [Cynthia Randles, United States of America]	Accepted.
7736	45	26	45	28	"…satellites, which allow for improved quantification of CO2 fluxes between the atmosphere and the Earth's surface." There is nothing between the atmosphere and the surface. Suggest this be revised to read: "…satellites, which have supplemented the limited number of surface measurement sites using different instruments [CO2 analyzers] with measurements by single instruments of the global distribution of CO2 within the atmosphere." [Forrest Mims, United States of America]	Taken into account; the 'Atmosphere' section has been significantly expanded in the revised draft.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
38140	45	26	45	28	GOSAT (http://www.gosat.nies.go.jp/en/) was launched in 2009 prior to OCO-2. This should be noted. [Hiroaki Kondo, Japan]	Taken into account; the section focuses on major new developments since AR5, and a full treatment of historical observations is beyond the scope of the section.
37330	45	27			Data on carbon dioxide have been derived fom satellites other than OCO. ENVISAT (instrument: SCIAMACHY) and GOSAT are two that predate OCO. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account; the section focuses on major new developments since AR5, and a full treatment of historical observations is beyond the scope of the section.
49418	45	34	45	34	There has been much discussion recently about the term "citizen science" and whether it is exclusionary to those who do not have citizenship, e.g. refugees, undocumented or stateless individuals. A better term might therefore be "community science" or "layperson science". [Sonya Legg, United States of America]	Accepted.
37332	45	36	45	40	The activities organised under the EU's Copernicus Climate Change Service (https://insitu.copernicus.eu/news/the-c3s-data-rescue-service), which include involvement with the mentioned ACRE and USCDMP activities, could be noted here. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account; this section has been significantly revised.
50726	45	42	45	42	Include the full name of the missions SMOS and SMAP. [Hernan Edgardo Sala, Argentina]	Accepted.
37334	45	46			GOSAT merits a reference here. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account; the section focuses on major new developments since AR5, and a full treatment of historical observations is beyond the scope of the section.
45740	45	49	45	51	wondering why only coral is highlight here? there are huge efforts to monitor biodiversity. further the coral example implies that data was only collected during the bleaching event. A better example might be the global alliance of CPR http://www.globalcpr.org/ [Katja Mintenbeck, Germany]	Accepted.
55218	45	50		51	Ha, I guessed that Hughes was probably your source for the coral nonsense, and I was right. If you're going to include that, at the very least you should also quote and cite Ridd, for balance. [David Burton, United States of America]	Noted; evidence of widespread coral bleaching and mortality linked to rising ocean temperatures is well-established across many papers.
7592	46	1	46	24	This is (as often) considering the cryosphere at the surface but there is also cryosphere ins the atmosphere – from =which actually much of the surface cryosphere originates. Solid precipitation.This is (as often) considering the cryosphere at the surface but there is also cryosphere in the atmosphere – from which much of the surface cryosphere originates. Solid precipitation is well known for being hard to measure (WMO Solid Precipitation Intercomparison Experiment (SPICE) 2012 – 2015, IOM report 131, WMO, Geneva, 2018, https://library.wmo.int/index.php?lvl=notice_display&id=20742#.XO6yFpzgoUE). The 1st model/analysis – independant climatology of snowfall over Antarctica was obtained using the 1st space borne cloud/precipitation radar flying on a polar orbit, CloudSat (Parlerme et al. 2014, https://www.the-cryosphere.net/8/1577/2014/). This allowed the 1st independent evaluations of antarctic snowfall in reanalyses (Palerme et al., 2015, DOI: 10.1016/j.atmosres.2017.02.015) and CMIP models (Palerme et al. 2016, DOI 10.1007/s00382-016-3071-1). [Christophe Genthon, France]	Accepted. Text added: "The first observed climatology of snowfall over Antarctica was obtained using the cloud/precipitation radar on board NASA's CloudSat (Palerme et al. 2014)."

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
42800	46	2	46	18	RGI and GRACE should also be mentioned here [Xiao Cunde, China]	Taken into account. RGI is mentioned is already mentioned in 1.3.1 as lines of evidence: observations in the pre-AR6 era. GRACE and its successor GRACE-FO are now explicitly mentioned in (new) 1.5.1.1. discussing new developments for observing the cryosphere.
17890	46	6	46	8	Please state the fine resolution implied. [Branko Grisogono, Croatia]	Accepted. Text revised. Added "(10 m or less)".
38396	46	12	46	13	In section 9.3.1.2 we argue that uncertainty of these sea-ice thickness estimates from Cryosat are too large to robustly establish even the sign of trends. You might want to include this information already here. [Dirk Notz, Germany]	Noted. Thank you. However an assessment of the quality of sea ice thickness estimates derived from CryoSat belongs in chapter 9, not in this introductory chapter.
48262	46	20	46	24	Please include references to publications on relevant datasets. [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. The reference for ESA CCI is now Hollmann et al. (2013). It is given at the end of the new subsection 1.5.1 discussing observational data and observing systems where ESA CCI is mentioned first.
49420	46	26	46	48	This subsection on ocean observations is very incomplete. The huge expansion of ARGO in the past decade is not mentioned. Satellite observations of the ocean are not mentioned. Other autonomous observations (e.g. gliders) are not mentioned. Be clear also about the time-period being discussed - is it the current state of observations, or the advances since AR5, or future developments? [Sonya Legg, United States of America]	Accepted. The scope of this section is more clearly stated in the revised draft, and the 'Ocean' section significantly expanded.
27654	46	32	46	33	replace with published article (Lombard et al) [Poot Delgado Carlos Antonio, Mexico]	Accepted. All references have been updated.
57908	46	35	46	37	Please include reference. [Catia Domingues, Australia]	Accepted. All references have been updated.
52482	46	39	46	39	"moored ocean buoys" - The OSNAP array consistents of moorings without a surface expression rather than surface ocean buoys [John Brian Robin Matthews, France]	Accepted.
26380	46	39	46	43	I find it odd that OSNAP is mentioned but not RAPID/MOCHA, which has had a large impact. [Jochem Marotzke, Germany]	Accepted. Other ocean mooring arrays are now mentioned.
37336	46	42			Have the TAO/TRITON arrays really expanded since AR5? GCOS (2015) documented a short-term degradation of the TAO component between 2012 and 2014, and the network returned only to more-or-less its original performance in 2015. Has it expanded since then? GCOS (2015) also reported that a staged removal of TRITON moorings had commenced, with only eight of the original sixteen moorings in place in 2015, with the array expected to be reduced to four moorings by 2017. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account; the discussion of the TAO/TRITON array has been significantly revised.
31594	46	50	47	45	Other advances in paleoclimate reconstruction are in deep-time, where we have more robust and better spatial coverage for high-CO2 time periods, especailly the mid-Pliocene (through PloMIP and PlioVAR) and early Eocene (through DeepMIP). [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Discussion of major new developments in deeper time paleoclimate is now included.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
19172	46	50	47	45	see previous comment: this section completely forgets about the paleoclimate information prior to 800 ka, inlcluding reconstructions of atm. CO2, temperature nd ocean acidification millions of years back in time and information that informed the studies listed in Table 1.1. At least a brief sentence with citation of some key papers seems appropriate (e.g. Foster et al. 2017, Zachos et al. 2001, Hönisch et al. 2012). [Baerbel Hoenisch, United States of America]	Accepted. Discussion of major new developments in deeper time paleoclimate is now included.
46108	46	51	46	52	As above, maybe include hard tissue accretion. Shorter than 'monthly' reconstructions [Amy Featherstone, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account; the paleoclimate section was significantly revised.
24222	46	51	46	52	Palaeoenvironmental archives provide direct climate data……..(in the case of corals) to hundreds of thousands of years [Natasha Barbolini, Sweden]	Taken into account; the paleoclimate section was significantly revised.
14984	46	51	47	45	his section misses a note to the continued international efforts in drilling efforts on land and in the ocean (eg. ICDP, IODP) which are making positive steps to improve data coverage for critical time windows e.g. the MPWP. [Erin McClymont, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account; the section focuses exclusively on major developments since AR5. But a more comprehensive assessment of deeper time paleoclimate advances since AR5 is now included.
6682	46				The discussion here on observational progress repeats that on page 34 and 35 [Helene Hewitt, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Every effort has been taken to avoid repetition across sections of Chapter 1.
9842	47	6	47	12	This reads more like an advertisement brochure than a scientific report. Much too rosy and too positive. The field of palaeoclimatology has indeed made major progress. Yet, there are still major issues with the statistical rollup of the large amounts of data. Hemispheric and global composite temperature records differ greatly from one study to the next. An update of the PAGES 2k (2013) temperature record seems to be currently in review and appears to go back to the Hockey stick times that we thought we have long overcome (see Figure 2-10d in Chapter 2). Notably, the 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. REFERENCES: 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. Paleoceanography 32 (11): 1219-1235, doi: 10.1002/2017PA003237 [Sebastian Luening, Portugal]	Noted; Recent papers (notably Neukom et al., 2019) note strong regional variability that emerges from improved data coverage, while further bolstering the notion that 20th century warming is exceptional in magnitude and global uniformity. Critical data gaps remain, but seem unlikely to upend many of the key conclusions about global-scale temperature changes over the common era. This section focuses on major new developments only, and does not focus on limitations of the observing system, which can be found in the respective chapters.
51766	47	8	47	9	Tierney et al. 2015 only used corals to reconstruct annual climate in the ocean, so it does not apply to "each continent". Additional citations are needed to support the each continent part of the sentence (e.g. PAGES2k 2017, Sci. Data; Pages2k 2013, Nature Geoscience) [Anson Cheung, United States of America]	Accepted. Relevant references have now been included.
44904	47	9	47	12	The sentence on paleo reanalysis seems like it belongs in the “reanalysis” section, where there’s a placeholder already. Hopefully, there will be additional paleo reanalysis products published before the final report is finished. [Darrell Kaufman, United States of America]	Accepted. Paleoclimate reanalysis is now included in the 'Reanalysis' section.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
46784	47	10	47	10	Unclear what is meant here with “homogenization efforts”. PAGES2k are, to my knowledge, not working with data homogenization per se. [Charpentier Ljungqvist Fredrik, Sweden]	Taken into account; text has been revised for clarity.
22170	47	14	47	17	The PAGES working group SISAL (Speleothem Isotopes Synthesis and AnaLysis) could be mentioned here, which compiles global speleothem isotope data to allow continued (re-)assessment of existing data in combination with new data, as well as data-model comparisons. References: @Article{essd-10-1687-2018, AUTHOR = {Atsawawaranunt, K. and Comas-Bru, L. and Amirnezhad Mozhdehi, S. and Deininger, M. and Harrison, S. P. and Baker, A. and Boyd, M. and Kaushal, N. and Ahmad, S. M. and Ait Brahim, Y. and Arienzo, M. and Bajo, P. and Braun, K. and Burstyn, Y. and Chawchai, S. and Duan, W. and Hatvani, I. G. and Hu, J. and Kern, Z. and Labuhn, I. and Lachniet, M. and Lechleitner, F. A. and Lorrey, A. and P\'erez-Mej\'{\i}as, C. and Pickering, R. and Scroxton, N. and SISAL Working Group Members}, TITLE = {The SISAL database: a global resource to document oxygen and carbon isotope records from speleothems}, JOURNAL = {Earth System Science Data}, VOLUME = {10}, YEAR = {2018}, NUMBER = {3}, PAGES = {1687--1713}, URL = {https://www.earth-syst-sci-data.net/10/1687/2018/}, DOI = {10.5194/essd-10-1687-2018} } @Article{quat2010007, AUTHOR = {Comas-Bru, Laia and Harrison, Sandy P.}, TITLE = {SISAL: Bringing Added Value to Speleothem Research}, JOURNAL = {Quaternary}, VOLUME = {2}, YEAR = {2019}, NUMBER = {1}, ARTICLE-NUMBER = {7}, URL = {https://www.mdpi.com/2571-550X/2/1/7},	Accepted. Relevant references have now been included.
51768	47	19	47	22	There's also jetstream reconstructions and implications on mid-latitude weather extremes, e.g.: Trouet et al. 2018 doi: https://doi.org/10.1038/s41467-017-02699-3 [Anson Cheung, United States of America]	Taken into account; relevant references are now included.
27656	47	22	47	22	replace with published article (Grothe et al) [Poot Delgado Carlos Antonio, Mexico]	Accepted. References updated.
27658	47	24	47	25	add more bibliography [Poot Delgado Carlos Antonio, Mexico]	Accepted. References added and updated in revised draft.
31592	47	25	47	25	My understadning is that the DeConto paper is laregly modelling-based, whereas this section is about observations of sea level. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. References updated.
43088	47	26			suggest deleting "grave". Emotive word. [David Frame, New Zealand]	Accepted.
46786	47	29	47	31	Trees used for paleoclimate reconstructions are NOT “trees are rapidly disappearing”. They are rarely growing in regions suffering deforestation and, moreover, it is fossil and sub-fossil trees (deadwood) that are of interest for building up long tree-ring based climate reconstructions. No dendroclimate literature, to the knowledge of me, are support this statement. (Same comment as to Chapter 1, p. 4, line 42.) [Charpentier Ljungqvist Fredrik, Sweden]	Taken into account; a literature-based assessment of this statement has been undertaken.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
44078	47	29	47	32	Can traditional knowledge-holders be considered historical data archives? I would argue that indigenous people with knowledge of oral traditions, including that of past climate states passed down in traditional stories, are also at risk of being lost due to climate impacts via loss of land (e.g., Kiribati) and degredation of cornerstone resources, as well as resulting from systematic cultural erasure (e.g., bannng of cultural practices in Hawai'i and for hundreds of Native American nations across the US, Canada, and Mexico; removal of indigenous children from communities, etc.) [Sara Kahanamoku, United States of America]	Inserted the sentence "Furthermore, oral traditions about local and regional weather and climate from indigenous peoples represent valuable sources of information, especially when used in combination with instrumental climate data ..."
35258	47	29	47	45	It´s quite confusing this paragraph. The idea that "paleoclimate records" are treated by human activities is ok, and absolutely relevant. As a paleo scientific, I´m afraid that a non-specialist reader could feel confused as the reason why this is important in the context of climate change is provided at the end of this paragraph. In this sense, I suggest to re-phrase this entire paragraph in order to highlight first that human activities are also affecting our visibility about the context for changes occurred over the past 200 years, and then provide the description of what activities are affecting the preservation of archives listed in the paragraph. [eugenia gayo, Chile]	Taken into account; this section has been substantially revised for clarity.
46534	47	31	47	31	"tropical ice cores" -> "tropical glaciers" [WGI TSU, France]	Accepted.
22168	47	32	47	32	are there references for these “internationally coordinated salvage efforts”? [Gwenaelle GREMION, Canada]	Accepted. Relevant references have been added.
49422	47	36	47	45	This paragraph, on the threats to current ocean observing systems, is in the wrong section. It does not belong in the section on paleoclimate data. [Sonya Legg, United States of America]	Accepted.
51770	47	36	47	45	I understand the importance to stress the need to continue to have robust data/observations, but it seems like this paragraph is a bit out of place and should be put somewhere else. Right now it seems as if it's related to paleoclimate archives. [Anson Cheung, United States of America]	Accepted.
22166	47	36	47	45	This paragraph should have a new section heading; it is not related to the heading “paleoclimate” [Gwenaelle GREMION, Canada]	Accepted.
38142	47	36	47	45	This part is not relevant to Palaeoclimate and another subtitle should be given for this paragraph. [Hiroaki Kondo, Japan]	Accepted.
32300	47	42	47	43	‘…many climate parameters of interest …’. Too generic and uninformative. Suggest a Table highlighting key parameters that are not measurable, e.g. surface air temp and humidity. [Simon Josey, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. This section has been substantially revised for clarity.
53170	47	48	49	24	Since this chapter has a broad audience I suggest you explain brielfy what reanalysis is, in the beginning of this section. [Jan Fuglestvedt, Norway]	We have now defined reanalyses in the first sentence: "Reanalyses are generally the output of a model (e.g. a numerical weather prediction model) constrained by observations using data assimilation techniques. The term has also been used to describe observation-based datasets produced using simpler methods and models (See Annex I). "

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
7738	47	50	47	50	In view of the IPCC requirement of “comprehensive, objective, open and transparent” reporting, the discussion of reanalysis requires an up-front acknowledgment that reanalysis of temperature records can be complex and even controversial. For example, Roger Pielke Sr. et al. in Documentation of Uncertainties and Biases Associated with Surface Temperature Measurement Sites for Climate Change Assessment. (Bull Amer. Met. Soc., June 2007. https://ccc.atmos.colostate.edu/pdfs/Pielke-etal_BAMS_Jun07.pdf) found major warming offsets in temperature measured by misplaced official monitoring sites. For many years, an asphalt parking lot was home to an official National Weather Service site at the University of Arizona at Tucson. Only after skeptics became aware of this was the site moved. [Forrest Mims, United States of America]	The discussion on the maintenance of observing sites is probably better placed in the section on observations, rather than reanalyses. It is just these aspects that you mention that form information for the production of high-quality, climate-ready datasets. For example, a site with a spurious heat spike relative to neighbouring sites would be highlighted and probably removed from the quality-controlled record. See Chapter 2, and references in Annex 1.
7740	47	50	47	50	On 19 Nov 2014, Jim Hansen and I spoke about climate change at a NASA-sponsored gathering of teachers at the Maryland Science Center. Afterwards, I was surprised to see a large black metal panel lying just under the instruments at the museum’s National Weather Service Station. The presence of this panel clearly warmed the site’s day time readings. (I notified the NWS and published a photo of this.) Many others have identified the lowering of early temperature records in the US and Australia during adjustments that create the impression of warming. This occurred near my permanent observing site, so I looked around the web and found many posts, some quite detailed, raising questions about this topic. A recent example: https://notalotofpeopleknowthat.wordpress.com/2018/01/25/new-yorks-temperature-record-massively-altered-by-noaa/ This cannot be cited, for it is not peer-reviewed. However, it’s symptomatic of what skeptics are posting across the web. Therefore, this section needs at least a mention of the controversy. [Forrest Mims, United States of America]	A situation similar to what you described can certainly occur, and may have some impact on the quality of the reanalysis at the local scale. But if its impact is large, the problem should be detected in the quality-control process and the record disregarded. In any case, as the aim of this section is to briefly introduce reanalysis, rather than observation systems and possible problems, there is no room for a discussion on this topic. For detailed discussions on observation systems, you may have a look at Chapter 2 and Annex 1.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
7580	47	50	48	11	I am not sure that this is a fully faithfull presentation of the genealogy and nature of reanalyses In particular, I am not sure that the term “reanalysis” has traditionally implied “gridded datasets statistically interpolated from station-based data” (page 1.48, line 8-8). The term “reanalysis” derives form the term “analysis”, which indeed initially designated “datasets statistically interpolated from station-based data”, then developed into “assimilating data using a forecast model” as weather forecasting turned numerical. However, numerical analyses (data assimilation in model) are produced since numerical weather forecast exists (a necessary step to initialize and run forecasts) while reanalyses turned up at a later time (in the mid-90s: Proceedings of the first WCRP International Conference on Reanalyses (Silver Spring, Maryland, USA, 27-31 October 1997) as a way to reduce spurious climate variability in analyses due to changes/improvements in numerical packages (so here indeed, “assimilating historical data using a single modern forecast model”). I think the (numerical) analysis step is worth mentioning. Also, there may be a confusion between analyses and forecasts (line 10). (Re)Analyses are not forecasts, and while all variables of interest can be forecasted, not all variable can be analyzed. For instance, although better observation and improved assimilation for non linear processes may change this in the future, precipitation is not currently analyzed. It is customary to refer to precipitation analyses but these are actually forecasts. The best forecast time step may or may not be 6 hours (line 10) as in some analyses / forecasts some “spin up” or “spin down” was found in the earlier forecasts. [Christophe Genthon, France]	We have now defined reanalyses in the first sentence: "Reanalyses are generally the output of a model (e.g. a numerical weather prediction model) constrained by observations using data assimilation techniques. The term has also been used to describe observation-based datasets produced using simpler methods and models (See Annex I). " There is no longer a discussion of the genealogy of reanalyses, as our assessment is of developments since AR5.
37338	47	50			Both reanalyses and datasets such as HadCRUT4 and GISTEMP are based on analysing observations and producing gridded datasets, so I would not say "Reanalyses complement observed datasets in describing ...". Reanalyses in fact use more types of observations than other types of observationally-based datasets, but differ in that they use a model-aided data assimilation system to analyse the observations rather than more direct gridding methods. I would suggest saying "Reanalyses are observationally-based datasets produced using analysis methods developed for numerical weather prediction. They complement datasets that use a more direct gridding of observations in describing ...". [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	We have now defined reanalyses in the first sentence: "Reanalyses are generally the output of a model (e.g. a numerical weather prediction model) constrained by observations using data assimilation techniques. The term has also been used to describe observation-based datasets produced using simpler methods and models (See Annex I). "
49424	47	52	47	52	I don't think that it is relevant to mention potential vorticity here, unless a definition is given, and an explanation why this is an important variable to obtain from reanalyses. [Sonya Legg, United States of America]	potential vorticity' has been replaced with 'wind-shear' as a variable that is not observed, but can be derived easily from 3-D reanalyses. "They usefully complement datasets of observations in describing the changes through the historical record because they provide gridded output, physical consistency across variables (within the limitations of the data assimilation system and model used), and information about unobserved variables (such as wind shear) and locations. "

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
37340	47	52			"model" should be changed to "data assimilation system". A data assimilation system involves both a model and a data analysis component, and both components are subject to limitations. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Some people may not understand that 'data assimilation system' means both a model and data analysis component, so, to be explicit, we have said: "Reanalyses are generally the output of a model (e.g. a numerical weather prediction model) constrained by observations using data assimilation techniques. "
37342	48	5	48	6	Add "land" to "ocean, atmosphere and cryosphere". [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	land' has been added.
37344	48	10			I suggest changing "often 6 hours" to "from six to 24 hours". The reference given is to Dee and colleagues' paper on ERA-Interim, which uses a 12-hour assimilation window. The same is true of ERA5, while ECMWF's centennial-scale analyses used 24-hour cycling. Other centres tend to use the 6h window. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	The section describing this detail has been removed.
51772	48	16	48	39	Is there a reason NCEP/NCAR reanalysis product is excluded here? [Anson Cheung, United States of America]	We have now included mention of NCEP/NCAR reanalyses: "Some studies still also use the NCEP/NCAR reanalysis, particularly because it extends back to 1948 and is updated in near real-time (Kistler et al., 2001). "
37346	48	18			The main journal article on JRA-55 is Kobayashi et al. (2015; doi: 10.2151/jmsj.2015-001). Harada and Ebita, whose papers are referenced on this line, are co-authors with Kobayashi. Ebita, Harada and Kobayashi are successive leaders of the Japanese reanalysis project. Perhaps all three references can be used. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	The citations are as follows: "Japanese 55-year Reanalysis (JRA-55) (Ebita et al., 2011; Kobayashi et al., 2015; Harada et al., 2016) "
26382	48	19	48	19	Isn't it the satellite era that stretches post-1979, rather than the post-satellite era? [Jochem Marotzke, Germany]	No applicable. This text has been removed.
31596	48	26	48	26	"the inclusion is the" should be "the inclusion of the" [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	This has been corrected. Thanks.
58006	48	26			Of note is the inclusion is the assimilation ???? [Tomas Halenka, Czech Republic]	This typo has been corrected to 'is the inclusion of the assimilation'
17892	48	28	48	28	A clumsy formulation: '...reanalysis cooled sharply...' Please reformulate it. [Branko Grisogono, Croatia]	This has been reworded to say: "However, the average global surface temperature from MERRA-2 is far cooler in recent years than temperatures derived from ERA-Interim and JRA-55, which may be due to the assimilation of these new components (see Chapter 2)."

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
56118	48	31	48	31	The avaiability an the advantages of ERA 5 should be rought out more celearly in the final report. For example, first cpmparisons of ERA 5 and ERA-Interim are bcoming availabe now (e.g. Hoffmann et al. Atmos Chem. Phys., 2019) [Rolf Müller, Germany]	The advantages of ERA5 have been elucidated further: "Higher resolution means a better representation of Lagrangian motion convective updrafts, gravity waves, tropical cyclones, and other meso- to synoptic-scale features of the atmosphere (Hoffmann et al., 2019). ERA5 also saw improvements in the forecast model and assimilation system compared to ERA-Interim, producing smaller errors when compared to observations, increasing the usefulness of these reanalyses (Hoffmann et al., 2019). "
37348	48	32			Hersbach and Dee (2016) should be replaced as a reference by Hersbach et al. (2019, submitted). Hersbach and colleagues' paper is expected to be submitted within the next month, and subject to acceptance by the journal will be the standard peer-reviewed reference for ERA5. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Hersbach et al. 2019 was not available to us at the time of submitting the SOD, but we will continue to look for it.
37350	48	33			Change "but will be extended" to "but is being extended". [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Changed to: "...years 1979 to the present but is being extended back to 1950. "
47428	48	41	48	48	For ocean reanalysis, a big progress has been made in recent 5 years. The current paragraph is not comprehensive and a webpage including the current status of this topic can be referred to, https://reanalyses.org/ocean/overview-current-reanalyses [Hong-Li Ren, China]	Thank you for the link. We have expanded the new developments in ocean reanalyses, but there is more to do in revision of SOD.
17894	48	41	48	48	Please state the fine resolution implied. [Branko Grisogono, Croatia]	Taken into account. Given the range of ocean reanalyses, references have been added to highlight the improved resolution: Zuo et al., 2017; Lellouche 8 et al., 2018; Heimbach et al., 2019.
37352	49	9	49	10	It is not only 20CR that uses an ensemble data assimilation method. Ensemble data assimilation was used for ERA-20C and CERA-20C, and is being used for ERA5. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	The text has been made more general, to say that many reanalyses include an ensemble.
27660	49	12	49	12	replace with published article (Compo et al) [Poot Delgado Carlos Antonio, Mexico]	20th Century Reanalysis (Compo et al., 2011; Slivinski et al., 2019) have been added.
26384	49	12	49	12	Compo et al. (in prep) not in ref. list. [Jochem Marotzke, Germany]	20th Century Reanalysis (Compo et al., 2011; Slivinski et al., 2019) have been added.
31598	49	15	49	15	Maybe Hugues Goosse could help out with this section? https://www.elic.ucl.ac.be/modx/index.php?id=79 [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	This section has now been added, including references cited at the website that you gave. Thank you.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
53172	49	25	49	25	Explanation of use of reanalysis in CMIP6 would be useful to have here. [Jan Fuglestvedt, Norway]	One key use is in GSAT: "One of the most important developments in the uses of reanalyses in the context of this assessment is their inclusion in the estimation of the global surface air temperature to help make the assessments on changes in GMST and GSAT (see Cross-Chapter Box 2.3)." Initialisation for decadal prediction is also noted. And the fact that ocean reanalyses do not quite represent the ocean variability well enough to be used extensively in this report. This could be further developed as we review the SOD.
15104	49	28	48	55	The reliance on bottom up models unconstrained by the top down requirements of the laws of physics is fundamentally flawed. Climate models have a very poor history of predicting the future climate owing to the many knobs and dials used to tune the models and the lack of confidence in what values for those knobs and dials make sense. They are consistently tuned to expectations which is not how simulations are supposed to work. The goal of a simulation is physical correctness and not to produce results consistent with policy goals, expectations or political ideology. [George White, United States of America]	Noted. It is unclear what revision is requested here. The performance of past IPCC projections of the future climate is assessed in section 1.3.5.
48264	49	28	49	28	Please include reference to regional climate models and CORDEX (Coordinated Regional Downscaling Experiment) in this section. [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Reference to CORDEX added.
57302	49	28	49	28	Like the section on the history of climate scence, 1.4 seems to me to be an excellent and well-written section that, sadly, might need to be shortened a lot. Keep the text, which is excellent, for a review paper. [Myles Allen, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. The section has been shortened.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
35144	49	28	49	29	After 1.4.3 Climate Models, consider inserting following text: As stated in AR6 1.3.4 Key findings of previous IPCC assessments (Page 39) the scope of evidence considered by Working Group I (WGI) of the IPCC is that of: “independent scientific analyses from observations of the climate system, palaeoclimate archives, theoretical studies of climate processes, statistical models and simulations using climate models”. The type of simulation most commonly used in climate science is often alternatively termed a global circulation model (GCM). Hence the models of the climate system used in the scope of evidence considered by Working Group I (WGI) of the IPCC can be seen to be statistical models and simulation models. Karplus (1977, 1992) has provided a framework for the characterisation and classification of models of systems. Enting (1987, 2010) and Cruz et al. (2017) have used this framework to assess model types used in climate studies. In connection with his framework (Leggett and Ball (2018), Karplus (1992) observes that valid models of systems are the key to the successful prediction of the response (outputs) of systems to specified excitations (inputs). Karplus goes on to observe that there are numerous techniques, but all can be regarded as employing combinations of deduction and induction in varying proportions. Deduction means starting with something general and deriving something specific (we start with the law and deduce the model). Induction means starting with specific information and inferring something	Rejected. The sentence in 1.3.4 does not need repeating in 1.4.3. Section 1.4.3 has been shortened and has become section 1.5.3. The references proposed by the reviewer are not added because they do not present new model developments significant in the context of this assessment.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
35146	49	28	49	29	Following above, consider inserting following text: 1.4.3.1 Empirical/statistical models As with process-based models, statistical models are widely used in climate science across time and spatial scales. They are used to gain insight into the climate of the past and present, and to project future climate. [Overview of statistical studies needed here – an approach could e mode to the authors of the review Granger Causality Analyses for Climatic Attribution Atmospheric and Climate Sciences, 2013, 3, 515-522 http://dx.doi.org/10.4236/acs.2013.34054, Alessandro Attanasio, Antonello Pasini1, Umberto Triacca] Using statistical modelling in the form of dynamic regression time-series analysis with autocorrelation correction, Leggett and Ball (2015) investigated the mismatch between the observed global surface temperature trend and that expected from the majority of process-based climate models. This mismatch was quantified as the difference between the trend in the level of CO2 and the trend in temperature. Leggett and Ball (2015) showed that the change in level of CO2 (first-difference CO2) leads temperature and that there is a highly statistically significant correlation between first-difference CO2 and temperature. Further, a correlation was found for second-difference CO2 with the Southern Oscillation Index, the atmospheric-pressure component of ENSO. Leggett and Ball (2015) also showed that both these correlations displayed Granger causality of their relevant climate variables. It was shown that the first-difference CO2 and temperature model shows no trend mismatch in recent years.	Rejected. The sentence in 1.3.4 does not need repeating in 1.4.3. Section 1.4.3 has been shortened and has become section 1.5.3. The references proposed by the reviewer are not added because they do not present new model developments significant in the context of this assessment.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
28122	49	28	49	29	After 1.4.3 Climate Models, consider inserting following text: As stated in AR6 1.3.4 Key findings of previous IPCC assessments (Page 39) the scope of evidence considered by Working Group I (WGI) of the IPCC is that of: “independent scientific analyses from observations of the climate system, palaeoclimate archives, theoretical studies of climate processes, statistical models and simulations using climate models”. The type of simulation most commonly used in climate science is often alternatively termed a global circulation model (GCM). Hence the models of the climate system used in the scope of evidence considered by Working Group I (WGI) of the IPCC can be seen to be statistical models and simulation models. Karplus (1977, 1992) has provided a framework for the characterisation and classification of models of systems. Enting (1987, 2010) and Cruz et al. (2017) have used this framework to assess model types used in climate studies. In connection with his framework (Leggett and Ball (2018), Karplus (1992) observes that valid models of systems are the key to the successful prediction of the response (outputs) of systems to specified excitations (inputs). Karplus goes on to observe that there are numerous techniques, but all can be regarded as employing combinations of deduction and induction in varying proportions. Deduction means starting with something general and deriving something specific (we start with the law and deduce the model). Induction means starting with specific information and inferring something	Rejected. The sentence in 1.3.4 does not need repeating in 1.4.3. Section 1.4.3 has become 1.5.3 and has been shortened. The references proposed by the reviewer are not added because they do not present new model developments significant in the context of this assessment.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
28124	49	28	49	29	Following above, consider inserting following text: 1.4.3.1 Empirical/statistical models As with process-based models, statistical models are widely used in climate science across time and spatial scales. They are used to gain insight into the climate of the past and present, and to project future climate. [Overview of statistical studies needed here – an approach could e mode to the authors of the review Granger Causality Analyses for Climatic Attribution Atmospheric and Climate Sciences, 2013, 3, 515-522 http://dx.doi.org/10.4236/acs.2013.34054, Alessandro Attanasio, Antonello Pasini1, Umberto Triacca] Using statistical modelling in the form of dynamic regression time-series analysis with autocorrelation correction, Leggett and Ball (2015) investigated the mismatch between the observed global surface temperature trend and that expected from the majority of process-based climate models. This mismatch was quantified as the difference between the trend in the level of CO2 and the trend in temperature. Leggett and Ball (2015) showed that the change in level of CO2 (first-difference CO2) leads temperature and that there is a highly statistically significant correlation between first-difference CO2 and temperature. Further, a correlation was found for second-difference CO2 with the Southern Oscillation Index, the atmospheric-pressure component of ENSO. Leggett and Ball (2015) also showed that both these correlations displayed Granger causality of their relevant climate variables. It was shown that the first-difference CO2 and temperature model shows no trend mismatch in recent years.	Rejected. The sentence in 1.3.4 does not need repeating in 1.4.3. Section 1.4.3 has been shortened and has become section 1.5.3.. The references proposed by the reviewer are not added because they do not present new model developments significant in the context of this assessment.
7742	49	28	49	36	This introduction to one of the major sections of Chapter 1 needs to at least mention the fact that while climate models have advanced since AR5, significant improvements are ongoing. Meanwhile, in keeping with the IPCC requirement that this report be “comprehensive, objective, open and transparent,” it is important to at least mention that models are subject to uncertainty and its potential consequences. For example, a highly relative quotation is by S. Kravtsov et al., who found “decadal mismatches between model-simulated and observed climate trends are common throughout the twentieth century, and their causes are still poorly understood.” (Global-scale multidecadal variability missing in state-of-the-art climate models. Climate and Atmospheric Science. 1, 2018, https://indd.adobe.com/view/da3d0bde-1848-474d-b080-f07200293f91). Judith Curry has provided a detailed review of the problems inherent in long range forecasting and the application of uncertain forecasts in public policy. (Climate uncertainty and risks. US CLIVAR 16,3, 2018, https://indd.adobe.com/view/da3d0bde-1848-474d-b080-f07200293f91). Many others have made similar assertions. These concerns should be acknowledged up front and not be buried in the complex discussions that follow. [Forrest Mims, United States of America]	Noted. The introduction of this subsection is modified to take into account this and other remarks.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
28126	49	28	49	55	Consider replacing existing text with: 1.4.3.2 Numerical Climate Models As with statistical models, numerical models (alternatively called process-based models or simulation models) are widely used in climate science across time and spatial scales. They are used to gain insight into the climate of the past and present, and to project future climate. Process-based models are also used to perform stylized experiments, such as instantaneous changes to climate parameters (e.g. a doubling of CO2 concentrations or an increase in the solar constant) (Eyring et al.,2016a; Myhre et al., 2017), or simulations of the climate conditions of aquaplanets (Webb et al., 2017), in order to gain insight into key processes and feedback mechanisms. Global Earth System Models (ESMs) are the most complex models which form the basis for assessments of future climate assessed by the IPCC. At the core of each ESM is a process-based model of the physical climate system called a Global Circulation Model (GCM), to which are added models of the terrestrial and 41 oceanic carbon cycles. The evolution of process-based models up to AR5 was outlined in Section 1.3. We discuss in this section the main evolutions of ESMs since the AR5. Key characteristics of the GCMs participating in CMIP5 and CMIP6 are listed in Annex III, and a synthesis is provided in Table 1.2. 46 47 1.4.3.1 Earth System Models 48 49 Earth system models are process-based models. They therefore consist of mathematical formulations of the laws that govern the evolution of climate-relevant 50 systems: atmosphere, ocean, cryosphere, geosphere, biosphere. The laws may be fundamental laws of 51 physics (e.g., Navier stokes equations and thermodynamics for	Rejected. the reviewer's suggestion does not enhance readability and it is not compatible with the requirement to shorten section 1.4.3.
53176	49	28	53	38	important that this section is used and referred to by other chapters. Would be good to link up with authors in there, if you havent already done so. [Jan Fuglestvedt, Norway]	Noted. Link has been made with chapters 3, 4 and 10
27320	49	28	64	49	Not sufficient emphasis on deep uncertainties associated with a complex coupled ocean-atmosphere-cryosphere non-linear chaotic climate system (AR5). Using ensembles and different CIMP5-6 models with emergent constraints does not remove the fundamental intrinsic problems&limitations of climate modelling. Same model outcome with conflicting tuning/parameterisations is current reality. The modelling community should be more explicit transparent about the current modelling reality : a good tuning-calibration fit of past climate records with different (often conflicting) tuning techniques does not provide a good scientific basis for confidence in future climate projections-scenario's. [ferdinand meeus, Belgium]	Noted. more links are made to other parts of the report, where these issues are discussed. A subsection discussing models "fitness for purpose" (1.5.4.8) has been added.
53076	49	28			1.4.3. may be a bit unbalanced between the various parts. You may consider shortening the longest one (the ocean and crysosphere). [Jan Fuglestvedt, Norway]	Accepted. the outline of 1.4.3. has been revised and the section shortened.
58010	49	28			Should concept of regional climate models appear briefly here in this subsection?!?! [Tomas Halenka, Czech Republic]	Accepted. The link is made clear with section 10, where downscaling is presented in more detail.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
51774	49	30	49	36	I think it's important to mention that models are also used to explore mechanisms of certain phenomenon observed in the instrumental record through partial assimilation/partial coupling experiments (e.g. Kosaka and Xie 2013 doi: https://doi.org/10.1038/nature12534; McGregor et al. 2014 doi: https://doi.org/10.1038/nclimate2330) [Anson Cheung, United States of America]	Taken into account in subsection 1.5.2 on new uses of reanalyses.
29518	49	34	49	34	"increase in solar constant": Total solar irradiance is not a constant! It is variable on timescales of the 11-year solar cycle, as well as shorter (27-day) and longer periods (88, 205yrs). [Katja Matthes, Germany]	Taken into account. text revised.
29282	49	35	49	36	Besides the prediction and the simulation fo current climate, models of varying complexity, from very idealized to very complex, are used to understand the physical mechanisms underlying the climate dynamics, a all space and time scales. I think the concept of hyerarchy of models (see e.g. I Held BAMS p. 1614, NOVEMBER 2005) shoild be mentioned here. [Fabio D'Andrea, France]	Noted - see new introduction of 1.4.3, which has become 1.5.3 in the SOD.
15228	49	38	49	44	Shouldn't Chapter 3 be part of these pointers? [Claudia Tebaldi, United States of America]	Accepted, text modified
42016	49	40	49	40	"Globlal" should be "Global" [Knud Boesgaard Christensen, Denmark]	Taken into account. "General Circulation Model" is used.
55084	49	40	49	40	GCM has already been define as something else (general circulation model) earlier in the chapter [Trude Storelvmo, Norway]	Taken into account. "General circulation Model" is used.
48266	49	40	49	40	"GCM" should be either "General Circulation Model" or "Global Climate Model". [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. "General circulation Model" is used.
51776	49	40	49	41	I believe it's not just carbon cycle, but more like biogeochemical cycles for many models? [Anson Cheung, United States of America]	Taken into account. text revised, now in section 1.5.3.1
6617	49	51	49	51	correct to "Navier-Stokes" [Tim Christiane Thys, Belgium]	Accepted. The term has been changed to "Navier-Stokes".
17898	49	51	49	51	Stokes' capitalized. [Branko Grisogono, Croatia]	Accepted. The term has been changed to "Navier-Stokes".
58004	49	51			Navier-Stokes [Tomas Halenka, Czech Republic]	Accepted. The term has been changed to "Navier-Stokes".
37354	49	51			After "physics (e.g. …)" one could add "and, in some cases, chemistry". [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The text has not been revised , to keep it concise.
15230	49	54	49	55	This sentence seems to equate higher resolution with higher relevance and better accuracy while I would say that it is simply a variable to consider or condition upon, when evaluating relevance and accuracy of different models' output. [Claudia Tebaldi, United States of America]	The sentence has been revised in section 1.5.3.1: "the spatial resolution of these grids is an important measure of the expected skill of the model in reproducing or projecting the evolution of physical phenomena."
39158	49	54	49	55	There is not obvious relationship between model resolution and model accuracy, therefore the resolution is not a measure of accuaracy of the model solutions. The accuracy of model solution is associated with model algorithm. [Lijuan Li, China]	The sentence has been revised in section 1.5.3.1: "the spatial resolution of these grids is an important measure of the expected skill of the model in reproducing or projecting the evolution of physical phenomena."

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
48268	49	55	49	55	Spatial resolution is not a measure of "accuracy" of model solutions, please rephrase accordingly. [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	The sentence has been revised in section 1.5.3.1: "the spatial resolution of these grids is an important measure of the expected skill of the model in reproducing or projecting the evolution of physical phenomena."
8244	50	4	50	11	In Table 1.2, 2 column, please change country to country or regions [Zong Ci Zhao, China]	Rejected. This table is consistent with the information that the modelling groups have provided in the CMIP6 database.
13126	50	5	50	10	For Table 1.2, use a stronger color scheme and make sure the table is not blurry. [Nora Richter, United States of America]	Accepted. The table has been revised.
17900	50	9	50	10	The Table 1.2 is hardly readable and thus barely useful. If you cannot improve it, just say how many models were used. [Branko Grisogono, Croatia]	Accepted. The table has been revised.
6684	50	14	51	12	Please consider cross-referencing ocean resolution discussion to chapter 9 where there is a figure to illustrate the relevance [Helene Hewitt, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. Figure 9.2 in the first order draft does not appear anymore in chapter 9 for the second order draft.
8006	50	20	50	20	ICON definitely has a very structured, icosahedral grid in the atmosphere. Perhaps you are referring to the ocean in this model? Not sure which grid that is using. [Olaf Morgenstern, New Zealand]	Noted. However, the section (section 1.5.3 in the SOD) has been shortened in response to the comments. The ICON model is no longer referred to in detail.
7790	50		50		Table1.2: Please increase the quality of the table. It is blurred. [Merja Tölle, Germany]	Accepted. The table has been revised.
39150	50		50		The Country of AS-RCEC in Table 1.2 should be China. [Lijuan Li, China]	Rejected. This table is consistent with the information that the modelling groups have provided in the CMIP6 database.
8008	51	10	51	12	This formulation can be misunderstood to imply that high resolution is necessary to resolve this SST bias. Hyder et al. (2018) show that the SST warm bias is predominantly caused by a cloud issue documented in AR5. I don't believe that resolution is the main problem here. (https://www.nature.com/articles/s41467-018-05634-2) [Olaf Morgenstern, New Zealand]	Taken into account. The text has been shortened, the southern ocean example is not longer mentioned.
53174	51	17	51	23	Fig 1.8 is very useful. Hope it will be kept. (Coordinate with other chapters) [Jan Fuglestvedt, Norway]	This comment has been considered during the preparation of the FGD. (In FGD) Taken into account. The figure has been kept (Figure 1.19) and the information has been coordinated with Chapter 9 and Annex II.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
15106	51	36	51	53	Clouds are an enigma that drives the system towards a desired equilibrium and trying to out-psych their behavior in order to determine what that equilibrium will be is fraught with peril. For example, no GCM can faithfully reproduce the relative behavior of clouds and the surface temperature as shown here: http://www.palisad.com/co2/sens/st_ca.png The reversal at 0C is a consequence of when the surface is covered by ice and snow, clouds have little, if any, effect on the albedo, while above 0C they have a large effect. That the behavior of clouds changes in response to changes in the system indicates that clouds are a free variable that adapts to the conditions which is reinforced by the fact that balance can be achieved for any amount of clouds. Unless a GCM/ECM can reproduce all of the relationships seen here: http://www.palisad.com/sens as well as the seasonal variability shown here: http://www.palisad.com/co2/plots/wbg/plots.html any of its predictions are absolutely meaningless. [George White, United States of America]	Not applicable in this section on new model developments. It is unclear what revision is requested by the reviewer. The links do not point to peer-reviewed literature.
8010	51	45	51	46	This sentence feels like and apples-to-pears comparison. ESMs target the interactive representation of GHGs, whereas CCMs usually target the interactive simulation of ozone. Saying that CCMs are more detailed than ESMs puts them into one category, and also ignores that many ESMs double as CCMs. I'd just drop "more detailed". [Olaf Morgenstern, New Zealand]	Accepted. The discussion of models has been shortened, Chemistry climate models are no longer discussed.
39156	51	45	51	54	The parameterization of anthropogenic aerosol optical properites and associated Twomey effect by Stevens et al. (2017) should be introduced in this paragraph, which is recommended by CMIP6 and used by many models. [Lijuan Li, China]	The discussion of models has been shortened. The Stevens et al reference is included in the presentation of aerosol forcing in CMIP, section 1.5.4.2
6686	51	56	52	46	Please consider cross-referencing ocean and cryosphere model discussion to chapter 9 to ensure consistency and generally reducing the detail here (which seems at odds with the atmosphere model descriptions) and reference chapter 9 [Helene Hewitt, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. This section has been shortened. Reference to chapter 9 will be added in the FGD.
45400	51	56	52	46	Links to the appropriate discussions in Chp 9 should be added. [Baylor Fox-Kemper, United States of America]	Accepted. This section has been shortened. References to chapter 9 has been added to the FGD.
31600	52	11	52	46	The cryospheric sections here seem to have substantially more detail than the other sections…maybe they could be reduced somewhat? (or the other sections increased) [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. The whole section on earth system models has been shortened.
49426	52	13	52	13	"although such refinements are still not incorporated into CMIP6". That depends on the particular CMIP6 model. For example GFDL's CM4 will include the iceberg parameterization of Martin and Adcroft 2010. [Sonya Legg, United States of America]	Taken into account. text revised.
6688	52	13			UKESM and HadGEM3 GC3 both run with interactive icebergs. This seems a little detailed maybe for chapter 1 and better to refer to chapter 9? [Helene Hewitt, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. text revised. References to chapter 9 will be added in the FGD.
33398	52	20	52	21	Given the past two years of low Antarctic sea ice, it may be worth it to check to see if the sea-ice extent trend is still increasing. [Marcus Sarofim, United States of America]	Rejected. The sentence refers to the trend in past decades. Sea ice trends and the underlying processes are documented in more detail in chapters 2 and 9.
8012	52	23	52	23	Incomplete sentence. Please fix. [Olaf Morgenstern, New Zealand]	The sentence has been revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
38394	52	27	52	32	I do not agree that improvements in sea-ice models have contributed to understanding the biases of sea-ice simulations. In Notz and Stroeve (2016) (cited in line 26), we argue that most of the biases in sea-ice evolution derive from biases in the atmospheric (and possibly oceanic) forcing of the sea-ice cover, rather than from the lack of representing specific details of the sea-ice cover itself. We currently have a paper under review for BAMS that establishes this point more firmly, which I'll send to Hui-Wen Lai. [Dirk Notz, Germany]	Not applicable. The whole paragraph has been shortened to address other comments. The causes of biases are no longer discussed.
8014	52	31	52	32	Paper by Lettie Roach et al. on interactive floe-size distributions in sea-ice modelling could be cited here. https://doi.org/10.1029/2017JC013692; https://doi.org/10.5194/tc-12-365-2018; [Olaf Morgenstern, New Zealand]	Not applicable. The whole paragraph has been shortened to address other comments. Specific parameterizations are no longer discussed.
50542	52	34	52	46	I suggest to have one section describing the progress for ice sheets and another section for glaciers. Despite some similarities, models looking at the future evolution of glaciers (on a large regional to global scale) are very different from ice sheet models. As it is written now, both can be easily confused. [Frank Paul, Switzerland]	Not applicable. The whole section on earth system models has been shortened to address other comments. The text on ice sheet and glacier models has been revised.
35304	52	55	53	2	This statement that no CMIP6 ESMs include permafrost carbon feedbacks in an interactive manner is not correct. CO2 and CH4 emissions from permafrost were added to the Community Land Model, version 4.5, as described in Koven et al 2013 (doi:10.5194/bg-10-7109-2013) and 2015 (https://doi.org/10.1073/pnas.1415123112). Because of the wide use of CLM4.5 and CLM5 throughout the CMIP ESMs, a representation of the CO2 feedbacks from permafrost are thus included in an interactive manner in 4 CMIP6 ESMs: CESM2, E3SM, NorESM2, and CMCC-ESM2. [Charles Koven, United States of America]	The whole section on earth system models has been shortened to address other comments. The representation of permafrost is no longer discussed.
42846	53	19	53	29	Note that ensemble simulations also create computing demands - not as large or nonlinearly scaling as the increase in process representation described in this section, but to make large ensembles that were shown post AR5 to be important for representing the internal variability more accurately - e.g. NCAR large ensemble experiments - important. [Michael Evans, United States of America]	Noted. However, the figure and the discussion have now moved to section 1.5.3.3. ("from global to regional models"). Ensemble modelling techniques are discussed in section 1.5.4.1
7594	53	19	53	29	Also mention variable resolution global models (équé, M., Marquet, P. & Jones, R. Climate Dynamics (1998) 14: 173. https://doi.org/10.1007/s003820050216, their are likely more recent references available), particularly if these contribute significantly to CORDEX. [Christophe Genthon, France]	The whole section on earth system models has been shortened to address other comments, and the outline has been revised. A reference to chapter 10, where downscaling methods are presented, has been added in section 1.5.3.3.
31744	53	20	53	22	It is not clear what the number of "climate centres" refers to. In CMIP1 the each climate model was, I believe, primarly developed by a team within a single institution. For CMIP6 the models are often the result of national or international collaborations involving multiple institutions. In the CMIP6 archive the results are typically listed under the name of a lead institution, but it would be mis-leading to record the number of lead institutions as the number of independent centres involved. [Martin Juckes, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The text has moved to section 1.5.3.3. (from global to regional models). The text will be revised when the final list of CMIP and CORDEX models used for this report is finalized.
37356	53	21			Perhaps "slowly" could be deleted. Or consider replacing it by "gradually". Quality and independence are required of CMIP models, and it may not be appropriate to suggest that development could have been quicker. [Adrian Simmons, 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
31742	53	26	53	28	“Regional information can be derived from standard CMIP6 models using regional climate models and downscaling techniques, presented in Chapter 10 and in the Atlas”: this is mis-leading. Regional information can be obtained directly from the CMIP6 model output (as done in the Atlas): downscaling can be used to derive local information at sub-regional scales not resolved by the global models. Calibration techniques (often referred to using the mis-leading jargon “bias correction”) can be used to problems associated with model uncertainty and climate variability at regional scales. “Regional Climate Models” can be used to represent processes which are not resolved in the global models and which may add skill to the projections in some regions and some parts of the model parameter space. A better formulation would be “Regional information from global CMIP6 models can be extended by using regional climate models and downscaling techniques, presented in Chapter 10 and in the Atlas” (note that CMIP6 includes some regional ice-sheet models simulating ice-sheet dynamics of Greenland and Antarctica). [Martin Juckes, United Kingdom (of Great Britain and Northern Ireland)]	A few details have been added to the text in the new subsection 1.5.3.3. "from global to regional models", but chapter 1 needs to be concise. The more complete description of downscaling methods, bias corrections ... is found in chapter 10.
31738	53	28	53	29	“Regional climate models are more diverse ...” provide a citation or (recommended) remove this and concentrate on the wider community of scientists. I don’t believe that the WG1 community has a robust means of assessing diversity in models, though this is an interesting idea. [Martin Juckes, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. The sentence has been revised.
42848	53	43	54	15	The last sentence of this section suggests that EMICs are systematically "wrong" and ESMs "right" - could it be the other way around for equilibrium simulations? Is the answer complicated by the lack of large ensembles and consistent external radiative forcing between the various classes of models? Give the argument in favor of EMICs even if the consensus of the community is a move toward ESMs even for long TCR and ECS-targeting experiments. For this purpose are EMICs being replaced by emulators? There is much active EMIC development, for instance with cGENIE (http://www.seao2.info/mycgenie.html). I am surprised to read there is no coordinated EMIC activity in support of the AR6. [Michael Evans, United States of America]	Noted. No change. The text does in fact not suggest what the reviewer claims it does. It highlights potential issues with EMICs related to their reduced complexity that have been raised in recent publications. Regarding a coordinated effort for the AR6: There is none, so far.
58008	53	45			AOGCMs or ESM to better identify where the gap is [Tomas Halenka, Czech Republic]	Taken into account. Text has been revised: replaced "AOGCMs and ESMs" by "AOGCMs or ESMs"
8838	53	53			an important reference should be added: Plattner, G.-K., R. Knutti, F. Joos, T.F. Stocker, W. von Bloh, V. Brovkin, D. Cameron, E. Driesschaert, S. Dutkiewicz, M. Eby, N.R. Edwards, T. Fichefet, J.C. Hargreaves, C.D. Jones, M.F. Loutre, H.D. Matthews, A. Mouchet, S.A. Mueller, S. Nawrath, A. Price, A. Sokolov, K.M. Strassmann, and A.J. Weaver, Long-term climate commitments projected with climate - carbon cycle models, J. Clim., 21, 2721-2751, 2008. [Thomas Stocker, Switzerland]	Accepted. Add reference here for the AR4 EMICs intercomparison in addition to the Zickfeld et al. AR5 EMICs intercomparison
46132	54	19	54	19	This section should include examples of how "the behaviour of ESMs depends on the tuning strategy" from the cited work (Hourdin et al., 2017) [Cynthia Randles, United States of America]	Noted. This section (1.5.3.2 in the second order draft) has been expanded to document tuning practices for CMIP6. Due to constraints of length chapter 1 cannot provide an exhaustive discussion of Hourdin et al. Note that a reference to another paper comparing tuning practices has been added (Schmidt et al, 2017).

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
53178	54	26	54	35	This para contains important information. Very useful to be aware of this - and to make improvements. Connections to WGIII are needed on this. [Jan Fuglestvedt, Norway]	Taken into account. The paragraph on simple models/emulators is revised.
25570	54	27	54	27	Give specific reference (section or page) within 1.5 Report. [Stephen E Schwartz, United States of America]	Taken into account. The sentence has been rewritten.
33400	54	31	54	32	Consider adding Hector (Hartin et al.) to the list of simplified climate models. [Marcus Sarofim, United States of America]	Taken into account. The paragraph on simple models/emulators is revised.
42926	54	31	54	41	for this section, for drfift tuning, note the idea that for climate change studies on timescales of revelance here, the actual climate might never be in equilibrium (e.g. b/c of the slowly varying deep ocean integrating over centuries); e.g. Gebbie and Huybers (2019); maybe we need to select from a large ensemble the simulations most similar to estimated drift in ocean properties for the preanthropogenic period to carry forward projections? [Michael Evans, United States of America]	Noted. Considering the CMIP6 documentation available at the time of the second order draft, only a minority of models are tuned for their trends during the historical period. Due to constraints of length we don't discuss trend tuning in detail.
38950	54	41			Inclusion of a section on model tuning is welcome and appreciated. But, users might wonder how they can make sensible use of outputs of "tuned" models? Full discussion may not be possible, but concise remarks would be appreciated. [Masahide Kimoto, Japan]	The section on model tuning has been expanded based on the CMIP6 documentation available at the time of the second order draft. We note that only 4 out of 29 models are tuned for their equilibrium sensitivity; ECS is thus an emergent property for the majority of CMIP6 models.
28472	54	43	54	52	This extension of a list over multiple sentences is somewhat problematic. The text could easily be rewritten to avoid this. [David Schoeman, Australia]	Editorial. The text will undergo professional copy-editing before publication.
7596	54	45	54	45	'different mathematical formulations », not sure this is correct. The mathematics (differential equations) is the same in all models but the numerics used to solve the equation differs (e.g. finite difference vs finite elements vs spectral). [Christophe Genthon, France]	Noted, not yet taken into account in this draft.
36640	54	46			"no unique equations…" I think it would be fair to add that our understanding of these complex biological processes is exceedingly limited and represents a source of potential error that is almost unquantifiable. The response of these biolgical systems to future warming is an almost impossible challenge to model in a meaningful way. The primary variables are genetic not simply physical and therefore are currently unquantifiable. [Paul Copland, New Zealand]	Noted. Chapter 1 briefly introduces new model developments and modelling techniques. Evaluation of models against observations is done in chapter 3, the use of models for projections is discussed in chapter 4, and model of biogeochemical cycles are discussed in chapter 5.
17902	54	54	55	39	Too soft and unclear about the parameterization approaches. Are only 1st order schemes used for turbulence parameteroization or bettter? Likewise, please make at least 1 sentence about key parameterizations . [Branko Grisogono, Croatia]	Noted. This section is not about new developments in parameterizations, but about coupled model tuning. This is made more clear in the text.
31602	55	2	55	2	I would call this a scientific process rather than an "art" ! [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. The sentence has been rewritten.
31604	55	10	55	12	""“the climate system should reach a mean equilibrium temperature close to observations when energy received from the sun is close to its real value (340 w.m-2)”." It is not clear where this comes from. Needs a citation. Also, units are not expressed in the IPCC standard. ALso, "energy received from the Sun" needs to be defined more precisely. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Noted. This sentence is taken from Hourdin et al 2017.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
27662	55	12	55	12	subscript (340 w.m-2) [Poot Delgado Carlos Antonio, Mexico]	Accepted. The text has been revised.
8016	55	13	55	13	Indeed knowing which models have undergone tuning so that historical simulations produce a good simulation of surface temperature is of prime importance in Ch3. Would it be possible to have a table that captures this essential information? [Olaf Morgenstern, New Zealand]	Taken into account. The tuning strategies are documented in more detail and the available information has been provided to other chapters.
25572	55	21	55	21	the website https://explore.es-doc.org/ is a very useful resource for description and comparision of models. I suggest that this link be provided earlier, at introduction fo the discussion of the models and be given more prominence. [Stephen E Schwartz, United States of America]	Noted. An introduction to section (1.5.3. in the second order draft) has been added but for the sake of length it cannot mention the tools for model documentation. ES-doc is described in annex III.
39152	55	37	55	39	The trend tuning of the preindustiral control simulation, aiming to the smallest drift, is basic for other type CMIP experiments, and it should be included. [Lijuan Li, China]	The section has been expanded, but it will evolve again as more CMIP6 documentation becomes available. We use the words "equilibrated pre-industrial balance" rather than "trend tuning aiming for that smaller drift".
42850	55	42	55	42	section 1.4.4 description of large ICEs: replace description with specific quantification of the "tiny" and "slightly" differences in the ICE members. For instance, would it be possible to give the mean percent difference in ICEs across the experiments, typically? Is it closer to 0.01%, 0.1%, 1%, 10%? [Michael Evans, United States of America]	Rejected. I see the point, but it is difficult to be so specific in a generic description. The text is revised to be more clear, though.
42852	55	42	55	42	section 1.4.4. Add introduction to stochastic parameterization approach that samples the structural uncertainty in the models - e.g. https://arxiv.org/abs/1510.08682 and related literature. [Michael Evans, United States of America]	Thanks. The discussion has been somewhat extended, in line with this comment.
47458	55	42	56	39	Overall chapter 1 is very sucessful for framing with comprehensive overview on most of aspects assessed in later chapters. More cross-referencing to other chapters on relevent issues will be useful. Subsection 1.4.4 on modeling techniques may need cross-referencing and coordination with subsection 4.2.1 on ensemble methodologies in Chapter 4. [June-Yi Lee, Republic of Korea]	Noted. We have interacted with Chapter 4 on linking better.
53180	55	42	62	42	1.4.4 is an important section. Should be used and referred to by other chapters. [Jan Fuglestvedt, Norway]	Noted. Thanks.
27664	55	44	55	52	Single line spacing [Poot Delgado Carlos Antonio, Mexico]	Editorial
26386	56	1	56	7	No single reference in entire paragraph, which refers to concrete progress since the AR5. [Jochem Marotzke, Germany]	References have been added during revision.
29946	56	1	56	7	ICEs are also important for isolating the forced response in a particular climate model. Since this is often a major uncertainty, it should be mentioned. [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	Thanks. The text has been revised in line with the proposal.
27666	56	1	56	15	Single line spacing [Poot Delgado Carlos Antonio, Mexico]	Editorial
26388	56	9	56	15	Paragraph seems misplaced, would more logically come in line 25. [Jochem Marotzke, Germany]	Thanks.
27668	56	22	56	39	Single line spacing [Poot Delgado Carlos Antonio, Mexico]	Editorial

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
38952	56	26	56	33	There is a study that attemted to construct an emsemble that account for uncertainties related not only to parameters but also to the physics packages. Shiogama, H., M. Watanabe, T. Ogura, T. Yokohata, and M. Kimoto, 2013: Multi-parameter multi-physics ensemble (MPMPE): A new approach exploring the uncertainties of climate sensitivity. Atmos. Sci. Lett., doi: 10.1002/asl2.472. [Masahide Kimoto, Japan]	Taken into account. The study is now cited.
29948	56	26	56	33	Another weakness of PPEs is that they mingle together uncertainty in the forced response (from the different parameter choices) and uncertainty from internal variability, which then become impossible to unravel. [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	Thanks. The text has been revised in line with the proposal.
15232	56	28	56	28	I hope I'm not wrong, but Tebaldi and Knutti 2007 is about MMEs, not PPEs [Claudia Tebaldi, United States of America]	Indeed. Thanks. Text revised.
48704	56	31	56	33	The stated weakness of PPE's also applies to MMEs as later indicated on 1-64: "28 The models may therefore not be fully independent, calling into question..." [Lev Tarasov, Canada]	Accepted. Text revised.
53182	56	37	56	39	I miss more on how knowledge is gained and integrated. [Jan Fuglestvedt, Norway]	Thanks. We have attempted to make this more clear.
15234	56	38	56	38	Aren't boundary conditions investigated through scenarios? [Claudia Tebaldi, United States of America]	Yes, but not in the sense intended by the text here. Revising the paragraph for clarity.
26390	56	42	67	1	The difference between ICE and PPE is not striking in the sketch, which therefore is not very effective yet. [Jochem Marotzke, Germany]	Taken into account. The figure has been revised.
26392	57	16	57	30	I think it's worth mentioning that the abrupt 4xCO2 is part of DECK because it gives ECS and the 1% per year because it gives TCR. [Jochem Marotzke, Germany]	Taken into account. The text has been revised.
9844	57	17	57	20	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. [Sebastian Luening, Portugal]	Noted. This is a larger issue, relating to CMIP design and model evaluation across this report. Here, we can only refer to what is being used and how evaluation is being performed - however the need for longer simulations should be raised later in the report.
6455	57	26	57	28	Add citations for "For simulations with prescribed aerosol abundances (i.e.not calculated from emissions), optical properties and fractional changes in cloud droplet effective radius are prescribed in order to provide a more consistent representation of aerosol forcing relative to earlier phases." References: Stevens, B., Fiedler, S., Kinne, S., Peters, K., Rast, S., Müsse, J., Smith, S. J., and Mauritsen, T.: MACv2-SP: a parameterization of anthropogenic aerosol optical properties and an associated Twomey effect for use in CMIP6, Geosci. Model Dev., 10, 433-452, https://doi.org/10.5194/gmd-10-433-2017, 2017. Fiedler, S., Stevens, B., and Mauritsen, T. (2017), On the sensitivity of anthropogenic aerosol forcing to model-internal variability and parameterizing a Twomey effect, J. Adv. Model. Earth Syst., 9, 1325– 1341, doi:10.1002/2017MS000932. [Stephanie Fiedler, Germany]	Accepted, text revised
48270	57	52	57	52	Linked to my comment on 49/28, suggest inserting a new subsection 1.4.4.2 here (or somewhere in 1.4.4) on CORDEX and related material on evaluations including a reference to those being generated in the Atlas/Interactive Atlas. [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. CORDEX is now discussed.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
8654	57		60		Citations missing. OMIP: Griffies et al 2016 (GMD); PMIP: Haywood et al 2016 (CP), Kageyama et al 2017 (GMD), Otto-Bliesner et al 2017, Jungclaus et al 2017 [Julia Hargreaves, United Kingdom (of Great Britain and Northern Ireland)]	References have been added. Thanks.
50728	60	5	60	5	Include in the title (1.4.4.2) the full meaning of CMIP [Hernan Edgardo Sala, Argentina]	Rejected. It is defined in the previous section, and used extensively in the text.
27552	60	5	61	11	It would be important to highlight that such tools can give a general idea of model performance but one still needs to do model evaluation for a particular purpose, e.g. assessing changing hazards at a particular region. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	True, good point. Revising the text.
50730	60	20	60	20	Include the full meaning of PCMDI. [Hernan Edgardo Sala, Argentina]	Accepted. Text revised.
35306	60	21	60	22	The correct reference for the ILAMB system as it exists is is Collier et al., 2018: https://doi.org/10.1029/2018MS001354. The Luo et al 2012 paper was more of a concept document. [Charles Koven, United States of America]	Thanks.
28128	61	14	61	19	1.4.4.3 Evaluation of process-based models against observations 15 16 Techniques used for evaluating process-based climate models against observations were assessed in AR5 (Flato et al., 2013),17 and process-based climate models have progressed rapidly since (Eyring et al., 2019). The most widely used approach continues to be to compare climatologies or time series of simulated (process-based) model output with observations while considering 19 observational uncertainty. A further approach is to compare the results of process-based model with those from statistical models. [Lionel Leggett, Australia]	Thanks. The text has been revised in line with the proposal.
14986	61	14	61	49	this section is very focussed on model evaluation against instrumental observations - but earlier in the document you referred to palaeoclimate data as a type of observation. Potential references for palaeoclimate data-model observations could include: Haywood et al. 2016 https://www.nature.com/articles/ncomms10646 and/or Dowsett et al. 2013 https://www.nature.com/articles/srep02013) [Erin McClymont, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The entire section has been substantially rewritten, which hopefully answers the comment by the reviewer.
43424	61	17	61	17	period missing [Saad Amer, United States of America]	editorial
6621	61	17	61	17	delete "that is continued to be" [Tim Christiane Thys, Belgium]	The phrase has been revised.
6619	61	18	61	18	add after "climatologies": "(long-term average of a specific climate variable)" [Tim Christiane Thys, Belgium]	The phrase has been revised.
6623	61	18	61	18	delete "is to compare" and alter as: "is comparison of" climatologies… [Tim Christiane Thys, Belgium]	The phrase has been revised.
6625	61	18	61	18	replace "while considering" by "taking into account the" [Tim Christiane Thys, Belgium]	The phrase has been revised.
9846	61	22	61	28	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, Portugal]	Noted. This is a larger issue, relating to CMIP design and model evaluation across this report. Here, we can only refer to what is being used and how evaluation is being performed - however the need for longer simulations should be raised later in the report.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
6627	61	22	61	28	I suggest to rephrase the entire paragraph - it is hard to understand / read this way. [Tim Christiane Thys, Belgium]	The phrase has been revised.
39300	61	29			Section 1.4.4.3 P1-61 Please add at line 29: In addition, it is possible to use linear stochastic models that are based on the scaling long term memory of the climate system. For the CMIP5 models, these scaling models can be calibrated using the historical period. When they are projected to 2050, 2100, they well reproduce the model temperatures both globally (Hébert, Lovejoy et al. 2019) and the regional pattern (Hébert and Lovejoy 2018). These models can then be used to project the historical data and yield projections comparable to the CMIP5 multimodel means but with much reduced uncertainties (Hébert, Lovejoy et al. 2019), (Lovejoy 2019). Hébert, R. and S. Lovejoy (2018). "Regional Climate Sensitivity and Historical Based Projections to 2100." Geophys Res Lett. 45: 4248-4254. Hébert, R., et al. (2019). "An Observation-based Scaling Model for Climate Sensitivity Estimates and Global Projections to 2100." Climate Dynamics (under revision). Lovejoy, S. (2019). Weather, Macroweather and Climate: our random yet predictable atmosphere. New York, N.Y. USA Oxford U. Press. [Shaun Lovejoy, Canada]	Thanks. The discussion has been somewhat extended, in line with this comment.
41136	61	31	61	32	Steiner et al. (2018) performed an evaluation of tropical convection regimes in climate models with new satellite observations from GPS radio occultation. Reference: Steiner, A. K., B. C. Lackner, and M. A. Ringer (2018), Tropical convection regimes in climate models: evaluation with satellite observations, Atmos. Chem. Phys., 18, 4657–4672, doi:10.5194/acp-18-4657-2018. [Andrea K. Steiner, Austria]	Rejected. Too detailed for this section.
48272	61	31	61	39	Suggest including in this paragraph a reference to James et al., 2015: Process-based assessment of an ensemble of climate projections for West Africa, J. Geophys. Res. Atmos., 120, doi:10.1002/2014JD022513. [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Text revised.
48384	61	32	61	34	Mention that "emergent constraints," when inappropriately overused, are sometimes called "fudge factors." [Stephen Parks, United States of America]	Rejected. Even if taking a critical view of the usage of climate models, we do not see that emergent constraints in particular can be used as fudge factors.
6629	61	44	61	44	rephrase "These approaches consist of converting" to "These instrumental approaches convert .." [Tim Christiane Thys, Belgium]	The phrase has been revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
28130	61	52	62	7	Consider replacing existing text with the following: 1.4.4.4 Climate informatics 53 The growing data volume from Earth system observations and models urge the need for new theories and tools that complement the existing approaches to extract relevant information. A significant development since the AR5 is an emerging field of climate informatics, a promising and growing path of research (Reichstein et al., 2019). Data science methods such as data mining (Friedman et al., 2001), causal graphical model discovery (Runge et al., 2015), and other machine learning techniques (Reichstein et al., 2019) that have successfully been applied in other scientific disciplines (e.g., bioinformatics) provide new ways of analysing Earth system data. The most common approach, climate networks, uses complex network analysis, a statistical method, to investigate [Lionel Leggett, Australia]	The climate informatics part has been removed for the SOD.
42854	61	52	62	42	Note in this section the requirement (debatable?) for independent validation of the patterns identified in climate informatics/machine learning studies, and the variety of ways in which this is being developed. [Michael Evans, United States of America]	Climate informatics has been removed from the discussion.
15236	62	48	62	48	I would challenge this statement about the narrowing of uncertainty. I don't see the evidence of that in the literature. [Claudia Tebaldi, United States of America]	Noted, thanks. We agree. Revising the text.
57304	62	50	63	41	Why is observed warming not considered an emergent constraint? This always seems a bit of an artificial distinction to me. [Myles Allen, United Kingdom (of Great Britain and Northern Ireland)]	Because it does not explicitly use the linear correlation concept, I believe. I would probably fit a broader definition, but not as it is currently used.
8018	63	8	63	8	Mangled sentence; please fix. [Olaf Morgenstern, New Zealand]	Accepted. Text revised.
25574	63	9	63	10	The finding of linearity should be supported with a citation and should be given more prominence. [Stephen E Schwartz, United States of America]	Accepted. Text revised.
53184	63	17	63	41	Emergent constraints is important throughout the report, as pointed out. Thus section 1.4.5.2 is important and needs coordination across chapters. [Jan Fuglestvedt, Norway]	Noted.
52696	63	17			I remember vaguely that we discussed critical literature about emergent constraints in Chapter 10. These papers should also enter the discussions here. Please contact Andy Turner (Ch 10) regarding the literature, he has brought them forward (they are not included in the chapter itself). [Douglas Maraun, Austria]	Noted, thanks.
6631	63	19	63	19	replace "a" relationship by "the" [Tim Christiane Thys, Belgium]	Accepted. Text revised.
6633	63	21	63	22	replace "so in principle ESMs tell" by "telling" [Tim Christiane Thys, Belgium]	Accepted. Text revised.
53186	63	35	63	38	This last part of the para could be improved to give a better explanation [Jan Fuglestvedt, Norway]	Accepted. Text revised.
27670	63	37	63	37	replace with published article (Hall et al) [Poot Delgado Carlos Antonio, Mexico]	Accepted. Text revised.
29784	63	40	63	41	Emergent constraints are also discussed and applied in section 5.4.6 in the carbon cycle chapter. This may be specified here. [Govindasamy Bala, India]	Accepted. Text revised.
26394	64	1	64	49	I think the treatment is largely consistent with Ch4, but I'm missing a concluding assessment of where we stand. [Jochem Marotzke, Germany]	Accepted. Text revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
9266	64	1	64	49	Should the reader interested by weighting issues in ensemble projections read this paragraph, or go to BOX 4.1 which deals with Ensemble Evaluation and Weighting? [philippe waldteufel, France]	Accepted. Mainly they should read Box 4.1. The link has been clarified.
47460	64	1	64	49	Subsection 1.4.5.3 on weighting techniques may need cross-referencing and coordination with Box 4.1 on ensemble evaluation and weighting in Chapter 4. [June-Yi Lee, Republic of Korea]	Accepted. Text revised.
53188	64	1	64	49	Weigthing techniques for model comparisons: Important to link to what is done in the various chapters. And coordinate with ch4 who has a box on this. [Jan Fuglestvedt, Norway]	Accepted. Text revised.
52698	64	1			Note that emergent constraints are itself an (implicit) model weighting technique. This has nicely been shown in the 2012 J Climate paper by Bracegirdle and Stephenson or later by Karpechko et al, JAS, 2013. It is the only weighting technique that explicitly links present performance to future projections. This should be discussed here. [Douglas Maraun, Austria]	Accepted. Text revised.
53190	64	3	64	12	Some references could be added; e.g. Knutti et al. [Jan Fuglestvedt, Norway]	Accepted. Text revised.
48274	64	8	64	8	Suggest adding, after "poorly performing models", a reference to McSweeney et al., 2015, Sub-selecting CMIP5 GCMs for downscaling over multiple regions, Climate Dynamics, 44:3237–3260, DOI 10.1007/s00382-014-2418-8 [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Text revised.
29950	64	16	64	19	This statement seems far too general to be unconditionally true. I quickly looked at the cited paper and could not find the support for this conclusion in either the Abstract or the Conclusion, so it is certainly not a key conclusion of this paper. In any case, the cited paper focuses exclusively on the forced response in North Atlantic SSTs, so the conclusion cannot be generalized to other parts of the climate system. [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	Thanks. The text has been revised.
8642	64	39	64	39	Annan and Hargreaves 2017 provides a quantifiable definition of independence that does not suffer from the obvious problems of performance-based measures (though it may have its own limitations of course). [James Annan, United Kingdom (of Great Britain and Northern Ireland)]	Noted, thanks. Including this study in the discussion.
8020	64	42	64	47	There is some duplication in this sentence. Please fix. [Olaf Morgenstern, New Zealand]	Accepted. Text revised.
50732	64	44	64	47	Please, check (there is a repetition). [Hernan Edgardo Sala, Argentina]	Accepted. Text revised.
28474	64	44	64	47	Part of the sentence seems to be repeated. [David Schoeman, Australia]	Accepted. Text revised.
42856	64	44	64	48	repeated sentence fragment. But: what approach will be used in AR6 to construct MMEs, estimate their statistics? [Michael Evans, United States of America]	Noted. Also, the definition is given in Box 4.1; the link to that section has been made clearer.
32034	64	52	64	53	Surely risk assessment is a cross-cutting topic for this assessment? [Rowan Sutton, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account; Sections on risk completely redrafted
8498	65	1	65	1	The meaning of "time transgressive" (for HTM) will be unclear to the non-geologist. [Robert Kopp, United States of America]	Rejected; Unclear to what this refers
8500	65	1	65	1	Cross-check MWP-1A with ch 9 [Robert Kopp, United States of America]	Rejected; Unclear to what this refers
53192	65	1	65	1	I think "mehtod" is too narrow. I would add "and approaches" [Jan Fuglestvedt, Norway]	Taken into account; Text rephrased
27554	65	5			what is the difference between past & historical? [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account; Text rephrased
6381	65	13			What is the meaning of Natural variability? Needs rephrasing [Baruch Rinkevich, Israel]	Taken into account, Text rephrased

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15108	65	15	65	31	It's equally important to point out that based on paleoclimate data, long term trends change direction on century scale time frames and the fact that a small short trend seems to have been detected, it can't be distinguished from the natural variability seen in the ice cores. Bear in mind that in the century preceding the LIA, the multi-century trend was negative. [George White, United States of America]	Taken into account; Text rephrased
47430	65	15	65	35	The title of 1.5.1.1 should be a statement instead of a special question. The second paragraph should not be needed in such a formal report. [Hong-Li Ren, China]	Taken into account; The second paragraph is critically important for decision makers to be aware of.
6637	65	17	65	18	reference needed. [Tim Christiane Thys, Belgium]	Noted; References added.
36688	65	17	65	31	Mention warming hiatus caused by cold phase of IPO/PDO [William Lorenz, Australia]	Noted; Cross Chapter Box discusses this in depth.
6635	65	18	65	18	replace "anthropogenic trends" by "trends due to anthropogenic forcing" [Tim Christiane Thys, Belgium]	Accepted; Text changed.
43426	65	19	65	24	References to two diagrams and specific colours in text make this section difficult to read througg. Global and local scales can be explained without overcomplicating their references. [Saad Amer, United States of America]	Noted; Text rephrased.
26396	65	22	65	22	Maher et al. Is not in ref. list; paper is now in press and available online with JAMES [Jochem Marotzke, Germany]	Accepted; Reference updated.
49104	65	26	65	26	Note that GSAT has been introduced here without distinguishing it explicitly from GMST which is used ubiquitously throughout the chapter. The choice of indicator has big implications for carbon budgets identified during SR1.5. Is it worthwhile introducing in Chapter 1 since it has signficance later on? [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	Cross-Chapter Box 2.3 now discusses this topic at length and we refer to it.
27556	65	27	65	31	revisit the grammar of this sentence [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account; The grammar of the sentence was revised
6639	65	33	65	35	rephrase - I suggest: "Therefore, it can be expected that short-term trends in a single realisation, appear to be different from the long-term trend or the outcome of climate models (high confidence) [Tim Christiane Thys, Belgium]	Taken into account; Text rephrased.
6641	65	33	65	35	reference needed. [Tim Christiane Thys, Belgium]	Taken into account; Text rephrased
50734	65	42	65	42	Consider adding "change" in: "...annual global surface air temperature..." in the following way: "...annual global surface air temperature change...". (Figure caption 1.13). [Hernan Edgardo Sala, Argentina]	Taken into account; Figure and caption updated.
53194	65	52	66	22	I miss more on implictaions at the end of section 1.5.1.2. I.e. implications for the chapters and how it is used later [Jan Fuglestvedt, Norway]	Accepted; Text added.
6643	65	54	65	54	insert "anthropogenic" in "The signal of ANTHROPOGENIC climate change...." [Tim Christiane Thys, Belgium]	Rejected; The signal does not have to be anthropogenic.
15238	66	8	66	8	Since this chapter gives some nice hitorical perspective, I'm going to point at a very old paper that looked at time of emergence: 10.1126/science.209.4458.763 [Claudia Tebaldi, United States of America]	Accepted; Reference added.
42858	66	8	66	12	also addressed in paleoclimate studies as an important goal (context for recent change): e.g. Abram et al (2016) for regional to global spatial scales. [Michael Evans, United States of America]	Accepted; Discussion added.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
39302	66	14			Section 1.5.1.2 P1-66 please insert in line 14: To understand this signal to noise problem it is helpful to recall that for scales longer than weather scales (about 10 days), instrumental and paleo temperature analyses display temperature fluctuations that systematically decrease with scale as the averaging period increases: the fluctuations largely cancel each other out, the temperature appears to be stable. Without external forcings (e.g. in GCM control runs), this continues to arbitrarily long time scales and characterizes the approach of the model to its long term climate (Lovejoy, Schertzer et al. 2013), (Lovejoy 2019), (Lovejoy, Varotsos et al. 2018). However, due to external forcings and/or very slow internal processes, at some critical time scale τc, the variability stops decreasing and starts to increase. τc punctuates the end of the high frequency macroweather regime. At lower frequencies - in the climate regime - temperature fluctuations grow with increasing time scale so that the temperature appears to "wander", to be unstable (Lovejoy and Schertzer 2013), (Lovejoy 2013). At τc, the internal variability becomes dominated by the responses to external forcings (and in the pre-industrial epoch, possibly to new slow internal processes). In the last decades, τc is about 16-18 years (Lovejoy 2014). At shorter time scales, the internal variability is the dominant source of variability, at longer scales, the forced response is dominant. Over the late Pleistocene, the average τc was ≈ 300 years although it varies at different phases of the glacial-interglacial cycle, and may be as long as several millennia in the pre-industrial Holocene (corresponding to an exceptionally stable period, (Lovejoy and Lambert 2019)). Similarly, by considering the pre-industrial probability distributions of temperature changes over centennial time scales, it is possible to estimate the probability that the industrial epoch warming was simply a giant natural fluctuation. Using this approach, (Lovejoy 2014) was able to reject the null hypothesis that the warming was natural with high confidence (>99.9%), thus effectively closing the scientific part of the debate about the provenance of the warming (Lovejoy 2015).	Taken into account; Discussion added on timescales.
29954	66	17	66	18	Fig. 1.14 is not a good example of this because the warming in this case is basically the same between tropics and extratropics [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	Examples used have been changed.
27558	66	21			Exposure is equally important, see e.g. https://iopscience.iop.org/article/10.1088/1748-9326/aaaa99 [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Accepted; Reference and text added.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
32628	66	34	66	34	As a general overview comment in discussing the capabilities for simulating regional climate change, I would suggest that it needs to be clarified that, at least for human-induced climate change, the issue is not whether there will be regional change occurring, but in how what is porjected to happen at the regional or even local scale might differ from the large climate zone scale changes that are simulated/projected using the global models that we have. Often, it seems that statements of uncertainty or even inability to simulate regional climate change are taken to mean that there will be no changes at the regional scale--and this is just wrong. There will be changes--what is really harder to project is, using the US as an example, is the extent to which the changes calculated for, say, Detroit and Dallas will be a bit above or less than the changes at those locations calculated using a global model. As models get to finer resolution and can better resolve hydrology, etc., it would seem there are likely differences that can be calculated, but even if they cannot be differentiated, this does not mean there will be no changes at the location. I would urge that this point somehow get made in this section. [Michael MacCracken, United States of America]	Noted.
32630	66	34	66	34	I would also urge making the point that the climate at a given location is really a distribution of weather systems, so in essence a bell shaped curve distribution of situations, and that a key issue is how much shift in the centroids of the distributions are compared to their breadth--a question that a Hansen et al. paper looks at. And so the changes that are found are not manifest by each day changing by the same amount, but there being a net change in the distribution of conditions. What the Hansen et al. paper shows that it is the change in the extreme conditions that can arise that do most of the harm, so it is really not the actual shift in the centroid that matters. Explanation of this--for temperature, precipitation/runoff, etc. would be particularly useful. [Michael MacCracken, United States of America]	Noted.
27560	66	35			It needs to be said very clearly that the impacts of climate change regionally can be very different in terms of size but also sign of change, Examples are e.g. in chapter 11 but probably also in chapter 12. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Noted.
6383	66	35			Suggest to consider as special part of the Regional climate change the climate change associated with marginal seas (e.g., Gulf of Suez, Mediterranean, Labrador, Weddell...). [Baruch Rinkevich, Israel]	Noted.
29956	66	38	66	39	It is only thermodynamic quantities that can be aggregated. Features of the atmospheric circulation generally cannot (except by zonally averaging, but even that can be problematical). If you need a reference for this statement, it is made in Shepherd (2019 PRSA doi: 10.1098/rspa.2019.0013). Hence your wording here is implicitly stating that climate change is only a thermodynamic phenomenon, which is very misleading at the regional scale. [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. The text has been revised accordingly.
53912	66	38	67	31	Take a look at WG II AR5, Part B, Chapter 21 (Hewitson et al. 2014) for a comprehensive treatment of how regions have been defined and applied in the IPCC. [Timothy Carter, Finland]	Noted.
8840	67	4			This is an atmospheric centred view here ignoring the ocean completely. Ocean and ocean-atmosphere processes are crucial in understanding and projecting climate change (e.g. ENSO, PDO, AMO, IDO, AMOC, SAM, ...). Since Fig. 1.16 contains 12 oncean only regions, they should be motivated and dicussed here as well. [Thomas Stocker, Switzerland]	Taken into account. The figure has been updated. See also Comment 56232.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
26398	67	28	67	28	For very good reasons, IPCC has always used "evaluation" of climate models and not "validation". [Jochem Marotzke, Germany]	Accepted. We modified the term and checked for consistency in the Chapter.
58012	67	28	67	29	(Beck et al., 2018; Rubel and Kottek, 2010, Belda et al.,) as well as climate projections (Feng et al., 2014, Belda et al., 2017), whereas …. Belda, M., Holtanova, E., Halenka, T., Kalvova, J., Hlavka, Z. (2015): Evaluation of CMIP5 present climate simulations using the Koppen-Trewartha climate classification. Climate Research, 64, 3, 201-212, DOI: 10.3354/cr01316; Feng S, Hu Q, Huang W, Ho CH, Li R, Tang Z (2014) Projected climate regime shift under future global warming from multi-model, multi-scenario CMIP5 simulation. Global and Planetary Change 112: 41-52; Belda, M.; Holtanova, E.; Kalvova, J.; Halenka, T. (2017): Global warming-induced changes in climate zones based on CMIP5 projections. CLIMATE RESEARCH, 71, 1, 17-31, DOI: 10.3354/cr01418 [Tomas Halenka, Czech Republic]	Noted.
42860	67	30	67	30	typo: Regional [Michael Evans, United States of America]	Editorial. We fixed the typo.
53914	67	49	67	49	Here regions are referred to as continental-scale in reference to WG II. Presumably, these are the WG II chapters, which are indeed continental-scale. However, treatment of most isues within each chapter is done on a sub-continental scale, often using the sub-continental definitions introduced by Giorgi and colleagues for describing climate observations and projections and other regional typologies for describing socioeconomic impact and responses. [Timothy Carter, Finland]	Taken into account. Related to Comment 45742.
45742	67	49	67	49	in AR6 WGII also has regionalisations in cross chapter papers eg deserts, mountains, [Katja Mintenbeck, Germany]	Taken into account. Such "regionalizations" are called "typological regions" in the current report. This has been made more explicit in the revised text.
53196	67	49	67	50	Please add a few words about what WGII-type is. [Jan Fuglestvedt, Norway]	Taken into account. Additional explanation has been added.
16128	67	55	67	55	The Atlas shows…' - a major editorial inconvenience… most of the figures, including the Atlas are not easily accessible while studyin the Report. [Branko Grisogono, Croatia]	Noted.
45744	68	6	68	10	See WGII cross chapter papers: biodiversity hotspots, citeis by the sea, deserts and semi-arid regions, Mediterranean region, mountains, polar regions, tropical forests [Katja Mintenbeck, Germany]	Noted. The proposed regions are called "Typological Regions" in the report.
15352	68	13	68	32	Impossible to assess without the map of land and ocean regions. Please add the map into SOD. [Oksana Lipka, Russian Federation]	Rejected. The map of land and ocean regions is available in a figure in Chap.1 and again in the Atlas.
50736	68	35	68	35	I suggest to add "period" at the end of the title of Section 1.5.3, in this way: "Anomalies, baselines and warming since pre-industrial period". [Hernan Edgardo Sala, Argentina]	Taken into account; Text restructured.
15240	68	46	68	46	Again for the sake of historical artefacts : Madden et al., 1993: The effects of imperfect Spatial and Temporal Sampling on Estimates of the Global Mean Temperature: Experiments with Model Data [Claudia Tebaldi, United States of America]	Accepted; Reference added

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43090	68	50			could change to ""but the global effects were relatively small for several decades, and industrialisation pre-1850 was confined to a small number of places in Western Europe and North America. For most of the world, industrialisation began much later." E.g. Eric Hobsbawm, The Age of Revolution, Chapter 2, Chapter 9 (p207 has the handily succinct: "Only one economy was effectively industrialized by 1848, the British[.] Probably by the 1840s the USA and a good part of Western and Central Europe had stepped across, or were on, the threshold of industrial revolution.") [David Frame, New Zealand]	Taken into account; Text restructured.
43092	69	2		4	I don't think this sentence is useful. The distinctive thing about industrial civilization is that it opens the fossil reservoir, and that fossil reservoir comes to dominate everything else. The RF from earlier periods is, Sung Dysnasty possibly excepted (see William McNeill, The Pursuit of Power, Chapter 2) almost certainly dominated by land use and land-use change. But I don't think the reason for choosing the IR is to do with uncertainty (otherwise 1850 is the better choice). It has to do with the beginnings (or the revival) of processes that led to the specific tragedy of the commons/collective action problem that climate change represents. The era is chosen because climate change's main causal processes start in that era. [David Frame, New Zealand]	Taken into account; Text restructured.
28580	69	2			The choice of a recent 20-y period as the standard baseline means that anomalies from models are mostly small during it, and all have the same mean. However, at earlier times the results spread out, as they do for the future (as seen in time series plots). How should the results for these earlier years be interpreted? They would not normally indicate uncertainty in the real world value, as might the spread in the future. Would using a longer period as the baseline be useful to avoid this? [Ian Watterson, Australia]	Noted; There is no perfect choice of baseline and the recent period has been chosen due to relevance to future projections rather than a broader set of factors which the reviewer correctly describes.
27562	69	3			seems important to refer to Paris agreement and UNFCCC to highlight why this is important [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account; Text restructured.
37358	69	12			When this figure is updated with CMIP6 results it should also be updated with ERA5 rather than ERA-Interim results. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Accepted; ERA-5 is now used.
15110	69	17	70	6	Declaring that a pre-industrial basis has any relevance inappropriately presumes that all change is due to industrialization which is in direct defiance of the null hypothesis which for all intents and purposes tells us that if the climate isn't changing, it's broken. The climate never has been and never will be constant across a decade much less a century. Presuming that most, if not all, change since the start of industrialization was caused by man is as foolish as presuming that the Earth is flat and at the center of the Universe. [George White, United States of America]	Rejected; There is an assessment of the fraction of warming due to human activity in Chapter 3.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
9848	69	17			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, Portugal]	Rejected; The pre-industrial period is chosen because this is when anthropogenic factors begin to affect the climate.
43094	69	18			I don't like "likely" with medium confidence. Suggest weakening the likely bit. [David Frame, New Zealand]	Taken into account; We considered this during preparation of SOD. Text refers to FOD p69, line 51?
42864	69	19	69	25	Note also the potential that even if the RF was small in any reference period, the climate itself might be out of equillibrium with respect to multidecadal timescales of interest for the climate change problem (e.g. Gebbie and Huybers, 2019). Given the papers and results cited, could the reference period be treated as a sensitivity test in analyses in AR6 that may depend sensitively on it? (Although I would also put in a plea to make AR6 figures simpler and clearer than in AR5, in which some figures were so complex as to be nearly impossible to parse.) [Michael Evans, United States of America]	Noted; Text restructured.
43096	69	23		24	suggest changing "partially offset" to "temporarily masked" since CO2-induced warming lasts much longer than volcanic cooling. [David Frame, New Zealand]	Accepted; Text restructured.
50738	69	31	69	31	Orphan parentheses in "...IPCC AR5, 2013)". [Hernan Edgardo Sala, Argentina]	Editorial; Parenthesis included
6461	69	33	69	33	Using 1850 as a starting point is fine but you should note that this was just after the Little Ice Age so some warming is expected. [Hugh Lefcort, United States of America]	Rejected, There is a discussion of the various factors.
31606	69	33	69	33	"Because" instead of "As" ["as" has two meanings]. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Accepted; Text was revised.
9850	69	35	69	37	Authors claim: “Although Lüning and Vahrenholt (2017) suggest a much longer context for defining pre-industrial, estimates of natural radiative forcings and global temperature are too uncertain to allow a reliable estimate for longer periods.“ This is a pretty poor excuse. You should be using the available temperature reconstructions of PAGES 2k (2013) and Marcott et al. (2013), even though we know that neither of them is perfect. The reluctance to calculate real pre-industrial temperature averages is even more puzzling because in the same chapter it is stated that the field of palaeoclimatology has made major progress. On page 1-47 (lines 6-9) the text says: “Major efforts completed since AR5 include an ever-expanding set of large-scale, multi-proxy temperature syntheses spanning the last 2000 years under the auspices of the PAGES2K initiative. As of 2018, a number of regional temperature reconstructions exist, including one for every continent and major ocean basins (Tierney et al., 2015)”. [Sebastian Luening, Portugal]	Rejected; The pre-industrial period is chosen because this is when anthropogenic factors begin to affect the climate.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
8842	69	35	69	37	Either this reference should be deleted or a more critical statement should be made. Luening and Varenholt (2017, paper unlikely peer reviewed) make a non-sensical proposal for the reference period: take the period 1940-1970 as a reference period as it "corresponds to the average pre-industrial temperature of the past two millennia." This makes no sense as the period 1940-70 is already strongly anthropogenically influenced by a combination of GHG and aerosol forcing. Lüning and Varenholt assume that LIA was a global phenomenon creating the "coldest phase of the last 10,000 years when mean temperatures deviated strongly negatively from the Holocene average". This is not correct: the latest comprehensive analysis shows that LIA was not global (Neukom et al, 2019, Nature in press). A much more relevant paper for this para would be Hawkins et al., 2017, BAMS doi: 10.1175/BAMS-D-16-0007.1 [Thomas Stocker, Switzerland]	Taken into account; Text restructured, but note that Luening and Varenholt (2017) was peer-reviewed.
37360	69	40			An additional, linking sentence could be added at the beginning of the paragraph to point out that AR5 itself provides a figure (5.7c of the WG1 report) that indicates that the 18th century global temperature was a little lower than the 1850-1900 temperature. This was subsequently confirmed by the study by Hawkins et al. (2017). [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account; The paleo-evidence is included in the discussion with updated data.
53198	69	41	69	41	I don't think "equivalent" is the right word here. "corresponding" may work better. [Jan Fuglestvedt, Norway]	Accepted; Text restructured.
9852	69	42	69	43	The claim that natural forcings of solar irradiance and volcanic activity around 1750 were similar to the modern period is hard to defend. The sun was just coming out of the deep Maunder Minimum which had a strong impact on climate in various places around the world. Likewise, volcanic activity 1750-1800 was particularly high, much higher than in modern times (Sigl et al. 2015). The theoretical forcings associated with these major changes in natural climate drivers may be close to zero in the climate models, however, in the palaeoclimatic record, the climatic effects can be clearly seen. It is therefore misleading to claim that the situation in the natural drivers in the coldest part of the LIA resembles that of the modern last few decades. Readers will misunderstand this. With the same logic of near-zero natural and anthropogenic forcing, one might use the temperature of the Medieval Climate Anomaly (MCA) as baseline. [Sebastian Luening, Portugal]	Rejected; See Hawkins et al. 2017 for a discussion of the radiative forcings around 1750.
46788	69	42	69	46	I would be much better to provide an envelope of this temperature difference based on all available reconstructions (i.e. as in AR5 but updated with also the newer once subsequently published). [Charpentier Ljungqvist Fredrik, Sweden]	Taken into account; Text restructured.
9854	69	43	69	44	The PAGES 2k representation of the Little Ice Age is to be challenged. The LIA was globally a cold period and a minor temperature drop of just 0.3°C compared to the Medieval Climate Anomaly is hardly plausible. A cold LIA has also been described from the Southern Hemisphere (e.g. Chambers et al. 2014, doi: 10.1177/0959683614551232). In Chapter 2 (page 6, lines 31-32) it is acknowledged that the LIA was the coldest phase of the Holocene, therefore the coldest part of the LIA 1600-1750 (e.g. Moberg et al., 2005; Hegerl et al., 2007; Ljungqvist, 2010), nor the end of the LIA (1850-1900) cannot be suitable pre-industrial baselines. [Sebastian Luening, Portugal]	Rejected; PAGES2k is a more recent evaluation of the data than the references cited.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
9856	69	45	69	48	The models were not calibrated through a successful hindcast of pre-industrial regional and global climate of the past 2000 and 10,000 years. 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. The validity of temperature results from climate models remains questionable until the pre-industrial hindcast of the past 2k and 10k years has successfully been achieved. [Sebastian Luening, Portugal]	Rejected; The PMIP last millennium simulations match the reconstructed temperatures well (see Chapter 2).
53918	69	48	69	48	Use Celsius or Kelvin consistently, but don't mix them in the same paragraph. [Timothy Carter, Finland]	Accepted; Text rephrased.
9858	69	50	69	53	As commented before, it really does not make sense to move the temperature baseline to 1750, into a natural cold phase that represents a climatic cold extreme for the entire last 10,000 years. Adjusting the remaining carbon budget to this new baseline makes even less sense. Time and time again it becomes clear that the scaling of the natural forcings seem to be grossly underestimated in the climate models used by the IPCC. The attempt by PAGES 2k to generate another hockey stick-type global temperature curve is questionable, given the enormous natural temperature variability seen over the past 2000 years. Global mapping of the Medieval Climate Anomaly (MCA) has demonstrated that the MCA is represented by predominantly warm temperatures on all seven continents. See Lüning et al. 2017 and 2019a+b for MCA temperature syntheses for Africa, South America and Oceania. Lüning et al. (2019a): The Medieval Climate Anomaly in South America. Quaternary International, 508: 70-87. doi: 10.1016/j.quaint.2018.10.041; Lüning et al. (2019b): The Medieval Climate Anomaly in Oceania. Environmental Reviews, doi: 10.1139/er-2019-0012; Lüning et al. (2017): Warming and cooling: The Medieval Climate Anomaly in Africa and Arabia. Paleoceanography 32 (11): 1219-1235, doi: 10.1002/2017PA003237. [Sebastian Luening, Portugal]	No specific suggestion made. MCA assessment is not done in Chapter 1.
10066	69	50	69	55	pls, match it is with the use of these terms on page 5 (line 16) [Tibor Farago, Hungary]	Taken into account; Statement in the Executive Summary is meant be consistent with chapter text.
28476	69	54	69	54	"plausibly"…could this be converted into confidence language? [David Schoeman, Australia]	Taken into account; Text was revised.
53916	69	54	69	54	The term, "early industrial", is a fair reflection of the period, but how is this to be communicated to the outside world who have been referring to it as pre-industrial up to now? All of the SR1.5 and AR5 reporting used that terminology, if I remember correctly, though the small print would have clarified the nuances, of course. Has there been a discussion about this in WG I and also across the WGs? It is very important for aligning the Paris temperature targets (themselves stated as being relative to pre-industrial) with the radiative forcing estimates (usually estimated wrt 1750). Will use of this term, even though accurate, actually muddy the waters and potentially lead to confusion? In fact, the actual observed MAT change since pre-industrial times might be somewhat greater than that cited in the SR1.5 report (as described earlier on this page), so the current practice of using 1850-1900 could be considered to be conservative. [Timothy Carter, Finland]	Taken into account; Much discussion on this issue and text revised.
26400	69	54	69	55	As I wrote earlier, I think it would be a mistake to introduce a new name for the period 1850-1900. [Jochem Marotzke, Germany]	Taken into account; Much discussion on this issue and text revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
31608	70	1	70	2	"As any anthropogenic warming which occurred before 1850 is at least partially offset by the volcanic activity during 1850-1900". Presumably this is because volcanic activity was relatively high in 1850-1900, leading to a cooling whih offsets early anthropogenic warming? Maybe spell this out (and provide a reference for the high volcanic activity). [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Accepted; We expanded this text to explain the effect of volcanism
27564	70	2	70	3	There should be a reference for this claim. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Accepted; Text revised.
53200	70	8	70	17	GMST and GSAT: Very good that you point to ch2. I think this needs more links to other chapters as well [Jan Fuglestvedt, Norway]	Taken into account; Main discussion in Chapter 2 and in FAQ1.3.
53202	70	8	70	17	GMST and GSAT: something here that can be formulated as knowledge gaps? [Jan Fuglestvedt, Norway]	Taken into account; Knowledge Gaps section deleted.
37362	70	9	70	10	The sentence beginning "In all existing observation based global temperature reconstructions …" is incorrect. Reanalyses provide observationally-based reconstructions of GSAT. They do not generally use marine air temperature observations, but deduce a marine air temperature from SST and boundary-layer modelling. The boundary-layer modelling is constrained by other type of observation, especially those that relate to surface winds. They are less constrained over sea ice, but Simmons and Poli (2015; doi: 10.1002/qj.2422) showed that they nevertheless can do quite well for change over the Arctic Ocean, biases over cold ice surfaces notwithstanding. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account; Text rephrased.
37364	70	12	70	13	It could be added, after the sentence that spans these lines, that Simmons et al. (2017; doi: 10.1002/qj.2949) showed the same for reanalyses as Cowtan et al. showed for model simulations, although quantitatively the effect was smaller than inter-dataset differences and other uncertainties. Further information on this topic is given in comments on Chapter 2. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account; Text revised.
30434	70	15	70	15	Cross-check with Ch2, where a range is given. [Joeri Rogelj, Austria]	Noted. Value no longer quoted.
13128	70	21	70	30	This is somewhat confusing, particularly because most of the scientific literature uses 1850 CE as the "pre-indusrial" baseline. I understand why this should be changed, but it might be worth emphasizing that this is different from what is commonly used in previous studies and explain why this terminology should be changed. [Nora Richter, United States of America]	Taken into account; Much discussion on this issue and text revised.
46196	70	22	70	22	There is a missing standard period in this box. We need a consistent approach to "current" levels of warming and which datasets are used to generate thes estimates. Discrepancies between SR1.5 and draft SRCCL Have been pointed out because of different time periods e.g. (1999-2018 v 30 year average centred on 2017), average across four datasets versus taking the dataset with the longest run, and the whole issue of GMST v GSAT which is surely for Chapter 1 to nail. [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account; Other chapters have taken the lead on this.
31610	70	22	70	22	define "post-glacial period" (e.g. "last 10,000 years" ?...oh, I see it is defined below…maybe use Capitals to indicate it is a formally defined period). Not sure what "Time transgressive" means. At the moment this stops at the LGM. In AR6 thre are many instances of older time periods being discussed (e.g. mid-Pliocene, early Eocene) - can they be defined here too ? [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account; Part of this content was moved to Chapter 2

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
8246	70	22	70	39	Please add a table to show the global mean temperatue differences between 1951-1980 (or 1961-1990, 1981-2010, 1986-2005) and 1850-1900 [Zong Ci Zhao, China]	Rejected; This will be done in Chapter 2.
47976	70	22	72	1	At face value, chapter 1 appears unbalanced towards scenarios, devoting ~20 word pages to introduce the topics with two cross-chapter boxes, when other key topics across the WGI and the AR6 as a whole are given much less space (Risk and D&A are also dimensions of integration across WGs but have roughly 2 pages each). [WGI TSU, France]	Taken into account; Chapter length and split between sections revised.
53920	70	24	70	30	Here the distinction is made for radiative forcing between early industrial and pre-industrial, but how much is this to be propagated through the report? The former period (1850-1900) was used as an approximate proxy for pre-industrial in earlier reports. Will that also be the case in this report or will correction factors be needed to arrive at pre-industrial temperature? [Timothy Carter, Finland]	Taken into account; Much discussion on this issue and text revised.
29556	70	26	70	26	Both the amplitude of the 11year solar cycle and the low-frequency part of solar irradiance have been lower in 1750 as compared to today; so the "similar to today" statement is not correct for the solar forcing! [Katja Matthes, Germany]	Taken into account; A reference for this would be helpful.
9636	70	27	70	30	Here authors retain the definition of 'pre-industrial' as the period around 1750, whereas in SR1.5 defined it as the period1850-1900 (p. 26 of the SPM). Clear explanation behind this change should clearly been made. [Mitsutsune Yamaguchi, Japan]	Taken into account; Much discussion on this issue and text revised.
37366	70	35	70	36	Twenty years may be a sufficient averaging period for multiple ensembles of model runs, but we have observations of only one twenty-year realization of the atmosphere for use in the evaluation. It would have been more comfortable if those designing CMIP6 had used the normal 30-year WMO averaging period. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account; There is no perfect choice of baseline and the recent period has been chosen due to relevance to future projections rather than a broader set of factors which the reviewer correctly describes.
46198	70	41	70	45	Note WG III is 2030 short-term; 2050 mid-term; up to 2100 long-term - appears consistent. [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account; Chapter 4 have chosen the stated periods.
37368	70	44			Why is 2061-2080 not considered? The period 2021-2100 could have been split 2021-2040, 2041-2070 and 2071-2100. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account; Chapter 4 have chosen the stated periods.
44906	70	47	70	48	CC box 1.3 Table 1: I don’t think it’s correct to call paleo periods “baselines”. More importantly, CH2 now includes a very similar table of paleo periods. The CLAs for CH1 and 2 need to decide whether the table will be reproduced in two places or whether it should somehow be separated into two between the two chapters. For example, CH1 could use the table to list sections across the report where each time period is covered (I have that information for the FOD) and CH2 could include a brief summary of the major features of the climate system during the different periods (my original intention when I wrote it). Either way, the title of the box needs to match the contents by including the words “reference paleo periods”. [Darrell Kaufman, United States of America]	Taken into account; These periods now moved to Chapter 2.
42862	70	47	71	2	some periods/events need description. Add the Eocene, as it is mentioned subsequently in this chapter. Add the mid-Pliocene, as it has produced a wealth of observations, reconstructions, simulations of the climate system under mid-Pliocene boundary conditions? [Michael Evans, United States of America]	Taken into account; Paleo period table moved to Chapter 2.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
45606	70	50	71	1	Table 1.3 is incomplete, recommend to add sth. like this after consulting literature or colleagues in the field: 8.2k event: "Abrupt centennial-scale cooling event predominantly around the North Atlantic region but with global impacts". Younger Dryas: "Last major abrupt cooling period associated with a partial collapse of the Atlantic Meridional Overturning Circulation (AMOC) and related climate feedbacks. The climate impacts were strongest over the Euro-Atlantic region but had significant global impacts". Bölling-Alleröd: "Very warm interstadial with a rapid warming at the onset of the Bölling and abrupt cooling leading into the Younger Dryas after the Alleröd. Abrupt warming and cooling is most likely due to instabilities of the AMOC during rapid warming of the deglaciation." Heinrich-Stadial 1 (HS1): "Last major Heinrich event associated with strong cooling and massive iceberg discharge in the North Atlantic Ocean" [Frederik Schenk, Sweden]	Taken into account; Paleo period table moved to Chapter 2.
7598	70	52	70	52	In cross chapter box 1.3, able 1 : may be also report magnitude of global / regional change. It is probably important to convey that LGM is much lager than LIA, although both refer to « ice ages ». [Christophe Genthon, France]	Taken into account; Paleo period table moved to Chapter 2.
49428	70	52	72	1	Cross-chapter box 1.3, table 1: Some of the items are missing a statement in the "significance of climate state" column. [Sonya Legg, United States of America]	Taken into account; Paleo period table moved to Chapter 2.
14988	70	52	72	1	It's unclear why these time intervals have been chosen, given that other intervals are noted in the text but not stated here. For example, the mid piacenzian warm period (MPWP) is missing from this table but is used in later parts of the documents. The Last Interglacial is also missing here but is discussed later. MPWP (in the late Pliocene) 3.0-3.3 Ma. The last interval of sustained relative warmth before the development and then later intensification of the glacial-interglacial cycles during the Pleistocene epoch (from 2.6 Ma). LIG = 129 - 116 ka, the penultimate interglacial period. Atmospheric CO2 similar to today but different orbital configurations. [Erin McClymont, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account; Paleo period table moved to Chapter 2.
46790	71	0	71	0	Last Glacial Maximum: This is wrong. Large parts of North America were covered by ice but the majority of North American continent (typically also including Mexico) was NOT covered by ice. [Charpentier Ljungqvist Fredrik, Sweden]	Noted; Paleo period table moved to Chapter 2.
26116	71	1	71	1	I consider you should use the term Medieval Warming Period- it is the accepted term. Surely you have more confidence in the AGW than to have to eradicate the word “warming” from all past events and periods! [Stephen Taylor, United Kingdom (of Great Britain and Northern Ireland)]	Noted; Paleo period table moved to Chapter 2.
44080	71	1	71	1	Younger Dryas: demonstrates that rapid temperature (> 5 deg. C) and climate shifts can occur over very short time periods (20-100 years, Dansgaard et al. 1989 https://www.nature.com/articles/339532a0; Smith et al. 1997 https://www.nature.com/articles/386818a0), resulting in large-scale changes in Earth system states without much early warning. Non-linearity of Earth system change is particularly important to understand when discussing future climate impacts and tipping points. [Sara Kahanamoku, United States of America]	Noted; Paleo period table moved to Chapter 2.
53922	71	1	71	1	This table could be extended to include the more up to date definitions used for pre-industrial up to present and projection periods too. Then all of the time periods commonly referred to in the report will be in one place - very useful for the reader! [Timothy Carter, Finland]	Taken into account; Baseline box retained in Chapter 1 and discussion of paleo-periods moved to Chapter 2.
56162	71	1	71	2	Climate intervals before the LGM as defined in Annex II, e.g., the last interglaciation (LIG), are missng in the current table. [Ning Zhao, Germany]	Taken into account; Paleo period table moved to Chapter 2.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
9860	71	1			LITTLE ICE AGE: Need to mention that it represents the coldest phase of the entire Holocene. See e.g. Chapter 2, page 6, lines 30-31. The reader needs to be informed about this in the table. MEDIEVAL CLIMATE ANOMLY: It is simply not true that the MCA was restricted to the North Atlantic region. This claim stems from a time when the database outside the North Atlantic was still fragmentary. Meanwhile much more data from e.g. the Southern Hemisphere are available which document that the MCA was warm in most parts of the world. See Lüning et al. (2019a): 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. Paleoceanography 32 (11): 1219-1235, doi: 10.1002/2017PA003237. For Australasia see Gergis et al. 2016, DOI: 10.1175/JCLI-D-13-00781.1 and Lüning et al. (2019b): The Medieval Climate Anomaly in Oceania. Environmental Reviews, doi: 10.1139/er-2019-0012. For Antarctica, for ice core data see Stenni et al 2017, doi 10.5194/cp-13-1609-2017, for non-ice core data see e.g. van der Bilt et al. 2017, DOI: 10.1002/jqs.2937. For further references click on sites colour-coded in red on this map: http://t1p.de/mwp. LAST MILLENNIUM: Solar effects acknowledged for pre-industrial last millennium. Why has this effect been ignored for the industrial period? HOLOCENE THERMAL MAXIMUM: It is not true that the HTM occurred mostly in the Northern Hemisphere. A warm HTM is documented for e.g. the southern Andes, Antarctic Peninsula, East African Rift Valley, New Zealand and eastern Indonesia. For references click on sites colour-coded in red on this map: http://t1p.de/htm. 8.2K EVENT: Text missing. This is a prominent early Holocene cold phase, as part of a series of Holocene cold events (Bond et al. 2001, doi 10.1126/science.1065680). [Sebastian Luening, Portugal]	Noted; Paleo period table moved to Chapter 2.
50740	71	2	71	2	In order to make it easier to understand I would also include at the foot page of the Table 1 (Cross-Chapter Box 1.3), the meaning of PMIP. [Hernan Edgardo Sala, Argentina]	Taken into account; Paleo period table moved to Chapter 2.
57910	71		71		What is the definition of Common Era (CE or BP? [Catia Domingues, Australia]	Accepted; Paleo period table moved to Chapter 2.
48706	71		71		Cross-Chapter Box 1.3, Table 1: Dating uncertainty for MWP-1A and HS1 is larger than the +/- 10 years implied by the given number of significant digits [Lev Tarasov, Canada]	Noted; Paleo period table moved to Chapter 2.
48708	71		71		Cross-Chapter Box 1.3, Table 1: Assuming LGM is being defined wrt to global mean sealevel minimum, then the temporal range is too narrow given current litt and constraints. The Barbados record (Peltier and Fairbanks, QSR 25, 2006) argues for LGM at 26 ka. This is disputed, but I don't see it as being fully refuted to date. The most recent study I'm aware of supporting the 19-21 ka range (Ishiwa et al, Quat. Intern. 397, 2016) is not supported by the data they present. They incorrectly relied only on dates within the sediment core horizons to define time ranges instead of considering bounding ages from the temporally closest samples in adjacent horizons. The dated samples they list in their tables only indicate the LGM horizion ("unit 2") was younger than 22.0 ka calibrated within 2 sigma uncertainty. Therefore a more accurate statement is LGM is likely within the 19-22 ka range, though a range back to 26 ka has yet to be fully ruled out. The community has suffered before from uncertainty ranges being to narrow, so please don't make that mistake. [Lev Tarasov, Canada]	Noted; Paleo period table moved to Chapter 2.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
47462	72	5	72	46	Subsection 1.5.4 on sources of uncertainty may need cross-referencing and coordination with subsection 4.2.5 on quantifing various sources of uncertainty in Chapter 4. [June-Yi Lee, Republic of Korea]	Taken into account; This section now refers to 4.2.5.
8248	72	6	72	39	If it is possible, please give the contribution rates of uncertainties caused by several factors. Is which one the main factor? [Zong Ci Zhao, China]	Taken into account; Text revised and figure updated.
27566	72	6	72	46	Why is this section only considering projections? Apart from the scenarios all the uncertainties also apply to hindcasts and are thus crucial for understadning and attributing. I'd thus reframe this section to sources of uncertainty in climate simulations and have scenario uncertainty last as it is particularly relevant for projections but there are also related uncertainties stemming from different estimates of past aerosol forcings for example. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account; This section has been revised and renamed.
38144	72	6	73	4	It is necessary not only to review a variety of uncertainty qualitatively but also review the transition of the range of uncertainty. [Hiroaki Kondo, Japan]	Taken into account; Not clear what the reviewer means. Different time periods are now given.
27318	72	6	73	4	Strongly recommend to add a section on uncertainties related to climate model projections addressing the complexity of tuning-calibration-parameterisation. More explicit transparancy on the "secret sauce" (Paul Voosen, Science 2016) and "Art and Science" (Hourdin, American Meteorological Society 2017) is needed and would help policymakers to take well-informed and better decisions. Similar model outcome with often conflicting tuning-parameterisation is current reality. The modelling community knows that a good tuning fit with historical climate records is not a good basis for confidence in future projections. [ferdinand meeus, Belgium]	Taken into account; Discussed in section 1.5.3.4
9866	72	6			The models were not calibrated through a successful hindcast of pre-industrial regional and global climate of the past 2000 and 10,000 years. 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. The validity of temperature results from climate models remains questionable until the pre-industrial hindcast of the past 2k and 10k years has successfully been achieved. [Sebastian Luening, Portugal]	Rejected; The PMIP last millennium simulations match the reconstructed temperatures well (see Chapter 2).
8844	72	8	72	10	It should be made very clear that there are QUALITATIVELY different uncertainties, some that pertain to the knowledge and understanding of the climate system and some that DONT. This distinction is crucial for the broader understanding of the limits and uncertainties of climate projections. Scenario uncertainty has nothing to do with the physical understanding of the climate system. This must be stated explicitly. This is elegantly illustrated by the "Hawkins figures" (Hawkins and Sutton, 2009, BAMS, Fig 4, Hwakins and Sutton, 2011, doi: 10.1007/s00382-010-0810-6) which are surprisingly missing in this introductory, scene-setting chapter. There would be an opportunity to include them here. This would also fill another serious gap here: uncertainty is TIME DEPENDENT during a scenario calculation. [Thomas Stocker, Switzerland]	Types of uncertainty now discussed in more depth, and Chapter 4 considers the time dependence also.
32036	72	8	72	28	As indicated in my comments on the internal draft I strongly suggest using the term "forcing uncertainty" in place of "scenario uncertainty" and "response uncertainty" in place of "model response uncertainty". Neither the scenarios nor the models are in fact uncertain - the uncertainty lies in the future forcing and in the response of the climate [Rowan Sutton, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account; Terminology has been revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
53204	72	12	70	20	Re "scenario uncertainty": As pointed out, this is different from other uncertainties. And later in chapter 1 it is said that it may be a slight misnomer. Please check across chapters and WGs if "scenarion uncertainty" is a formulation that will work and if it is used in a consistent way. We should also check WGIII views and uses. THere are some paper that coudl be referenced here; Christensen et al. PNAS 2018, Schneider 2001, van Vuuren et al., GEC 2007. [Jan Fuglestvedt, Norway]	Taken into account; Terminology has been revised.
27044	72	19	72	20	the sentence saying that scenario uncertainty is relatively small in the next few decades is too vague (what does relatively small, and next few decades, mean: precise) and might be interpreted as if we can do nothing on mitigation for the next decades. In addition, the reference given is already a decade old... update with newer references. [Céline Guivarch, France]	Taken into account; Time dependence now considered but no reference provided by the reviewer.
42314	72	22	72	22	Should this be titled "climate response uncertainty"? Models are tools used to evaluate and characterize our understanding of the climate response. Uncertainty in projections could arise due to uncertainty in the model response or from lack of consideration of climate responses in the modeling (e.g., permafrost emissions). [Gabrielle Dreyfus, United States of America]	Taken into account; Terminology has been revised.
26402	72	22	72	28	It is a matter of nomenclature yet more than editorial: In a GCM the ERF is part of the model response, because it is (indirectly) calculated by the radiation code (indirectly because it's never computed explicitly in standard simulations, hence the additional runs in RFMIP). But in a forcing-feedback or forcing-response framework, ERF is forcing. This casts a bit of doubt on using "model response uncertainty" rather than "model uncertainty". [Jochem Marotzke, Germany]	Taken into account; Terminology has been revised.
9862	72	22	72	28	Need to mention still large range of CO2 climate sensitivity of 1,5-4,5°C per CO2-doubling [Sebastian Luening, Portugal]	Rejected; The ECS issue is discussed elsewhere.
27568	72	23			Assuming a particular future scenario or observed external forcings. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Accepted Text revised.
9864	72	30	72	33	AMO, PDO, NAO and other ocean cycles are not random but quasiperiodic and may in part be even linked to solar activity in a non-linear way. There is a significant amount of literature about this subject. [Sebastian Luening, Portugal]	Noted; No references provided by the reviewer.
48276	72	30	72	33	Consistent with my comment on the ES statement (5/22), suggest rephrasing this to note that internal variability, as an inherent property of the climate system, is not a projection uncertainty but it will impose an error bar on the projected change from an individual realisation of simulated future climate. [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	Take into account. Text revised.
27570	72	30	72	33	It would be important to also include natural variability. In parts of the literature that is used synonymous to internal variability but often includes variations in natural external forcings. It's important to know how IPCC defines it. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account; Text revised.
9268	72	35	72	46	When considering the ensemble spread as shown on figure 1.18, on expects that this information shoul help to characterize the model uncertaintiy. However this aspect is not commented upon. Box 4.1 indicated that the way using this spread in AR5 had drawbacks, but does not say what happened thereafter. [philippe waldteufel, France]	Taken into account; Text has been revised.
8502	72	37	72	37	Isn't it the ensemble -- not just the ensemble mean -- that estimates the model response uncertainty? [Robert Kopp, United States of America]	Rejected; Usually the ensemble mean is used to define the model response and the model response uncertainty is the range in those ensemble means

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
42866	72	38	72	40	This becomes more true as the ensemble becomes large - should emphasize this point. How large? Do we know? This could be illustrated by computing statistics of small, larger and complete samples of the largest ensembles of simulations (if not already done in the literature). [Michael Evans, United States of America]	Noted; Large Ensembles discussed briefly here.
8022	72	41	72	41	Suggest not to use words that are not widely understood, such as "aleatoric" or "epistemic". That doesn't help clarity. [Olaf Morgenstern, New Zealand]	Accepted; We revised the text to improve clarity.
17904	72	41	72	41	Avoid heavy Latin words. Most of people do not study the Latin language [I had the privilege to study it 2 years]. At least make a footnote with translation. [Branko Grisogono, Croatia]	Accepted; We revised the text to improve clarity.
27046	72	42	72	42	what is meant by "reliable probabilities": objective probability distribution in a frequentist interpretation of probabilities? [Céline Guivarch, France]	Taken into account; Text revised.
37370	72	43			Variations in solar activity can properly be regarded as external forcing. But volcanic activity is part of the internal variability of the Earth System, if not the climate system. It may also be influenced by climate change, through changes in capping glaciers. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account; Text revised. A reference for glacier capping effects would be helpful.
27572	72	44			add that impacts of volcanic eruptions can be studied in hindcasts [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Accepted; Text added.
26404	72	46	72	46	An example/reference would be useful, such as Maher et al. (GRL, 2015) on volcano--ENSO interactions. [Jochem Marotzke, Germany]	Accepted; We included a reference about this topic.
9868	73	7			Need to include the context of the last 2000 years as context or any attribution of extreme weather events. There are now large amounts of palaeoreconstructions of all types of extreme weather, e.g. droughts, floods, storms etc. [Sebastian Luening, Portugal]	Text now includes: "...extending the record in time using paleoclimate archives (e.g. WGI Section 1.5) may allow for greater certainty in detecting that a recent trend, change or extreme is outside the usual variability prior to industrialisation (Abram et al., 2016; Lüning and Vahrenholt, 2017)."
26406	73	9	73	17	The field started with Hasselmann's seminal 1979 paper in the admittedly hard-to-find book "Topics in Tropical Meteorology". [Jochem Marotzke, Germany]	The history of attribution has been removed from this section (now all in XC Box 1.4).
8846	73	9	73	17	The important overview papers on detection and attribution of regional changes and extremes, respectively, by Stott et al. in WIRES (2010, 2016) should be cited. [Thomas Stocker, Switzerland]	The history of attribution was cut. The background for trend attribution now only has a couple of references. While for event attribution, Jezequel et al. 2018 covers the range of methods more widely than Stott 2016.
27574	73	12	73	13	Rephrase this sentence it's not clear what you mean without having read the box & also only a historical marker is needed here. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	The short introductory paragraph has been folded into the XC box, where the broad concept of attribution is now introduced using IPCC messages.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
48278	73	15	73	15	Suggest including the phrase "the magnitude and/or frequency of extreme events" after "precipitation" as this is an important expanding area of attrribution research. [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	This point has been illustrated with examples: "Different approaches can lead to different messaging, such as: "This particular type of event is X% more likely to occur in the current climate" (frequency); "This event is likely to have a greater intensity due to climate change" or "The anomaly is half due to climate change" (magnitude). "
57306	73	22	73	22	We seem to have lost the distinction between single-step and multi-step attribution that was a big deal in the cross-WG IPCC expert report in 2010. Maybe check back to that report to see if you want to ditch it (in which case say so, and say why), or if not, then you should probably mention it. [Myles Allen, United Kingdom (of Great Britain and Northern Ireland)]	This box is used to assess the developments since AR5. We reference Hegerl et al. 2010 for context.
27580	73	22	74	10	This part is much less clear written than the following. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	The XC X-WG Box on Attribution in AR6 has been re-written to introduces uses first, and these caveats are spread through the introduction of the different methods.
53924	73	22	76	43	This is referred to as a cross-chapter Box, but it also includes attribution of impacts, which is a WG II issue. Why is this included here? There is a danger of duplication with WG II, unless it is thought helpful to use this as a cross-WG Box. Note in line 43 that this is (not will be) assessed by WG II, when this comes to be published. [Timothy Carter, Finland]	On your final point, the tense has been updated. This is identified as a cross working group box.
53206	73	22			Cross chapter box 1.4 is useful. The authors may consider adding some more text on role of D&A for LnD and international processes (e.g., WIM) (page 76, line 29). And also how D&A is relevant for WGII and WGIII. [Jan Fuglestvedt, Norway]	This is a X-WG box, and further efforts have been made to highlight this, including input from WGII and WGIII authors. In the list of uses of Attribution results we now include: "Inform efforts towards mitigation or prevention of climate-related disasters, and inform the discussion of losses and damages (Huggel et al., 2015; James et al., 2019; Parker et al., 2017). "
15242	73	28	73	28	I think somebody would take issue with placing Hegerl et al. 2010 as "the start" of definitions and practice [Claudia Tebaldi, United States of America]	The history has been removed. Hegerly et al 2010 was an IPCC-focussed discussion and guidance paper, so is relevant in the context of this box.
27576	73	28			It hasn't evolved starting with Hegerl 2010 but since Hegerl 2010 the field has evolved considerably hence the guidance cannot be used as a best practice for all anymore, but for event attribution the NAS report or reviews like Stott et al., 2016, Otto 2017 or Jezequel et al. 2018 provide a basis. Are their review papers on impact attribution that could be refered to as well? [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Thank you for the suggestions. The references that you suggest have been added to the event attribution section (NAS 2016; Stott 2016; Jezequel 2018, among others). Note also that the history has been removed.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
15244	73	32	73	33	I don't think the content following this statement is consistent with this description of the text being about "new developments" only [Claudia Tebaldi, United States of America]	The introductory sentences have been changed to: "This cross-chapter, cross-Working Group Box discusses why attribution studies are of use, and describes the methods used,..."
27578	73	37	73	43	I don't understand this paragraph. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	These concerns about shifting baselines etc. have been shifted to sit within the methods section, and now have more context.
54164	73	45	73	45	"...observed change or of extreme event…" should read "observed change or of the extreme event…" [Sarah Sparrow, United Kingdom (of Great Britain and Northern Ireland)]	The sentence now reads: "This requires observations whose temporal and spatial coverage, quality and homogeneity are deemed sufficient to capture the change or event."
9870	73	45	73	49	Needs firstly a pre-industrial palaeorecord of extreme events to define the corridor of natural variability and possible drivers. Extreme weather in the industrial phase can only understood once this context is provided, otherwise attribution of events into natural or anthropogenic is impossible. [Sebastian Luening, Portugal]	Text now includes: "...extending the record in time using paleoclimate archives (e.g. WGI Section 1.5) may allow for greater certainty in detecting that a recent trend, change or extreme is outside the usual variability prior to industrialisation (Abram et al., 2016; Lüning and Vahrenholt, 2017)."
54166	74	1	74	1	In this sentence there are two "or"s either replact first or with a comma or alternatively put a comma before the final "or" [Sarah Sparrow, United Kingdom (of Great Britain and Northern Ireland)]	The sentence has been cut. Reference to confounding factors is now included in this sentence: "Other considerations have been found to widen the uncertainty bounds on attribution estimates. (Qian and Zhang, 2015; Schurer et al., 2018). "
27582	74	4			It would be important to highlight that this also holds for all other studies using a climate model that come up with a result. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	This is a good point to make, and should also be made in other parts of this chapter, and the report.
27584	74	21			add 'spatial patterns' to the unique response [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Changed to: "a 'fingerprint' is the expected space-time response pattern to different climate forcing agents "
27586	75	7	75	10	I don't understand this. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	This has been changed to: "An alternative framing" is to estimate the proportion of tidal flooding that would not have happened in the absence of anthropogenically driven global mean sea-level change, by considering both global and local factors affecting regional sea level (Strauss et al., 2016, Section 9.6.4.1).
54168	75	24	75	24	The bracket should come before the e.g. with the citation of Chtistidis et al. [Sarah Sparrow, United Kingdom (of Great Britain and Northern Ireland)]	Corrected.
27588	75	25	75	26	It would be better to give the range of possible event definitions, e.g. from one-day record temperatures at the city scale to several years drought over a region. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Added: "Events can range in scale from a one-day record temperature in a city to several years of drought over a region."

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
6645	75	27	75	31	Enhanced readibility of this paragraph could be achieved if some examples of the challenges of untangling trends in hazards, sensitivity, vulnerability and exposure, are included (that is some extreme weather events …) [Tim Christiane Thys, Belgium]	This discussion comes later, in the 'Attribution of impacts...' section. e.g. "Climate impacts on an ecological or social system result from the interactions of a climatic impact driver with vulnerability and exposure of the system. Therefore, a number of steps may be required to disentangle the drivers of change in both the climatic variables and the impacted systems... "
48378	75	39	75	39	The text here needs to be consistent with the defintion of risk we are using and as this refers to hazards suggest changing "risk-based" to "likelihood-based", maybe adding that in the literature to date the phrase "fraction of attributable risk" is widely used but not appropriate here and replacing "likelihood" with "likelihood/intensity" at the end of the line. [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	The discussion of FAR has been removed, replaced with an example of the wording of attribution statements: "Different approaches can lead to different messaging, such as: "This particular type of event is X% more likely to occur in the current climate" (frequency); "
29958	75	41	75	41	Event-based storyline approaches are not qualitative, they are quantitative. [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	This text has been replaced with: "Another approach describes facets of the weather and thermodynamic status of the event (Shepherd et al., 2018). "
29960	75	42	75	42	Section 1.2.4.3 does not (currently) discuss storyline approaches for event attribution. A concise reference for this statement would be the paper introducing the concept of stoyrline in this context, namely Shepherd (2016 CCCR doi: 10.1007/s40641-016-0033-y). [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	We specifically refer to: Shepherd, T. G., Boyd, E., Calel, R. A., Chapman, S. C., Dessai, S., Dima-West, I. M., et al. (2018). Storylines: an alternative approach to representing uncertainty in physical aspects of climate change. Clim. Change 151, 555–571. doi:10.1007/s10584-018-2317-9.
29962	75	44	75	44	Otto et al. (2016) is not a peer-reviewed publication and so should not be cited here. The best reference for this point would be the NAS 2016 report, which is already in your reference list. [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	Thank you, we have added this reference here, and removed Otto et al. 2016.
54170	76	3	76	3	the reference to Philip et al 2018 doesn't specify whether this is a or b. [Sarah Sparrow, United Kingdom (of Great Britain and Northern Ireland)]	Only one Philip et al. 2018 is referred to now.
45746	76	6	76	35	Please remove this section on attribution of impacts as this will be covered in the WGII report. This could be a nice handshake between the WGs, where WGII can pick up from this box to add discussion of impacts attribution [Katja Mintenbeck, Germany]	This is a X-Working Group box, with WGII and WGIII authors. The aim is to highlight that attribution is used across all three working groups. Further assessment will of course be picked up in each report.
45880	76	6			The attribution of impacts remains behind how it was framed in the AR5 WGII report. This section is totally written from the point of view of WGI and may generate problems later when the respective aspects are discussed by WGII. Recommend dropping and referring to AR5. [Katja Mintenbeck, Germany]	This is a Cross-Working-Group box. Your point is taken, and we have had greater input from WGII authors in the SOD, with reference to relevant chapters in AR6, and pointers to AR5.
54172	76	10	76	10	There are additional brackets around the Philip et al reference that need to be removed. [Sarah Sparrow, United Kingdom (of Great Britain and Northern Ireland)]	Corrected.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
27590	76	10			as droughts can be defined purely meteorologically, floods might be the better example here, e.g. http://dx.doi.org/10.5194/hess-23-1409-2019 [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	We no longer list examples of WGI studies in this introductory paragraph, but we do give an example of end-to-end assessment of flood: "...there is now end-to-end analysis from emissions, through the resulting meteorological change, to the impact attributed e.g. for floods (Schaller et al., 2016)"
27592	76	15			delete 'detection and' there is no formal detection in event attribution [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Accepted; This has been removed.
54174	76	18	76	18	There are additional brackets around the Otto et al reference than need to be removed. [Sarah Sparrow, United Kingdom (of Great Britain and Northern Ireland)]	Corrected.
27594	76	18			delete 'detection and' [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	This has been removed.
54176	76	24	76	25	The list of references could also include Philip et al 2018b here. [Sarah Sparrow, United Kingdom (of Great Britain and Northern Ireland)]	This paragraph has been removed.
48386	76	27	76	31	only adverse effects are mentioned as examples. Longer growing seasons, increased arable land, and faster crop growth are also results at high latitudes. [Stephen Parks, United States of America]	This paragraph was describing attribution in the context of the risk framework. This section has been re-written to provide more of a setting for WGII work. Thus these points will be picked up in WGII.
27596	76	43			all of the above mentioned methods attribute changes in natural systems [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	We now include reference to the diverse range of WGII studies - i.e. AR5 Ch 18 and Stone et al. 2013.
53268	76	48	76	48	Explaing the SSP framework is in my view very valuable. And we need to coordinate with WGIII and WGII on how to present and communicate these scenarios and the thinking behind. [Jan Fuglestvedt, Norway]	Accepted. We followed up with cross Working Group coordination on the presentation of the SSP framework. We clarified the language.
57244	76	48	77	9	The dimension of integration lack the socio-economic assumption. This is less relevant for WG1, but highly relevant for WG2 and WG3. Figure 1.19 is therefore incomplete. In fact, the AR5 SYR approach has been overly simplistic in ist treatment of the socio-economics and more progress needs to be made to better integrate impacts, adaptation and mitigation. For example, the reasons of concern not only vary with temperature but also with SSPs. Something to be worked out better in AR6. [Elmar Kriegler, Germany]	Noted. We focus here on information relevant for the WGI AR6, while still trying to ensure the link to WGs II and III.
46200	76	48	85	27	I found the amount of material devoted to issues not related to physical science quite surprising here. [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The subsection has been shortened and the level of detail reduced. This section intends to provide just the context of scenarios and the links with other WGs, without assessing the literature that will be rightfully assessed and examined in detail in WGIII.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
54298	76	48			This section on dimensions of integration is important in general, as a way to describe how information in WG1 will be integrated, and how it can be integrated with other working groups. However it seems much longer than it needs to be, and at least from a cursory look at other chapters in the report is somewhat out of balance with the degree to which topics are relevant to the rest of the report. I think the section would be much more effective and useful to the report if the content were reduced by identifying those topics that are actually used within WG1, and are planned as points of integration with other WGs, and then provide focused assessment only of those topics. That way the section will serve more as an explanation of the approach to integration in the report rather than as a stand-alone assessment of topics related to scenarios, temperature levels, etc. As some selected examples, it's not clear why this chapter in WG1 would be a natural place to address the history of scenario development, the nature of socioeconomic scenarios as representing societal choices, approaches used in WG3 to classification of emissions scenarios, the benefits of multiple scenario (SSP) analysis (more relevant to other WGs; are there any within WG1?), a full description of the SSP-RCP matrix approach and its uses, scenario applications to the Paris Agreement (primarily a WG3 topic), etc. While there are certainly at least indirect connections to WG1 that can be pointed to in these cases, the question is about where is the appropriate place to assess these topics in AR6, what redundancy (and therefore inconsistency) this may generate across WG reports), and what the role of Ch 1 in WG1 is within the larger report. [Brian O'Neill, United States of America]	Noted. Comments are noted and the revised section on scenarios is shortened and focussed in response. Still, as WG1 will be the first report that is released, some contextualisation of the presented climate projections is important (see also other reviewer comments). We hope we struck an appropriate balance.
53208	76	48			Section 1.6 is very useful and needed both for readers of WGI, but also for AR6 as a whole. The use of scenarios is one of the main elements across WGs and this section may help readers to see more of the bigger picture - which is essential for the users' understanding of what scenarios are saying - and not saying - how they can be used and not used. It needs further coordination with WGII and WGIII in order to be consistent with their assessments. It also helps to develop a good basis for the use of scenarios - and other integrating elements - in the Synthesis report. [Jan Fuglestvedt, Norway]	Noted. We provided the draft of the revised section 1.6 to WG3 as part of the WG1-WG3 coordination and handshake process.
53210	76	51	76	51	You may change "reference point" to "basis" or "framing" [Jan Fuglestvedt, Norway]	Noted. The introduction to section 1.6 has been revised, and hopefully improved. "reference point" is still used but in a context that is clearer.
50750	76	53	76	53	Add "(DI)" after ‘dimensions of integration’. [Hernan Edgardo Sala, Argentina]	Noted. Figure 1.19 where the abbreviation "DI" is used has become figure 1.28. The definition of the abbreviation "DI" is made clear in the figure legend.
50752	77	4	77	9	I suggest to rewrite the caption of Figure 1.19, in this shorter a way: "The Dimensions of Integration (DI) across Chapters and Working Groups (WGs) in the IPCC AR6. Building on the Synthesis Reports of the IPCC AR5 (background image detail) this report adopts three explicit DI to integrate knowledge across chapters and WGs. The first dimension (DI 1) are scenarios, the second dimension (DI 2) are global-mean temperature levels relative to pre-industrial levels and the third dimension (DI 3) are cumulative CO2 emissions." [Hernan Edgardo Sala, Argentina]	Taken into account. The figure 1.19 is now 1.28 in the second order draft, and the legend has been shortened.
53212	77	4	77	9	Figure 1.19 is a nice way to link the 3 Dimensions of integration together. [Jan Fuglestvedt, Norway]	Noted. The figure has been kept and become figure 1.28

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
57360	77	14	78	8	The discussion and Figure 1.20 is missing the link between WG2 and WG3. Socio-economic assumptions affect emissions scenarios, mitigation scenarios and climate change impact scenarios, and thus need to be well coordinated to achieve some degree of meaningful synthesis. This is the basic motivation behind the SSPs. The SSPs themselves are less relevant for WG1, here the forcing levels (formerly RCPs) matter much more. See https://climatescenarios.org/primer/ for an overview. [Elmar Kriegler, Germany]	Noted. We revised the figure to include a WGII and WGIII link for completeness. We limit the text however more on WG1 aspects of this cross-WG scenario generation process.
8250	77	14	85	30	Please introduce why the IPCC gave many emission scenarios since FAR. Is which one able to be the possible scenario? [Zong Ci Zhao, China]	Taken into account. The classification of scenarios and contextualisation with previous assessment reports is presented earlier in the second (1.6.1).
35178	77	14			There is a strong thread on SSPs, which is fine, but it could also be an entry point to confusion. My understanding is WG1 will analyse the SSP-Markers. They are a sample of several scenarios from the larger set of SSP scenarios, which in turn are a subset of the scenario literature. It sometimes sounds like SSPs are the scenario literature, they are just a subset. It also sounds like the WG1 will analyse the SSPs, they will not, the will analyse the SSP-Markers (just like AR5 analysed the 4 RCPs). WG3 may analyse SSPs, as a part of teh literature, but like SR15, it may be an element, not the entire framing. I guess the main point here is to make sure that people know, including LAs, that they are analysing SSP-Markers, and not analysing SSPs per se. I think an important distinction, and something that was completely stuffed up in AR5 with RCPs. [Glen Peters, Norway]	Accepted. Revised to make clear we only look at an SSP subset, the marker SSPs.
35180	77	14			Three elements of framing: SSPs, budgets, climate targets. In principle, this is fine. The text is fine, etc. But who is the framing for and why? I get a sense that SSP-Markers might be given far more emphasis in WG1 than in WG3, which will lead to some confustion. I am sure the majority of analysis will be based on the RCP level, and no one in WG1 will care if it was SSP1, 2, 3, 4, 5. WG2 maybe. On budgets. AR5 looked at budgets from WG1, WG3. SR15 took only an WG1 approach to budgets, and it looks like this will be the approach in AR6. I am sure WG3 will mention and discuss budgets, but not so clear it will be a framing element. While IAMs are quite important for budgets, particularly nonCO2, they seem to be have excluded from the budget discussion. My sense is that the budgets will be very much a WG1 thing, and only a side issue in WG3. Maybe I am wrong, just noting. On temperature levels, that makes more sense as a framing element, and that is more likely to be a common thread through the report. My long comment here is basically trying to say that this section tries to honestly frame and find points of integration. This is great. The challenge is that it sets expectations, and if the other chapters dont frame around those elements, then the expectations are not met. If you try and force people to frame around these three elements, they may not be so happy. [Glen Peters, Norway]	Noted. The text now makes explicit links with other WG1 chapters, mainly Chapter 5 examining cumulative carbon emissions, Chapter 4, 5 and in particular Chapter 11 extensively relying on the temperature levels as dimension of integration.
35174	77	16	77	16	What is a scenario? WG1, 2, 3 might conceptualise scenarios quite differently, so perhaps worth defining and mentioning how different WGs conceptualise scenarios. [Glen Peters, Norway]	Noted. We provide a definition of "scenario" in both the glossary and also in Cross-Chapter Box 1.5 on "Scenarios, Projections, Pathways and temperature levels."

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
26408	77	16	77	17	I do not understand what this sentence is trying to tell me. [Jochem Marotzke, Germany]	Noted. An "also" went missing in the second half of the sentence and was inserted. Furthermore, the sentence now appears later in the section (1.6.4) where the context is clearer for the reader.
32918	77	24			thermosteric change (preferred) or thermal expansion [Aimee Slangen, Netherlands]	Accepted. Sentence has been revised.
46202	77	26	77	34	This is a very good concise summary of the x-WG links [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	Noted. No Action needed
53214	77	28	77	28	"cumulative" is missing before "emissions" [Jan Fuglestvedt, Norway]	Accepted. Text moved to Section 1.6.3
53926	77	28	77	29	Are these really the "two policy relevant dimensions"? With respect to what audience and which aspects of this assessment? Other policy-relevant dimensions of the scenario framework include land use changes and socioeconomic determinants of exposure and vulnerability, which have to be aligned with the climate and emissions projections. [Timothy Carter, Finland]	Noted. The sentence has moved to section 1.6.4. There are many more policy relevant aspects, but here we focus on the dimensions OF INTEGRATION most relevant for WGI and AR6.
27598	77	30			with respect to cause&effect also past emissions and temperature responses simulated and obeserved and attributed temperatures are important. Might be worth mentioning that for most of the across timescales publications (i.e. attribution+projections https://iopscience.iop.org/article/10.1088/1748-9326/aae9f9) the temperature integration is generally used. Maybe not here but where it fits in the section. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Certainly the attribution is also key. The specific reference related to the Western Cape drought might be to specific in this general introduction, but will hopefully be cited in the D&A sections of this report.
43428	77	36	77	37	Sentence structure implies something else should be in the sentence, eg "not only .... but..." [Saad Amer, United States of America]	Taken into account. Text has been rewritten, the sentence is no longer part of section 1.6.1.
35176	77	36	77	40	This is basically explaining the idealised Moss et al (2010) framework, and later split into the SSP-SPA-RCP framework. While this is the theory, I don't think this is the practice. The practice is much more adhoc. I would not say there is a "process", rather a bunch of connections within established networks. Not all scenarios start with a story line process, not all scenarios use SSPs, not all scenarios lead to forcing pathways, and not all scenarios go to WG1. SSPs are only a small subset of the scenario space. In SR15, only 40% of the scenario database was SSPs. In the AR6 scenario database, it is likely that the share of the SSPs will be smaller. Basically, the SSPs are one element of the scenario world, and probably not a dominant element. This section frames it as the scenario world. [Glen Peters, Norway]	Taken into account. Text in section 6.1.1. now says "scenario generation process (...) starts (...) with the definition of new socioeconomic storylines".
38146	77	36	77	54	The cost for mitigation and adaptation countermeasures does not linearly depend on the amount of emission of GHGs. Because the cost of countermeasure is one of the most important choices to determine the strategy, a perspective how to reduce the range of uncertainty is also useful information for WG III. [Hiroaki Kondo, Japan]	Noted. No action. The referenced paragraph does not claim that countermeasures linearly depend on the amount of GHG emissions.

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54246	77	36	77	54	This paragraph's description of the scenario process, at least as it currently occurs, is not quite right. The storylines and drivers don't start in WG3, but are a joint product of WG2 and WG3 research communities, as well as other researchers that don't neatly fall in these categories (eg, futures studies). This is because the socio-economic scenarios (storylines and quantitative elements) are at least as important as a basis for impact analysis as they are for emissions and land use projections. As soon as the socioeconomic scenarios are developed, they are used immediately in combination with already existing climate model projections to carry out impact analyses. The WG2 community does not wait for emissions scenarios to be produced, and then ESM simulations, in order to start doing impact analysis. [Brian O'Neill, United States of America]	Taken into account. the discussion has been shortened and clarified, as well as the figure (now Figure SOD 1.23).
46204	77	38	77	38	The storylines are not just WG III - they are also relevant to adaptation hence WG II [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	Noted. We have added "generally starts in the WGIII". Note that the FOD text only spoke about the origin of the narratives in WGIII, not that narratives are exclusively relevant for WGIII. The text has been revised and shortened for the SOD.
30436	77	40	77	40	For completeness, one can also include here a reference to the study that quantified 1.5°C consistent (SSPx-1.9) scenarios based on these storyline at a later point in time: Rogelj, J., A. Popp, K. V. Calvin, G. Luderer, J. Emmerling, D. Gernaat, S. Fujimori, J. Strefler, T. Hasegawa, G. Marangoni, V. Krey, E. Kriegler, K. Riahi, D. P. van Vuuren, J. Doelman, L. Drouet, J. Edmonds, O. Fricko, M. Harmsen, P. Havlík, F. Humpenöder, E. Stehfest and M. Tavoni (2018). "Scenarios towards limiting global mean temperature increase below 1.5 °C." Nature Climate Change 8(4): 325-332. [Joeri Rogelj, Austria]	Noted. We have not added the extra reference; please note that this overview intends to provide the key references for the general SSP framework, not the specific scenarios per se.
53218	77	50	77	50	you may add "global" before "climate indicators" [Jan Fuglestvedt, Norway]	Noted, no action.
15246	77	51	77	51	I may agree personally but I think a lot of physical climate scientists would not agree with this identification of "main use of climate projections". Maybe simply adding an "In the context of integrated research,…" would somehow circumscribe the domain and make this statement more acceptable? [Claudia Tebaldi, United States of America]	Accepted. The paragraph has been shortened and the sentence has been removed.
26410	77	54	77	54	This figure and quite a number of others are so poor quality and resolution that it is impossible to tell what they are supposed to expresss. I know this is probably an issue for the TSU rather than the author team (we had similar cases in Ch4, where figures that had been decent in our World file turned blurry during production). [Jochem Marotzke, Germany]	Noted. The figure quality has been improved for the SOD.
54248	77	54	77	54	Figure 1-20 is very hard to read, the text is low resolution so I am not sure what exactly is listed in the boxes across the page. But it looks like an entirely linear process that does not describe the parallel process that was actually followed in the SSP-RCP framework (see the Moss et al paper describing that process). In addition, as mentioned in my previous comment, impact communities don't wait for new climate projections to begin carrying out impact assessment. They use new socioecononomic scenarios with existing climate projections. In fact that is what much of the WG2 assessment will be based on: studies using SSPs combined with CMIP5 simulations (CMIP5 was not produced with SSP-based emissions or concentration scenarios). Another way to look at this is that the figure shows a process that spans at least two IPCC cycles, and is missing the overlap with the previous process (SRES->CMIP5). [Brian O'Neill, United States of America]	Taken into account. Figure and text revised and simplified (figure, now 1.23, shows the process as a loop)

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
53216	78	1	78	10	Figure 1.20: I find this figure very useful as an illustration of how the different activties in the WGs and communities are linked together. It could be further emphasized that it shows the processes and links, and that it is not meant as "reseach framing" or analytical framework. [Jan Fuglestvedt, Norway]	Noted. The figure has been simplified. The new circular design emphasizes that it shows a process and links between the WGs.
50742	78	5	78	5	I suggest to add "(DI)" at the end of: "Also, the three dimensions of integration", because "DI" is present in the Figure 1.20. [Hernan Edgardo Sala, Argentina]	Noted. The figure has been revised but as an oversight the legend has not been corrected for the SOD. For the FGD the figure was revised and the abbreviation DI no longer used.
27672	78	10	78	10	double parenthesis [Poot Delgado Carlos Antonio, Mexico]	Noted. done
38160	78	13	78	27	The place of Figure 1.21 may not be here but after line 11 in page 79. [Hiroaki Kondo, Japan]	Noted. This figure is no longer in the second order draft.
46216	78	15	78	15	The "marker" scenarios are not SSP scenarios; they are SSP/RCP combinations. It is wrong to describe SSPs as emission scenarios . They are what it says on the tin "socioeconomic pathways". They can be combined with any level of climate ambition (subject to models solving). [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	Noted. We followed this comment up with extensive consultations between WG1 and WG3, concluding that we will continue to use the now pervasive terminology of SSPX-Y within the chapters of WG1 - also after having consulted with WG3 CLAs. We however note the option and intention to find simpler scenario labels for the SPM.
53220	78	15	78	25	This seems very promising but the quality makes it really hard to read it. Looking forward to SOD. [Jan Fuglestvedt, Norway]	Noted. This figure is no longer in the second order draft.
25970	78	15	78	32	the term "marker SSP scenario" is introduced without definition or motivation. More broadly the SSPs must be fully described and motivated.The legend refers to multiple SSPs. It seems essential to have first a graph of the forcing that would be expected as a function of time for each SSP. Evidently the graphs at the right of the figure are meant to represent the forcing. That needs to be explicit, and the unit should be W m-2. And the graphs need not be filled to the abscissa; simple curves will work, and the several SSPs can be placed on the same graph for clarity. The caption refers to "warming" in panel b; I cannot read the ordinate label. But the more explicity term, forcing or increase in global mean temperature, should be used rather than the vague "warming". The discussion starting with "overall" should be moved from the caption to the text. [Stephen E Schwartz, United States of America]	Not Applicable. Figure has been dropped. Marker scenarios are now being introduced as part of the SSP discussion
25972	78	15	78	32	There is no discussion here of the role of aerosols despite their large contribution to total forcing and their inevitable change relative to ghgs in the several scenarios. This could have enormous consequence if the present cooling forcing of aerosols is a substantial fraction of ghg warming forcing. So this must be discussed, both the assumptions built into the analysis presented and the consequence of change of aerosol forcing in the future. [Stephen E Schwartz, United States of America]	Noted. Figure has been dropped. Aerosols are discussed later and shown in Figure 1.25.
27674	78	18	78	18	double parenthesis [Poot Delgado Carlos Antonio, Mexico]	Noted. This figure is no longer in the second order draft.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
57374	78	30	78	34	SPAs have been introduced in the SSP framework, but note that only a minority of IAM scenarios (those in the original SSP application) follow the SPAs defined in Riahi et al., 2017. Most make their own policy assumptions, some harmonized across a model comparison study (in which case they still might be called SPAs), others not. The SPAs defined in Riahi et al. were formulated before the adoption of the PA, so do not include NDCs etc. In the AR6 database, the latest policy relevant (S)PAs will look different. [Elmar Kriegler, Germany]	Noted. We simplified the discussion on the scenarios and the new text does not go into the issue of SPAs any more.
46208	78	30	78	48	I imagine this is almost incomprehensible to a policymaker. The discussion is mostly about WG III IAM analysis strategy and will be described fully in the "scenarios and modelling methods" Annex to WG III. Optiosn are to drop much of this or look at a re-draft. I understand what its trying to say but I am not sure everyone would. Note also that there will be other ways of interrogating scenarios literature in WG III (what is described is Chapter 3 only). [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. Text removed, section has been substantially revised and shortened.
57308	78	30	78	48	The most obvious way of categorising scenarios is by cumjulative CO2 forcing-equivalent emissions (Wigley, 1998; Jenkins et al, 2018) to the time of peak warming, which for a given value of TCRE corresponds unambiguously to peak warming. Why not make life simple? [Myles Allen, United Kingdom (of Great Britain and Northern Ireland)]	Noted. This section has been substantially revised and the presentation is hopefully simpler.
27050	78	30	79	47	the three paragraphs are very hard to understand, please consider rephrasing. A number of sentences are very obscure (eg "Examining the emission pathway characteristics of all scenarios in one temperature class allows for a better insight of cost-optimal and second-best emission milestones and characteristics while at the same time providing insights regarding the flexibility to divert from the middle-of-the-road pathways in a specific scenario class. The disadvantage is clearly that uncertainties are folded into the scenario classification that are external to the scenarios themselves."). Some are not full sentences (eg "However, with a proper characterisation and synthesis of uncertainties across the AR6 report, ranging from the CO2-induced warming, non-CO2 greenhouse gas and aerosol effect, as well as carbon cycle and Earth system feedbacks."). The use of the latin phrase 'pars-pro-toto' is not making things clearer, please consider using an english phrase or explain the meaning. [Céline Guivarch, France]	Noted. This section has been substantially revised and the presentation is hopefully clearer.
30438	78	31	78	31	Two good references here would be to IPCC AR5 WG3 Chapter 6 and IPCC SR15 Chapter 2, which are the two most recent IPCC assessments of the scenario literature. [Joeri Rogelj, Austria]	Noted. This section has been substantially revised and this discussion of IAMs is no longer part of the SOD.
46206	78	32	78	32	I would introduce the "marker" scenarios earlier. They are the key to x-WG integration and will allow policmakers a better picture of teh overall integration strategy. [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. We shifted the description of marker scenarios upwards in section 1.6.
57254	78	32	78	33	Scenarios don't really 'follow' SPA (there are 5, not 'a few'). Not sure if mention of SPAs is really necessary, but if so, then section should be extended so SPAs and there role can be better explained [Oliver Geden, Germany]	Taken into account. We left out the topic of SPAs in the revised text.
30440	78	32	78	34	This is incorrect. The SPAs do not determine whether emissions are high or low. SPAs determine the potential for and conditions under which climate policy can be applied in SSPs. In other words, the determine "how" climate policy can happen, but not if or how stringently it is assumed. For the latter, SSP storylines are run with additional climate constraints imposed, for example, reaching a certain level of radiative forcing in 2100 like in the RCPs. [Joeri Rogelj, Austria]	Taken into account. We left out the topic of SPAs in the revised text.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
43098	78	32		36	How about "With the overwhelming majority of future greenhouse gas induced warming determined by elevated carbon dioxide concentrations, irrespective of scenario, it is key to focus on the centrality of cumulative emissions of carbon dioxide. Warming does not stop in any scenario until net CO2 emissions are zero (or below). Second-order effects can also be important, especially as CO2 emissions are declining towards zero. For example, methane emission rates shortly before and at the time of peak warming levels can have an effect on the remaining carbon budget for a given temperature target." [David Frame, New Zealand]	Noted. This section has been substantially revised and shortened.
27600	78	32			explain marker scenario [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Marker scenarios are defined in the cross chapter box. The text has been revised and this sentence is not in the second order draft.
57376	78	34	78	36	There are many more ways to classify the scenarios which will be explored in WG3, e.g. time of carbon neutrality, degree of temp or budget overshoot (peak - end of century), 2030 emissions (NDCs vs. above/below NDCs), emissions profile (ratio of emissions until 2030 to 2030-2050 to 2050-2100) etc. And there are socio-economic classifications e.g. the SSPs, but also high/low energy demand and food demand etc. I think it would therefore be good to refrain from a full classification of IAM scenarios here. The discussion should restrict itself to climate outcomes and potentially emissions outcomes, but this requires close coordination with WG3. [Elmar Kriegler, Germany]	Noted. The section has been substantially revised. We deleted most of this paragraph.
27602	78	36			do you mean 'early-industrial'? [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Noted. No. In line with the Paris Agreement and previous UNFCCC accords, this text refers to pre-industrial.
57378	78	37	78	38	I suggest to avoid cost-optimal and second best terminology here. Meaning of sentence is unclear to me. The temperature class is not necessarily the "dominant" class in which "second best variations from middle of the road"(???) can be explored. [Elmar Kriegler, Germany]	Accepted. This section has been substantially revised and shortened.
53222	78	39	78	41	Would be good with some explanation about the uncertainties folded into the classification. [Jan Fuglestvedt, Norway]	Noted. Text revised and simplified.
9270	78	41	78	43	Something is missing in that sentence [philippe waldteufel, France]	Noted. This section has been substantially revised and shortened.
8024	78	41	78	43	This sentence is incomplete. Please fix. [Olaf Morgenstern, New Zealand]	Noted. This section has been substantially revised and shortened.
46212	78	41	78	43	This is not a sentence. No verb [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	Noted. This section has been substantially revised and shortened.
54250	78	43	78	43	Where in this report are these uncertainties assessed? Please indicate. [Brian O'Neill, United States of America]	Taken into account. Uncertainties are assessed across the board for the various considered domains. For example, Chapter 4 characterises uncertainties in future projections. Chapter 5 looks at uncertainties of CO2 and non-CO2 warming relevant to the remaining carbon budget. etc. Section 1.6 has been substantially revised and shortened.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
27604	78	43	78	48	Add that temperature integration links directly to UNFCCC goals and also the integration of hazard assessment accros timescales is based on this (comment above) [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. We revised and reorganized the text and now provide a link to UNFCCC / Paris Agreement temperature goals.
54252	78	47	78	47	Where in this report will this cumulative emissions categorization be performed? And is this meant to indicate that chapters throughout WGI will be using this categorization routinely in carrying out their assessments? If so that should be explained here. [Brian O'Neill, United States of America]	Noted. Section 1.6 has been substantially revised. The sentence is now: "The classifications according to cumulative carbon emissions (see Section 1.6.3) and temperature levels (see Section 1.6.2 and Cross-Chapter Box 7.1 on emulators) complement those forcing labels."
46210	78	50	78	50	When does GMST v GSAT get addressed? [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	Noted. It was part of FOD Section 1.5.3.2, and now section 1.4.1 of the SOD.
57380	78	50	79	11	The reasons of concern depend on socio-economic conditions. For a 2 degree warming, the risk level will be very different in an SSP3 world compared to an SSP1 world. This has been neglected so far, but would need to be brought in to achieve a meaningful synthesis. The discussion does not reflect this important fact (same comment for Fig. 1.22) [Elmar Kriegler, Germany]	Noted. Reasons for concern are no longer discussed in this section.
57384	78	50	79	11	It is not clear to me why cumulative carbon emissions and temperature would be complementary in spanning the spectrum of climate effects. Are they not rather imperfect substitutes? Complementary seem to be things like peak warming and overshoot (peak - end of century warming). When it comes to climate change impact (WG2) and mitigation outcomes (WG3), there are of course more dimensions relevant than just these two (SSPs, early vs. late action, CDR, etc) [Elmar Kriegler, Germany]	Noted. Section 1.6 has been substantially revised and shortened.
27052	78	50	79	11	The paragraph would need to explain the differences between temperature and cumulative CO2 emissions use as representative, which advantages and drawbacks are each bringing? [Céline Guivarch, France]	Noted. Section 1.6 has been substantially revised and shortened. The paragraph is no longer in the second order draft.
28478	78	52	78	55	These lines don't make much sense to me at all. [David Schoeman, Australia]	Noted. Section 1.6 has been substantially revised and shortened. This sentence has been removed.
53928	78	52	78	57	This explanation is a somewhat inadequate pars-pro-toto of the full range of integrated uses of scenarios in climate change research, which are only partially represented in this account. The exclusion of any mention of socioconomic scenarios that underpin vulnerability and exposure to climate-related hazards rather undermines the whole concept of integrated scenario analysis, and more specifically of the SSP-RCP framework that is described later. it is written frm a physical science perspective where impacts of climate are the main interface with WG II. There should be recognition that other mediating conditions will modify these impacts, and they may be intimately related to the drivers of emissions and the climate itself (i.e. economics, populaton, development ...). Incidentally, fancy Latin expressions may not really be especially comprehensible to all audiences of this report! [Timothy Carter, Finland]	Noted. Section 1.6 has been substantially revised and shortened. The Latin expression has been removed.
43430	78	54	78	54	Reasons For Concern should be capitalized [Saad Amer, United States of America]	Noted. Reasons for concern are no longer discussed in this section.
31612	78	57	78	57	"pars-pro-toto" should be italicized and without hyphens, I think. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Section 1.6 has been substantially revised and shortened. The Latin expression has been removed.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
43100	79	3		5	The use of scenarios in practical and academic circles goes back quite a bit further (especially in the military). Academically, Hermann Kahn's work introduced the term in the sense used here. Also Pierre Wack and others developed quite a few of the relevant ideas. I would use these rather than, or as well as, the Limits to Growth stuff (which is an unnecessarily polarising reference, in any case). [David Frame, New Zealand]	Noted. Comments refers to p79, lines 50. The sentence about "limits to the growth" has been removed.
30416	79	9	79	11	There also are more specific papers available here: Rogelj, J., M. Meinshausen, M. Schaeffer, R. Knutti and K. Riahi (2015). "Impact of short-lived non-CO2 mitigation on carbon budgets for stabilizing global warming." Environmental Research Letters 10(7): 075001. A discussion of the variation in AR5 carbon budgets is provided in: Rogelj, J., M. Schaeffer, P. Friedlingstein, N. P. Gillett, D. P. van Vuuren, K. Riahi, M. Allen and R. Knutti (2016). "Differences between carbon budget estimates unravelled." Nature Clim. Change 6(3): 245-252. [Joeri Rogelj, Austria]	Noted. Section 1.6 has been substantially revised and shortened. Due to constraints in length the references have not been added.
38148	79	14	79	19	Figure 1.22 is not referred in the main text. [Hiroaki Kondo, Japan]	Not Applicable. Figure has been deleted.
54268	79	16	79	19	What is the plan for figure 1-22? Since updated version of the burning embers and of the WG3 emissions scenario analysis will not be avialable when the WG1 report is published, how will those parts of the figure be included? Shouldn't this figure really be part of the synthesis report? Or do you plan to use the AR5 synthesis report figure with only the WG1 panel updated? [Brian O'Neill, United States of America]	Not Applicable. Figure has been deleted.
50744	79	17	79	17	Because "GHG" has not been previously defined in this chapter, I suggest to add its complete meaning. [Hernan Edgardo Sala, Argentina]	Not Applicable. Figure has been deleted.
53930	79	24	79	24	I'm really not sure what these "dimensions of integration" are that have apparently emerged in recent years. I would have thought they have been with us for as long as we have been working with systems models and applying scenarios, or am I missing something? [Timothy Carter, Finland]	Noted. They have been implicitly part of the community for probably decades. The Synthesis Report figure from AR5 is the exact depiction of these three dimensions, with the reasons of concern along one dimension, the temperatures. Section 1.6 has been revised and the discussion (now in 1.6.4) is shortened.
57386	79	24	79	47	I think the analogy between delay in emissions reductions (WG3) and the use of warming time slices from higher emissions scenarios (WG1) does not work. These are unrelated things. [Elmar Kriegler, Germany]	Taken into account. Section 1.6 has been substantially revised and shortened, this discussion no longer appears. We did not intend to draw any analogy between a delay in emission reduction and the use of warming slices, as the reviewer correctly says that these concepts are unrelated.
53224	79	25	79	25	You may add a couple of essential references regarding the emergence of these dimensions [Jan Fuglestvedt, Norway]	Noted. Section 6 has been substantially revised and shortened. The sentence is no longer there in the second order draft.
43432	79	25	79	26	should be: a body of literature has also investigated their limitations, non-linearities and shortcomings. As of now, 'those' does not refer to anything. [Saad Amer, United States of America]	Noted. Section 6 has been substantially revised and shortened. The sentence is no longer there in the second order draft.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
30442	79	32	79	34	It would be useful to make the workign assumption explicit that the trajectory of temperatures during the 21st is irrelevant in this case. This might be an assumption that, although widely applied in scenario studies, might not be widely supported outside the technical modelling world. [Joeri Rogelj, Austria]	Noted. Useful but not necessary. We now do provide an example: "knowledge around path-dependencies and lock-in effects (e.g. todays decisions regarding fossil fuel related infrastructure)"
27606	79	34	79	35	where? [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. This sentence is now at the end of section 1.6.3 and a reference to chapter 5 has been added.
54254	79	34	79	35	Where will this report explore the options referred to? [Brian O'Neill, United States of America]	Taken into account. This sentence is now at the end of section 1.6.3 and a reference to chapter 5 has been added.
57388	79	50	80	11	Good discussion. See https://climatescenarios.org/primer/ for a similar view and further aspects of the scenario approach. [Elmar Kriegler, Germany]	Noted. No action.
46214	79	50	84	30	This is an extraordinarily long section for something that is "exogenous to WG I" (page 80 line 13). I would argue that this needs edited back to cover the key x-WG links rather than delving too much into WG III territory. This is ground that will be covered in WG III (chapter 3 on emissions and long-term goals; scenarios methodology annex). There's a real risk that inconsistencies will develop as WG III will not finish till after WG I is approved. Some statements are potentially controversial and there are some inaccurate descriptions. Froma WG I perspective, the key point is surely that emissions in marker scenarios reflect assumptions about both background socio-economic conditions and climate ambition. Some degree of filling out is warranted but not at the length here? [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Section 1.6 has been substantially revised and shortened to better balance the material and to keep closer to material relevant to WGI.
15250	79	50	85	29	This section is extremely rich and complex, and even if personally I find it interesting, I'm wondering how much of this the reader of the WG1 report will want to digest. I'm afraid it goes into too much detail, technical and historical. I would try to simplify and shorten it significantly. Particularly about the aspects that relate eminently to WG2 and WG3 concepts. How does this content relate to the WG3 Annex about Scenarios, for example? [Claudia Tebaldi, United States of America]	Noted. Section 1.6 has been substantially revised and shortened to better balance the material and to keep closer to material relevant to WGI.
27608	79	50	86	20	These two subsections are in part verbatim repetitions of the summaries given above, it would read much more useful to integrate the necessary details into the section above as the discussion in 1.6.1 makes much more sense once you actually know what a scenario is. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. The scenarios are now introduced in 6.1.1.
53932	79	54	79	54	This cross-chapter box from SRCCL will not be accessible to everyone and should probably be reproduced in the AR6 somewhere. [Timothy Carter, Finland]	Not applicable. SRCCL is published by now.
53934	79	55	80	1	"Probabilistic scenarios" are an oxymoron. By definition, scenarios are developed precisely because it is not possible to assign probabilities to projected futures. If one could do that, they would be described as forecasts or predictions. In fact, probabilistic climate projections are usually presented as being conditional on a given forcing "scenario", such as an RCP or SSP-RCP combination that offers one plausible representation of future forcing. [Timothy Carter, Finland]	Taken into account. Sentence is revised : "Scenarios are not to be confused with deterministic or probabilistic predictions." in section 1.6.1
53226	80	1	80	1	Are there some more recent referenes that can be added here? [Jan Fuglestvedt, Norway]	Noted. Section 1.6 has been substantially revised and shortened and this sentence has been removed. No new references have been added.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
54258	80	1	80	2	Saying that scenarios do not assign probabilities because "the future is intrinsically unpredictable" is too sweeping of a statement. Scenarios don't assign probabilities because it is not considered meaningful for multi-dimensional global futures over long time periods and across many interacting sectors. But they do contain some probabilistic information in that they are intended to be plausible (at least some small probability). And there are probabilistic projections produced for certain elements of society or for particular sectors or time periods. [Brian O'Neill, United States of America]	Taken into account. The sentence has been removed. The text (now in 1.6.1) is substantially revised and shortened.
53936	80	1	80	11	If scenarios are not probabilistic then they should be described in terms of plausibility throughout, not relative likelihood, which is used in places here. [Timothy Carter, Finland]	Noted. Text revised accordingly
53938	80	13	80	14	Actually, scenarios have been used since the FAR in 1990 (Scenarios A-D) - see the FAR WG I Annex. [Timothy Carter, Finland]	Noted. The text and the figure is still being discussed by the author team (now Box 1.3, Figure 1).We kept the text unchanged, but will be updated and FAR scenarios included if kept for the FGD.
54256	80	13	80	15	Legget et al was a supplement to the FAR containing the IS92 scenarios, but there were scenarios already in the FAR itself in 1990 which should be added to this list. [Brian O'Neill, United States of America]	Noted. The text and the figure is still being discussed by the author team (now Box 1.3, Figure 1).We kept the text unchanged, but will be updated and FAR scenarios included if kept for the FGD.
35182	80	16	80	16	The SSPs are not analysed in WG1, only the SSP-Markers. And the SSPs may not be analysed in detail in WG3. SSPs are only one of many elements that one could analyse scenarios. [Glen Peters, Norway]	Noted. Text revised accordingly
27084	80	18	80	19	In the case of biomass burning emissions and land use patterns, it had better consider that some land use patterns were specific to location. It would be difficult to generalize. Also, in case of shifting cultivation (swidden cultivation), the biomass regrowth increases with the fallow age. It seems to be neutralize the emission and sequestation. Please refer to the following papers: (1) https://doi.org/10.1659/MRD-JOURNAL-D-14-00083.1; and (2) https://doi.org/10.1016/j.foreco.2013.05.038 [Nyein Chan NIL, Myanmar]	Rejected. References too specific to be included here.
28480	80	20	80	20	How can an economy be "high"? [David Schoeman, Australia]	Taken into account. We put "high" in quotation marks.
53940	80	22	80	22	Ever after -> Ever since [Timothy Carter, Finland]	Accepted. Sentence has been revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
54260	80	27	80	31	I think the characterization of scenarios as not representing uncertainty, but instead representing choices, is not correct and should be eliminated. The important point here is that societal changes represent a different kind of uncertainty than physical climate system uncertainties, because in societal systems, there is no equivalent to the unchanging laws of physics that exist within physical systems. There are several reasons why characterizing societal scenarios as representing choices rather than uncertainty is inadvisable: (1) scenarios have been defined in the literature for decades as an approach to uncertainty, and an IPCC assessment should reflect that literature, not introduce a new take; the reference to Knutti et al is an exceptional case (and not the main thrust of their paper, nor discussed in any detail) rather than the norm; (2) scenarios are framed throughout AR6 as an uncertainty, so this will introduce an inconsistency within the report; (3) while some scenario outcomes are obviously the result of conscious choices, it is unlikely that all are; asserting that all human behavior at all scales is the result of choices would need to be established for this characterization to be valid, and would require discussing the behavioral literature on this point; (4) even to the degree that choices play a role in societal outcomes (as they certainly do), are future choices not uncertain? so why would this make socioeconomic scenarios not an approach to uncertainty? [Brian O'Neill, United States of America]	Taken into account. Text revised accordingly. the sentence now reads " in contrast, future emissions in scenarios depend, to a large extent, on the outcome of collective choices"...
15248	80	27	80	36	This point about scenario uncertainty being different seems to be introducing a concept that does not go anywhere, so I tend to think it could be dropped altogether [Claudia Tebaldi, United States of America]	Noted. We have revised the text for clarity and to avoid misunderstandings, but continue to believe that pointing out the fundamental difference of scenario uncertainty versus geophysical uncertainties is a key point.
30444	80	27	80	46	An example of how these choices can be presented is, for example, the approach of the IPCC SR1.5, where four illustrative scenarios that are to a varying degree consistent with limiting warming to 1.5°C are presented as four examples of the choices that have to be made. [Joeri Rogelj, Austria]	Noted. No action
9272	80	30	80	31	Since there is a growing feeling that some decrease of the global human population should eventually be recommended, why take "growth" for granted? it is suggested to replace "population growth" by "population changes" (which was chosen on page 76 line 35!) or "population dynamics" . [philippe waldteufel, France]	Noted. No action. Proposal ok, but not necessary
6263	80	31	80	33	energy consumption pattern is also needed to be considered (Jafari, M. and Smith, P., (2018). Climate Change as a Driving Force on Urban Energy Consumption Patterns. In Encyclopedia of Information Science and Technology (4th ed., pp. 7815-7830). IGI Global. https://doi.org/10.4018/978-1-5225-2255-3.ch680) [Mostafa Jafari, Iran]	Noted. No action, we want to remain concise.
53228	80	33	80	33	Instead of "collective choices" you may write "sum of choices" or something like that (since collective may be interpreted as coordinated set of choices) [Jan Fuglestvedt, Norway]	Noted. We kept it for now as we don't think the term is wrong. Could be reconsidered as part of the FGD revisions.
53230	80	36	80	36	I suggest changing "collective aggregate choice" to "aggreate of choices" [Jan Fuglestvedt, Norway]	noted. Section 1.6. has been substantially revised and shortened. The sentence has been removed.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
25576	80	38	81	56	It is hard to infer much quantitative from these paragraphs. I tried but pretty much gave up; Figure no help either. [Stephen E Schwartz, United States of America]	Noted. Those paragraphs are meant to describe the qualitative nature of the scenarios. The Figure (now 1.24) has been revised to present the classical matrix form of SSP and RCP scenarios in conjunction with the band form.
29364	80	45	80	45	Would suggest to replace 'nothing new' to 'not new' [Minal Pathak, India]	Taken into account. Sentence has been revised and reads "Storylines have been used in the past in climate research and they are the explicit or implicit starting point..."
54264	80	48	81	25	This text on the SSP-RCP matrix approach is a bit hard to follow and also the point about the sense in which socioeconomic scenarios are independent of emissions is unclear. In general the two things are not independent; their independence depends on (1) understanding that mitigation actions are not part of the storyline, and (2) the storyline is sufficiently broad and general that it does not strongly dictate emissions outcomes separate from mitigation activity. That is, a storyline that was very specific about the evolution of the energy system (demand, supply, fuel types, efficiencies, etc.) and specific about mitigation actions would NOT be idependent of emissions outcomes, but rather would largely dictate them. The sense in which some degree (not complete) independence holds needs to made much more clearly here. [Brian O'Neill, United States of America]	Taken into account. Text revised accordingly.
25578	80	53	80	53	The initials A1FI, A1B and A1T, are opaque and hardly convey high, medium and comparatively lower emissions rates [Stephen E Schwartz, United States of America]	Taken into account. Text revised accordingly.
46218	80	54	80	55	I find it amazing that there is less space devoted to the RCPs in Chapter 1 of WG I than is devoted to SSPs. I think you need more on RCPs to explainhow SSPs and RCPs are combined. [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	Noted. We hopefully clarified the use of the terminology we use here, as WG1 chapters use SSPX-Y terminology (and in short SSP scenarios) as the shorthand for the SSP1-1.9, SSP1-2.6 etc) scenarios. Thus, all this text is about RCP levels as well, which are an intrinsic part of the SSP marker scenarios. We make that now clear with a clear language of "marker" scenarios and have further moved the Cross-Chapter box 1.5 on scenarios earlier in the Section 1.6
57390	81	2	81	4	I would formulate this weaker. "consistent with a wide range of emissions futures". For example, SSP3 is likely to be inconsistent with RCP2.6 and 1.9, and SSP1,2,4 are unlikely to reach up to 7 W/m2 or higher even in a baseline w/o climate policy. [Elmar Kriegler, Germany]	Taken into account. Change not made for the SOD, but text was substantially rewritten for the FGD
54262	81	2	81	4	The statement "any socio-economic development storyline can be consistent with almost any emission future assuming the appropriate level of mitigation action" is too strong. It would be better to say that any socioeconomic development storyline can be consistent with a wide range of emissions futures, assuming the appropriate level of mitigation action. [Brian O'Neill, United States of America]	Taken into account. Change not made for the SOD, but text was substantially rewritten for the FGD
53232	81	3	81	3	I suggest adding "in principle" before "any" [Jan Fuglestvedt, Norway]	Not applicable. Change not made for the SOD, but text was substantially rewritten for the FGD

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27054	81	3	81	4	the statement "any socio-economic development storyline can be consistent with almost any emission future assuming the appropriate level of mitigation action" is too strong. The lowest emission levels (RCP2.6 and 1.9) are reached in only a subset of SSPs. For some SSPs it is robust accross models. [Céline Guivarch, France]	Taken into account. Text revised accordingly. Reference added.
8504	81	4	81	4	Some pairings (e.g., RCP 8.5 with SSPs 1-4) require anti-mitigation policy (e.g., negative carbon tax); Riahi et al. (2017) [Robert Kopp, United States of America]	Noted. Reference added.
27056	81	5	81	9	No. As phrased, it seems as if socioeconomic development choices do not matter; they do matter, a lot. [Céline Guivarch, France]	Noted. We are not sure why the reviewer think the text might imply that socioeconomic choices would not matter.
57392	81	11	81	13	This is deep into WG3 territory, would leave it out here to avoid inconsistencies. The statement is not wrong, but selective. [Elmar Kriegler, Germany]	Noted. We decided to keep this as examples. The co-benefits in terms of air pollution as this are closely tied to Chapter 6 in WG1 on SLCF. We could discuss to remove the part on electricity prices for the FGD. We added that more specific information on the SSPs and the assumptions underlying those will be provided in the IPCC WGIII report (WGIII, 2022).
46220	81	15	81	25	Not even 1.5/emerging WG III AR6 is so bold as to name the SSPs! We need to discuss whether we name them or simply number them with an accompanying short description of each that avoids potentially tendentious terminology. [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	Noted. SR1.5 names the SSPs with the same labels as we do here. See e.g. Table 2.3 in Chapter 2 of SR1.5. Both in SR1.5 and here, the SSP scenario literature has simply been cited with these names.
27058	81	17	81	18	"While the lowest emission leels are generally not achieved in a world that is otherwise set on a course of fossil-fuel development…". This is very confusing. What is meant here? That development based on fossil-fuels leads to high emissions? [Céline Guivarch, France]	Taken into account. Revised text reads: "Scenarios that strongly rely on fossil-fuels for the envisaged global development, only rarely reach the lowest emission levels unless larger mitigation efforts are being considered (O'Neill et al., submitted). Likewise, sustainability-oriented socioeconomic developments at the global scale are not envisaged to go hand in hand with very high emission levels. "
46222	81	20	81	20	If thet are "marker" scenarios call them that. Consistent terminolgy will avoid confusion. [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Text revised accordingly. We now refer to "marker" scenarios. TBD
45136	81	22	81	23	Several decimal points are missing in the list of "Tier 1" scenarios. These should read:" ...SSP1-2.6, SSP2-3.4, SSP3-7.0 and SSP5-8.5 …" [David Wratt, New Zealand]	Accepted. The terms have been revised.
25580	81	27	81	33	Some mention should be made here of the influence of aerosols, the warming that might result from cessation of sources of aerosols, the entanglement between aerosol forcing and sensitivity. The entire para exudes a confidence that is way beyond present understanding. [Stephen E Schwartz, United States of America]	Not applicable. We reduced the relevant text section. Yet, aerosols were already implicitly referred to as they are part of the "non-CO2" forcers
57394	81	29	81	31	At the time of carbon neutrality, not the time of peak temperature. [Elmar Kriegler, Germany]	Not applicable. We reduced the relevant text section. Yet, the time of peak temperature is more important in this aspect

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27060	81	35	81	35	"idealized scenarios" is a confusing terminology: the scenarios refered to are not "ideal" in terms of climate outcomes for instance. [Céline Guivarch, France]	Rejected. "Idealized" is a often used term. It refers to the simplification of the scenario, not the outcome of the projections under the scenario.
27062	81	35	81	37	why are "the more complete set of sceanrios collected by the integrated assessment community" classified under the "idealized scenarios"? [Céline Guivarch, France]	Not applicable. We reduced the relevant text section.
53942	81	35	81	41	I'm not convinced that these should even be referred to as scenarios, as they are idealised experiments, and hence implausible. You might wish to consult Figure 2.4, Chapter 2, WG II, AR4, if you can find it! [Timothy Carter, Finland]	Taken into account. We change the terminology from "idealised scenarios" to "idealised experiments" or "idealised pathways".
53850	81	44	81	56	Figure 1.23 does a very good job in commuicating the idea behind this framework. [Jan Fuglestvedt, Norway]	Noted. Thanks. No action.
54270	81	46	81	54	I like figure 1-23. I'm not sure it shows more information than in a standard 2-d line graph, but maybe it emphasizes more the alternative-pathway aspect of the future scenarios. One detail: I suggest emphasizing that the future pathways shown are the ones that ESMs are running as part of CMIP6 (in Tier 1 or 2), which is especially important context for the WG1 report, rather than calling them "priority" scenarios. The "priority" terminology can make them sound more important for reasons that were not associated with the choice made to select them. [Brian O'Neill, United States of America]	Taken into account. Figure and text revised. Historical evolution removed from figure. We changed from priority to "marker" scenarios.
31752	82	5	82	12	The outllok for the 22nd century should also be reviewed. We have already gone through a small but significant part of the 21st century and many people alive today will, if major catastrophes are avoided, live to see the 22nd century. [Martin Juckes, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. In the description of the scenarios and its various inputs, we now included a short mention of the extensions beyond 2100, which is picked up also in Chapter 4 on the beyond-2100 climate change.
46224	82	5	83	13	This is WG III stuff [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The revised text substantially shortened the SSP socio-economic narrative explanations, but expanded on the WG1 description of input datasets for the scenarios (aerosol, solar, volcanic, strat. Ozone, GHG concentrations etc), which is otherwise not covered anywhere else and represents a substantial community effort in preparation for CMIP6.
6329	82	5	84	28	Enhancing socio-economic parameters/infrastructure could reduce people's and other ecosystem's vulnerability to climate change. Can we integrate the fact that enhancing socio-economic parameters could in effect, amplify or enhance people's capacity to exploit more which in turn could rather make them more vulnerable other than our quest to of using socio-economic parameters to reduce climate vulnerablity. [Isaac Sarfo, Ghana]	Noted. No change. The section has been substantially be cut and we don't have space to dwell on more WGII-type parts. Figure deleted
53234	82	12	82	12	"syntheisis of what? Results from different studies. You may add a few words. [Jan Fuglestvedt, Norway]	Not applicable. We reduced the relevant text section.
42316	82	14	82	32	Add reference to SR1.5 Chapter 5 p. 467 "To date, no pathway in the literature proves to achieve all 17 SDGs because several targets are not met or not sufficiently covered in the analysis, hence resulting in a sustainability gap (Zimm et al., 2018)." [Gabrielle Dreyfus, United States of America]	Not applicable. We reduced the relevant text section.

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53236	82	21	82	21	you may add " (SPA) " [Jan Fuglestvedt, Norway]	Noted. We simplified the discussion on the scenarios and the new text does not go into the issue of SPAs any more.
53238	82	22	82	22	I suggest adding " and their precursors" after "aerosols" [Jan Fuglestvedt, Norway]	Not applicable. We reduced the relevant text section.
53948	82	22	82	23	Climate policy should also refer to adaptation policy, which would entail a modification of the assumptions concerning the degree of adaptation challenge. This is rarely discussed, but is a second, potentially very important feature of the scenario matrix idea (for IAV analysis) touched on in van Vuuren et al (2014). [Timothy Carter, Finland]	Noted. We reduced the relevant text section and now point to this important aspect from a WGII perspective.
30446	82	26	82	33	There seems to be some confusion about the reference here. This table is from the IPCC SR1.5 Chapter 2 (Rogelj et al, 2018 - see below), providing a synthesized overview of SSP characteristics that were defined in (O'Neill et al 2017). O'Neill et al 2017 is thus not the reference for the table, only for the SSPs. Rogelj, J., D. Shindell, K. Jiang, S. Fifita, P. Forster, V. Ginzburg, C. Handa, H. Kheshgi, S. Kobayashi, E. Kriegler, L. Mundaca, R. Séférian and M. V. Vilariño (2018). Mitigation pathways compatible with 1.5°C in the context of sustainable development. Global Warming of 1.5 °C: an IPCC special report on the impacts of global warming of 1.5 °C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty. G. Flato, J. Fuglestvedt, R. Mrabet and R. Schaeffer. Geneva, Switzerland, IPCC/WMO: 93-174. [Joeri Rogelj, Austria]	Not applicable. Table was removed from Section for SOD.
13130	82	28	82	31	For Table 1.4, is there a cleaner and more eye-catching way to present this? The gray space and dull colors take away from the importance of this table. Consider leaving it black and white or making more colorful. It is also difficult to determine which socio-economic challenges are part of the mitigation vs. adaptation scenario. Make this more clear by maybe listing the categories on the side and using a simple color scheme to indicate "high, medium, and low." [Nora Richter, United States of America]	Not applicable. Table was removed from Section for SOD.
53944	82	28	82	31	This table (or Figure?), even though it originates from the SR1.5 report, is not formatted in the way that I have seen it designed elsewhere. There, the medium SSP lies central to the figure, but also adjacent on all sides to the other four. This requires a design similar to Figure 1 in: doi:10.3390/ijerph15010003 , but where the central diamond representing SSP2 is slightly larger to match the size of the four squares at the corners. The text could probably be fitted into this space, with some creativity, but the point is that SSP2 lies somewhere in between the other four, which themselves may share some characteristics for some variables, if not others. The grey spaces in Table 1.4 are distracting and a little misleading. How did it slip through SR1.5 review? [Timothy Carter, Finland]	Not applicable. Table was removed from Section for SOD.
28482	82	30	82	30	The text in this table needs crafting. For example, human development cannot be "high"; neither can technological progress…. [David Schoeman, Australia]	Not applicable. Table was removed from Section for SOD.
7792	82		82		Table1.4: Please increase the quality of the table. It is blurred. [Merja Tölle, Germany]	Not applicable. Table was removed from Section for SOD.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
57396	83	1	83	13	Singling out renewable energy policies here (why not fuel efficiency standards, coal phase out etc?) appears selective, would simply speak of climate-related policies. The argument for reference can be made based on the fact that some climate-related policies are already in place and had an impact. There is also the difference between baseline and reference. I think we ended up calling the highest SSP scenarios (w/o climate policies) baselines. [Elmar Kriegler, Germany]	Taken into account. Text revised accordingly
53946	83	1	83	13	Good section, and it might be useful to state that SSP2 should not be regarded as a BaU scenario, even if in some respects it may be more analogous to scenario archetypes that have been classified in the past as BaU than similar attributes of the other SSPs. I have seen this useage, and it is misleading. I agree that reference scenario is a preferable term for non-intervention scenarios. In fact all SSPs are non-intervention; only when SPAs (sharted policy assumptions) are introduced can forcing levels be brought down to RCP levels below 8.5 Wm-2. [Timothy Carter, Finland]	Not applicable. Text was removed from Section for SOD.
54266	83	1	83	13	The point here about the increased challenges of disintinguishing what constitutes a "no new policies" scenario is a good one. However this is not the same thing as what is a "business as usual" scenario or not. BaU scenarios typically refer to a single, central scenario that not only has no new policies, but also has trends in socioeconomic factors (population, gdp, technology, etc.) that are central (compared to their own ranges of uncertainties). One might say that SSP2 currently fills the role of a BaU scenario, whereas in SRES there was a conscious decision not to create a central scenario among the scenario set. This was only partly (and not mainly) about the issue of new policies. [Brian O'Neill, United States of America]	Not applicable. Text was removed from Section for SOD.
30448	83	10	83	13	"baseline" is another term often used. [Joeri Rogelj, Austria]	Noted. No action.
46226	83	15	83	40	This is highly relevant in a x-WG context. [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	Noted. No action
43434	83	15	83	40	A chart detailing GHGs/pollutants and their relevance in climate silulations (what protocols they're already limited under, what factors like costs accociated) may be useful. This could be integrated into figure 1.25 [Saad Amer, United States of America]	Noted. Not Applicable. Figure has been dropped.
43726	83	18	83	19	I think the first point should be the development of individual historical and future concentration and emission scenarios based on the works of Meinshausen et al., Hosely et al, van Marle et al and the individual SSP papers. Historical and future emission scenarios were then combined to produce a consistent dataset for MIPs as described by Gidden et al. [Vaishali Naik, United States of America]	Taken into account. The section has been restructured and slightly expanded to properly describe the CMIP6 input datasets.
43728	83	24	83	28	To be consistent with chapter 6, I think these reactive gases should be referred to as SLCFs. [Vaishali Naik, United States of America]	Taken into account. Text revised "reactive species".
17906	83	32	83	34	Hegglin et al., unpublished work, is over-cited, i.e., twice in three lines in total. [The comment could have been editorial too.] [Branko Grisogono, Croatia]	Noted. Reference is no longer used, not submitted in time.
43102	84	3			Aim not "goal". [David Frame, New Zealand]	Noted. No action, Comment refers to p84, line 35?
30450	84	4	84	4	"SSP-based scenarios" [Joeri Rogelj, Austria]	Noted. We now refer to "SSP marker scenarios" throughout the text.
53240	84	10	84	10	You may change to "vary across Earth System Models" [Jan Fuglestvedt, Norway]	Noted. No action
53242	84	21	84	21	The referenc to fig 1.25 comes at page 90. Is it missing earlier? [Jan Fuglestvedt, Norway]	Not Applicable. Figure has been dropped.
54272	84	21	84	28	Figure 1-25 plots forcing until 2300, but the SSP extensions have not yet been introduced in the text. I think the plot should be used once the extensions have been discussed. [Brian O'Neill, United States of America]	Not Applicable. Figure has been dropped.

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57398	84	33	84	55	A comparison of emission profiles against NDCs should be done solely in the WG3 report. But this comparison could give rise to additional classifications of scenarios in terms of their 2030 emissions levels (e.g. in addition to their peak and end of century cumulative CO2 emissions) and the temperature outcome of those scenarios could then explored in the WG1 report. But most of those scenarios will not be the original SSP scenarios used for scenarioMIP (their SPAs were developed before the PA and do not account for NDCs), thus the temperature outcome has to be based on RCMs. Those will also be used in WG3. So very close coordination is needed here. It may be ok to duplicate some content, but it needs to be fully consistent. [Elmar Kriegler, Germany]	Taken into account. Text was removed from Section for SOD.
35184	84	35	84	36	This is in incorrect quote of Paris. Check it. [Glen Peters, Norway]	Not applicable. Text was removed from Section for SOD.
30452	84	35	84	36	As a direct quote from the Paris Agreement, this doesn't really cut the mark. The agreement text reads: "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 impacts of climate change;" Maybe refer to: Schleussner, C.-F., J. Rogelj, M. Schaeffer, T. Lissner, R. Licker, E. M. Fischer, R. Knutti, A. Levermann, K. Frieler and W. Hare (2016). "Science and policy characteristics of the Paris Agreement temperature goal." Nature Climate Change 6(9): 827-835. [Joeri Rogelj, Austria]	Not applicable. Text was removed from Section for SOD.
53246	84	35	84	36	When you use " " be sure to us ethe exact wording of the Paris Agreement: 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 ..., [Jan Fuglestvedt, Norway]	Not applicable. Text was removed from Section for SOD.
10068	84	35	84	38	The 1.5°C threshold emerged already in 2007 in AR4 (e.g. as lower value in the 1.5-2.5°C range and some expected critical impacts of warming above ..) and it had its influence on subsequent climate negotiations: Bali Mandate, 2007; Copenhagen Accord, 2009 (where already explicitly mentioned the 1.5°C threshold), Doha Amendment of the Kyoto Protocol, 2012 (for the second commitment period of the Kyoto Protocol (which is mentioned in another context on page 91 of the WGI draft document) [Tibor Farago, Hungary]	Not applicable. Text was removed from Section for SOD.
30454	84	37	84	38	A better reference here would be the report of the UNFCCC Structured Expert Dialogue and the 2013-2015 of the Adequacy of the Long-term Temperature Goal, which explicitly states that: (Message 5) "The 2 °C limit should be seen as a defence line", "The 'guardrail' concept, in which up to 2 °C of warming is considered safe, is inadequate and would therefore be better seen as an upper limit, a defence line that needs to be stringently defended, while less warming would be preferable", and (Message 10) "While science on the 1.5 °C warming limit is less robust, efforts should be made to push the defence line as low as possible" Reference: UNFCCC (2015). FCCC/SB/2015/INF.1 - Report on the structured expert dialogue on the 2013–2015 review. Bonn, Germany, UNFCCC: 1-182. [Joeri Rogelj, Austria]	Not applicable. Text was removed from Section for SOD.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
30456	84	38	84	43	Current scenarios, however, might not adequately reflect the requirements of the Paris Agreement long-term temperature goal, because current scenarios based on the SSP-RCP framework focus on 2100 warming, without limits to overshoot. New concepts are being developed and published, and could be mentioned here. [Joeri Rogelj, Austria]	Not applicable. Text was removed from Section for SOD.
57256	84	40	84	43	The sentence on overshoot scenarios is (grammatically) incomplete but it's hard to tell what's missing because the meaning of this sentence remains quite unclear [Oliver Geden, Germany]	Not applicable. Text was removed from Section for SOD.
53248	84	42	84	42	I suggest deleting "initial" [Jan Fuglestvedt, Norway]	Not applicable. Text was removed from Section for SOD.
53250	84	45	84	45	Not sure if this formulation is precise enough . You mean the NDCs? I suggest you write "current nationally stated mitigation ambitions as submitted under the Paris Agreement" or something like that, which is more clear. (I.e. it is not a total goal of the PA) [Jan Fuglestvedt, Norway]	Not applicable. Text was removed from Section for SOD.
10070	84	45	84	45	There are no emissions targets for 2030 under the Paris Agreement. Not all NDCs (and INDCs) include explicitly quantified emission targets and not all use the same target year (i.e. 2030) and reference year (e.g. 1990), so that the so-called aggregate values (ranges) are estimates. Besides the UNFCCC Secretariat, a UNEP expert team produced valuable analysis of this information (the annual “emission gap reports” of the UNEP). [Tibor Farago, Hungary]	Not applicable. Text was removed from Section for SOD.
27064	84	45	84	45	I do not know what the "current emissions tragets under the Paris Agreement reach until 2030" refer to. Is it the nationally determined contributions from article 4? If it is the case, note that they are not strictly emissions targets. Some countries have emissions targets in their NDC (together with other elements), some countries do not have emissions targets. [Céline Guivarch, France]	Not applicable. Text was removed from Section for SOD.
30458	84	45	84	45	It is 2030 at most. Several NDCs only reach to 2022 or 2025. [Joeri Rogelj, Austria]	Not applicable. Text was removed from Section for SOD.
30460	84	48	84	48	An additional resource could be the NDC assessment in IPCC SR1.5 - CrossChapter Box 11 in Chapter 4. de Coninck, H., A. Revi, M. Babiker, P. Bertoldi, M. Buckeridge, A. Cartwright, W. Dong, J. Ford, S. Fuss, J.-C. Hourcade, D. Ley, R. Mechler, P. Newman, A. Revokatova, S. Schultz, L. Steg and T. Sugiyama (2018). Strengthening and Implementing the Global Response. Global Warming of 1.5 °C: an IPCC special report on the impacts of global warming of 1.5 °C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty. A. Abdulla, R. Boer, M. Howden and D. Ürge-Vorsatz. Geneva, Switzerland, World Meteorological Organisation. [Joeri Rogelj, Austria]	Not applicable. Text was removed from Section for SOD.
38150	85	14	85	35	Although the figure is not shown, this figure may be very important. [Hiroaki Kondo, Japan]	Not applicable. Figure has been dropped.
53252	85	16	85	25	From the fig caption Figure 1.27 sounds promising; looking forward to seeing a draft. [Jan Fuglestvedt, Norway]	Not Applicable. Figure has been dropped.
57258	85	16	85	25	Unfortunately, there is still no figure yet in the annex (although this caption was already included in the ZOD). If this caption will be kept, then the text itself (which still makes no clear reference to it) should have a detailed explanation what exactly constitutes the "decision power/policy relevance" of scenarios (or certain elements thereof) [Oliver Geden, Germany]	Not applicable. Figure has been dropped.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
57400	85	16	85	27	Policy relevance of scenarios can come from many considerations, the temperature outcome only one of them. I suggest to stay away from this notion here. It will come naturally from the WG3 report. [Elmar Kriegler, Germany]	Not applicable. Figure has been dropped.
51594	85	35	85	36	This is the perfect kind of sentence - simple, clear and to the point - which non-scientists absorb deeply. [Lindsey Cook, Germany]	Noted. Thanks!
53254	85	44	85	44	I don't think "equivalent" is the right word here? Equivalent in terms of what? Impacts? Perhaps better to simply say "approximately equal" ? [Jan Fuglestvedt, Norway]	Not applicable. Text was removed from Section for SOD.
54274	85	55	85	55	In this table, I don't understand the entry for 2 C, which says "Impacts are those that would be avoided, if Paris Agreement target to limit warming to “well below 2.0°C” were achieved." This doesn't seem correct. Impacts in a 2 C scenario would only be completely avoided if warming were limited to 0 C. Please clarify. [Brian O'Neill, United States of America]	Taken into account. Text revised to read "In line with climate futures and impacts that would result from limiting warming at 2.0°C - close to but ultimately missing the Paris Agreement “well-below” 2.0°C target. "
54276	85	55	85	55	In this table, Tier 1 and Tier 2 temperature levels are introduced but these naming conventions do not appear in the text. They also conflict with naming conventions for ScenarioMIP simulations, so choosing some other terminology might be better. And what will the rest of the report do with these two types of temperature levels? There needs to be a statement somewhere of how the report will actually use these levels to integrate results. [Brian O'Neill, United States of America]	Taken into account. Terminology revised and mentioned in the text. We now refer to "primary" and "secondary" levels. Integration across Chapters in WGI is also ensured in the Technical Summary.
49110	85	55	85	55	This table uses warming levels based on GSAT unannounced, whereas GMST is used commonly in other parts of the chapter. The distinction between the two indicators could be set out clearly in Chapter 1 as it is highly relevant in subsequent chapters. [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Cross-Chapter Box 1.2 briefly touches upon this issue and refers to the detailed assessment in Cross-Chapter Box 2.3.
57310	85	55	85	55	Table 1.5 decides, on behalf of the Parties, to define the long-term goal of the Paris Climate Agreement in terms of the increase in GSAT. This is highly policy prescriptive. UNFCCC has (despite it being pointed out repeatedly that this would be a good idea) refused point blank to clarify what it meant by global average temperature, but all the most quantitative indicators available prior to the Paris Agreement suggest that it referred to GMST. To be consistent, current warming at the time of publication should then be given as 1.2C. [Myles Allen, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. We disagree with the point made by the reviewer that "all the most quantitative indicators available prior to the Paris Agreement suggest that it referred to GMST". To our knowledge, there are very few, if any, studies that use GMST for "FUTURE" studies. Some used harmonisation with HISTORICAL GMST observational datasets, others used model assessments of GSAT all the way. Furthermore, the important table 2.2 in the SR1.5 report also highlights the distance to the 1.5C target in line with an historical GSAT temperature assessment - approved SR1.5 plenary. Furthermore, the decision has been taken for WGI AR6 that all temperature references refer to GSAT by default (although GMST numbers can be stated as well).
33294	85	55	86	1	Perhaps I am missing something, but Table 1.5 seems superfluous. [Erika Wise, United States of America]	Noted. The table is maintained and used to emphasise the more systematic treatment of temperature levels as a dimension of integration in WGI and across WGs in IPCC AR6.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
32634	85	55	86	1	This Table makes no allowance for the need to potentially come back to less than 0.5 C if the objective of the UNFCCC is to be met--I'd like to see mention of getting back to lower amounts of temperature increase. Also, there needs to be a table like this done for sea level rise--and it needs to reflect that paleoclimatic data suggest an equilibrium sea level sensitivity to global average temperature of something like 20 meters per degree C. This is likely the most critical impact factor. [Michael MacCracken, United States of America]	Taken into account. We clarified now the caption of the table so that it explicitly refers to the temperature levels used in this report as dimension of integration. It is not to be confused with a list of potential temperature targets.
47488	85	55	86	2	Table: Notes on 3°C, the Paris agreement target is 'well below 2°C' not "2°C". [Birgit van Munster, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Text revised to read "In line with climate futures and impacts that would result if the Paris Agreement “well-below” 2.0°C target were to be missed by at least 1°C, resulting in 3°C warming relative to pre-industrial levels. Several studies considering climate outcomes of current NDC pledges suggest temperature outcomes in this vicinity (see section 1.2.2 and WGIII)."
35186	86	1	86	1	Table 1.5. Well, I guess there is no choice here, but this is a rather unfortunate range of temperatures. At the moment, most studies line up NDCs are 3C. So, it would be very appropriate to analyse 2.5 and 3.5. In fact, 2.5 is likely far, far more relevant than 1.5C. And I guess there is some rounding here. RCP2.6, for example, is more likely 1.7C or so in 2100, 66% below 2C. And so on. Two issues: 1) not sure the temperature levels are the relevant ones, 2) the temperature levels are perhaps a little too rounded... [Glen Peters, Norway]	Noted. These temperature levels have been agreed to in a cross-Chapter and cross-Working Group effort. Going to finer detail than 0.5C steps seemed impractical from a WGII perspective. Also, the new SSP1-2.6 scenario might not hit exactly 1.7C, in fact is likely to be higher due to higher climate sensitivities in the models. The fact that scenarios are not 1:1 aligned with those or other temperature levels is the motivation to have the temperature levels in the first place as "dimension of integration". In that way, the results across various studies can be compared and integrated.
13228	86	1	86	1	Table 1.5, is there a better way to present this? Currently, this table does not seem necessary. [Nora Richter, United States of America]	Noted. The table is maintained and used to emphasise the more systematic treatment of temperature levels as a dimension of integration in WGI and across WGs in IPCC AR6.
43436	86	1	86	1	table 1.5 -- the 3 degree scenatio should be explaind differently; it currently reads as "3 - 2 = 1." It further minimizes the impact a 1 degree difference would have [Saad Amer, United States of America]	Noted. The table, however, does not provide a description of impacts. Information on the severity of impacts is to result from analysis in subsequent chapters and from the WGII assessment.
53256	86	4	86	15	It is useful that you present the different types of paths. But what about overshoot case? Not included as far as I can see. [Jan Fuglestvedt, Norway]	Noted. We decided not to expand and include the "overshoot" case. Could be added for the FGD, though, if it turned out to be heavily used in other WGI chapters.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
15252	86	4	86	15	Would pattern scaling as a statistical method be worth mentioning here in this list? And/or in the box of Statistical Approaches (it's a linear regression, in certain implementations). [Claudia Tebaldi, United States of America]	Noted. Subsequent chapters in WGI do not rely on pattern scaling to the extent that it seems warranted here as a highlighted method.
56192	86	7	86	8	It might be more useful for communication to highlight that current INDCs would be consistent with a warming of 3°C (at present, i.e. mid-2019). [Sonia Seneviratne, Switzerland]	Taken into account. No changes here, but this is taken up in Section SOD 1.2.2
31614	86	20	86	20	This cross-chapter box may sit better in Chapter 7. It seems somewhat specialised and out-of-place here, I think. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Box moved to Chapter 7
46228	86	20	86	20	This is a very long box and migh rmake a better Annex. The Special Report practice has been to a say a box must fit in two opposing printed pages. Vert useful, but what I am missing is a comparison of the outputs of the models. It's about methods rather than performance. This maybe for the WG III annex but x-WG discussion is needed. [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Chapter 1 now covers emulators in the text on "new developments". The Box was moved to Chapter 7. As this box relates to climate, the appropriate place is in WG1, although WG3 is welcomed to reproduce it.
56194	86	20	87	33	There are new developments with respect to climate emulators. E.g. development of a geographically-explicit emulator for mean temperature reproducing CMIP5 (Beusch et al., to be submitted). Please contact our group for more background on this point (sonia.seneviratne@ethz.ch; lea.beusch@env.ethz.ch). [Sonia Seneviratne, Switzerland]	Noted. Chapter 1 now covers emulators in the text on "new developments". The Box was moved to Chapter 7.
53258	86	20	90	44	Useful to have the box 1.5 on emulators, especially given the essential role for scenarios and use in WGIII. Overview of use in various chapters on page 89 is helpful for the reader. [Jan Fuglestvedt, Norway]	Noted. Chapter 1 now covers emulators in the text on "new developments". The Box was moved to Chapter 7.
28764	86	20	90	44	I like this box and section 1.6.2 . I think I was maybe a CA of the box though so should perhaps be listed :) [Piers Piers Forster, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Chapter 1 now covers emulators in the text on "new developments". The Box was moved to Chapter 7.
53950	86	20	90	44	This is a rather lengthy box, but good to have this in Chapter 1, as these models are commonly used a lot in the WG I assessments and for synthesis. Moreover, there doesn't appear to be a separate model evaluation chapter in AR6 as there has been in previous assessments, so this discussion is needed somewhere in the report. I now see that there is an Annex III on models, which could be used to list some of these simple models, rather than using up valuable chapter space. [Timothy Carter, Finland]	Noted. Chapter 1 now covers emulators in the text on "new developments". The Box was moved to Chapter 7.
57312	86	20	90	44	It would be enormously useful for this box to give a minimal set of equations that provide an adequate emulator, rather than just listing emulators and sending people off into the literature. I think we have got it down to 5, and can provide a complete table of coefficients corresponding to all CMIP6 ESMs available in time for the SOD to be included in the Supp Online Material [Myles Allen, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Chapter 1 now covers emulators in the text on "new developments". The Box was moved to Chapter 7 and it is for Ch7 to consider including the five equation model as part of the box. The purpose of the box is to compare various emulators in their skill to replicate numerous CMIP6 models.
27610	86	21	90	46	This box needs a brief motivation in the main text. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Chapter 1 now covers emulators in the text on "new developments". The Box was moved to Chapter 7.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
42868	87	3	87	16	Briefly contrast the emulator paradigm with that of the EMIC. I think the idea is that an emulator represents a much more sophisticated version of the climate system via emulation of an ESM than does an EMIC, which may span the same set of processes, but at coarser resolution or higher level of structural uncertainty. I understand estimation of their uncertainty is a work-in-progress, but as a cross WG integration tool, how will that uncertainty be propagated into WG2 and WG3 objectives? Maybe as an ensemble of estimates from which WG2 and WG3 uncertainties may then be estimated? [Michael Evans, United States of America]	Taken into account. EMICs are briefly described in the Model section SOD 1.5.3.4. They are generally not used as emulators of complex GCMs or ESMs, at least not explicitly, but feature advantages in terms of higher computationally efficiency for long-term integrations, broader process representation etc. Given that the box is now moved to Chapter 7, we introduce a brief text here in Chapter 1 to explain simple climate models and emulators and their respective overlaps.
53260	88	1			Box 1.5 table 1 gives a useful overview of the various models. [Jan Fuglestvedt, Norway]	Noted. Chapter 1 now covers emulators in the text on "new developments". The Box was moved to Chapter 7.
25582	88	6	88	7	Not sure why you single out Geoffroy 2013. Some additional pertinent references: Schneider and Thompson, 1981; Gregory, 2000; Held et al 2010. Held IM, Winton M, Takahashi K, Delworth T, Zeng F, Vallis GK (2010) Probing the fast and slow components of global warming by returning abruptly to preindustrial forcing. J Clim 23:2418–2427. doi:10.1175/2009JCLI3466.1 Gregory JM (2000) Vertical heat transports in the ocean and their effect on time-dependent climate change. Clim Dyn 16:501–515 DOI: 10.1007/s003820000059 Schneider, S. H., and S. L. Thompson (1981), Atmospheric CO2 and climate: Importance of the transient response, J Geophys Res, 86, 3135-3147, doi:10.1029/JC086iC04p03135. [Stephen E Schwartz, United States of America]	Noted. The references are updated to include the additional references. The box is now moved to Chapter 7 - with a potential full model description in Annex III.
25584	88	23	89	2	Give specific reference within 1.5 Report. [Stephen E Schwartz, United States of America]	Noted. The references are updated to include the additional references. The box is now moved to Chapter 7 - with a potential full model description in Annex III.
48710	88		88		Cross-Chapter Box 1.5, Table 1: Two papers that should be cited: showing applicability of artificial neural networks and Gaussian process emulators for GCM calibration are: Hauser, Tristan and Andrew Keats and Lev Tarasov, Artificial neural network assisted Bayesian calibration of climate models, Clim. Dyn., 10.1007/s00382-011-1168-0, 2011 David M. H. Sexton, James M. Murphy, Mat Collins, and Mark J. Webb. Multivariate probabilistic projections using imperfect climate models part I: outline of methodology. Clim Dyn (2012) 38:2513–2542, DOI 10.1007/s00382-011-1208-9 [Lev Tarasov, Canada]	Noted. The references are updated to include the additional references. The box is now moved to Chapter 7 - with a potential full model description in Annex III.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
46770	89	9	89	18	Table 2: It is not 100% clear that the more asterisks, the better model. Even assuming that, it is not stated the upper limint in the number of asteriks. For example, models with *** have the same high quality and present no room for improvement in any aspect? [Eloy Sanz-Pérez, Spain]	Noted. Chapter 1 now covers emulators in the text on "new developments". The Box was moved to Chapter 7.
17908	89	17	89	18	Table 2 in Box 1.5: unclear meaning of the Table that is mostly filled with 1-2-3 dots. [Branko Grisogono, Croatia]	Noted. Chapter 1 now covers emulators in the text on "new developments". The Box was moved to Chapter 7.
47568	89	43	90	7	As an additional point, SCM has also been used to directly generate scenarios, for example, those satisfying the Paris temperature targets. DICE is probably the most prominent SCM (or a simplified IAM) serving for this purpose historically. ACC2 has been applied recently to generate pathways satisfying the Paris Agreement targets in various ways (Tanaka and O'Neill, 2018, Nature Climate Change, doi:10.1038/s41558-018-0097-x). There are many other examples like this. [Katsumasa Tanaka, Japan]	Noted. Chapter 1 now covers emulators in the text on "new developments". The Box was moved to Chapter 7.
47570	90	16	90	16	Note that TOTEM is an exception, including the representation of global carbon, nitrogen, phosphorus cyles (Ver et al., 1999, Am. J. Sci., doi:10.2475/ajs.299.7-9.762; Mackenzie et al. in Treatise on Estuarine and Coastal Science Vol. 5 (eds E. Wolanski & D. S. McLusky) 317-342 (Academic Press, 2011)). This model has been applied to the intermodel complexity model of Joos et al. (2013, Atmospheric Chemistry and Physics, doi:10.5194/acp-13-2793-2013). [Katsumasa Tanaka, Japan]	Noted. Chapter 1 now covers emulators in the text on "new developments". The Box was moved to Chapter 7.
25586	90	24	90	46	I see no reference in the text of the box to Figure 1 of the box; just the caption. So the figure needs to be introduced. Evidently the figure represents response to increase in CO2 at 1% per year up to the time of doubling or quadrupling, but that does not seem to be stated. Importantly, the slope dT/dt is related to the transient sensitivity Str as dT/dt = Str*dF/dt, so that point should be made, greatly strengthening the physical interpretation of the more or less constant dT/dt during the ramp period. The discussion of the figure (in the text of the box) should also point out that the increase in temperature after cessation of increase of CO2 consists of two components, a small component the unrealized temp increase due to the short time constant of the system and the continued increase over longer time, due to the difference between transient sensitivity and equilibrium sensitivity. All that would strengthen the discussion and make the figure much more meaningful. This is discussed in Appendix A of Schwartz, 2018, which might be referenced. Schwartz, S. E. (2018). Unrealized global temperature increase: Implications of current uncertainties. J. Geophys. Res. Atmospheres, 123, 3462–3482. https://doi.org/10.1002/2017JD028121 [Stephen E Schwartz, United States of America]	Noted. Chapter 1 now covers emulators in the text on "new developments". The Box was moved to Chapter 7.
57364	90	49	91	18	The discussion does not clarify the type of CO2 budget: remaining carbon budget to stay below a temperature limit, peak temperature budget, threshold return budget etc. This should be clarified. Although, due to the other GHGs the T-Cum CO2 relationship is not precise across the scenarios. Note that WG3 AR5 Annex II.10 attempted to use a cumulative CO2 classification to be used as a substitute for end of century forcing classification in situations where emissions scenarios did not offer a complete set of forcing agents. [Elmar Kriegler, Germany]	Noted. No action. Carbon budgets are not explicitly mentioned here. They are being extensively discussed in Chapter 5 of the WGI report.
53262	90	49	91	24	Some very important issues are brought up here ; especialy how to handle the non-CO2 components. This section should be coordinated with ch5 on remaining C budgets and section 7.7 on metrics [Jan Fuglestvedt, Norway]	Noted. No action. Coordination is taking place.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
27612	91	1	91	2	This is in contrast to integrating along temperature levels? [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Yes. For example, several scenarios in the final AR6 WGIII database won't necessarily be related to temperatures as they are CO2 only.
27614	91	7	91	11	This sentence needs unpacking. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Noted. No action. No suggestions made.
45138	91	9	91	9	I think "Figure 1.6.3, Panel d" should be "Figure 1.21 Panel d" ? [David Wratt, New Zealand]	Taken into account. Text revised accordingly. Figure SOD 1.26
57314	91	9	91	9	I can't find figure 1.6.3 panel d, but that is probably just as well, since it doesn't sound all that meaningful. Cumulative CO2-e emissions of SLCFs are meaningless if defined using the conventional usage of GWP100. There are other options, including MGTP, GWP* or CO2-fe emissions, that make more physical sense. This would be a good point to air these. The obvious and most physically robust way to classify scenarios is using CO2-fe emissions. These need an invertible carbon cycle model to calculate them, but there are perfectly acceptable approximations that would have little impact on the classification. [Myles Allen, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. We have revised the SOD figure 1.26 to reflect the fact that GWP-100 weighted non-CO2 gases are not necessarily related to peak temperatures.
57366	91	13	91	18	I doubt that the relationship will hold up so neatly. The significant variation that Non-CO2 can introduce to the temperature profile of emissions scenarios with same cumulative CO2 is documented in the literature (see e.g. Rogelj et al., ERL, and Fuglestvedt et al, PTRSA). Also, you seem to rely on cumulative GHG emissions based on GWP100. SLCF forcing may peak at other times than the point of carbon neutrality, and tends to decline in the latter part of the century despite positive CH4 emissions, so Non-CO2 warming is declining while NonCO2-eq (using GWP100) continues to accumulate. This means the CO2-eq is not a good metric any more when CO2 emissions approach zero (same comment for Figure 1.21) [Elmar Kriegler, Germany]	Taken into account. We expanded that part of FOD Figure 1.21 and include it in SOD Figure 1.26 to shed light on the contribution of non-CO2 over time within the considered set of scenarios.
27616	91	14			What is meant by emission baskets? [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Noted. No action.
27618	91	20	91	24	A figure actually comparing asssessments across cum. emissions would be very helpful here. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. The figure would be helpful, indeed, but we decided against it for space reasons.
53264	91	23	91	23	I think the use of CO2-equivalent concentrations has been abondoned. In my view, this unit is confusing and shoud be avoided. Please coodinate with WGIII on this. [Jan Fuglestvedt, Norway]	Noted. AR5 relied heavily on CO2-equivalence concentrations. In fact AR5 WG3 used it as the main classification for their scenario binning (for better or worse). We consider CO2-equivalence concentrations to be an educative quantity to express the additional warming from non-CO2 greenhouse gases. this does not imply any other and further use in WGI AR6.
54278	91	27			Section 1.6.5 seems squarely in the WG3 domain, it is unclear why this topic is being assessed by WG1. [Brian O'Neill, United States of America]	Rejected. WGI Ch1 needs to introduce the scenarios used in WGI reports past and present. See approved outline for AR6

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
13638	91	29	91	29	Do please retain the term 'history of the future' in next drafts! [Stephen Humphreys, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Revised to "history of history of how the future was seen' to better reflect the temporary nature of the "view of the future"
27620	91	33			Delete first sentence. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. No reason provided.
45140	91	53	92	4	Table 1.6 showing the relationship between scenarios used in this report and those used in previous IPCC assessments is very helpful and policy-relevant. Please ensure it is retained through into the final draft! [David Wratt, New Zealand]	Noted. thanks. No action.
46230	91	55	91	56	If these are the marker scenarios call them that? Desscriptions (column 2) need careful review [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Text revised accordingly. Updated descriptions and checked for consistency with WGII/III usage.
53266	91	55	92	4	Table 1.6 is useful. Would be good if you say briefly what "closest" is in terms of. [Jan Fuglestvedt, Norway]	Noted. This is part of the description in the table.
15986	91		92		As indicated in Table 1, there is no direct correspondence beyond 2050 of any SSPX-Y scenarios with RCP6.0 which has been extensively referenced in AR5. Presumably, the closest ones are SSP4-6.0 and SSP3-7.0. Guidance shall be needed as to whether those two SSP scenarios will be more likely to realize than RCP6.0 and which SSP scenario should be more appropriate for consideration as a replacement of RCP6.0. [SAI MING LEE, China]	Noted. We amended the table to provide more clarity on the SSP to RCP comparison, noting that some scenarios cannot be tracked/closely aligned with previous RCP scenarios.
26412	92	1	92	1	It's worth saying that RCP2.6 is second-highest by 2020 (to avoid the statement being interpreted as "throughout"). [Jochem Marotzke, Germany]	Taken into account. Text revised accordingly.
8506	92	1	92	1	RCP 6 is actually lower forcing than RCP 4.5 in the early decades [Robert Kopp, United States of America]	Noted. No action.
51596	92	1	92	1	I appreciate the revised naming from RCP, but it is even more a struggle for the brain to identify what the 'label' means in temperature rise. SSP1-1.9 is sustainable 1.5C, (but not named SSP1-1.5) and SSP1-2.6 is under 2C, etc..... [Lindsey Cook, Germany]	Rejected. SSP terminology and naming conventions need to be consistent across WGs. Temperature levels won't work as they differ a lot for particular SSP depending on models etc.
15254	92	1	92	1	The meaning of the text in the cell describing the RCP equivalent of SSP1-2.6 is difficult to understand [Claudia Tebaldi, United States of America]	Noted. No action.
53952	92	1	92	1	Table 1.6 seeks to match these new scenarios to SRES - an attempt for some of the RCPs used in AR5 was already done in doi 10.1007/s10584-013-0974-2 (Table 3). [Timothy Carter, Finland]	Noted. No action.
9110	92	1	92	2	The lack of direct comparability of the SSP scenarios of AR6 with the RCP scenarios of AR5 is unfortunate; it is unclear precisely what emissions scenario each SSP represents. [Jim O'Brien, Ireland]	Noted. The design of the SSPs marker scenarios was outside the realm of WGI and is here only compared to provide background and context for the projections shown in WGI.
9112	92	1	92	2	As in comment 9 above, the deletion of the SSP5-8.5 (and maybe also SSP3-7.0) scenario should be considered as being an unrealistic future emissions scenario. [Jim O'Brien, Ireland]	Rejected. WGI will describe the scenarios used in the underlying (mostly) peer-reviewed literature. We Can't simply "delete" a scenario.
27622	92	1	92	2	Why are IS92 not included in the table? [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Noted. For space reasons and also because this report is focusing on the latest sets of scenarios used in IPCC reports (SSP, RCP, SRES)

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
53954	93	1	93	1	I wonder if the developers of Scenarios A-D in 1990 would regard those as "less prominent" IPCC scenarios. [Timothy Carter, Finland]	Noted. No action.
46232	93	1	93	26	This is a long excursion into deep history. Does it not belong (greatly edited) in 1.3.3/1.3.4? [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. Should be part of the scenario discussion, not the climate understanding discussion. But it has been streamlined to focus on those elements particularly relevant for the IPCC assessments.
43438	93	16	93	17	Scenario reffered to is omitted. [Saad Amer, United States of America]	Noted. Unclear comment. No change.
31616	93	17	93	17	"mitigation scenario in" should be "mitigation scenario" ? [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Sentence has been revised.
27624	93	19			collapsing decline' doesn't seem to be the right term [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Noted. No change.
31618	93	29	93	29	"feature how" should be "feature of how" ? [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Sentence has been revised.
27626	93	32	93	33	Rephrase [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. Unclear what change was being proposed.
43440	93	44	3	44	"Fossil & industrial CO2" is not a term. [Saad Amer, United States of America]	Accepted. Replace "&" by "and"
35188	93	44	93	48	This paper is relevant here https://www.nature.com/articles/nclimate1783 [Glen Peters, Norway]	Noted. No action.
53270	93	50	93	51	The two sentences can be combinded, and made more clear. (Speaking of limitation in SSP scenarios sounds very general). [Jan Fuglestvedt, Norway]	Accepted. Text revised accordingly
27628	93	50	93	51	Delete sentence. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. No reason provided. Sentence has been revised.
27630	94	4	94	5	You mean in the absence of implementation, agreemments alone don't lower emissions [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Text revised accordingly to make this clearer.
53272	94	7	97	17	this box is very helpful for the reader to understand the various conepts used. And the box 1.6 Table 1 is useful. [Jan Fuglestvedt, Norway]	Noted. Thanks.
46234	94	9	94	9	This box overlaps with a lot of chapter text and actuay sets out some things more concisely and clearly. The material could greatly improved understanding if placed earlier. [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. We moved the box more upfront in the scenarios section - in line with the revised order of scenarios, temperature levels and cumulative emissions. The text has been streamlined and shortened.
53274	94	13	94	13	I don't think you need to mention the AR5 SyR. But good to show that it is coordinated with the three SRs in AR6. [Jan Fuglestvedt, Norway]	Noted. Thanks.
35190	94	36	94	44	This is all fine. But, what about a 1%CO2 "scenario". [Glen Peters, Norway]	Noted. the 1%CO2 pathways are mentioned under Pathways. We have reordered the entries in the box for a more logical flow of information.
54282	94	46			In Box 1.6, for this entry on Emissions scenarios, please make sure it is consistent as well with the AR5 WG3 glossary, not just the WG1 glossary. [Brian O'Neill, United States of America]	Noted. AR6 cross-WG Glossary work is underway. Consistency was ensured in AR5, but the level of detail in definitions between WGs could differ where necessary.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
43442	94	52	94	52	Concentrations scenario definition is verbose and hard to read through [Saad Amer, United States of America]	This comment has been considered during the preparation of the FGD. (In FGD) Noted. Definitions have been updated, along with the Glossary entries.
38152	94	52	94	55	"...plus human-induced land cover changes that can be radiatively active via albedo changes,"; This part describes concentrations scenario. It is not adequate to refer albedo change. Instead, land cover change definitely changes the budget of GHGs. [Hiroaki Kondo, Japan]	Rejected. Unclear why the reviewer thinks that it is inadequate to refer albedo changes in relation to land use changes. Land-use changes do affect albedo which affects the radiative balance.
54284	94	52			In Box 1.6, for this entry on Concentration scenarios, it should be consistent with the distinction between scenarios and pathways, especially given the already prominent role of (representative) concentration pathways. The distinction is that a scenario is a more comprhensive, internally consistent description of concentrations and the underlying driving forces that led to them (see emissions scenario definition), whereas a pathway contains only the concentration outcome itself. This distinction is made in the box entry for pathways, but I don't see it in the concentration scenario definition. [Brian O'Neill, United States of America]	Taken into account. Change not made for the SOD, but text was substantially rewritten for the FGD
54286	95	6			In box 1.6, I believe this entry for scenario storyline comes from WG3 AR5, which should probably be indicated. [Brian O'Neill, United States of America]	Noted. All glossary items in this table are taken from previous glossary definitions, if available, to ensure consistency. In AR6, an effort is made to even share the main part of glossary definitions, which is why a reference / assignment to different working groups seems not necessary.
57362	95	10	95	18	The definition correctly notes the second definition of pathways as target-oriented scenarios, as highlighted also in SR1.5 This definition is much more common in the WG2 and WG3 literature, and can therefore expected to be prevalent in the reports of these working groups. The use of "pathways" for individual trajectories in a multi-variable scenario (as in RCP and the quantitative parts of SSP) is rather isolated to these cases and has caused some confusion among socio-economic scenario researchers. I therefore suggest to frame this carefully here, and introduce the pathway as used in RCP/SSP rather as addition than the rule. See https://climatescenarios.org/primer/ for an example. [Elmar Kriegler, Germany]	Noted. The primary purpose of the Cross-Chapter Box is to introduce the use of terms in the WGI report. Coordination with WGs II and III will be mainly through the Glossary, which is only now being finalized. The description will be updated for the FGD if needed.
57316	95	10	95	18	Are we abandoning the SR1.5 distinction between "prospective" scenarios where emissions are prescribed irrespective of the climate outcome, and target-oriented scenarios in which policies are assumed to adapt to the emerging climate response? This seems unfortunate. I accept that target-oriented scenarios don't feature in CMIP6, but as Barbossa put it in Pirates of the Caribbean, "Best start believing in ghost stories, Miss Turner, because you're in one." [Myles Allen, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The TARGET-ORIENTED pathways from the SR1.5 report are already mentioned in the definition of PATHWAYS with an explicit reference to SR1.5.
53276	95	16	95	16	It is not clear which SR you refer to, but I think it must be SRCCL. Please make clear. [Jan Fuglestvedt, Norway]	Noted. Apologies for this omission. Fixed to SR1.5 for the FGD
45750	95	16	95	16	Specify which Special Report you are talking about (guess SR15?) [Katja Mintenbeck, Germany]	Noted. Apologies for this omission. This was fixed to SR1.5 in the FGD
37372	95	26			"pre-industrial levels" could be changed to "the pre-industral baseline". [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Definitions will be updated for the FGD, along with the Glossary entries.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
54288	96	5	96	18	In box 1.6, this entry for defining SSPs lacks a definition. Instead it describes how SSPs are used with RCPs, and how the SSP acronym is used. For a definition, I would suggest using the definition in the O'Neill et al 2014 paper in Climatic Change (Volume 122, Issue 3, pp 387–400) that defines SSPs: "The SSPs describe plausible alternative trends in the evolution of society and natural systems over the 21st century at the level of the world and large world regions. They consist of two elements: a narrative storyline and a set of quantified measures of development. SSPs are “reference” pathways in that they assume no climate change or climate impacts, and no new climate policies." [Brian O'Neill, United States of America]	Taken into account. Change not made for the SOD, but text was substantially rewritten for the FGD
53956	96	17	96	17	share -> shared [Timothy Carter, Finland]	Accepted. Text revised accordingly
53958	96	18	96	18	Is it correct that 8.5 Wm-2 is achieved using SPAs? I thought that for SSP5 (alone) this was a non-intervention scenario (and see Table 1.6). [Timothy Carter, Finland]	Taken into account. Change not made for the SOD, but text was substantially rewritten for the FGD
27632	96	19			Why are the SPAs not mentioned? https://link.springer.com/article/10.1007%2Fs10584-013-0971-5 [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Definitions will be updated for the FGD, along with the Glossary entries. SPAs are mentioned in the Box but not elsewhere in Chapter 1.
54280	96	23			Table 1 is a good idea for clarifying terminology, but there are several aspects that are not clear or seem inconsistent with the literature. For example: What is an SSP "family"? In SSPX, X stands for a specific pathway, not a family. What is an SSP "background family"? Socioeconomic conditions are not background conditions, they are simply socioeconomic conditions. An analyst may or may not treat them as background conditions. Sometimes they are foreground. What is the distinction between SSPX-RCPY and SSPX-Y? This is a distinction not made in the literature, so if this is being introduced for a special purpose in WG1, please make that clear. SSPX-Y may refer to an emissions or land use scenario for the purpose of WG1, but in the broader scenario literature it is a broader idea that means an integrated climate-society scenario in which development follows SSPX and climate evolves according to RCPY. It is in fact the goal of the SSP-RCP framework: to produce such integrated scenarios and analyses. Those scenarios can involve emissions, land use, mitgation activities, impacts, adaptation, non-climate impacts, SDG outcomes, etc. -- either individually or in combinations. I strongly suggest making clear what specficic type of SSPX-Y scenario you are talking about by stating it explictly, eg SSPX-Y emissions scenario, rather than adopting the SSPX-Y terminology to mean emissions scenarios only. [Brian O'Neill, United States of America]	Taken into account. Definitions were updated for the FGD, along with the Glossary entries. On the question of whether SSPX-RCPY is distinct from SSPX-Y. Yes, they are. Most of the impact literature uses the SSPX-RCPX notation in one form or another to indicate that they assumed the SSPX pathway in conjunction with climate information from a CMIP5 RCPY outcome. This parallel mix&match community design of separately developed SSPs and RCPs (as outlined in Moss et al. 2010) was good and will continue to be used, is however now complemented by the new set of SSP marker scenarios supplied by the IAMs of WG3. These new SSP1-2.6, SSP5-8.5 etc. scenarios that are, e.g., described in the reviewer's ScenarioMIP paper are causing different climate projections than for example an the previous RCP2.6 and RCP8.5 scenarios from the times of CMIP5. Thus, an impact study under the SSP5-RCP8.5 framework will have different findings than one under the SSP5 pathway, but using the new SSP5-8.5 related climate information. For example, ocean acidification will be markedly higher in SSP5-8.5 compared to RCP8.5 due to markedly higher CO2

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
27066	97	0	97	0	last two lines of table 1: the difference between SSP X-RCP Y and SSP X-Y is not clearly explained. Maybe for the latter, something along the lines "SSP X-Y is a socioeconomic scenario based on SSP X assumptions and where climate mitigation policies are implemented so as to reach emissions levels cocnsitent with RCP Y pathway" would help. [Céline Guivarch, France]	This comment has been considered during the preparation of the FGD. (In FGD) Taken into account. Definitions has been updated and explanations clarified.
53960	97	1	97	1	Some duplication with Table 1.6 here [Timothy Carter, Finland]	Noted. Please note that this table is about the terminology underlying the SSPs and RCPs, whereas table 1.6 is about comparing SSP-RCPs in terms of their outcomes.
32038	98	4	98	27	"Gaps and opportunities for integration of climate knowledge" need to be assessed in relation to a specific purpose which addresses the needs of policy makers - this is the job of the IPCC - rather than only "improving our understanding". In this context, integration of knowledge to inform risk assessment is a critical need. There are overlaps with "opportunity area #1" but there is a need for an explicit focus on the needs for risk assessment. [Rowan Sutton, United Kingdom (of Great Britain and Northern Ireland)]	This section is now entitled ''Factors limiting the assessment'. We take your point of the importance of the needs for risk assessment, and the text has been shortened and we now say "...an end-to-end assessment of risks, mitigation choices, adaption responses and shifts in the physical climate system is required to allow robust assessments of risk and informed policy decisions." and goes onto recognise the special reports as an example of a step towards this goal.
27638	98	4	98	55	A glaring gap seems to be some more systematic research and information on aprupt changes, including (ideally) likelihoods of them happening. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	This section is now shorter, and does not go into details about abrupt changes in e.g. AMOC, but this has been noted as a possible addition, post-SOD. There has been a point added to the list of limitations about surprises in future radiative forcing scenarios: "There are also a number of limitations in future forcing scenarios. The first limitation relates to sudden large natural forcings, specifically large volcanic eruptions that can substantially alter the climate for years or even decades (see Section 4.4.4)." It is hard to estimate the likelihood of this occurring.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
42870	98	4	99	10	This section is great. Could we add one more at least? The potential to leverage massive ensembles, stochastic parameterization, machine learning/emulators, a hierarchy of climate model compexities, and a wider range of SSPs and RCPs to generate truly representative sampling of potential future climate states? In other words - better estimation of the uncertainty ranges at the expense of being able to estime a median or mean, in support of risk analysis. [Michael Evans, United States of America]	This section has shifted focus to be more about the limitations to the assessment, rather than the opportunities, but these do cover some as you suggest: "Second, the range of scenarios from very low to very high emission scenarios might falsely provide an impression of a minimum and maximum for the future evolution of the climate. Third, the scenarios have mostly been determined by integrated assessment models to provide cost-optimised pathways over the full century, making a wide range of assumptions that are unlikely to represent actual societal evolution and choices. Fourth, the limited number of scenarios assessed in this report means that not all variations are considered."
27634	98	6	98	10	What about gaps that are not addressable in the near future (& thus do not provide opportunities) [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	This section is now entitled ''Factors limiting the assessment' and thus includes factors such as the inability to perfectly predict the future - both because of limitations in models and forcing scenarios - a gap that will take a long time to address.
39472	98	12	98	13	Shouldn't be "… the assessment of climate change impacts on socio-ecological systems"? [Carolina Vera, Argentina]	Thank you. Yes - that is more accurate. That line no longer appears in the text.
53278	98	12	98	27	The para contains some interesting reflections on the role of IPCC, the way forward and the value of integration. The latter point is an implication of much of the discussion in ch1, and seems well justified. However, the future role of the IPCC, especially on line 16-19 is a bit beyond the scope here, in my view. [Jan Fuglestvedt, Norway]	This has been reframed as a need, which the IPCC is working to address, and the comment in FOD has been removed.
9274	98	12	98	27	I understand your point but it is a pity that no practical suggestion to overcome the drawback you point out is put forward. Considering an AR6 size which is likely to end up with closer to 10000 then 5000 pages, one cannot get away without a strong organizing scheme. Moreover if you really want to explore policy pathways, integrating the economy into the picture becomes mandatory and is bound to make matters worse; Right now this paragraph is echoed in the chapter summary by lines 37 to 39 on page 5, using a considerably softer formulation. Hence this soundr, at the present stage, rather like an internal discussion among AR6 authors or some part of the "IPCC community". I look forward to reading whether some of this will find its way towards SPM, and how.! [philippe waldteufel, France]	This section is now entitled 'Factors limiting the assessment'. We have shortened the sub-section you refer to, and drawn the point from the Executive Summary into the text. We refer to the special reports as an example of how to begin to integrate, but we're probably not there yet.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
28766	98	12	98	27	This one wasa little strange. I also don't like the WG structure, but I think that WG1 is not the place to say this, write a commentry? [Piers Piers Forster, United Kingdom (of Great Britain and Northern Ireland)]	This section has been renamed 'Factors limiting the assessment' and as this is an introductory chapter, and there is a renewed focus on bringing the three WGs together, this is one of the limitations of the full assessment. The sub-section has been significantly reduced and re-worded, using the special reports as an example of a different approach.
27636	98	12	98	27	In plain language you mean actually designing the IPCC in accordance with the risk framework instead of trying to fudge the research into it after the fact, right? I think it would be useful to just say that in slightly more elaborate words but not as convoluted as in the current text. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Thank you for clarifying this aspect of this point. We have added extra note of the requirements for risk assessment in this section n
57260	98	23	98	25	should be "e.g." instead "i.e." (at least in the first two instances, maybe not for SRM) [Oliver Geden, Germany]	Text was revised, and these examples are no longer included.
47484	98	25	98	27	Explain what in the 'current structure of the IPCC assessment reporting process' prohibits the assessment of policy pathways including the key feedbacks between social and physical systems. This is very important given the ever increasing gap between current emission trajectories and those required to remain under established international targets (wel below 2°C , possibly 1.5°C) and the disastrous implications this has for the future of ecosystems and human societies. [Birgit van Munster, United Kingdom (of Great Britain and Northern Ireland)]	This has been strongly edited. More detail on the emissions scenarios as a dimension of integration across the working groups has been added.
45748	98	25	98	27	The Special Reports provide these opportunities and also in WGII - WGII takes WGI climate info to do these assessments [Katja Mintenbeck, Germany]	This point has now been added to the text.
8508	98	29	98	43	Hay et al. (2015) is a GMSL reconstruction; see ch 9 for refs focused on ice sheet rates. [Robert Kopp, United States of America]	This section has been greatly reduced, with a pointer to Ch9.
6690	98	29	98	44	It seems odd to highlight sea level rise here with no reference to either chapter 9 where these issues are treated in detail or chapter 12 where regional sea level is also discussed. I don't dispute that this is an important opportunity (and I am pleased to see it elevated here) but it's not clear to me that this topic comes out from the preceding text of the chapter. I might argue that what is described here is a key part of the content of chapter 9. [Helene Hewitt, United Kingdom (of Great Britain and Northern Ireland)]	This section has been greatly reduced, with a pointer to Ch9.
8852	98	29	98	44	mention the important contribution of glaciers and the remarkable recent progress (e.g. Zemp et al., 2019, doi: 10.1038/s41586-019-1071-0 [Thomas Stocker, Switzerland]	The contribution of glaciers is important, but we now point to Ch9 and SROCC for this discussion.
32920	98	31	98	32	This is not the only focus: it is also about improving the use of hisotorical information with advanced methods [Aimee Slangen, Netherlands]	We now point to Ch9 and SROCC for this discussion.
37374	98	31	98	32	The thermosteric contribution to sea-level rise is significant, and there is effort devoted to improving estimate of ocean heat content. It is a bit puzzling why only ice-sheet melting is mentioned here. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	We now point to Ch9 and SROCC for this discussion.
31620	98	36	98	36	Presumably "Eocene" is a typo here, as there was no ice! I think the Pliocene is meant here (also makes sense given the statement about 21st century CO2). [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	It is Pliocene. This section has been greatly modified, and no longer mentions details, but points to SROCC and Ch9 for discussion of sea-level.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
32922	98	43			worst-case = high-end (to be consistent with terminology used in Ch9) [Aimee Slangen, Netherlands]	Text was removed
32924	98	44			Perhaps insert reference to WG2 and WG3? [Aimee Slangen, Netherlands]	Text was removed, and reference to SROCC was added.
44908	98	46	98	47	We should try to be consistent with the use of the term “observational”. In CH2 we are including indirect (proxy) indicators as “observations”, opposed to “simulations”. I think this section refers to integration of instrumental records with paleoclimate datasets. Importantly, the latter includes both proxy data plus model simulations. [Darrell Kaufman, United States of America]	This paragraph has been rewritten. The separation between observations and paleoclimate records has been noted. New text: "Gaps in our observing networks and the limited extent of paleoclimatic-archives have always posed a challenge to many different assessments within the reports. The relative lack of long-term observations is particularly evident in Antarctica and in the depths of the ocean. "
48280	98	46	98	47	Suggest adding the phrase "enhanced data rescue/digitisation" somewhere in this sentence. [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	Data rescue is now covered earlier in Ch1, see Section 1.5.1.1
47988	98	50	98	50	Please check the use of this IPCC uncertainty language term. Are you able to provide a traceable account to assigning this uncertainty statement? Note that likelihood statements are quantified terms - phrases like likely and very likely have quantifiable probabilities associated with them. Please check it has been used correctly here. Please refer to the IPCC guidance note on uncertainty: https://wg1.ipcc.ch/SR/documents/ar5_uncertainty-guidance-note.pdf [WGI TSU, France]	Noted. The section has been shortened, and the focus is now on 'Gaps', with reference to the Chapters . We have removed the term 'likely' in this context.
37376	98	51			My preference woould be "reanalysis datasets" not "reanalyses datasets". [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	The section has been shortened, and the focus is now on 'Gaps', with reference to the Chapters. This is now in Section 1.5.
6463	99	1	99	1	The expressing of uncertainty by reporting evidence and agreement (i.e., robust evidence, low agreement) is very confusing. I see why you use it but as a scientist I find it baffling. Please just report your stat test and P value. If you don't have a stat test then do not use terms normally used in statistics. Instead of saying medium confidence just say nothing. [Hugh Lefcort, United States of America]	Noted. It is not clear to which section the reviewer is referring to. However, IPCC uncertainty guidance is to be followed throughout the report.
44910	99	5	99	5	In addition to climate extremes, the integration of paleo data is needed to better define the magnitude and long-term trends in natural variability, which is essential for all detection and attribution analyses. Modes of variability are a good example: In CH2 we conclude that we don’t know much about their long-term behavior. [Darrell Kaufman, United States of America]	This paragraph has been greatly reduced, with a focus on 'Gaps', and only two examples (Ocean and Antarctica). Your point is well made though, and will be considered in the revision of the SOD. (In FGD) Noted. The new approaches to better account for internal climate variability in attribution studies are mentioned (Ch 3.2), however specific mention of paleo data is not included at that point. Including paleodata as a line of evidence is included in the discussion of impact attribution.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
49330	99	5	99	9	Consider adding abrupt climate change... "iv. Improved understanding of the causes and potential consequences of major abrupt climate changes (e.g., from AMOC shutdown) which have not been observed directly" [Yarrow Axford, United States of America]	This paragraph has been greatly reduced, with a focus on 'Gaps', and only two examples (Deep ocean and Antarctica). The reviewer's point regarding abrupt change is well made though, and has been considered in the revision for the SOD of the WGI report. There is mention of abrupt changes in a number of chapters of the reports, e.g., 4, 5, 8, 9, considering, among others, AMOC changes or volcanoes and their effect on future radiative scenarios.
53280	99	12	100	16	this is a useful overview and guide for the report. As pointed out, this needs to be developed along with the development of the report. We may also consider using this at a higher level in the report [Jan Fuglestvedt, Norway]	Noted.
47486	99	12	100	16	Climate information, understanding, impacts, projections are presented at reginal scale. It is important that the soyrce of emissions are also presented at national (per capita) scale for understanding, for international agreements and of course for ethics. [Birgit van Munster, United Kingdom (of Great Britain and Northern Ireland)]	Noted. This is WGIII area and will be covered in their report.
44912	99	19	99	20	Chapters 2-4 concern “large-scale” climate, which are defined as global to continental or ocean-basin scale, not “hemispheric”. See Cross Chapter Box 2.1. [Darrell Kaufman, United States of America]	Accepted. Text corrected accordingly.
44914	99	20	99	20	I think it’s important to specify that CH2 remit is an assessment of the “observational evidence, both direct and indirect” for the changing state of the climate system. [Darrell Kaufman, United States of America]	Noted.
9264	99	34	99	47	What is "regional"? The definition is not given. Perhaps it refers to scales smaller than "hemispheric", as suggested by the definition of Global information on lines 19-20 above. An alternate choici is to consider the way the global map is splitted as shown by figure 1.16 [philippe waldteufel, France]	Rejected. Definitions/Maps/explanations are provided earlier in the chapter, not the place to repeat it here.
31622	100	11	100	11	Maybe add Chapter 7 to Oceans - there is substantial discussion of ocean heat content. Also Chapter 3 for paleoclimate (a lot of LGM and mid-Holocene model-data comaprisons will go there). [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Accepted.
56196	100	11	100	16	Would be useful to include "extremes and abrupt changes" as a cross-cutting theme, since these are topics of high interest within the public [Sonia Seneviratne, Switzerland]	Accepted.
44916	100	11			It’s great to see this table, but it will require a lot of work before it accurately reflects the contents of the entire report. It would help to develop criteria for what constitutes a “main chapter”. As a suggestion, to be a “main chapter”, the topic in that chapter should be described in at least one ES statement and be formally assessed with controlled vocabulary. Using this criterion, I think that CH2 will end up being a “main chapter” for more topics than are currently indicated. Also, for some topics, I think it would be helpful to have a dedicated table of contents. For the “paleoclimate” theme, I worked with a group of ECRs to generate a table of contents. It’s available at: http://pastglobalchanges.org/news/all-news-items/9-latest-news/2274-ipcc-ar6-wg1-fod-may-19 It’s more extensive than is needed for the report, but could be boiled down. [Darrell Kaufman, United States of America]	Rejected. We appreciate the suggested approach, which is certainly valid. However, such an approach would produce a very extensive table with too much detail, similar to an index, which is beyond the objective of the current table. The WGI report will have its index, with a great level of detail. The objective of the current table is not to be an index, but rather to offer a quick outlook of some key cross-cutting topics in the report.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
38154	100	14	100	15	Why do not the bold numerals make ascending order? [Hiroaki Kondo, Japan]	Taken into account. Chapters in bold are listed in order of relevance (whenever it is possible to determine it). For instance, Ch.9 is listed first in the theme "oceans". The order is now explicitly explained in the table caption.
47978	100		100		Suggestions of topics to include: Natural variability, extremes, ECS, ERF [WGI TSU, France]	Taken into account. The cross-cutting themes listed in this table correspond to the cross-cutting topics identified in the TSU documents “WGI Report Thematic Focus Teams” and “Bureau-TSU Debrief on FOD”. The rankings are based on the information provided by the mentioned documents and our own assessment. This table will be regularly updated to reflect the creation of new cross-cutting topics.
6692	100				Can I suggest that se level is added to table 1.7? Also I would say that oceans and cryosphere are covered as much by chapters 2 and 4 as chapter 3. Chapter 9 should be added to the water cycle. [Helene Hewitt, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. The cross-cutting themes listed in this table correspond to the cross-cutting topics identified in the TSU documents “WGI Report Thematic Focus Teams” and “Bureau-TSU Debrief on FOD”. The rankings are based on the information provided by the mentioned documents and our own assessment. This table will be regularly updated to reflect the creation of new cross-cutting topics.
7744	101	1	101	1	Some of the FAQs in AR5 are very well composed and illustrated. Many students who will read AR6 will not have read AR5. Therefore, I respectfully request that you include some of the AR5 FAQs in AR6. The AR5 FAQ explaining greenhouse gases is especially good and merits republication here in AR6. [Forrest Mims, United States of America]	Thanks, and we agree about the quality of AR5 FAQs, but n general each AR creates its own FAQs based on the contents of its chapters.
50534	101	1	106	42	A framing section like this one probably reqiores more than just 4 FAQs. [Anton Holland, Canada]	Noted. We believe four is adequate judged from the balance in the whole report.
43104	101	1			Merge in some D&A material with FAQ1.2 [David Frame, New Zealand]	FAQ 1.2 has been substantially revised.
6647	101	3	101	3	Rephrase FAQ - I suggest: "How much did our understanding of climate change improve, compared to the first IPCC report? [Tim Christiane Thys, Belgium]	This rephrasing suggests a quantitative answer, which we cannot provide. Now reads: "FAQ 1.1: Do we understand climate change better now compared to when the IPCC started?"
43444	101	3	101	55	This answer could further add our growing understanding of how climate change will impact people, economies, human health, human migration, etc. It is important that our increased understanding of climate change include our understanding of how it will impact people [Saad Amer, United States of America]	Human impacts are the province of Working Group II. Other elements of AR6 describe the role of Working Group I, particularly in identifying hazards (physical effects of climate change that combine with vulnerability and exposure to create human impacts). FAQs for Chapters 8-12 address some of these.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
6649	101	5	101	5	Replace "Yes - much better" by "It improved a lot". [Tim Christiane Thys, Belgium]	These are not very different, and we prefer the original formulation.
24470	101	6	101	8	About FAQ 1.1, in the text: “Today, evidence is abundant that the climate has already changed since the mid-20th century, and we know that human emissions of carbon dioxide methane, and other gases are the principal cause of that change.” Comment: Why black carbon aerosol is not included here, since its contribution is larger than “other gases”? [Rubén D Piacentini, Argentina]	Black carbon is mentioned later in the FAQ (described as "soot.") FAQs are intended as summaries for lay people, so the word "soot" is more likely to be understood.
37378	101	7			"know" could be replaced by "are virtually certain" to be consistent with standard terminology. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Text revised with this phrase.
7652	101	8	101	10	Comment : in the sentence "With much more … " the last part is not clear, I suggest "With much more and much better data, we understand more about how the atmosphere interact with the oceans, as well as with the ice and snow that cover large parts of the Earth." [Anne Coudrain, France]	Revised to read: "With much more data and better models, we also understand more about how the atmosphere interacts with the oceans, ice, snow, vegetation, and land surfaces of the Earth."
26118	101	10	101	13	And many climate model predictions have been incorrect. Why try to boost confidence in, by definition, untested climate models.You should put “ Compared with the computer climate simulations of 1990, today’s Earth system models include many more physical processes, and they should be able to make more accurate projections of future changes and where they occur geographically.. [Stephen Taylor, United Kingdom (of Great Britain and Northern Ireland)]	Sentence now reads: "Computer climate simulations have also improved significantly, incorporating many more natural processes and providing projections at much finer resolutions."
16314	101	14	101	24	The FAQ clearly explains that we understand climate change better than in 1990. One suggestion would be to provide a brief overvew of what types of new instruments have been deployed to collect data, and how these instruments have improved from the older observing systems. [Renee van Diemen, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. The infographic (figure) for FAQ 1.1 includes a list of variables now measured by satellite remote sensing, as well as the extended lengths of geological records of temp, CO2, and sea level.
37380	101	17	101	18	The wording "inceasingly accurate" applies to satellite data and the latest instrumental data from older observing systems. But some of the increase in climate data comes from rescuing observations made in the past. These particular data cannot be classified as being of increased accuracy. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Sentence now reads: "New satellite instruments have also provided a wealth of increasingly fine-grained data, and additional data from older observing systems and even hand-written historical records have now been integrated into observational datasets."
50544	101	21	101	21	Instead of 'gigantic glaciers' please write 'ice sheets'. [Frank Paul, Switzerland]	Text revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
7746	101	38	101	39	The assertion that: "…in these tests models have predicted the actual changes reasonably well." is so clearly erroneous that the authors need to refer to Fig. 11-25 in AR5. This chart generated considerable attention in the scientific and the public literature, depicts forecasts by 138 climate models and it affirms the slight temperature decline from 2005 to 2012. At the publication date of this figure in AR5, the composite of 4 surface measurements was below ALL 138 model forecasts. (Of interest is that NVAP-M (see below) shows a decline in global water vapour during this period.) The IPCC requires that this report be "comprehensive, objective, open and transparent." Besides being erroneous, the assertion above fails to meet these requirements. See comment above re. p. 49. [Forrest Mims, United States of America]	Text now reads: "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." This is supported by AR5 Figures SPM.6 and 9.8. AR6 Chapters 1 and 3, including Section 1.3.6 and Cross-Chapter Box 3.1 (which assesses new findings on the early 21st century slowdown in warming rates), provide new and additional support.
50746	101	50	101	55	Define FAR, SAR, TAR and AR4 in the caption of the figure proposal (or alternatively in the figure itself). This would be helpful to a person who only reads the FAQs (omitting the main text of the chapter). [Hernan Edgardo Sala, Argentina]	Figure do not include references to reports other than FAR and AR6. Caption spells these out.
43402	103	1	103	1	Unlear what "it's" refers to. Consider: At what point do we know climate change is responsible for regional impacts? [Saad Amer, United States of America]	FAQ 1.2 has been substantially revised.
6651	103	1	103	1	This FAQ needs to be rephrased - I suggest: "How do we know it is human-caused climate change? [Tim Christiane Thys, Belgium]	Noted; FAQ 1.2 has been substantially revised.
26120	103	1	103	15	This is horrible because you yourselves defined climate as an average of observable weather over a 30 year period (See IPCC 5 Glossary P1450 re WMO). So how do we know its changing – we must wait 30 years and see if it has changed. You are encouraging woolly thinking.You should reword as 'When will we know for certain that mankind has significantly influenced the climate?' or 'When will we know that the climate has significantly changed?' [Stephen Taylor, United Kingdom (of Great Britain and Northern Ireland)]	Noted; FAQ 1.2 has been substantially revised.
29964	103	1	103	22	The text in FAQ 1.2 seems to be predicated on the notion that we know the sign of climate change, and appears to be referring only to thermodynamically driven aspects of change. For aspects of change closely related to atmospheric circulation, including its variability, we often do not even know the sign of the change. This situation should be reflected in the answer to this question, as the issue often arises when dealing with the public. [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	Noted; FAQ 1.2 has been substantially revised.
56200	103	1	103	22	Chapter 11 would also have useful inputs to this FAQ (FAQ 1.2). [Sonia Seneviratne, Switzerland]	FAQ 1.2 has been substantially revised.
13132	103	1	103	23	It would be worth pointing out the timing of when we know "climate change" and the rise of CO2 became important (this is tied in with the definition of "early industrial"). It would also be worth noting some of the key consequences of climate change that are relevant to humans, e.g., sea level rise, extreme events, changes in precipitation vs. evaporation. [Nora Richter, United States of America]	Noted; FAQ 1.2 has been substantially revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
45142	103	1	103	23	There is potential for confusion and / or ambiguity in this FAQ, given the different definitions of climate change used by the IPCC ("a change in the state of the climate that can be identified …by changes in the mean and/or the variability …") and the UNFCC definition ("a change of climate which is attributed directly or indirectly to human activity ..."). Maybe the FAQ question should be changed to "At what point do we know it's HUMAN-INDUCED climate change" - if that is what you plan to address? Otherwise you will need to discuss the differences between the IPCC and UNFCCC definitions of climate change. (See the definition in the Glossary of the AR6 WG1 report) [David Wratt, New Zealand]	FAQ 1.2 has been substantially revised.
47464	103	1	103	32	"This FAQ (1.2) will be reshaped later" Good! The question itself is not clear - what does "it" refer to? If you mean "At what point do we know that the climate is changing?" then the draft text does not answer this but rather seems to be addressing global vs regional observations/projections. Is this question even necessary in Chapter 1? You have already stated in the answer to FAQ 1.1 that there is abundant evidence that the climate has already changed and FAQ 2.2 deals with this. If the question is more "how do we know that human activities are causing climate change" that is covered in FAQs in Chapter 3. [Pauline Midgley, Germany]	FAQ 1.2 has been substantially revised.
14470	103	1	103	34	In addition to FAQ 1.2., another FAQ that can be considered to clearly pin climate change would be,..To what extent are the natural effects observed linked to climate change? [Ivan Lule, Uganda]	Noted; FAQ 1.2 has been substantially revised.
43446	103	1	103	34	This answer should be sure to address smaller storms, like hurricanes, which are often the subject of climate debate [Saad Amer, United States of America]	FAQ 1.2 has been substantially revised.
44918	103	1			FAQ 1.3: “at what point do we know it’s climate change?” doesn’t seem to match the answer. The question sounds like it’s about D&A, but the answer is about regional variability and risk. Also, given that climate is always changing, the question itself seems misstated. The question about D&A is already addressed (FAQ3.1). I suggest that this question be rephrased to more clearly relate to the direction that the answer seems to be taking: regional variability and risk. [Darrell Kaufman, United States of America]	FAQ 1.2 has been substantially revised.
16316	103	6	103	12	This is a very topical question, and would be a valuable FAQ. The response could be strengthened with a brief explanation of some of the key terms used: what are 'climate variables'? What are 'background climate variations'? What is meant by 'smaller variations' (e.g., smaller variations in what?)? What is meant by 'larger signal of change'? [Renee van Diemen, United Kingdom (of Great Britain and Northern Ireland)]	Noted; FAQ 1.2 has been substantially revised.
51598	103	10	103	12	This is such a profound statement, can you elaborate? Visualise what the 'hot house' looked like, 50 milloin years ago? Most readers have not reference to what this entails, what we love and depend on for survival would be gone. [Lindsey Cook, Germany]	FAQ 1.2 has been substantially revised.
24472	103	11	103	11	About FAQ 1.2, in the text “Observed and projected temperature change is often smaller in the tropics than at higher latitudes”. Comment: This seems to be true at Northern higher latitudes, but not at Southern higher latitudes (like in different regions of Antarctica, except the Antarctic Peninsula) [Rubén D Piacentini, Argentina]	Noted; FAQ 1.2 has been substantially revised.
37382	103	12			Perhaps "perceived" would be better than "seen". Where variability is high what we see is a mixture of climate change and variability, but we cannot tell quite how much of what we are seeing really is climate change. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	FAQ 1.2 has been substantially revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
33296	104	1	105	8	Additional points that could be made in FAQ 1.3: 1) Understanding components of the climate system that change slowly over time & which we cannot understand from the instrumental record (e.g., Pacific Decadal Variability) (this goes beyond separating trends from variability); 2) section states that paleo data can "allows us to test the general applicability of our models", but even more than that, these data can substantiate how well a model performs at simulating past conditions and can even help improve models through data assimilation, etc.; 3) paleoclimate can also teach us about how other systems (ecological, hydrological, etc) changed in response to a past climate change. For instance, in the past when the ITCZ shifted or storm tracks moved from their present locations, what was the impact on forests, drought, etc. in X region? [Erika Wise, United States of America]	Accepted; FAQ text has been modified to reflect this input.
42872	104	1	105	27	Add: observation of what is possible: extreme event detection (e.g. literature on paleotempestology) when we are able to "watch" the system for long periods of time. Although subject to great uncertainties (incomplete in space and time, subject to filtering, integration of multiple variables over time and space, others - described in proxy system models (PSMS) , can be benchmarked/can be used to benchmark long simulations of the climate system under unforced and constant (high, low) forcing conditions - e.g. the mid-Pliocene. Thus essentially helping us to ascertain whether processes explicitly described in models, processes emulated/parameterized in models, etc are an adequate description of the actual climate system. [Michael Evans, United States of America]	Accepted; FAQ text has been modified to reflect this input.
31626	104	1	105	27	I really like this FAQ, but I think it could be made a bit more focussed. There are a number of nice paragraphs, but I think that each one needs a clear message. At the moment, some paragraphs seem a bit redundant. For example, I am not sure of the message in the paragraph beginning "The earth climate is a complex system..." [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	This comment may have been addressed to FAQ 1.2 or other; the word "complex" does not appear in the FAQ1.3
39792	104	1	106	42	Include FAQ: Are we – humanity and individual 197 Parties – stopping (emission cuts) climate change now, compared to when IPCC and the UNFCCC Treaty started? FAQ: What do past climate change (emission cut) failures – of humanity and individual 197 Parties - teach us about the future? [Michael Wadleigh, United States of America]	Rejected. Beyond scope.
32632	104	3	104	3	Always, when referring to the planet, "Earth" needs to be capitalized; otherwise "earth"="dirt". A chapter scrub needs to be done on ths--it has mostly looked good, but not entirely. [Michael MacCracken, United States of America]	Accepted. Revised accordingly.
55220	104	3		5	The text 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." That's wrong. Rising GHG concentrations have caused no detectable increase in rate of either sea-level rise or extreme weather. 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/987052536883376128.html [David Burton, United States of America]	Rejected. There are multiple lines of robust evidence to support the assertions made herein. Chapter 2 of the assessment will detail these for AR6, but AR5 as well as the National Climate Assessment and the SROCC contain more updated data and knowledge.
47466	104	4	104	4	would be "punchier" here to say "warming of both the atmosphere and the oceans" rather than just "warming" [Pauline Midgley, Germany]	Accepted. Revised accordingly.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
31624	104	5	104	6	"Past climate variability over the last centuries to millennia serves as the most relevant baseline against which to measure anthropogenic changes in climate". I feel that this needs some context to make the point clearer. For example "human-induced changes in climate need to be put in the context of past changes, to indicate if they are unusual; past climate variability over the last centuries to millennia can provide such a baseline." Or similar.... [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Revised accordingly.
47468	104	6	104	6	as a matter of communication to the less expert, broader audiences for the FAQs, do you want to use the term "anthropogenic" here? It might be better to use more approachable language here in the header as well as in line 16. OK thereafter since defined. [Pauline Midgley, Germany]	Accepted. Revised accordingly.
51778	104	21	104	25	This paragraph is not well written. While it introduces the concept of using paleoclimate to constrain climate sensitivity, it doesn't help link the latter part (which essentially discusses about response of climate system towards forcings) to the first paragraph and tie everything into one piece. [Anson Cheung, United States of America]	Taken into account; the paragraph in question has been substantially revised.
50748	104	28	104	29	Consider to modify the sentence: "...allowing for the separation of natural causes of climate change (natural variability) and greenhouse-induced trends in earth's climate.", in the following way: "allowing for the separation of natural causes of climate change (natural variability) and human-induced trends in earth's climate (via greenhouse gases emissions)." [Hernan Edgardo Sala, Argentina]	Taken into account; the paragraph in question has been substantially revised.
47470	104	29	104	29	"greenhouse-induced trends" is a bit of jargon used here as a short cut. For the less expert, broader audiences for the FAQs, suggest spelling out here, e.g. as "trends induced by emissions of greenhouse gases" [Pauline Midgley, Germany]	Taken into account; the paragraph in question has been substantially revised.
49332	104	29	104	29	"in recent millennia" should be quantified or at least distinguished from a pre-Holocene timescale, e.g. "in the past several millennia" or "for the past eight millennia" [Yarrow Axford, United States of America]	Accepted. Revised accordingly.
35262	104	29	104	36	I would say that atmospheric [Co2] have stable at least over the last 2-3 millenia. This needs to be clearly stated, as over the past 18 millenia there is an overall trend in increasing concentrations. Exccet that in this section are refering to the last MILLENIUM, as I see some verbs conjugated in singular form, which it´s confusing at least for me. [eugenia gayo, Chile]	Accepted. Revised accordingly.
55222	104	29		32	[pt 1 of 2] The text says, "In recent millennia, atmospheric CO2 concentrations were relatively stable, such that changes in solar irradiance and volcanic eruptions represented the primary external drivers of global climate variability. During this time, global temperature variations amounted to less than 0.5°C and sea level varied by no more than 10cm." This is a 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 [cont'd] [David Burton, United States of America]	Rejected. There are multiple lines of robust evidence to support the assertions made herein. Chapter 2 of the assessment will detail these for AR6, but AR5 as well as the National Climate Assessment and the SROCC contain more updated data and knowledge.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
55224	104	29		32	[pt 2 of 2] 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 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]	Rejected. It is beyond the scope of the FAQ to document the host of local to regional-scale climate variations that have occurred in the last centuries to millennia. The FAQ will focus on large-scale (hemispheric to global-scale) trends and variability.
26122	104	31	104	32	There is evidence of changes in sea level of the order of 0.3 to 0.5 metre over the past 2000 years. e.g See Internationales Asienforum, Vol. 38 (2007), No. 3–4, pp. 353–374 Sea Level Changes and Tsunamis, Environmental Stress and Migration Overseas The Case of the Maldives and Sri Lanka NILS-AXEL MÖRNER [Stephen Taylor, United Kingdom (of Great Britain and Northern Ireland)]	It is beyond the scope of the FAQ to document the host of local to regional-scale sea level variations that have occurred in the last centuries to millennia. The FAQ will focus on large-scale (hemispheric to global-scale) trends and variability. Recent efforts provide updated estimates of global sea level variations over the last millennia (see Kopp et al., 2016) to support the numbers provided here.
46792	104	31	104	33	On what time-scale is this amplitude of change referring to? In connection with large volcanic eruptions the temperature change was certainly bigger than this. Moreover, some multi-proxy reconstructions for the Northern Hemisphere (e.g., Christiansen and Ljungqvist 2012) indicated larger changes and multi-decadal to centennial timescales. The data for the Southern Hemisphere is very uncertain so it is hard to make global estimates that are reliable. 0.5°C may well been an underestimation. Borehole-based reconstructions (Huang et al. 2008) also indicates changes on centennial time-scales of about up to 1°C. The difference between the 11th century and the 17th century in various reconstructions (regional to hemispheric) are provided in Table 1 Christiansen and Ljungqvist (2017) showing a large spread and several Northern Hemisphere reconstructions exceeding an amplitude of 0.5°C on this time-scale. References: Christiansen, B., and Ljungqvist, F.C. 2017: Challenges and perspectives for large-scale temperature reconstructions of the past two millennia. Reviews of Geophysics, 55: 40–96. Huang, S. P., Pollack, H. N., and Shen P.-Y. 2008. A late Quaternary climate reconstruction based on borehole heat flux data, borehole temperature data, and the instrumental record. Geophysical Research Letters. 35, https://doi.org/10.1029/2008GL034187. [Charpentier Ljungqvist Fredrik, Sweden]	It is beyond the scope of the FAQ to document the host of local to regional-scale climate variations that have occurred in the last centuries to millennia. The FAQ will focus on large-scale (hemispheric to global-scale) trends and variability.
8510	104	32	104	32	Assuming source for the 10cm is Kopp et al. (2016), the total (max to min) range was about 20 cm, so this should be ± 10 cm. [Robert Kopp, United States of America]	Taken into account; the paragraph in question has been substantially revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
45144	104	32	104	32	I think your statement that during recent millenia "sea level varied by no more than 10cm" is incorrect. For example, Fig 13.3 of the AR6 WG1 report has various observations which are substantially outside this range. Section 13.2.1.4 of that report says there is "medium confidience that fluctuations in GMSL during this interval" [the last 2000 years]"do not exceed ~±0.25m on time scales of a few hundred years". Please correct. [David Wratt, New Zealand]	Taken into account; the paragraph in question has been substantially revised.
44082	104	33	104	36	Geological records from the past few milennia also offer insight into pre-industrial human impacts on regional climate system as a result of land use change, e.g. Ejarque et al. 2015 (https://www.sciencedirect.com/science/article/pii/S0277379115000414). Offers ability to reconstruct baselines prior to human settlement, and provides records of human impact during prehistoric periods of human occupation (which can augment traditional knowledge), colonial periods (including indirect records of widespread land-use changes), industrialization, and globalization. Thus, paleoclimate and geohistorical records provide a picture of holistic Earth system responses to the acceleration of human impact across the past milennia. [Sara Kahanamoku, United States of America]	Accepted. Revised accordingly.
49334	104	34	104	34	"the last millennia" should be "the last millennium" (?) [Yarrow Axford, United States of America]	Taken into account; the paragraph in question has been substantially revised.
19174	104	34	104	35	last millennium provides or last millennia provide, I suspect the first is meant [Baerbel Hoenisch, United States of America]	Taken into account; the paragraph in question has been substantially revised.
47472	104	38	104	38	"greenhouse gas-forced" is better [Pauline Midgley, Germany]	Taken into account; the paragraph in question has been substantially revised.
41404	104	42	104	45	It says: “Over the last million years, Earth has transitioned from glacial climate states characterized by markedly lower atmospheric CO2 concentrations (200 parts per million) to interglacial climate states (with CO2 concentrations of 280-300 parts per million) every ~100,000 years.” Add a reference to Figure 1.2 showing changes in CO2 along time and it can be seen that lowerl atmospheric CO2 concentrations reach values under 200 ppm. [Lucas Bianchi, Argentina]	Taken into account; Figure revised significantly.
19176	104	52	104	52	it would be nice to use quantitative words such as increase or decrease, instead of shift or change. In this case it is not clear what is meant by "changes in weathring" - weathering neutralizes CO2 and does not contrinbute to rising CO2 [Baerbel Hoenisch, United States of America]	Accepted. Revised accordingly.
55226	104	53	105	4	The text says, "During the Eocene period, roughly 50 million years ago, global temperatures were as much as 8°C warmer, sea level was 20-40m higher, and ocean pH varied appreciably. While the rates of present-day atmospheric CO2 change, temperature change, ocean pH change, and sea level rise 1 are many times higher than they were during past geologic intervals, these “hothouse” worlds hold key lessons for our climate future. In particular, they provide a window into how our planet may eventually end up like, if emissions of greenhouse gases continue unabated..." 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 cause 8°C of warming, or 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]	Updated text no longer contains this language.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
19178	104	55	104	55	similar to previous comment: what is meant by "pH varied substantially"? I am only aware of the Anagnostou study as a reliable candidate and that one shows increasing pH across the Eocene. It might be worthwhile to say this but then highlight the hyperthermals as examples of rapidly increasing acidity (e.g. Penman et al. 2014, Gutjahr et al. 2017, Babila et al. 2018) [Baerbel Hoenisch, United States of America]	Taken into account; space constraints do now allow for a full explanation of pH swings through this time.
31682	104		105		FAQ.1.3: Whilst analysis and understanding of past climate is undoubtedly important, this FAQ lacks balance. Clear discussion should also be added that different balances between past and future forcings often means different balances between mechanisms. Eg. Klein and Hall (2015), Rowell (2019), and other papers. Klein, S.A. and Hall, A., 2015: Emergent Constraints for Cloud Feedbacks. Curr Clim Change Rep, 1, 276-287. Rowell, D.P., 2019: An Observational Constraint on CMIP5 Projections of the East African Long Rains and Southern Indian Ocean Warming. Geophys. Res. Lett., doi:10.1029/2019GL082847 [Dave Rowell, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. The FAQ was revised significantly.
45146	105	3	105	3	Delete "like" from: "...they provide a window into how our planet may eventually end up like" [David Wratt, New Zealand]	Taken into account; the paragraph in question has been substantially revised.
31628	105	3	105	3	"how our planet may eventually end up like" could be "the possible future climate state of our planet" [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account; the paragraph in question has been substantially revised.
31630	105	7	105	7	"This is especially true as models that were constructed and tested against instrumental climate data are charged with projecting climate changes that occur under vastly different boundary conditions than today." could be "This is especially true as models that were originally evaluated against instrumental climate data are, when simulating extreme paleoclimates, being asked to predict climate changes that occur under vastly different conditions than today." [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account; We focus here on future projections, not model hindcasts, because we are making the link between hothouse worlds and future climate states.
32926	105	24			Would be best to use the same sea-level data from Ch9 as in Figure 1.2 (paleo, 20th C and projections) - contact Kopp/Slangen [Aimee Slangen, Netherlands]	Accepted. We have tried to use figures derived from other chapters wherever possible.
13134	106	1	106	35	It might also be worth including ocean heat content in this section, since this an important measure of how major components, i.e. the oceans, of our Earth are warming [Nora Richter, United States of America]	This comment has been considered during the preparation of the FGD. (In the FGD), not applicable -- FAQ1.4 has been removed.
50512	106	1	106	35	This FAQ text was analyzed for readbility for a general audience (policy makers, non-expert citizens). The resulting scores (shown in the following series of comments) are far from the target scores (8 - 10) that would result in effective communication to these audiences. This is a serious issue that must be addressed. Certainly, application of plain language writing principles will help, as well as accompanying infographics/visualizations to complement the text. [Anton Holland, Canada]	This comment has been considered during the preparation of the FGD. (In the FGD), not applicable -- FAQ1.4 has been removed.
50514	106	1	106	35	Flesch-Kincaid Grade Level -- 14.3 [Anton Holland, Canada]	This comment has been considered during the preparation of the FGD. (In the FGD), not applicable -- FAQ1.4 has been removed.
50516	106	1	106	35	Gunning Fog Index -- 16.4 [Anton Holland, Canada]	This comment has been considered during the preparation of the FGD. (In the FGD), not applicable -- FAQ1.4 has been removed.

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50518	106	1	106	35	Coleman-Liau Index -- 14.9 [Anton Holland, Canada]	This comment has been considered during the preparation of the FGD. (In the FGD), not applicable -- FAQ1.4 has been removed.
50520	106	1	106	35	SMOG Index -- 15.6 [Anton Holland, Canada]	This comment has been considered during the preparation of the FGD. (In the FGD), not applicable -- FAQ1.4 has been removed.
50522	106	1	106	35	Automated Readability Index -- 14.7 [Anton Holland, Canada]	This comment has been considered during the preparation of the FGD. (In the FGD), not applicable -- FAQ1.4 has been removed.
50524	106	1	106	35	FORCAST Grade Level -- 12.1 [Anton Holland, Canada]	This comment has been considered during the preparation of the FGD. (In the FGD), not applicable -- FAQ1.4 has been removed.
50526	106	1	106	35	Rix Readability -- 12 [Anton Holland, Canada]	This comment has been considered during the preparation of the FGD. (In the FGD), not applicable -- FAQ1.4 has been removed.
50528	106	1	106	35	Raygor Readability -- 13 [Anton Holland, Canada]	This comment has been considered during the preparation of the FGD. (In the FGD), not applicable -- FAQ1.4 has been removed.
50530	106	1	106	35	In addition, we see that 57% of sentences in this text are over 30 syllables, while 64% are over 20 syllables. The target in this case should be at least 50% of sentences under 20 syllables (exluding essential words for which no reasonable alternative is available). [Anton Holland, Canada]	This comment has been considered during the preparation of the FGD. (In the FGD), not applicable -- FAQ1.4 has been removed.
50532	106	1	106	35	The other FAQ examples demonstrate similar issues. [Anton Holland, Canada]	This comment has been considered during the preparation of the FGD. (In the FGD), not applicable -- FAQ1.4 has been removed.
14472	106	1	106	42	FAQ1.4. Describes how one calculates the global temperature change. However, the description given is for AVERAGE global temperature change. It would be prudent to consistently use the term "Global average temperature change" throughout the document. [Ivan Lule, Uganda]	This comment has been considered during the preparation of the FGD. (In the FGD), not applicable -- FAQ1.4 has been removed.
56202	106	1	106	42	Important topic. Could refer to SR15 on this. A decision should be taken regarding which definition is used throughout the AR6 WG1 report. Could also be useful to highlight here or elsewhere the impact of the differing definitions of GMST. [Sonia Seneviratne, Switzerland]	This comment has been considered during the preparation of the FGD. (In the FGD), not applicable -- FAQ1.4 has been removed.
24474	106	3	106	5	About FAQ 1.4, in the text “We calculate global surface temperature change by analyzing the readings of thermometers all over the globe using statistical techniques to take into account areas like the poles where there are fewer measurements." Comment: The global surface temperature change is also determined through satellite measurements. Please, include them in the above text. [Rubén D Piacentini, Argentina]	This comment has been considered during the preparation of the FGD. (In the FGD), not applicable -- FAQ1.4 has been removed.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
37384	106	4			Add "or modelling and other observations" after "statistical techniques". Then reanalysis is covered as well as the approaches such as used in GISTEMP or by Cowtan and Way. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	This comment has been considered during the preparation of the FGD. (In the FGD), not applicable -- FAQ1.4 has been removed.
27164	106	7	106	9	This expert reviewer recommends to built a figure to compare data of Figure 2.12 (preferably monthly data) with data of Fig. 5.5a restricted to anthropogenic emissions (without land-use change) like Figure 3 on page 60 of the book "L'urgence climatique est un leurre" published by L'Artilleur in 2018. Among the 1°C of average temperature increase since the pre-industrial period, it is seen that about 0.6°C has been achieved between 1910 and 1945 when the emissions were much lower than nowadays. As a result, Ring, M.J., Lindner, D., Cross, E.F., Schlesinger, M.E., 2012 (Causes of the global warming observed since the 19th century. Atmos. Clim. Sci. 2, 401–415) consider that this increase was mainly natural. This is confirmed in Fig. 1 of FAQ 9.2 with only 15 % of human driver in the period 1900-1950. Since the accelaration of emissions starting in 1945, the increase of temperature has been only about 0.4°C up to the plateau before (and after) the El Niño peak of 2016. +0.4°C since 3/4 of a century does not justify the alarmism of the AR6 report and suggests a low climate sensitivity. [François GERVAIS, France]	This comment has been considered during the preparation of the FGD. (In the FGD), not applicable -- FAQ1.4 has been removed.
55228	106	7		9	The text says, "The surface temperature of the world has, on average, increased by around 1 °C since the pre-industrial period – hence the term 'global warming'. Making such a statement implies that we are confident in the ability of science to determine how surface temperatures change over time." The 2nd sentence is ironic considering how the first sentence glosses over 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 greater certainty than we actually do. [David Burton, United States of America]	This comment has been considered during the preparation of the FGD. (In the FGD), not applicable -- FAQ1.4 has been removed.
14990	106	10	106	15	This is an excellent way of indicating the challenge and nature of the measurement approach. [Erin McClymont, United Kingdom (of Great Britain and Northern Ireland)]	(In FGD)
37386	106	12			After the full stop add "Some approaches draw information from related observations, such as the sea-ice cover or surface winds over the sea." to cover the case of reanalysis. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	This comment has been considered during the preparation of the FGD. (In the FGD), not applicable -- FAQ1.4 has been removed.
16318	106	16	106	20	This statement could be strenghtened by an additional sentence explaining how different groups treat areas with no information. [Renee van Diemen, United Kingdom (of Great Britain and Northern Ireland)]	This comment has been considered during the preparation of the FGD. (In the FGD), not applicable -- FAQ1.4 has been removed.
43298	106	16		32	This sentence should be inscribed at the beginning of the introduction. [Onema Adojoh, United States of America]	This comment has been considered during the preparation of the FGD. (In the FGD), not applicable -- FAQ1.4 has been removed.
37388	106	20			Delete "somewhat" as reanalysis differs quite a lot from the other approaches. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	This comment has been considered during the preparation of the FGD. (In the FGD), not applicable -- FAQ1.4 has been removed.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
37390	106	21	106	26	This paragraph could be kept in, though it does not apply to reanalysis, and the differences between GMST and GSAT are only one of several sources of uncertainty in the datasets. In line 23 one could add, before the full stop ", though some newer model-aided analysis methods estimate the air temperature over sea" to cover the case of reanalysis. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	This comment has been considered during the preparation of the FGD. (In the FGD), not applicable -- FAQ1.4 has been removed.
37392	106	28			30 years is the WMO standard; 20 years is something that the CMIP modellers have come up with. The traditional (HadCRUT4 etc) datasets are defined as anomalies relative to 30-year means not 20-year means. The text states "at least 20 years" so that does cover 30 years, but it would be better to mention the number 30 explicitly. "average at least 20 years to obtain" could be changed to "average 20 to 30 years, or even more, to obtain" [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	This comment has been considered during the preparation of the FGD. (In the FGD), not applicable -- FAQ1.4 has been removed.
16320	106	33	106	35	It might be worth explaining the difference between the first paragraph and the last paragraph of this FAQ - the first one indicates that surface temperature has increased by around 1C, but the last states 0.87C [Renee van Diemen, United Kingdom (of Great Britain and Northern Ireland)]	This comment has been considered during the preparation of the FGD. (In the FGD), not applicable -- FAQ1.4 has been removed.
57318	106	33	106	35	No, the 0.87C refers to GMST (combined air and sea water temperature) [Myles Allen, United Kingdom (of Great Britain and Northern Ireland)]	This comment has been considered during the preparation of the FGD. (In the FGD), not applicable -- FAQ1.4 has been removed.
31590	111	58	111	61	This reference appears twice. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. We have fixed the duplication of references.
50510	134	1	148	2	This would be effective as an interactive timeline graphic. [Anton Holland, Canada]	Noted. This is not an option for the Appendix 1.A. But we are considering to include a figure in the post-SOD revisions, with an interactive timeline graph as part of Section 1.3, covering the history of climate understanding up to the IPCC AR5 and the AR6 series of Special Reports.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
45950	139	3	148	2	Table 1.A.1, last column “AR6 SPM statement” and last row “Projections of Future Changes in Climate - AMOC”: Given the observed strong cooling in the subpolar gyre southeast of Greenland with the coldest SST on record in 2015 and the long-term evidence of unprecedented weak AMOC states reached in recent decades in the context of up to 1600 years (Caesar et al. 2018; Thornalley et al. 2018), I do no longer agree with the confidence statement “It is very unlikely that the AMOC will undergo an abrupt transition or collapse in the 21st century for the scenarios considered.” I would rather stress that we have a very low understanding and cannot judge how likely it is. There is also paleoclimate evidence for a partial AMOC collapse during the Eemian interglacial (Salonen et al. 2018; Tzedakis et al. 2018) which was likely warmer than the current climate and there were no significant ice sheets which could explain the AMOC weakening with excess meltwater. So there is evidence that the AMOC may partially collapse during a warmer climate without the contribution of ice sheets. References: Caesar, L., Rahmstorf, S., Robinson, A., Feulner, G. & V. Saba (2018): Observed fingerprint of a weakening Atlantic Ocean overturning circulation. Nature 556, 191–196, https://doi.org/10.1038/s41586-018-0006-5 Thornalley et al. 2018: Anomalously weak Labrador Sea convection and Atlantic overturning during the past 150 years. Nature 556, 227–230, https://doi.org/10.1038/s41586-018-0007-4 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 statement the reviewer is referring to is from the WGI AR5 SPM. This is what this table currently includes -- key SPM statements from past assessment reports. The AR6 assessment is still being performed.
33298	139	9	148	1	Table 1.A.1: A table does not seem like the appropriate format for this information. Very difficult to read. Perhaps an outline format where the top category is the Topic and each statement is a subcategory? But read top to bottom instead of side to side as here. [Erika Wise, United States of America]	Noted. No change.
47990	139	9	148	1	Please check the use of the IPCC uncertainty language terms in this table (eg likely). Are you able to provide a traceable account to assigning this uncertainty statement? Note that likelihood statements are quantified terms - phrases like likely and very likely have quantifiable probabilities associated with them. Please check it has been used correctly here. Please refer to the IPCC guidance note on uncertainty: https://wg1.ipcc.ch/SR/documents/ar5_uncertainty-guidance-note.pdf [WGI TSU, France]	Noted. All the statements are taken from past approved SPMs. So all uncertainty assessments do have a traceable account in the underlying reports. Note that in some cases the uncertainty terminology and its formatting has been lost/changed during the editorial process. This has been corrected for the SOD. We hope the TSU will be able to include Line numbers in the tables for easy referencing in the next round of reviews.
8512	147	1	147	1	Uncertainty in past AR statements about sea level rise projections is incompletely reflected. For example, the SAR presents 50, 15, and 95 cm scenarios. This suggests directly cribbing a single sentence from a past SPM may present an inadequate picture of the conclusions of past reports. [Robert Kopp, United States of America]	Accepted. Revision for the SOD properly reflects past assessment statements. The version used was what was picked by AR5 Chapter 1. This has now been updated to provide a more accurate summary of the actual assessment from past reports.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
8514	147	1	147	1	Assessed likelihood language missing from AR5 assessment of AMOC weakening over the 21st century. [Robert Kopp, United States of America]	Accept. Sentence should read "It is very likely that the Atlantic Meridional Overturning Circulation (AMOC) will weaken over the 21st century." All entries have been checked and, where necessary, corrected.
29638	147		147		Tab. 1. A1 Please explain acronym AMOC in the first column of the table for better reading [luisa Sturiale, Italy]	Taken into account. Acronym is now introduced at the first use. The printed report will include a comprehensive list of acronyms as an Annex
28768	149	0	180	0	Figures are generally to complex for my liking [Piers Piers Forster, United Kingdom (of Great Britain and Northern Ireland)]	Thanks for your comments! We have made significant efforts to improve the figures.
46768	149	0	180	70	It is quite challenging to read the text on many figures. I guess it will be fixed in the final version, but it is difficult to perform the review on the figures as they are now. [Eloy Sanz-Pérez, Spain]	Thanks. The figure has been extensively revised.
51750	149	1	149	1	How were the latitude bands defined for the precipitation wedge? [Anson Cheung, United States of America]	Thanks. The figure has been extensively revised.
25588	149	1	149	1	Why a circle, not a simple rectangle? It seems to overemphasize recent past? Is this propaganda or science? [Stephen E Schwartz, United States of America]	Thanks. The figure has been extensively revised.
50508	149	1	149	2	This is an effective, simple, and clear roll up of key issues. If this was made to be ineractive, is could be used a jumping point to drill down further and obtain more detail. In contract, the rosette is a little hard to follow for a more general reader (policy maker). [Anton Holland, Canada]	Thanks. We have considered making it interactive, it's a matter of capacity mostly.
57810	149	1	149	3	I think "old fashioned" rectangular trend plots (with time on the x-axis) are more compelling and easier to grasp in a glance than the fancy color-coded "wedge" plot. The problem with the wedge plot is that it has to rely on color scales to convey the trends, which unnecessarily adds a qualitative or subjective/perceptual layer of abstraction. In other words, the plot compromises the essential meaning of the plots (the magnitude/speed of trends) for the sake of clever/novel packaging, which isn't a good trade. Keep it simple! [Peter Kalmus, United States of America]	The figure has been revised.
57812	149	1	149	3	The precipitation wedge is problematic. The latitude bands need to be noted both on the figure and in the caption, and this adds an additional "dimension" to the plot that seems unwanted. Some regions do not have an immediately obvious trend given the color scales, and overall the wedge looks too noisy. I think precip change might be a good choice for the sixth variable plotted here, but more thought should be given as to how to capture it in a Figure 1.1 plot setting the stage for the entire AR6. For example, maybe changes in extreme precip events could be plotted instead. But perhaps precip is too complex for this basic, introductory, stage-setting figure; if so, consider other options. Ocean Ph (although it isn't technically a climactic change) or ice sheet loss (although cryosphere change is already captured by glacier loss). Once critical dimension of change missing from the figure is the biosphere. Could essential global ecosystem change be captured in very basic figure like this? Perhaps mean leaf or bloom date trends? Perhaps a mean measure of species range changes if such a measure exists? (Note too that there is no notation under "biosphere" in the schematic left portion of Figure 1.1 either.) Or cumulative species extinctions (although habitat loss is a significant driver so it isn't a "pure" climate indicator). [Peter Kalmus, United States of America]	The figure has been revised. As we don't do the actual assessment we're dependent on information from chapter 2. The contents of the stripe plots (which replace the wedges) have been agreed upon with them.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
26932	149	1	149	7	The right panel cannot be assessed because the graphic quality is too poor. [Joachim Rock, Germany]	Thanks. The figure has been extensively revised.
13136	149	1	149	8	For "Precipitation" replace the work "changing" with a better description, e.g., in some regions precipitiation is increasing and in some regions precipitation is decreasing. Ocean pH is also not mentioned in this figure and might be worth including. In addition, changes in the "biosphere" in terms of CO2 uptake and relsease might also be worth including. [Nora Richter, United States of America]	Thanks. The figure has been extensively revised.
13138	149	1	149	8	This is figure is difficult to interpret, consider using a bar graph with time on the y-axis and variables on the x-axis. Why does precipitation have different "color wheels" inside the section of the color wheel that describes precipitation? In the description it says the "rosette" starts from "1850" but on the figure it says it starts at "1880." Correct this, and specify that this represents "observational data from historical records" (assuming that is what this represents?). [Nora Richter, United States of America]	Thanks. The figure has been extensively revised.
45148	149	1	149	8	Figure 1.1 is excellent - clear and policy relevant. Please ensure it is retained through into the final draft. Regarding the comment back on Page 7 that the "precipitation" sector of Figure 1.1 might be changed to a pH sector: I don't think the rainfall sector should be removed, as it is of strong policy relevance as is the message that the regional pattern of change is different to that for temperature. However, a pH sctor could be added. [David Wratt, New Zealand]	Thanks. The figure has been extensively revised.
42874	149	1	149	8	Fig 1.1, left: add changes in cryosphere and biosphere (carbon storage, greening?) [Michael Evans, United States of America]	Thanks. The figure has been extensively revised.
56226	149	1			I like the rosette figure, but not clear what the 4 subsets of the precipitation wedge are referring to. [Sonia Seneviratne, Switzerland]	Thanks. The figure has been extensively revised.
43378	149	2	149	3	I'd recommend changing the schematic in Figure 1.1a to explicitly connect glacier mass to cryosphere-- right now it's not clear that they're part of the same thing. Alternatively, sea ice extent could be an alternative or additional diagnostic to describe the cryosphere. In Fig 1.1b, in the non-placeholder figure the different precipitation segments (based on latitude bands) should be described as such. [Kristina Pistone, United States of America]	Thanks. The figure has been extensively revised.
8850	149	2			Right panel: Interesting figure with high outreach potential! Unclear what the azimuthal dimension in the precip sector is. Are these latitude bands? I suggest to add in addition to GMST also latitude bands and show then in the azimuthal direction. In addition to CO2 I would suggest to add CH4, and make use of a broader color palette. Also, tick marks would help on the radial time axis. [Thomas Stocker, Switzerland]	Thanks. The figure has been extensively revised.
24448	149	4	149	4	In the “Figure 1.1” Comment: The letters and numbers in the figure are very small, mainly in the right hand figure. Please, amplify them. [Rubén D Piacentini, Argentina]	Thanks. The figure has been extensively revised.
43692	149	4	149	7	Caption indicates that annual means from 1850 are used but the figure shows 1880 in the center. It is also not noted in the caption that precipation changes for 5 five latitude bands are shown. I would suggest to separate the 5 latitude bands with a black line to clearly show that the precipitation wedge is not global but depicts changes for 5 regions. [Vaishali Naik, United States of America]	Thanks. The figure has been extensively revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
15636	149	4			Nice Figure! For glaciers you may use the length change data from Zemp et al. (2015, Fig 6) or the mass change estimates from Zemp et al. (2019). The latter may be complemented by mass change reconstructions based on length change data by Leclerque et al. (2011). Leclercq, P. W., Oerlemans, J., & Cogley, J. G. (2011). Estimating the glacier contribution to sea-level rise for the period 1800–2005. Surveys in Geophysics, 32(4-5), 519. Zemp et al. (2005): see above. Zemp, M., Huss, M., Thibert, E., Eckert, N., McNabb, R., Huber, J., Barandun, M., Machguth, H., Nussbaumer, S.U., Gärtner-Roer, I., Thomson, L., Paul, F., Maussion, F., Kutuzov, S., and Cogley, J.G. (2019): Global glacier mass changes and their contributions to sea-level rise from 1961 to 2016. Nature, https://doi.org/10.1038/s41586-019-1071-0. [Michael Zemp, Switzerland]	Thanks. The figure has been extensively revised.
33392	149	5	149	6	Figure 1.1 caption: For the precipitation wedge, the caption needs to describe what the 5 slices are (my guess is each slice is 70 days in the year?). Additionally, it seems odd that slice 4 is mostly brown and slice 5 is mostly blue: if it is a change in precip, I'd expect browns & blues within any given slice to even out. My guess is that this is showing percent change from the average of the entire year, but it would be better to be percent change from the precipitation within that 70 day window. [Marcus Sarofim, United States of America]	Thanks. The figure has been extensively revised.
32040	149		149		I like the Rosette figure but I think it might look better if a common blue-white-red colour scale was used for all variables. This would illustrate how different variables have changed at different rates. [Rowan Sutton, United Kingdom (of Great Britain and Northern Ireland)]	Thanks. The figure has been extensively revised.
57980	149		149		No description of finer structure of prcipitation wedge in Fig. caption [Tomas Halenka, Czech Republic]	Thanks. The figure has been extensively revised.
29640	149		149		Fig. 1 right The center indicates the year 1880, but in the legend 1850 is indicated. Which of the two years is the correct one? [luisa Sturiale, Italy]	Thanks. The figure has been extensively revised.
42706	149		149		Figure 1.1 - Potentially will be changed for SOD, but connection between left-side phenomena and right-side wedges are unclear, consider formatting to increase letter emphasis, color coding text elements rather than whole schematic, or reducing clutter (simplifying schematic) to emphasize text elements [Stephanie Courtney, United States of America]	Thanks. The figure has been extensively revised.
17910	149		184		More than 50 % of the Figures are of relatively low quality; that may compromise the understanding of Chapter 1 and more. [Branko Grisogono, Croatia]	Thanks! We have taken your useful comment into account in improving the quality of the figures in the chapter.
15320	150	0	150	0	Figure 1.2 charts are excellent. In separate and similar charts, I recommend highlighting trends from paleoclimatic data of the past 10,000 years (or whatever time frame is deemed relevant to human settlements) in addition to the call-out of the observed trends since 1850. Rationale: demonstrate the key characteristics of the climate during human societies' development as compared to the paleoclimatic data and the current trends. [Lia Cairone, United States of America]	Noted. We prefer to stick to the 800'000 year focus vis-a-vis the most recent past in order to not dilute the power of the figure here. The Holocene evolution is covered in Chapters 2 (several topical subsections) and 5 (SOD section 5.1)
25590	150	1	150	1	Panel b should be clearly labeled "global average surface temperature CHANGE" [Stephen E Schwartz, United States of America]	Taken into account. Label now refers to "Global temperature anomaly"

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
25592	150	1	150	1	I am surprised at use of Snyder time series, single reference for this important quantity, especially given the concern raised by Schmidt et al., . Schmidt, G. A., Severinghaus, J., Abe-Ouchi, A., Alley, R. B., Broecker, W., Brook, E.,…Stocker, T. F. (2017). Overestimate of committed warming. Nature, 547(7662), E16–E17. https://doi.org/10.1038/nature22803 [Stephen E Schwartz, United States of America]	Noted. The comment by Schmidt et al. Does not criticise the record per se, but the conclusions drawn from it.
13140	150	1	150	19	The x-axis is confusing, stick to one time format (either BP or CE). In addition, the zoomed in axis is not very obvious. It might be worth separating the plots so it does not look like one continuous plot. [Nora Richter, United States of America]	Accepted. X-axis has been split. X-axis label changed. Clarity has been improved, though the different time axis are necessary to see something for the past 170 years…
42876	150	1	150	19	Fig 1.2: add ECR estimates, especially for sea level [Michael Evans, United States of America]	Rejected. Unclear what the reviewer is referring to here…ECR estimates? No references given
32302	150	1	150	20	Fig.1.2 panel 3 sea level. The change in yaxis scale interval from negative to positive values is very confusing. At first reading I thought that the two major paleo sea level rises were of order 30-100m. Only on a detailed look did I realize that they were using the rh scale and thus less than 2m. Suggest a revised figure in which the negative and positive values are separated by a small blank space gap (i.e. split the current panel 3 into two separated sub-panels as they have different scales) and the y axis values are clearly labeled on both left and right axes [Simon Josey, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Figure was revised accordingly to increase clarity. The different timescales are in separate panels now. The positive axis has been added on the left side of both panels.
30418	150	1	150	20	During the scenario cross-chapter and cross-WG coordination also the lowest scenario available in the ScenarioMIP set (SSP1-1.9) was recommended to be included as default scenario in plots. Please consider adding it here. See Chapter 1 Box 1.6. [Joeri Rogelj, Austria]	Accepted. Figure 1.3 does now include SSPs as available at the time of the SOD
26934	150	1	184	7	Many figures are of such a poor quality that they could not be assessed (e.g., 1-16, 1-20). Please make sure that this is corrected in the SOD. [Joachim Rock, Germany]	Accepted. This problem occurred during the compilation of the FOD, to keep the size of the chapter file to an acceptable level. The actual figures have a better resolution.
31536	150	4	150	4	It looks on the x axis that 0 (i.e. 1950) on the left-hand x axis lines up with 1850 on the right-hand x axis. Might be clearer to have the left-hand axis as "time before 1850". [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Done
31546	150	4	150	4	It would be nice if this figure and/or the associated text references the Chapters/Sections where the paleoclimate records shown are discussed in more detail. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. We did add references to the Chapters of the WGI report where the corresponding assessment can be found. Note that this is a general problem as the IPCC decided to no longer have a paleo chapter. There might be an opportunity to have a dedicated paleo sections in the Technical Summary, which we would support.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
13676	150	6	150	7	Ice core CO2 data in the deep part of EPICA Dome C have been revised in "Bereiter et al., (2015)", add this reference to the source of CO2 data from ice cores, AND revise CO2 over the last 800,000 years plotted in Figure 1.2a with the new data of that paper (changing CO2 between 600,000 and 800,000 BCE). Bereiter, B., S. Eggleston, J. Schmitt, C. Nehrbass-Ahles, T. F. Stocker, H. Fischer, S. Kipfstuhl, and J. Chappellaz (2015), Revision of the EPICA Dome C CO2 record from 800 to 600 kyr before present, Geophys. Res. Lett., 42, 542–549, doi:10.1002/2014GL061957. [Peter Köhler, Germany]	Accepted. Reference added.
19154	150	7	150	7	please add or replace MacFarling Meure et al., 2006 citation by Bereiter et al. 2015; I also believe the Dlugokenky and Tans, 2019 reference should be Tans & Keeling 2019? At least that is what the Mauna Loa website requests [Baerbel Hoenisch, United States of America]	Accepted. Reference added.
24450	150	16	150	19	In the “Figure 1.2 caption [PLACEHOLDER: projections are based on CMIP5. They will be replaced by CMIP6 in the SOD; uncertainties will be added to the paleoclimate reconstructions in the SOD. Also, SLR projections will likely use Spratt and Lisiecki (2016) (re-referenced to 1850-1900) for the SOD instead of Bintanja and van de Wal (2008).” Comment: The “[“ symbol needs to be closed (at the end). What means “SLR”? If it is “Sea Level Rise”, actually in this figure 1, it is indicated “Sea Level Change”, consequently in place of “SLR” it must be “SLC”. [Rubén D Piacentini, Argentina]	Accepted. Note that the placeholder text is a placeholder. It will be deleted for the final draft the latest.
57984	150		150		No a), b), c) in the Fig., missing b), c) in the caption [Tomas Halenka, Czech Republic]	Accepted. Caption revised accordingly
42708	150		150		Figure 1.2 - Dramatic changes in axis scales are unclear. Emphasize boundaries, maybe using small zigzag at top or bottom of axis boundary (or other familiar axis-break notation). Would also suggest standardizing title/context text placement, i.e. place Atm. CO2 text the same as lower two graphs, especially since there is plenty of in-graph space. [Stephanie Courtney, United States of America]	Accepted. Figure was revised accordingly to increase clarity. The different timescales are in separate panels now.
6694	150				Can we please coordinate so that figure 1.2 uses sea level data consistent with chapter 9? [Helene Hewitt, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Yes, we aim for this. Paleoperiod assessed ranges from Chs 2/9 and the related Annex have been included in the figure for comparison.
53962	151	1	151	1	I hope a new version of this figure is in the planning. This version is less detailed than the original from WG II AR5. If the intention is to include trade offs and synergies of policies, which themselves can affect risk, then presumably that figure is also under revision too in the cross-WG group discussing this. [Timothy Carter, Finland]	Propeller diagram has been revised, and will probably be revised further after the SOD. Cross-WG risk discussion group needs to provide materials in time for WG1 deadlines.
42878	151	1	152	14	Figs Box 1.2 Fig 1, Fig 1.3: could another fig be added to the Cross chapter box showing the distribution of hazard, vulnerability, exposure with climate projection (as is done in Fig 1.3)? Would be great to illustrate how the risk changes with the amplitude of climate forcing/change. [Michael Evans, United States of America]	Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.
46236	151	4	151	4	This is the WG II risk framework. It is not used in WG III. WG III has no problems with this framework for impacts. Just not relevant for much of WG III. [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	We have reduced the emphasis on a cross-WG common risk framework, since that does not seem achievable.
24452	151		151		Comment to the Cross-Chapter Box 1.2, Figure 1: Why there are 2 blue lines pointing to the right part of the figure, in between Vulnerability and Exposure? Explain them or eliminate them. [Rubén D Piacentini, Argentina]	Fig 1 was a placeholder for a revised figure in the SOD.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
31558	152	1	152	14	For the second-order draft, this figure could be updated with the new assessed range of ECS in AR6. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Noted. New figure SOD 1.12 provide an AR5-based illustration of the concepts of low-likelihood, high impact events.
9872	152	1			Sutton 2018 is not in references [Sebastian Luening, Portugal]	Taken into account. Reference added.
47992	152	4	152	12	Please check the use of the IPCC uncertainty language terms in this table (eg likely). Are you able to provide a traceable account to assigning this uncertainty statement? Note that likelihood statements are quantified terms - phrases like likely and very likely have quantifiable probabilities associated with them. Please check it has been used correctly here. Please refer to the IPCC guidance note on uncertainty: https://wg1.ipcc.ch/SR/documents/ar5_uncertainty-guidance-note.pdf [WGI TSU, France]	Taken into account. Italics added where appropriate. Note that part of the formatting was lost in the pre-FOD editorial process.
24454	152		152		Comment to Figure 1.3: In the horizontal axis, the variable “Climate sensitivity” is given in units of [K] (Kelvin) but in the figure caption it is described in units of °C. Uniform this notation. [Rubén D Piacentini, Argentina]	Accepted. Revised: IPCC standard is to use °C, we believe.
29642	152		152		Fig 1.3 The references (Sutton 2018 and Weitzman 2011) there aren't in the final references. [luisa Sturiale, Italy]	Taken into account. Reference added.
8516	154	1	154	1	"Statistics" is a different category of entity than models, observations, and experiments. Statistics of what? [Robert Kopp, United States of America]	Taken into account. See also comments 30412 and 30414.
24456	154		154		Comment to Box 1.1, Figure 1.1: It is difficult to read the text in “white color” included in the figure placed at the central-top part of the whole figure. Modify the base (gray) color or gives a color different from white to the letters. [Rubén D Piacentini, Argentina]	Noted. Figures were compressed in the FOD. The figure of the SOD have a better quality.
24458	155		155		Comment to Figure 1.5: There is an error in the vertical axis of the top figure, since the variable is written as “Temperature vs time”. However, it must be (as described in the figure caption): “Temperature change over time (°C per decade)”. Note that the unit of temperature in the vertical axis of both figures (top and bottom) is written only with a “C”, but in the legend it is indicated as “°C”, like in the rest of the Chapter. Also, expand the names and years, since they are very small. [Rubén D Piacentini, Argentina]	Figure has been revised/replaced.
51780	156	1	156	1	It's a bit odd to just show legend in subplot b. [Anson Cheung, United States of America]	Figure design was revised
51782	156	1	156	1	The abbreviation "GW" was never defined. [Anson Cheung, United States of America]	GW was defined.
13142	156	1	156	9	Include a map here to show which regions these different "boxes" and plots cover. [Nora Richter, United States of America]	A map was included in the figure.
51784	157	1	157	1	Lake sediments are absent in the figure. [Anson Cheung, United States of America]	Accepted. Lake sediments are now included.
46114	157	1	157	5	Fig 1.7: There is a single bivalve reconstruction that's nearly 1400 years (Butler et al. 2013. Paleo, paleo, paleo. Vol 373. 99. 141-151) , multiple ones go further into detail including the Little Ice Age and Medieval Climate Anomaly (Wannamaker et al. 2011. Paleo, paleo, paleo, Vol. 302, pp. 43-51). I feel you need to add this very long-lived and highly reproduced source of annual data to this graph. [Amy Featherstone, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. A larger number of archives are now included in the revised figure.
13144	157	1	157	5	It might be useful to either include in the caption or next to the figure what the different paleoclimate observations are recording. It would also be nice to show that for some of our paleoclimate observatios there is overlap instrumental observations (e.g., precipitation, temperature, sea level, etc.). [Nora Richter, United States of America]	Taken into account; the Figure has been significantly revised, such that overlap with the instrumental record is now visible.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
42880	157	1	157	5	Add to paleoclimate: historical records (e.g. indigenous, archaeological, documentary), lake records. [Michael Evans, United States of America]	Accepted. A larger number of archives are now included in the revised figure.
44920	157	1			Fig. 1.7. I'm biased, but "lake sediments" really need to be included in the list of sources of paleoclimate observations. Pollen from lake sediments is the most common terrestrial paleoclimate indicator beyond 1000 years ago. Boreholes should probably also be included as well, although they are not yet represented in the report. [Darrell Kaufman, United States of America]	Accepted. A larger number of archives are now included in the revised figure.
44922	157	1			Fig 1.7. I think the purpose of each bar is to represent a data "source", but "temperature" isn't a source. Maybe "thermometers"? [Darrell Kaufman, United States of America]	Accepted. Instrumental and paleoclimate sources of information are now distinguished in the figure.
44924	157	1			Fig. 1.7. "Tropical ice cores" is a very specialized category of paleoclimate observations. I agree that there are precious few remaining glaciers in the tropics, but mountain glaciers everywhere are being extinguished. Also, some of the paleoclimate information that we glean from them is based on fluctuations in size, which does not require an "ice core". I suggest changing "tropical ice cores" to "mountain glaciers" generally. Also how about changing "stalagmites" to the more general "speleothems"? [Darrell Kaufman, United States of America]	Taken into account; the text makes reference to vanishing mountain glaciers, but in terms of climate timeseries, it is the tropical ice cores which are called out specifically as "at risk" archives.
9874	157	1			Lake sediments and wetlands need to be added as natural palaeoarchives [Sebastian Luening, Portugal]	Accepted. A larger number of archives are now included in the revised figure.
33300	157		157		Figure 1.7: Great figure. I could not see how the decrease in instrumental coverage was being displayed, though (it is clear in the ice cores bar). [Erika Wise, United States of America]	Taken into account; we have opted not to conduct an assessment of instrumental climate data coverage in the last several decades, and as such the bars do not reflect changes in coverage coming into the present.
56228	158	1			Useful figure, but some questions: 1) It might be more logical to show CMIP5 on the left panels, and CMIP6 on the right panels (given that time is often displayed as moving from left to right); 2) How about HighresMIP? Shouldn't that MIP be considered in the CMIP6 panel - or else mentioned in the figure caption?); 3) Should maybe mention temporal availability of CMIP6 simulations (i.e. delays). While statistics for CMIP6 look good, given simulation delays it is well possible that several assessments from AR6 will need to build on CMIP5 instead. [Sonia Seneviratne, Switzerland]	1) Change in panels' order is accepted. Mentions of 2) HighresMIP and delay are noted. They have been considered when the final version has produced. Eventually, HighresMIP models are included in the final figure. The delay was not mentioned because a good number of CMIP6 simulations have become available for most part of AR6 assessments.
36666	159	4	159	4	Please change "Nanjin" to "Nanjing". [Jiafu Mao, United States of America]	Noted. The figure has not been revised for the second order draft, it will be finalized when more CMIP6 and CORDEX data are available.
39154	159		159		The information of CAS model in Fig. 1.9 is not correct. The previous models/versions of CAS (IAP, GOALS, FGOALS_g1, FGOALS-g2, FGOALS-s2) have parcipated in all previous CMIP. [Lijuan Li, China]	Noted. The figure has not been revised for the second order draft, it will be finalized when more CMIP6 and CORDEX data are available.
6696	159				Figure 1.9 might consider showing UKESM as a sperate effort from MOHC-it is linked but represents increased effort from a more scientifically diverse UK community [Helene Hewitt, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The figure has been updated in the FGD but because of constraints of readability it has not been possible to include the details of all CMIP6 consortia. This is indicated in the figure legend.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
51786	160	1	160	10	in figure c), the difference in color needs to be explained. [Anson Cheung, United States of America]	Accepted. The figure has been revised.
13146	160	1	160	11	This figure is not very clear. It might help to modify the "key" so that it reflects what is written in the figure caption. [Nora Richter, United States of America]	Taken into account. The figure has been revised.
56230	160	1			Mention in caption or in the text: Recent evidence suggests that single-model initial-conditions ensembles cannot cover the same degrees of freedom as a multi-model ensemble, because model characteristics substantially affect model behaviour. See Beusch et al., to be submitted (article can be obtained from lea.beusch@env.ethz.ch and sonia.seneviratne@ethz.ch at ETH Zurich). [Sonia Seneviratne, Switzerland]	Accepted. Point added to the text.
24460	160		160		Comment to Figure 1.10: In the figure c) Perturbed Physics Ensemble (PPE), the results shown as segmented lines in green color are not detailed at right, as in the case of black color lines, Model 1. [Rubén D Piacentini, Argentina]	Noted. The figure has been revised.
24462	162		162		Comment to Figure 1.12: Actually, this figure has two variables represented in the y-axis: Earth system sensibility at left and Long-term intermodel uncertainty. However only it is described in the figure caption, the left y-axis variable. Include the description of the right y-axis variable. [Rubén D Piacentini, Argentina]	Taken into account, thanks.
42712	162		162		Caption is very helpful for Figure 1.12, however causaul relationships of constraints are unclear. Fine as is, but consider splitting into stages or adding text that integrates/walks through features of the graphic. Relationship to long-term uncertainty unclear. [Stephanie Courtney, United States of America]	Thanks. The figure has been revised.
51788	163	1	163	1	I don't quite understand why show 3 members for OHC but 2 only for other variables. Why not just make it more consistent? [Anson Cheung, United States of America]	Taken into account; The figure was updated
51790	163	1	163	1	The linear trends plotted up are not very helpful, they just make the figure busier. [Anson Cheung, United States of America]	Taken into account; The figure was updated
13148	163	1	163	11	The "trend lines" are not very clear. Consider making the "trend lines" dashed and have them go through the entire plot. [Nora Richter, United States of America]	Taken into account; The figure was updated
45150	163	1	163	11	I find it confusing that in the caption for figure 1.13 you refer to three individual ensemble members, but that in four out of the five panels you only show two of these. I suggest you simplify things by removing the third ensemble member from the top left panel, and changing the caption text to:" ...and the coloured lines represent TWO individual ensemble members. BOTH members shown have very similar OHC trends (top left) but vary considerably for other climate metrics." [David Wratt, New Zealand]	Taken into account; Figure revised.
50754	163	3	163	10	Possibly, it could be worth to include (in the main text or in the caption of Figure 1.13) a short comment comparing the variability of the OHC versus the surface air temperatures, and its consequences in the calculated trends. For instance, trends are easily recognizable (even at a glance) in OHC but not so much in suface air temperatures. [Hernan Edgardo Sala, Argentina]	Taken into account; Text revised.
29644	163	4	163	4	Fig. 1.13 Attention: Maher et al, 2019 no in references. [luisa Sturiale, Italy]	Accepted; Reference updated.
50756	163	5	163	5	Consider adding "change" in: "...annual global surface air temperature..." in the following way: "...annual global surface air temperature change...". (Figure caption 1.13). [Hernan Edgardo Sala, Argentina]	Taken into account; Figure revised.
33302	163		163		Fig 1.13: I don't think this figure is conveying the message that the authors are trying to convey; it is difficult to interpret. What is the main point that a reader should be extracting from the figure? Could that point be displayed more clearly? [Erika Wise, United States of America]	Taken into account; The figure was updated to better convey the message

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
42714	163		163		Figure 1.13 - Titles of lower graphs look like x-axis labels of upper graphs, need different spacing or something. Short term linear trends representation is confusing - consider only showing short term trend rather than superimposition with long-term trend and/or separating the trend from the data (above or below) with dedicated in-graphic text. At this point in-graphic text is more a repetition of the caption rather than adding to it - stronger in-graphic text might be more big-idea, along the lines of the first mini-paragraph and not the second and third, and integrated with graphic features. [Stephanie Courtney, United States of America]	Taken into account; The figure was updated.
29646	164	5	164	5	Fig. 1.14 Sutton et al, 2016 but in references is 2015!!! Why only Ghana and UK!!! [luisa Sturiale, Italy]	Taken into account; Reference updated. Two exemplar countries chosen as described in text.
56232	165	1			Consider including the following in this graphic: 1) Land-atmosphere interactions (from 1km to 100km); 2) land use forcing (from 1km to 100km); 3) aerosol forcing (from 10km to 100km). Note that all of these have effects going from days to decades. [Sonia Seneviratne, Switzerland]	Taken into account. This has been taken into account together with Comment 8840.
50758	165	4	165	8	In order to reach a wider audience, I suggest to include in the caption of this figure (Fig. 1.15) the meaning of some of the acronyms used in it (PDV, AMV, QBO, MJO, etc.). [Hernan Edgardo Sala, Argentina]	Accepted. Acronyms have been included in the figure.
38156	166	1	166	1	The figure c should be placed in left column. [Hiroaki Kondo, Japan]	Taken into account. Order of letters was revised.
57224	166	1	166	2	Only about the resolution of the Figure 1.16, not so clear the numbers and names of the regions in c) and d). [Sharl Noboa, Ecuador]	Noted.
31750	166	2	166	16	It would be useful to have some comparison with AR5 regions. [Martin Juckes, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The requested comparison has been included in the Atlas and it is referenced in the caption of this figure.
15638	166	2			Global glacier studies use the 19 first-order regions of GTN-G (2017): GTN-G (2017): GTN-G Glacier Regions. Global Terrestrial Network for Glaciers. DOI: 10.5904/gtng-glacreg-2017-07. [Michael Zemp, Switzerland]	Noted.
42882	166	15	166	15	Indonesian Throughflow [Michael Evans, United States of America]	Accepted. Revised in caption.
24464	166		166		Comment to Figure 1.16: The inner text in figure (d) can not be seen, since it is too small. Write it in the figure caption if there is no place there. [Rubén D Piacentini, Argentina]	Noted.
31678	166				Fig.1.16(a): Add a Sahel region, as this has been much studied, behaves differently to WAF, CAF & SAH (past and projected), and is an especially vulnerable region [Dave Rowell, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The definition of regions is a joint decision of multiple chapters.
31680	166				Fig.1.16(b): Add an East Africa region, which behaves very differently to SAF (past and future), and has a large and vulnerable population [Dave Rowell, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The definition of regions is a joint decision of multiple chapters.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
25594	167	1	167	1	This figure, Figure 1.21, gives tremendous perspective because it reveals the vast range of the global temperature in the models, a range of 12 to 15 C at the start of the time series and a range of 13 to 16 at the end of the time series, a spread of 3 K. This spread can be readily compared in the figure to the increase in GMST over the period of record, about 1.1 K (suggest show HadCrut in the figure also). Three times as great. What needs to be addressed is the consequence of such a range in the models.If the increase in GMST so far is exerting such a large set of changes in Earth (decreases in arctic sea ice; changes in precip amount and intensity of storms, length of growing season, distribution of vegetation.; the list goes on and on), a world at 16 C should be expected to be 3 times as different from a world at 13 C as the differences observed on Earth over the instrumental record.13 vs 16 C is more of a difference than the year without a summer!. Likewise, there are many arguments raised that climate sensitivity may itself be changing with increasing T. So is there a systematic difference in sensitivity in the models with T = 12-13 C vs 15-16C? It doesn't appear so; the anomalies all pretty much lie on top of each other. So there really needs to be a discussion of the apparent lack of differences in many climate attributes between the 12-13 C worlds and the 15-16 C worlds represented by the several models, and the extent to which such differences might be expected to affect projections of climate and climate change with such models having such different base-state temperatures. [Stephen E Schwartz, United States of America]	Hawkins & Sutton (2016) highlight there is no strong link between absolute GSAT and climate sensitivity in CMIP5, and Chapter 3 discusses model evaluation in more depth. HadCRUT4 does not include an absolute GMST value.
25596	167	1	167	1	Show the temp anomaly time series of anomalies at bottom for the full time range and on same horizontal scale as temperature itself above. Include the several historical assessments: HadCrut, GISS, etc. [Stephen E Schwartz, United States of America]	Taken into account; Figure revised.
25598	167	1	167	1	Use different color codes and line codes for the different models, and please provide time series for all models, with models identified. [Stephen E Schwartz, United States of America]	Taken into account; The figure was updated. We retain a single colour for each model as identifying which model is which is not necessary for this figure.
51792	167	1	167	8	I don't think there's any observations included -- all of them are reanalysis products [Anson Cheung, United States of America]	Taken into account; The figure was updated. Observational estimates of absolute temperature of GMST do not generally exist. Added text.
8252	167	1	167	9	suggestion is to add the CMIP5 mean in top figure. [Zong Ci Zhao, China]	Rejected; The mean is not important for this illustration.
38158	167	4	167	9	It should be explicitly noticed which baseline is selected for the bottom figures. [Hiroaki Kondo, Japan]	Noted; Figure revised.
42716	167		167		Figure 1.17 - Clarify baseline difference in bottom graphs within graphic (not just caption). Consider a title with the main idea of entire figure (i.e., like in caption, baseline period choice affects climate comparisons) [Stephanie Courtney, United States of America]	Taken into account; The figure was updated
15322	168	0	168	0	Propose including a list of the model uncertainties to complement Figure 1.18. This would provide useful context. [Lia Cairone, United States of America]	Rejected; Not clear what is meant by this comment.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
53964	168	1	168	1	I quite like this figure (maybe because I've used similar representations myself). However, it is missing an additional layer for regionalisation (i.e. RCM and SD methods), which is important to include, given that CORDEX simulatons have tended to be limited to only a selection of RCPs (typically 4.5, 8.5 and perhaps 2.6), and themselves are embedded in only a subset of the global models represented by each of the lines in the diagram. In fact, the initial condition variability may be less important to represent than the regionalisation, if one is to choose between them. IAV analysts typically apply only one GCM realisation, but more commonly employ RCM or other downscaled representations. What does chapter 12 say about this? [Timothy Carter, Finland]	Additional layers could be added to the cascade, but lack of space and complete sets of simulations with RCMs precludes including them.
53966	169	1	169	1	I'm not sure how useful this figure is here. One figure should be sufficient to illustrate the cross WG use and interpretation of scenarios, and I think Figure 1.20 (and maybe also 1.22) serves that purpose. This is better located in the Synthesis report, but I'm not even convinced of that! [Timothy Carter, Finland]	Taken into account. SOD Figure 1.28 relates to the dimensions of integration, it is now placed at the very end of Section 1.6 as a summary. SOD Figure 1.23 instead illustrates the complex scenario generation process and makes pointers to the dimension of integration only for cross-referencing and completeness. Thus, the two figures serve two different purposes. The new figure SOD 1.28 is however adapted to be visually clearer and more illustrative than quantitative.
57370	169	1	169	15	The dimension of integration lack the socio-economic assumption. This is less relevant for WG1, but highly relevant for WG2 and WG3. Figure 1.19 is therefore incomplete. In fact, the AR5 SYR approach has been overly simplistic in ist treatment of the socio-economics and more progress needs to be made to better integrate impacts, adaptation and mitigation. For example, the reasons of concern not only vary with temperature but also with SSPs. Something to be worked out better in AR6. (Same comment for 1.6) [Elmar Kriegler, Germany]	Noted. We here present the dimensions of integration as important for WGI linkages with the two other working groups. We however fully realise that the socio-economic dimension is important for the WG2 - WG3 linkages. We revised the figure to point to that fact, but keep that in the background.
47490	169	1	169	15	Very important graph, linking the 3 dimensions 'secnarios, global mean temperature levels and cumulative CO2 emissions. It is important to explain why there is a deviation from the 'straight' line of the scenarios, indicating a lower temperature level for cumulative emissions around 3000 GtCO2 (where it matters most for the international temperature targets). [Birgit van Munster, United Kingdom (of Great Britain and Northern Ireland)]	Noted. "Explanations" are given as part of the supporting text in SOD Section 1.6. But the actual assessment is covered by the subsequent chapters, in particular Ch5
57226	169	3	169	4	The Figure 1.19 The Dimension of Integration, in the part of D1, the number beside the ellipses can not read clearly. [Sharl Noboa, Ecuador]	Accepted. Figure revised and figure quality in review files improved
24466	169		169		Comment to Figure 1.19: Some numbers in the inner part of the figure can not be seen. [Rubén D Piacentini, Argentina]	Accepted. Figure revised and figure quality in review files improved
42718	169		169		I see that Figure 1.19 is referring to previous figures but they're hard to see - less saturation on the background, more on gray/black text, enough that they are readable. Inconsequential, but I'd also suggest labeling "Dimension 2" instead of "DI 2" [Stephanie Courtney, United States of America]	Accepted. Figure revised and figure quality in review files improved
53968	170	1	170	1	This figure might be interesting to assess, but it is pretty illegible in my version. This could also qualify as a figure use in all three reports and/or in the synethsis report. [Timothy Carter, Finland]	Accepted. Figure revised and figure quality in review files improved

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
57372	170	1	170	10	Figure 1.20 is missing the link between WG2 and WG3. Socio-economic assumptions affect emissions scenarios, mitigation scenarios and climate change impact scenarios, and thus need to be well coordinated to achieve some degree of meaningful synthesis. This is the basic motivation behind the SSPs. The SSPs themselves are less relevant for WG1, here the forcing levels (formerly RCPs) matter much more. See https://climatescenarios.org/primer/ for an overview. (same comment for 1.6.1) [Elmar Kriegler, Germany]	Accepted. We amended the figure with a link between WG3 and WG2, which is an important one for the xWG nature of the scenario generation process.
45152	170	1	170	10	Figure 1.20: The concept for this figure is good - but I can't review it because most of the text on the actual figure is illegible due to the low resolution. Please ensure you provide higher resolution figures for the Government Review. [David Wratt, New Zealand]	Accepted. Figure revised and figure quality in review files improved
47492	170	1	170	10	The words in the figure cannot be read, it is therefore impossible to comment on it [Birgit van Munster, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Figure revised and figure quality in review files improved
46238	170	3	170	3	This is a good way of illustrating the links. But what it does not capture is the way that scenario generation is linked to WGs II and III. The SSPs which get so much treatement in the text are not reflected here. Socio-economic development affects the vulnerability element of WG IIs risk propellor diagram. Can this be characterised as a circle rather than linear so that WGs II and III are also joined up. Scenario development does not belong solely to WG III. [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. We amended the figure with a link between WG3 and WG2, which is an important one for the xWG nature of the scenario generation process.
24468	170		181		Comment to Figures of pages 170 to 181: The figures in this pages, have letters and numbers that are not very clear (diffuse) and difficult to read. Correct these and all other figures with the same problem. [Rubén D Piacentini, Argentina]	Accepted. We have improved the quality of this and other figures in the chapter.
25600	171	1	171	1	The labels and legendsin Fig 1.21 are illegible in the draft, limiting meaningful review. [Stephen E Schwartz, United States of America]	Not Applicable. Figure has been dropped.
57368	171	1	171	14	I doubt that the relationship will hold up so neatly. The significant variation that Non-CO2 can introduce to the temperature profile of emissions scenarios with same cumulative CO2 is documented in the literature (see e.g. Rogelj et al., ERL, and Fuglestvedt et al, PTRSA). Also, you seem to rely on cumulative GHG emissions based on GWP100. SLCF forcing may peak at other times than the point of carbon neutrality, and tends to decline in the latter part of the century despite positive CH4 emissions, so Non-CO2 warming is declining while NonCO2-eq (using GWP100) continues to accumulate. This means the CO2-eq is not a good metric any more when CO2 emissions approach zero. (same comment for Section 1.6.4) [Elmar Kriegler, Germany]	Taken into account. Figure as such was dropped. We expanded that part of FOD Figure 1.21 and include it in SOD Figure 1.26 to shed light on the contribution of non-CO2 over time within the considered set of scenarios.
45154	171	1	171	14	Figure 1.21: The concept for this figure is good - but I can't review it because most of the text on the actual figure is illegible due to the low resolution. Please ensure you provide higher resolution figures for the Government Review. [David Wratt, New Zealand]	Not Applicable. Figure has been dropped.
53970	172	1	172	1	This figure would seem to pre-empt outcomes that are to be assessed in later chapters or other reports. The temperature outcomes for the SSP-RCP marker scenarios are only assumed based on simple models. Perhaps these are better expressed as radiative focing on the vertical axis in the top part of the figure. Then remove the burning embers diagram, which is based on AR5 WG II risk assessment, so potentially out of date and anyway not a part of the WG I assessment. This combined figure might actually be better in the synthesis report. Best just to show the right hand graphs here, but for emissions and radiative forcing, not assumed temperature. [Timothy Carter, Finland]	Not Applicable. Figure has been dropped.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
6902	172	1	172	1	(The same problem can be noticeable in the figure 1.28, page 179 of chapter 1.) Figures (b) and (c) show the global mean peak temperature change according to cumulative anthropogenic CO2 emissions. These figures are interesting because they illustrate that the mean temperature has already increased. Furthermore anthropogenic CO2 emissions has reached nearly 2000 GtCO2 since the industrial revolution as we can read it in figure (c). 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 GtCO2 when we already emitted 1760 GtCO2 (J. Treiner, 2015, [1]). So we will not be able to emit 6000, 7000, or 8000 GtCO2 as suggested by (b) and (c) figures. More precisely a study published in Energy and Environmental Science (I. Capellan-Perez et al., 2016, [2]) finds that the “ultimately recoverable [fossil] ressources” (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 realized by Dave Rutledge (2018, [3]) showed 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. A recent thesis (Y. Quilcaille, 2017, [4]) discussed IPCC’s AR5 SSP scenarios and proposed new carbon budgets. Even if IPCC’s missions omits forecasts of fossil energy extraction, the publication of emissions scenarios implies keeping data up-to-date. 1 : https://www.refletsdelaphysique.fr/articles/refdp/pdf/2015/01/refdp201543p46.pdf 2 : https://pubs.rsc.org/en/content/articlepdf/2016/ee/c6ee01008c 3 : http://www.its.caltech.edu/~rutledge/Rutledge2018ACS.pptx 4 : https://tel.archives-ouvertes.fr/tel-01936095 [Olivier Raguenes, France]	Noted. Figure has been dropped. Please note that chapter 1 of WG1 takes the emission and concentration scenarios somewhat as exogenous, delivered by the IAM community. Thus, the plausibility of the scenarios is more an issue for IPCC WG3 and to be raised in the upcoming reviews there. Also Chapter 5 of thee WG1 report might be a more appropriate place to contract the remaining carbon budgets that are consistent with different temperature levels against estimates of fossil fuel reserves and resources.
57382	172	1	172	6	The reasons of concern depend on socio-economic conditions. For a 2 degree warming, the risk level will be very different in an SSP3 world compared to an SSP1 world. This has been neglected so far, but would need to be brought in to achieve a meaningful synthesis. Figure 1.22 does not reflect this important fact (same comment for Section 1.6.1) [Elmar Kriegler, Germany]	Not Applicable. Figure has been dropped.
56234	172	1			I am a bit confused by this figure: Since the RCP1.9 scenarios are those consistent with a limitation of global warming to 1.5, and given that SR15 states that a stabilization at 1.5 would require net-zero CO2 emissions, I would assume that SSP1.9 should be centered at -100%. The discrepancy might be explained by considering GHG emissions rather than CO2, but in this case, please consider displaying the bottom right graph for CO2 only. The message "net-zero CO2 emissions in 2050" (or equivalently -100% reduction in CO2 emissions) is a key message of the AR6 cycle with respect to 1.5°C target. [Sonia Seneviratne, Switzerland]	Not Applicable. Figure has been dropped.
56236	172	1			Please indicate with some type of shading which part of the graphs/scenarios are compatible with the 2015 Paris agreement and which are not. [Sonia Seneviratne, Switzerland]	Not Applicable. Figure has been dropped.
46240	172	2	172	2	Would like the utility of the WG III element of this diagram to be discussed in the x-WG scenarios team. This element is extremely difficult to explain to non-scientific audiences.. [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	Not Applicable. Figure has been dropped.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
42720	172		172		Figure 1.22 - There's room in this figure to use horizontal y-axis text rather than vertical, especially since this is meant to be a summary figure. Maintaining the same x-axis in the B and C graphs is ok, but it's not very meaningful in C so could also do without to save room. [Stephanie Courtney, United States of America]	Not Applicable. Figure has been dropped.
25602	173	1	173	1	this figure is borderline eye candy. It conveys little. If the titles Sustainability etc are to mean something they must be discussed. One has no idea what is plotted in the foreground; what the crossing quantities are in the middle beneath the green region with the arrow, whatthe multiple brson the panels represent and how they relate to the titles on the panels. [Stephen E Schwartz, United States of America]	Taken into account. Figure has been revised for clarity, but proposed shading was not added. Figure has been complemented with the classical SSP-RCP matrix.
53972	173	1	173	1	Nice figure! I think it would be very important to illustrate that some high levels of forcing are not plausible for some SSPs and similarly some low levels are unattainable for others. These implausible ranges could be indicated with some kind of shading, though I appreciate that there are uncertainties attached to defining these. I have questions about the upper level of SSP3 - can it plausibly attain 8.5 Wm-2 by 2100, because many impact assessments assume this? I haven't checked C 4 yet. There were rumours that such levels could be achieved in some IAM runs, but the ScenarioMIP document doesn't acknowledge them. It is also important to emphasise that SSP5 could conceivably be associated with a 1.9 Wm-2 outcome, with the necessary severe mitigation measures applied in a timely fashion, ythough this would not be feasible for SSP3 or SSP4 (or SSP2?). Another feature could be some shading illustrating where the SSPs may attain certain forcing levels without mitigation, and those regions where mitigation is necessary. So to summarise: three coloured zones on each vertical bar, presumably with some overlap: unmitigated, mitigated, implausible. Make sure that all five SSPs are fully visible (that's an interesting challenge!) and this is a potentially very useful illustrative device indeed. [Timothy Carter, Finland]	Noted. Figure has been revised for clarity, but proposed shading was not added. Figure has been complemented with the classical SSP-RCP matrix.
56238	173	1			Would be useful to indicate in this graph which scenarios are consistent with the 2015 Paris agreement (e.g. with grey background shading going from +1°C to ca. +1.75°C and fading up to +2°C). The large number of scenarios may give the wrong expectation of several policy-consistent scenarios, but given Paris agreement only SSP1-1.9, SSP1-2.6, and SSP5-3.4 OS would seem consistent with agreed policy. [Sonia Seneviratne, Switzerland]	Noted. The introduction of the Paris agreement targets might add too much complexity in here. Also, the temperature bands are only illustrative and hence an overlay of Paris Agreement bands with those illustrative temperature bands might result in an undue assessment of how much below 2C the SSP1-2.6 pathway is. We have added an additional figure SOD 1.22 which illustrates historical global-mean surface air temperatures as warming stripes from blue (cold) to red (warm) until 2015 and climate model projections for possible futures under five scenarios from “very low” SSP1-1.9 to “very high” SSP5-8.5.
46242	173	3	173	3	Very pretty but not sure how much it adds. An RPC/SSP table might to be easiet to interpret. [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Figure revised and now combined with the SSP-RCP-Matrix.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
25604	174	0	174	0	This seems to be the most quantitative material about the SSP emissionss. Why give SO2 as an example? Show what is important, which is CO2. Althugh the SO2 is illuminating because it implies that aerosol forcing may or may not be substantially reduced (impossible to read the legends in this figure) So many more examples are required. [Stephen E Schwartz, United States of America]	Noted. The importance of CO2 in the SSP scenarios is visible from SOD Figure
25606	174	0	174	0	SO2 is not an aerosol. does this matter? Only if one is trying to convey the impression that the authors have some knowledge about what they are talking about. [Stephen E Schwartz, United States of America]	Noted. No action
25608	174	0	174	0	The SO2 panel is very important as this gas is an important aerosol precursor. The decrease in negative forcing due to this decrease in SO2 emissions could be very important. . [Stephen E Schwartz, United States of America]	Noted. We agree and the figure has been updated for clarity.
25610	175	0	175	0	I wonder whether this figure might be more effective with CO2 at the top of the stack as much of the change is due to this substance, and with the strong slopes it is hard to ascertain he changes in other substances. [Stephen E Schwartz, United States of America]	Noted. Figure has been updated to make it clearer. Yet, the CO2 part remains at the bottom -- we did not find the alterative better.
46794	176	0	176	0	Mann et al. (1999) is a very outdated pioneering reconstruction that has been superseded by numerous better ones since then during the past two decades (see already AR5). In fact, Mann et al. (2009, Science) as well as the one of Mann et al. (2008, PNAS) replaces/supersedes it (and they also extend further back in time). Indeed, Chapter 5 of IPCC AR5 (2013) already clearly states that Mann et al. (1999) is fully superseded by Mann et al. (2009) – so it should not be used in AR6. It makes simply no sense to use the second oldest of all temperature reconstructions, based on so little proxy data and also with some know methodological issues, when numerous better and newer reconstructions now are available. AR6 should show the state-of-the-art knowledge 2019 and not that of 20 years ago! Moreover, Emile-Geay et al. (2017) is not a quantitative temperature reconstruction but a database composite. Either just use Mann et al. (2009, Science) – the only global two millennia-long actual temperature reconstruction to date – or show an “ensemble” of reconstructions as in the Palaeo chapter of IPCC AR5 (2013) but with the addition of the few new Northern Hemisphere reconstructions published after AR5. All the data can of course easily be obtained from: https://www.ncdc.noaa.gov/data-access/paleoclimatology-data [Charpentier Ljungqvist Fredrik, Sweden]	Taken into account. Figure has been updated. The temperature proxies over the last 2000 years were compiled by the PAGES 2k Consortium (PAGES 2k Consortium, 2019). Consistent with Ch2, WGI AR6.
51748	176	1	176	1	Why not use Mann et al. 2008 (doi: https://doi.org/10.1073/pnas.0805721105) instead of Mann et al. 1999? [Anson Cheung, United States of America]	Rejected. Figure has been updated. The temperature proxies over the last 2000 years were compiled by the PAGES 2k Consortium (PAGES 2k Consortium, 2019). Consistent with Ch2, WGI AR6.
45514	176	5	176	5	Emile-Geay et al. (2017) is not really a quantiative reconstruction but rather a database composite which does not refelct the correct long-term variability at all. I strongly recommend to use Mann et al.)2009) here or like in the previous report an "ensemble" of reconstructions as in Chapter 5 of IPCC AR5 (2013) [Frederik Schenk, Sweden]	Taken into account. Figure has been updated. The temperature proxies over the last 2000 years were compiled by the PAGES 2k Consortium (PAGES 2k Consortium, 2019). Consistent with Ch2, WGI AR6.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
15436	176	5	176	6	A new global temperature over past two millennia by PAGES 2k consortium (2019) is suggested to replace Mann et al. (1999)'s reconstruction, since the more dataset and more methods are introduced in the Pages 2K project to estimate the uncertainty. [Feng SHI, China]	Taken into account. Figure has been updated. The temperature proxies over the last 2000 years were compiled by the PAGES 2k Consortium (PAGES 2k Consortium, 2019). Consistent with Ch2, WGI AR6.
45512	176	6	176	6	It makes no sense to use Mann et al. (1999) here. This reconstruction is very outdated and does not refeflect at all the multi-decadal variability. I urge the authors to use the newest reconstruction by e.g Mann et al. (2009) or even better, show all available reconstructions here. It makes no sense to all of a sudden use a much older reconstruction here from 20 years ago while a newer version was used in the previous IPCC [Frederik Schenk, Sweden]	Taken into account. Figure has been updated. The temperature proxies over the last 2000 years were compiled by the PAGES 2k Consortium (PAGES 2k Consortium, 2019). Consistent with Ch2, WGI AR6.
45156	177	8	177	17	Figure 1.27: I find the caption of this figure difficult to understand in the absence from this draft of the actual figure. Even when you do have a figure (Government Review draft?) I suggest you look carefully at providing clear and understandable wording for the caption. [David Wratt, New Zealand]	Not Applicable. Figure has been dropped.
38162	178	3	178	13	The figure caption for the left panel is unclear and insufficient. It should be improved. [Hiroaki Kondo, Japan]	Not Applicable. Figure has been dropped. SOD Cross-Chapter Box 7.1 covers the discussion of emulators used in the WGI AR6.
50762	178	7	178	7	I suggest to add the complete meaning of AOGCMs and ESM in the figure caption (Cross-Chapter Box 1.5, Figure 1). [Hernan Edgardo Sala, Argentina]	Not Applicable. Figure has been dropped. SOD Cross-Chapter Box 7.1 covers the discussion of emulators used in the WGI AR6.
53974	179	1	179	1	Why are the scenarios from the FAR excluded here? I daresay someone can retrieve the emissions trajectories from Scenarios A, B, C and D - see Annex to WGI FAR (1990), pp 329-341. [Timothy Carter, Finland]	Noted. The figure is still being discussed by the author team (now Box 1.3, Figure 1). It was kept for the SOD, but will be updated and FAR scenarios included if kept for the FGD.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
46244	179	3	179	3	All this tells me is that anything is possible and in that respect nothing much is changed. Do we need this deep history? [Jim Skea, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The figure is still being discussed by the author team (now Box 1.3, Figure 1). It was kept for the SOD, but will be updated if kept for the FGD. Regarding the key points contained in the figure: (i) the fact that not much has changed in the scenario space is one of the important message that this figure conveys, i.e. robustness of the future scenario uncertainty space. The benefit of this is that past 2100 WG1 climate assessments should be - roughly speaking - comparable. Two other messages that the figure attempts to bring out, i.e. (ii) the evolution of historical emissions is in the upper region of projected ranges. And (iii) the lower range of future emissions has come down substantially and negative emissions are a key element of the range of scenarios assessed.
42722	179		179		Figure 1.28 - Since the point of the figure is comparison, maintain equal y-axes, especially because it's already difficult to compare y values with vertical stacking. Right-side tick marks would also help, with or without number labels, maybe every-other bolded or some way to keep track. [Stephanie Courtney, United States of America]	Noted. The figure is still being discussed by the author team (now Box 1.3, Figure 1). It was kept for the SOD, but will be updated and the points by the reviewer will be addressed for the FGD.
46766	181	0	184	70	Some FAQ Figures have titles included in the figure itself, while some others do not. It would be interesting to do that for all, since the FAQ and the Summary are the two most read sections by laymen. [Eloy Sanz-Pérez, Spain]	Good idea.
50506	181	1	181	4	Better production values for this visualization, with some explanatory text to text the reader through the content is required. This needs to be a much more engaging product that telss a clear story, especially since it is used in the FAQs. [Anton Holland, Canada]	Figure given here was a placeholder only.
33306	181		181		FAQ 1.1 Fig 1: this is listed as "Placeholder" so presumably it will be updated to include AR5 & AR6? Hope so; it is a very good and useful figure. [Erika Wise, United States of America]	Figure will compare FAR and AR6 only.
9876	182	1			This figure essentially duplicates with the figure on page 164 (Fig. 1.14). Duplication is to be avoided. [Sebastian Luening, Portugal]	Noted; FAQ 1.2 has been substantially revised.
42724	182		182		Figure 1.14 - Essentially the same content as FAQ 1.2, Figure 1, but FAQ figure has much more accessible integrated text and caption, consider making more similar (except keep the good title of Fig. 1.14 as is). [Stephanie Courtney, United States of America]	Noted; FAQ 1.2 has been substantially revised.
8518	183	1	183	1	Where does the range for the future come from? This is different than the RCP range (~420-900 ppm) and the ScenarioMIP SSP/RCP range. [Robert Kopp, United States of America]	Accepted; Value revised accordingly.
8520	183	1	183	1	Where does the GMSL value for 2019 come from? Ch. 9 assessment is 0.15-0.22 m between 1901 and 2012. [Robert Kopp, United States of America]	Accepted; Value revised accordingly.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
15438	183	1	183	4	It is suggested to use a same number or similar range for the paleo-co2 concentration in the whole report. e.g. there is 800ppm at PETM in Figure 1, but there is 2200ppm in Annex II: Paleoclimate. I know that there is a large uncertainty, but such as different numbers would mislead the readers. [Feng SHI, China]	accepted.
33394	183	3	183	5	FAQ1.3, Figure 1: Shouldn't there be uncertainty ranges associated with the PETM and LGM temperatures? [Marcus Sarofim, United States of America]	Accepted. All values have ranges in the revised version
46110	184	4	184	4	Fig 1.4: I suggest that you don't have different icon for each type of recorder, just because it will make the map look a little cluttered (I tried to do this once). Different coloured spots may be more suitable. Different icons are great if there's a virtual map, however. [Amy Featherstone, United Kingdom (of Great Britain and Northern Ireland)]	This comment has been considered during the preparation of the FGD. (In the FGD), not applicable -- FAQ1.4 has been removed.
29648	184		184		FAQ 1,.14 Fig. 1It would be advisable to have a legend with icons that represent the different techniques used, as long as they are clearly visible. Otherwise, you could replace the icons with numbers, that are clearer in the global map [luisa Sturiale, Italy]	This comment has been considered during the preparation of the FGD. (In the FGD), not applicable -- FAQ1.4 has been removed.
8790	11324	51			The major anthropogenic driver for climate change is greenhouse gas emissions - of which 84% is CO2 (after IPCC and EPA). 95% of greenhouse gases are water vapour. Greater care should be taken when refering to greenhouse gases and greenhouse gas emissions. [Dennis Paterson, United Kingdom (of Great Britain and Northern Ireland)]	We have clarified this throughout the text, thanks.
8802	14611	24		29	There is a linkage drawn between atmospheric concentrations of CO2, CH4 and N2O and temperature but the rate of temperature changes is similar between 1910 - 1940 and 1975-2000 but CO2 concentrations are far apart. Likewise, CO2 concentrations increase from 1940-present but average global temperatures fell over the 25-year period 1950-1975. This is still the case; CO2 concentrations are rising but average global temperature rises have paused or fallen. A direct link between atmospheric CO2 concentrations giving rise to temperature is incorrect. [Dennis Paterson, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. Comment claim is inconsistent with the scientific information available. Refer to Chapter 3 in this report and to the series of past IPCC reports for comprehensive assessments of these issues.
8800	14611	27			CO2 and CH4 may be at high levels given the past 800,000 years, but generally they are at the lowesst levels seen since the Permian. [Dennis Paterson, United Kingdom (of Great Britain and Northern Ireland)]	Noted. This is correct, but not relevant for the discussion here.
8804	14611	42		53	Data from Vostok ice cores shows that temperature falls and CO2 follows - with an approximate 800-year delay. NEVER has CO2 fallen before temperature and the argument that billions of dollars should be spent to reduce atmospheric CO2 because it will lead to an immediate, measurable reduction in temperature is not shown. We know that CO2 concentrations rose during the period 1950-1975 - but temperatures fell. Falling temperatures therefore do not rely on diminished concentrations of CO2 alone. [Dennis Paterson, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. Comment claim is inconsistent with the scientific information available. Refer to Chapter 5 in this report and to the series of past IPCC reports for comprehensive assessments of the global carbon cycle, its perturbation and related issues.
8806	14611	48			here and throughout the report, there are references to "increase ocean acidification". Oceans are not acid but alkaline and this term is both pejorative and misleading. It is perfectly fair to say that oceans are becoming less alkaline - but they are not acid. [Dennis Paterson, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. No claim is made that oceans are acidic. Ocean acidification refers to the process of decreasing pH from uptake of CO2. Acidification thus means "increasingly acidic," which is synonymous with "decreasingly alkaline" and responds to the cause of acidification, i.e. the reaction of seawater with CO2 to produce carbonic acid. It does not mean that the oceans are acidic.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
6513	1-42	8		10	Line need to be rephrased and in the term "if temperature is high" , high has not ben defined quantitatively. [Ram Kumar Dhurmea, Mauritius]	Taken into account. Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.
6515	1-42	12		12	"avoidable imapcts" instead of "avoided impacts" [Ram Kumar Dhurmea, Mauritius]	Noted. This comment refers to page 42 line 12 and the sentence have been rewritten.
8808	15342	12		14	The average temperature range in which thriving coral reefs and communities are found varies by significantly more than 2 degrees. The statement that coral reefs will decline by more than 99% following a 2 degree increase is not credible. [Dennis Paterson, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. Claim not substantiated. The text sticks to the SR1.5 findings.
6517	1-42	37		38	I suggest: " ……CO2 emissions must be reduced by 25%....". It is not the limiting of 2 degrees that going to lead to a decline in CO2 but rather a reduction of CO2 will limit the rise of 2 degrees. [Ram Kumar Dhurmea, Mauritius]	Taken into account. Several similar comments indicate problems with the risk framing section. Section has been heavily revised and moved to Cross-Chapter box 1.3.
6519	1-42	40		41	"……..following a peak". Reader is lost in looking for a quantitative value associated with that peak and when this peak is expected to occur. [Ram Kumar Dhurmea, Mauritius]	No specific peak or timing is intended in this sentence. In the FGD, we will restate this as "following a peak at some higher temperature."
8810	15707	4			define realistic [Dennis Paterson, United Kingdom (of Great Britain and Northern Ireland)]	A definition of 'realistic' was included.
8812	16072	14		18	Models undertaken over areas which contain the greatest concentration of data and time records, (graph pg 1-184) generate temperatures at or below the best estimate range. It is not good enough to look back and conclude the errors arose from over-estiamtes of atmospheric CO2. Immese economic disruption is proposed based on model outcomes that cannot forecast an outcome that falls within a high confidence band. This outcome is not given adequate visibility in light of the economic displacement being encouraged. What if this patterns is repeated in subsequent models simply because the matter isn't settled and the solution is more multi-dimensional than atmospheric CO2 concentrations? The socio-economic consequences are enormous. [Dennis Paterson, United Kingdom (of Great Britain and Northern Ireland)]	Noted. This is a larger issue than can be tackled in this particular context, but we do now include a broader discussion of mode fit-for-purpose in section 1.5.4.
6521	1-67				The climate and impact of climate change on island states are different on island states, particularly those located in the tropics. Considering such island states as a region would give another dimension to the analysis. [Ram Kumar Dhurmea, Mauritius]	Noted. Small island states are classified as "WGII-Type Regions and are covered in the report where appropriate (e.g. Chap.12).
8814	26665	42		43	or it could be a consequence of other factors unrelated to climate change. Is this statement balanced? [Dennis Paterson, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Can't understand what "it" refers to in lines 42-43, so cannot respond to this comment.
8772	43556	15		19	At this point, greenhouse gases, by far the greatest of which is water vapour, is not mentioned or distinguished from "other" - presumably greenhouse gas emissions. One presumes that the reference is to all greenhouse gases rather than selective greenhouse gases. Or does this statement apply exclusively to an increase in CO2 - in which case that point should be made clear. [Dennis Paterson, United Kingdom (of Great Britain and Northern Ireland)]	This level of detail is unnecessary in the summary statements. Most GHGs including water vapor are rising. An exception is some CFCs and HFCs, which are falling.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
8774	43556	27		32	How is one to distinguish what variation in climate is natural and what is anthropogenic? This statement suggests man is responsible for 100% of such changes. It is emotional and potentially misleading. [Dennis Paterson, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. We disagree. The statement does not claim 100 percent anthropogenic change, and does not contain "emotional" language.
8776	43556	27		32	Climate change pprojections made since the 1980s are not always in good agreement with observed temperatures. Models regularly and consistently overestimate changes. This is also not supported by Fig 1.5 on page 1-155 or Fig. 1.6 on 1-156. The former shows considerable variability and ranges between models and observation and the latter shows observed temperatures on the low side of estimates and sometimes below the zone of highest confidence. Refer to JR Christie, University of Alabama in Huntsville, Model output: KNMI Climate Explorer, Global Bulk Atmospheric Temperature (Surface - 50k ft) which shows average of 102 IPCC CMIP-5 Climate Model runs versus baloon and satellite data sets. This analysis shows a poor and decreasing agreement over time. [Dennis Paterson, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Assessment in Ch1 and subsequent Chapters supports this "generally in good agreement with the amplitude and pattern of subsequent observed temperature change" statement. Nevertheless, the statement has been revised somewhat as part of the SOD preparations.
8778	43556	34		43	Attributing the loss of archives to anthopogenic climate change is specious. The loss of tropical ice for cores may be reality and related to climate change but at this stage it is not possible to state unequivically that it is due to anthopogenic climate change. The point can be made without politicisation. [Dennis Paterson, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. We assess from the available literature that anthropogenic climate change is one cause of this loss. Bullet revised to read: "Overall, capabilities to observe the physical climate system have continued to improve and expand, but losses in existing observational capacity are also occurring. Progress in climate science relies on the quality and quantity of observations from a range of platforms, including surface-based instruments, aircraft observations, satellite-based retrievals, in situ measurements and paleoclimatic records. Emerging risks of loss of coverage or continuity include reductions in certain satellite coverage, surface station networks, and radiosonde launches. In addition, 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 (high confidence). Substantial quantities of known instrumental observations of weather and other climate variables, which could fill gaps in existing datasets, remain undigitized. {1.5.1} "
8780	43556	45		49	Data has been interpolated and extrapolated within limits provided by models. Such a system does not enhance the value of the data but rather risks its politicisation. [Dennis Paterson, United Kingdom (of Great Britain and Northern Ireland)]	A model used to produce reanalyses will provide physically consistent information between observations. It is not merely extrapolated.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
8782	43586	16		20	This paragraph suggests that all changes to climate bewtween 1850-present are anthropogenic and none are natural variations [Dennis Paterson, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. Not sure which part of the Chapter this comment refers to. The text on page 6 simply lists the mandate of the IPCC
8784	43617	4		14	This statement implies that you can both understand and distinguish "human-induced" climate change from natural variability. No supporting argument or references to validate this statement is provided. Computing capabilities and understanding of various processes may have improved but that does not support scientific process or the claims being made. Robustness of understanding is not proof and to claim that we understand the consequences of a process we dont fully understand is disingenuous. [Dennis Paterson, United Kingdom (of Great Britain and Northern Ireland)]	There have been 5 IPCC ARs assessing exactly this. This para is putting the current report in context. It does not make any claims about human vs. Natural changes.
8786	43617	16		17	without a counterbalance to show any potential beneficial impacts arising from climate change - without attributing whether natural or induced? [Dennis Paterson, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. Unclear what is being asked for in terms of revision. It is evident that the IPCC makes a distinction between natural and induced climate change.
8788	43647	17		24	Not supported by mny, including Berger 2017, "Slowdown of Global Surface Air Temperature Increase and Acceleration of Ice Melting: Global Warming slowdown and Ice Melting," AGU Publications. Figure 1-6 shows temperature rising slower than mean IPCC best estimates since pre-industrail times in every case. [Dennis Paterson, United Kingdom (of Great Britain and Northern Ireland)]	Thanks for the comment. However, this view is not borne out by the present assessment. The rates of warming and melting are assessed elsewhere in the report, and support the claims we make here. (References expanded.)
8794	43709	10		15	Fig 1.2 also shows that temperatures have been higher than recorded today 3 times in the past 400,000 years - current changes fall within established precedents and auto-corrected without the expenditure of billions of dollars and massive economic disruption. [Dennis Paterson, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. Comment ignores science evidence regarding current rates of changes and future projections.
8796	43709	17		24	The importance of natural variations in greenhouse gases. Careful analysis of the temperature/CO2 graph relationship established by the Vostok ice cores clearly illustrate that temperature controls CO2 and not the other way round as you are erroneously implying in this statement. These statements are deliberately misleading. Petit et al 1999, 2001 [Dennis Paterson, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. The reviewer is incorrect. For the paleoclimate record: CO2 and temperature change synchronous (Shakun et al, 2012). For the Present and the Future: CO2 is driver as demonstrated already in previous IPCC reports.
8798	43709	40		43	The case for a 6th mass extinction has not been made and representing that it will happen is scare-mongering. The International Union for Conservation of Nature and Natural Resources Red List shows that only 5 species underwent extinction in the decade 2000-2010 and the number of confirmed extinctions has been falling for a century. To suggest that we face an extiction equivalent to those mass extinctions in the geological record is specious and scare mongering. Geological records are clear that carbonate skeletal fauna evolved and thrived when oceans were significantly less alkaline than today and atmospheric CO2 rates were approximately 20 times higher than present day. Egregrious exaggeration does not belong in an objective study. This is political and not scientific reporting. [Dennis Paterson, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. The statement here is supported by the relevant references to the scientific literature. Detailed assessment is carried out in following chapters, WGII and WGIII as well as IPBES.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
27294	1-20	1	1-20	18	This paragraph confuses values with public opinion regarding climate science. The literature discussed, especially McCright and Dunlap 2011, focuses on the drivers of public opinion and acceptance of climate science, not individual values. Additionally, it obscures and misinterprets the drivers of public opinion on climate change. What has been established very clearly in this literature is that partisan political identity (not values) is the major driving factor of public opinion on climate change in the U.S. I would suggest that this paragraph be rewritten to properly differentiate between values and public opinion, and to properly reflect the role of partisan political identity as the major driver of different beliefs about climate change & the acceptance of climate science. Additionally, these references are dated. See Dunlap, R. E., & McCright, A. M. (2015). Challenging climate change. Climate change and society: Sociological perspectives, 300. Shwom, R. L., McCright, A. M., Brechin, S. R., Dunlap, R. E., Marquart-Pyatt, S. T., & Hamilton, L. C. (2015). Public opinion on climate change. Climate change and society: Sociological perspectives, 269. [Robert Brulle, United States of America]	This section has been heavily revised with the inclusion of numerous contributing authors in a cross-chapter group. The nature of the values discussed in this section has been clarified; it refers to the values of societies and social groups, not of individuals. We did not succeed in addressing the issue of partisan political identity as a driver during this round of revision, but will consider whether it can be addressed in the next draft. Such a discussion will probably be seen as out of scope for WG1. (In FGD) Taken into account. The nature of the values discussed in this section has been clarified; it refers to the values of societies and social groups, not of individuals. We have updated references and included the following paragraph on political identities: "Political cultures also give rise to variation in how climate science knowledge is interpreted, used, and challenged (Leiserowitz, 2006; Oreskes and Conway, 2010; Brulle et al., 2012; Dunlap and Jacques, 2013; Mahony, 2014, 2015; Brulle, 2019). McCright et al. (2016), in a meta-
6507	1-20	20			efforts "and" strengthening -replace and with either "for" or "to" [Ram Kumar Dhurmea, Mauritius]	Not applicable. The sentence has been rewritten.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
27296	1-20	43	1-20	48	This discussion reduces a complex argument about the factors driving public concern regarding climate change to a one dimensional analysis of media coverage. Indeed, as my publication, which you cite (Brulle 2012) shows that it is elite cues by political actors, operating through media, that drives climate perception and literacy. This has been amplified in a series of further papers (Carmichael and Brulle 2016, Carmichael et al. 2017). Additionally, the specific media used also influences beliefs and perceptions (Carmichael and Brulle 2018). The key point is that media serves as an intermediary function, and that it is the actions of political elites that shape media coverange, which in turn, impact public opinion. This section should be revised to more accurately reflect the relevant scientific literature on this topic. Additionally, this section entirely ignores the massive amount of literature that describes the role of a deliberate, organized misinformation effort by corporations and trade associations to distort public understanding of climate change, thus impacting climate perception and literacy. See Dunlap and McCright 2015 and Farrell et al. 2019 for excellent summaries of this scientific literature. This literature has established this causal chain at the level of virtually certain. Yet there is no mention of this factor. There is a clear prescedent for major scientific reports to address this factor. For example, in the 2011 National Academy of Sciences Report, America's Climate Choices (Chapter three, page 35), the following statement is made: Most people rely on secondary sources for information, especially the mass media; and some of these sources are affected by concerted campaigns against policies to limit CO2 emissions, which promote beliefs about climate change that are not well supported by scientific evidence. U.S. media coverage sometimes presents aspects of climate change that are uncontroversial among the research community as being matters of serious scientific debate.16 Such factors likely play a role in the increasing polarization of public beliefs about climate change, along lines of political ideology, that has been observed in	Thank you for this valuable comment. This section has been heavily revised for SOD, but "dramatic" enlargement is impossible given our page limits. Given the very limited space available, and the comments of other reviewers who worry that this subsection already strays too close to a political analysis, we have not been able to do more than introduce some additional references. We will reconsider this comment at the next Lead Author Meeting.
6509	1-22	20		21	I suggest that the word "potential" be associated only with the positive effect as it is certain that in most cases the eefct is adverse. Thus the expression" potential adverse effect" tend to negate the indeed adverse effect of climate change. Even UNFCCC is not refering to any sort of potential positive impact. [Ram Kumar Dhurmea, Mauritius]	This word does not appear at the indicated location.
6511	1-22	32		33	How risk can be associated to mitigation and adpatation has to be highlighted as "in certain circumstances" [Ram Kumar Dhurmea, Mauritius]	Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.
6499	1-8	12		13	Incomplete sentence/ missing word [Ram Kumar Dhurmea, Mauritius]	Text revised.
6501	1-9	27		28	to rephrase …the word "outside" may be substituted by the word "exceed" [Ram Kumar Dhurmea, Mauritius]	Taken into account. Missing word "moved" added
6503	1-9	41		41	The word "sixth" lead to confusion…is it possible to consider another word or do we actually need this word here. [Ram Kumar Dhurmea, Mauritius]	Noted. This is a standing expression; a reference is given. No action.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
6505	1-12				In several places the terminology "long term" has been used such as long term goal and long term plan. Is it possible to assign a limit to that staement, like may be "in the forthcoming 30-50 years it is expected that …." [Ram Kumar Dhurmea, Mauritius]	Noted. We refrain from specifying long-term here in the global stocktake context given that it not defined as year range in the Paris Agreement, yet the use of "long-term" is important to distinguish those "long-term" goals from the near term NDCs that are set for 2025 and 2030.
8816	1-101	38		42	"These experiments show that without our influence, the observed post-1960 warming would not have occurred." How is it possible to make this statement when "there is no way to do a controlled laboratory experiment on the actual earth"? Models and simulations have shown this; not expiramentation. [Dennis Paterson, United Kingdom (of Great Britain and Northern Ireland)]	Now reads: "Since there is no way to do a controlled laboratory experiment on the actual Earth, climate model simulations can also provide a kind of “alternative Earth” to test what would have happened without human influences. Such experiments show that without our influence, the observed warming would not have occurred."
8818	1-103	6		9	Pejoritive wording. Regions may see changes in climate - not all of which are necissarily unprecedented or or worse. Climate change in some areas will mark an improvement. Change is not always negative and can be an improvement - just as one might argue that the change from the little ice age to warmer pre-industrial times represented an improvement for many. [Dennis Paterson, United Kingdom (of Great Britain and Northern Ireland)]	Noted; FAQ 1.2 has been substantially revised.
8792	1-176	3		9	the hockey stick chart that eliminates the medieval warming period and/or mini ice ages includng the 17th -century, Maunder minimum. These charts have been discredited and actual data records should be shown to avoid contraversy. You should return to the climate change graph used in 1990 IPCC report where these various warming and cooling periods were illustrated. Bernier 2001, Royer et al 2004 [Dennis Paterson, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Figure has been updated. The temperature proxies over the last 2000 years were compiled by the PAGES 2k Consortium (PAGES 2k Consortium, 2019). Consistent with Ch2, WGI AR6.
6379	entire				There is a need to specify what are the angles/new directions/overlapping points with SROCC, primarily on the physics and chemistry of oceans, and processes in the cryosphere. These should be highlighted all along the SR6 [Baruch Rinkevich, Israel]	Noted. This chapter refers to SROCC and other SRs in relevant parts. The relevant changes are assessed in other chapters of AR6, especially in Chapter 9 which deals with this issue carefully.
41236			31		I did not review this chapter in detail but I would like to comment on the Executive summary. The summary is very clear in what it covers but it seems important to use this space to emphasize what is now understood scientifically and by people on the ground. Not only line 31 are “projections made since the 1980s are generally in good agreement with the amplitude and pattern of observed temperature change” but in many cases the impact of these changes are being realized on the ground modifying rainfall intensity, sea level rise, flood impacts etc. A phrase such as this could usefully added after line 32! [Leonard Berry, United States of America]	Rejected. Impacts of these changes are dealt with in other chapters and WG reports.
41240					P 12-14 line 24 Include precipitation intensity [Leonard Berry, United States of America]	(this comment is about Chapter 12). TAKEN INTO ACCOUNT: Intense rainfall events are included under 'pluvial flooding'
41242					P 12-22 3.3.2 Include impacts of flooding in urban areas and on businesses. [Leonard Berry, United States of America]	(this comment is about Chapter 12). REJECTED: This falls outside the scope of WG I and is more of a WG II topic

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41244					P 12-27 after 3.7.3 Insert section on combination of hazards [Leonard Berry, United States of America]	(this comment is about Chapter 12). TAKEN INTO ACCOUNT: Section 12.3.7.4 now addresses compound hazards
41246					P 12-33 line 28 Insert importance of high night time temperatures on plant productivity. [Leonard Berry, United States of America]	(this comment is about Chapter 12). TAKEN INTO ACCOUNT: We have added stronger guidance to the figure caption to underscore that this is a conceptual figure that does not specify actual temperature levels, which makes it not directly comparable across sectors, and also that the intent is to identify graduating thresholds and as temperatures become more extreme in the hot and cold direction. - move thermometer to the left - place group labels in a more readable location/orientation
41248					P 12-33 line 44 Evidence of northward impact of tropical storms? [Leonard Berry, United States of America]	(this comment is about Chapter 12). REJECTED: No literature
41250					P 12-35 12.4.2 divide Asia into sub regions redraft whole section. [Leonard Berry, United States of America]	(this comment is about Chapter 12). ACCEPTED: We now discuss Asia as a collection of sub regions and entire section has been redrafted. Splitting into further sub-sections would require similar splits in other regions, but the diversity of Asian regions receives increased focus in the SOD.
41252					P 12-58 12.4.5 paragraph to subdivide Europe [Leonard Berry, United States of America]	(this comment is about Chapter 12). ACCEPTED: The regional sub division within Europe has now been explained
43300					Most of the figures are highly obscured and poorly respresented. Check: Fig. 4.1; Fig 1.1; Figure 1.28-1.29; FAQ 1.1, Figure 1 [Onema Adojoh, United States of America]	The figures have been improved.
41254					P 12-71 12.4.6.1 Need here or somewhere else a section on hurricanes and their future changes maybe as a case study. [Leonard Berry, United States of America]	(this comment is about Chapter 12). TAKEN INTO ACCOUNT: We have assessed hurricane related literature per region within 12.4.X. We are limited in the number of case studies we can include due to space limitations
41256					P 12-79 12.4.5 Need a case study of impact on small islands. [Leonard Berry, United States of America]	(this comment is about Chapter 12). REJECTED: Ch 12 mandate is to assess hazards only. Impacts fall within the purview of WG II
41258					P 12-100 Box importance of climate services to the private sector. Contribution of the private sector to climate services. [Leonard Berry, United States of America]	(this comment is about Chapter 12). TAKEN INTO ACCOUNT: The private sector is mentioned both in Section 12.6 and in the box

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45876					In light of limited use across WGI report the risk concept may be too prominent in this chapter and at the beginning of the report, as a CCB. The discussion should be moved to where relevant and focus on hazards. [Katja Mintenbeck, Germany]	Taken into account. The discussion on risk has been substantially changed, although not removed. It is used now extensively in the later chapters of the report.
45878					The report should clearly cross-reference to information used from other Working Groups and refrain from using information that has not been assessed as this may create problems with coherency across reports. Suitable references would therefore be AR5 WG reports as well as SR1.5. Items which are core to other WGs should not be discussed extensively in the WGI report. [Katja Mintenbeck, Germany]	Noted. We include terms relevant for this report primarily, although some general context must also be given. Some topics, such as scenarios, have been coordinated with other WGs.
7992					Well done. Versus the FOD, this is now a much smoother read. I'm sure the chapter will be well received. [Olaf Morgenstern, New Zealand]	Noted. Thanks very much!
45882					This chapter provides a nice entry into the WGI AR6 by giving a comprehensive overview of concepts and methodologies. This said the chapter is quite long and goes beyond the scope of a framing chapter by its strong focus on historical developments. [Katja Mintenbeck, Germany]	The history part has been shortened.
11630					As Mike Hulme of the University of East Anglia writes of two views of the climate issue: 1) “The overwhelming scientific evidence tells us that human greenhouse gas emissions are resulting in climate changes that cannot be explained by natural causes. Climate change is real, we are causing it, and it is happening right now.” Or 2) “The overwhelming scientific evidence tells us that human greenhouse gas emissions, land use changes and aerosol pollution are all contributing to regional and global climate changes, which exacerbate the changes and variability in climates brought about by natural causes. Because humans are contributing to climate change, it is happening now and in the future for a much more complex set of reasons than in previous human history.” As Mike Hulme writes ”….these two different provocations – two different framings of climate change – open up the possibility of very different forms of public and policy engagement with the issue. They shape the response.” http://theconversation.edu.au/youve-been-framed-six-new-ways-tounderstand-climate-change-2119 The IPCC report focuses on the first view, but does not present evidence and reasoning as to why the second view is essentially ignored. [Roger Pielke Sr, United States of America]	Noted. The comment seems to be related to "IPCC report" in general terms. It is not clear what in this Chapter is targeted by the comment.

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11632					Past IPCC WG1 reports did not highlight the hypothesis testing aspect of science e.g. see https://www.sciencebuddies.org/science-fair-projects/science-fair/steps-of-the-scientific-method]. Ask a Question Do Background Research Construct a Hypothesis Test Your Hypothesis by Doing an Experiment Analyze Your Data and Draw a Conclusion Communicate Your Results As the IAC Review of the IPCC report in the section IPCC's Evaluation of Evidence and Treatment of Uncertainty [http://reviewipcc.interacademycouncil.net/report/Chapter%203%20-%20IPCC%E2%80%99s%20Evaluation%20of%20Evidence%20and%20Treatment%20of%20Uncertainty.pdf] wrote with respect to AR4 The IPCC uncertainty guidance provides a good starting point for characterizing uncertainty in the assessment reports. However, the guidance was not consistently followed in the fourth assessment, leading to unnecessary errors. For example, authors reported high confidence in statements for which there is little evidence, such as the widely-quoted statement that agricultural yields in Africa might decline by up to 50 percent by 2020. Moreover, the guidance was often applied to statements that are so vague they cannot be falsified. In these cases the impression was often left, quite incorrectly, that a substantive finding was being presented." I do not see this shortcoming being adequately remedied in AR5, but encourage it be done in AR6. [Roger Pielke Sr, United States of America]	Not applicable. This comment talks about the past IPCC reports. It is not clear what revision in this Chapter is requested.
11634					There are three hypotheses that can be focused on with respect to the human role in the climate system. These are Hypothesis 1: Human influence on climate variability and change is of minimal importance, and natural causes dominate climate variations and changes on all time scales. In coming decades, the human influence will continue to be minimal. Hypothesis 2: Although the natural causes of climate variations and changes are undoubtedly important, the human influences are significant and involve a diverse range of first- order climate forcings, including, but not limited to, the human input of carbon dioxide (CO2). Most, if not all, of these human influences on regional and global climate will continue to be of concern during the coming decades. Hypothesis 3: Although the natural causes of climate variations and changes are undoubtedly important, the human influences are significant and are dominated by the emissions into the atmosphere of greenhouse gases, the most important of which is CO2. The adverse impact of these gases on regional and global climate constitutes the primary climate issue for the coming decades. These hypotheses are mutually exclusive. Thus, the accumulated evidence can only provide support for one of these hypotheses. The question is which one? Hypotheses 2 and 3 are two different oppositional views to hypothesis 1. Hypotheses 2a and 2b both agree that human impacts on climate variations and changes are significant. They differ, however, with respect to which human climate forcings are important. The hypotheses can be tested with respect to climate effects on important social and environmental resources such as drought, tropical cyclone intensity and so forth. [Roger Pielke Sr, United States of America]	Noted. What was suggested does not match the mandate of this chapter.

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11636					Model skill can also be tested using the hypothesis approach. Specially, The Framing Hypothesis Knowledge of CO2 emissions into the atmosphere and resultant global averaged surface temperature anomaly are sufficient as the primary metrics to generate accurate and meaningful regional projections of changes in regional climate statistics. This hypothesis claims that the accuracy of climate forecasts of changes in regional climate statistics emerges at time periods beyond a decade, when greenhouse gas emissions dominate over other human forcings, natural variability, and influences of initial value conditions. The hypothesis assumes that changes in climate are dominated by atmospheric emissions of greenhouse gases, of which CO2 is the most important. If this hypothesis is rejected, then multidecadal model forecasts incorporating detailed initial value conditions seeking to predict changes in regional climate statistics set an upper bound on the accuracy of climate projections based primarily on greenhouse gas emissions. According to this latter view, successful models must account for all important human forcings—including land surface change and management—and accurately treat natural climate variations on multidecadal time scales. If the Framing Hypothesis is rejected, these requirements significantly complicate the task of prediction. Testing the hypotheses must be accomplished by using “hindcast” simulations that attempt to reproduce past climate behavior over multidecadal time scales. The simulations should be assessed by their ability to predict not just globally averaged metrics but changes in atmospheric and ocean circulation patterns and other regional phenomena (i.e., changes in regional climate statistics). [Roger Pielke Sr, United States of America]	Noted. It is unclear what revision is suggested by the reviewer.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
11638					I have two overarching comments on the WG1 draft report. First, the terminology “physical climate system” is actually inaccurate as biogeochemical components of the climate system are included. One can discuss the physical comments of the climate system, but it is not correct to imply there is also a “biological climate system”. Indeed, “climate system” is defined by the American Meteorological Society as “the system, consisting of the atmosphere, hydrosphere, lithosphere, and biosphere, determining the earth's climate as the result of mutual interactions and responses to external influences (forcing)” [http://glossary.ametsoc.org/wiki/Climate_system]. Thus the WG1 report is actually a report on the entire climate system. The header of 1.2.1 in Chapter 1, as one example, is not appropriate. My recommendation is that the terminology “physical climate system” be changed to “climate system” everywhere in the report. This inclusive view was also adopted in these assessment reports National Research Council, 2005: Radiative forcing of climate change: Expanding the concept and addressing uncertainties. Committee on Radiative Forcing Effects on Climate Change, Climate Research Committee, Board on Atmospheric Sciences and Climate, Division on Earth and Life Studies, The National Academies Press, Washington, D.C., 208 pp. http://www.nap.edu/openbook/0309095069/html/ Kabat, P., Claussen, M., Dirmeyer, P.A., J.H.C. Gash, L. Bravo de Guenni, M. Meybeck, R.A. Pielke Sr., C.J. Vorosmarty, R.W.A. Hutjes, and S. Lutkemeier, Editors, 2004: Vegetation, water, humans and the climate: A new perspective on an interactive system. Springer, Berlin, Global Change - The IGBP Series, 566 pp. http://www.springer.com/us/book/9783642623738 but was not recognized even in the subsequent IPCC reports. [Roger Pielke Sr, United States of America]	Ch1 now includes the biosphere in the definition of the climate system, following these precedents, and in some places uses the phrase "climate system" in place of "physical climate system."

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11640					Secondly, in terms of the framing of the report, the inclusive approach would be to start with what is the spectrum of risks to society and the environment, and where does the human role in the climate system fit in. As we discussed in Pielke Sr., R.A., R. Wilby, D. Niyogi, F. Hossain, K. Dairaku, J. Adegoke, G. Kallos, T. Seastedt, and K. Suding, 2012: Dealing with complexity and extreme events using a bottom-up, resource-based vulnerability perspective. Extreme Events and Natural Hazards: The Complexity Perspective Geophysical Monograph Series 196 © 2012. American Geophysical Union. All Rights Reserved. 10.1029/2011GM001086. http://pielkeclimatesci.files.wordpress.com/2012/10/r-3651.pdf and in the Preface to Pielke Sr, R.A., Editor in Chief., 2013: Climate Vulnerability, Understanding and Addressing Threats to Essential Resources, 1st Edition. J. Adegoke, F. Hossain, G. Kallos, D. Niyogi, T. Seastedt, K. Suding, C. Wright, Eds., Academic Press, 1570 pp. http://pielkeclimatesci.files.wordpress.com/2013/05/b-18preface.pdf there are two approaches – outcome vulnerability and contextual vulnerability. The former starts with a WG1 approach but, as a result, eliminates (at least certainly makes more difficult) a balanced assessment of risk. With contextual vulnerability, as we write in Pielke Sr et al 2012 “We discuss the adoption of a bottom-up, resource-based vulnerability approach in evaluating the effect of climate and other environmental and societal threats to societally critical resources. This vulnerability concept requires the determination of the major threats to local and regional water, food, energy, human health, and ecosystem function resources from extreme events including those from climate but also from other social and environmental issues. After these threats are identified for each resource, then the relative risks can be compared with other risks in order to adopt optimal preferred mitigation/adaptation strategies. This is a more inclusive way of assessing risks, including from climate variability and climate change, than using the outcome vulnerability approach adopted by the Intergovernmental Panel on Climate Change	Rejected. What is proposed is handled in WGII, which has a dedicated chapter on key risks (WG IIChapter 16). here we only introduce the concept of risk, which is in AR 6a consistent framework across the three WGs for the first time

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9082					Comments of Sidney Oldberg, accredited IPCC Expert Reviewer, follow on the First Order Draft, report of IPCC Working Group 1, UNIPCC AR6. Section 1.2.1.1 states that "The physical climate system comprises all components and processes that combine to form weather and climate." In the language of systems theory, the entity that is referenced by the term "system" is composed of a set of 'parts." In the document at http://scienceandpublicpolicy.org/wp-content/uploads/2013/05/spinning_the_climate.pdf the former IPCC Expert Reviewer Vincent Gray, PhD reports on his experiences as an IPCC Expert Reviewer. Dr. Gray has passed away. While he was alive, I communicated by email with Gray and in this way gained a detailed understanding of what Gray meant by his report. My understanding is reported by me in the document at https://wmbriggs.com/post/7923/. This document has the standing of a peer-reviewed article. The editor and referee for this article was Dr. Willam Briggs, a PhD in mathematical statistics, professor of mathematical statistics at Cornell University and meteorologist who has served on committees of the American Meteorological Society on statistical issues and published in the peer-reviewed literature of global warming climatology. Dr. Briggs has granted me permission to reveal his identity as the referee for my article. This article is published in Dr. Briggs's blog. Before communicating with Dr. Gray I had spent the major portion of my career as a systems theorist and builder of models of complex physical systems. This background allowed me to translate Dr. Gray's remarks into the language of systems theory and to check with Gray on whether I had translated his	Not applicable. This comment seems to question the mentioning of the climate system in 1.2.1.1. The reviewer expresses his personal views and those from others, without support by peer-reviewed publications in scientific journals. It is not clear what modification the reviewer requests in this chapter.
56702					Figure 1.1: Left - the design of the schematic should be modernized. Writing "decreasing" in blue is counter-intuitive in the context of loss of glacier mass. The order (a, b, c) does not read well for a first-time reader ("atmospheric CO2" is being read first, yet it is second in the right plot (b). Right - At a first glance, it is unclear what the five different sections within the precipitation wedge are representing.Why not representing the glacier mass loss in whit-blue scale too? Right plot should match better with left schematic. For more guidance, contact the TSU graphics officer. [WGI TSU, France]	Thanks. The figure has been extensively revised.
56704					Figure 1.2: The change of time scale is not intuitive at a first glance. Two options: A) clearer separation bewteen the change of scale on the x axisor B) move the Y axis at the bottom of the figure, on top (right below the annotations "paleoclimatic…". same goes for "sea level change" y axis. For more guidance, contact the TSU graphics officer. [WGI TSU, France]	Accepted. Figure was revised accordingly to increase clarity. The different timescales are in separate panels now.
56706					Cross-Chapter Box 1.2, Figure 1: Why not adding the two other key-words "Risk implementation" and "impacts" into the schematic too? And also indicate where WGI stands (mainly assessing the hazard part of the risk framework)? For more guidance, contact the TSU graphics officer. [WGI TSU, France]	Graphic and labels have been revised by the cross-WG group working on this box. Revision is ongoing.
56708					Figure 1.5: It is unclear what 1, 2a, A, B, C (hansen et al) and A2 (IPCC TAR) stands for. Either explain it in the caption or remove it from the figure if it is unnecessary information. [WGI TSU, France]	Figure revised.

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56710					Figure 1.7: At a first glance, it is unclear which bar(s) "ground-base instrumental coverage" represents. Maybe a label in the schematic would help?. When looking at the schematic only, if gradient towards white indicates density of coverage or vanishing archive. It would be great to have that information in the figure directly. For more guidance, contact the TSU graphics officer. [WGI TSU, France]	Noted. The figure has been significantly revised.
56712					Figure 1.8: It would facilitate understanding if the following title (or similar) would be added: for a/b "future projection scenario experiments" (written in blue) , for c/d "biogeochemical feedback assessment" (written in green). does the gradient within each plot indicate something? The reader will probably expect some type of information from the gradient. [WGI TSU, France]	Accepted. The colour gradient is simply the oceanic resolution. It is removed in the revised version which is a 2D figure rather than 3D.
56714					Figure 1.9: red and purple are not distinguishable in colorblind vision. [WGI TSU, France]	Noted. The figure has not been revised for the second order draft, it will be finalized when more CMIP6 and CORDEX data are available.
56716					Figure 1.10: It would be clearer to replace V by "quantity (V)" in Y axis and add Time (t) in X axis. Having "quantity" written directly in the Y axis facilitates the understanding without looking for the information in the caption. Adding (t) is just to keep the axis titles consistent. What does the other green color represent in c? Like in (a), add model 2, model 3, ... in the legend [WGI TSU, France]	Accepted. The figure has been revised.
56718					Figure 1.13: thin solid lines would stand out more if they were dotted/dashed lines. Mention in the figure annotations what are the three colours (for example: ensemble member 1, ensemble member 2, ensemble member 3). Add visual cues to allow the reader to match the annotations with the elements in the figure (i.e. add a dotted line next to "linear trends over..." [WGI TSU, France]	Taken into account; The figure was updated
56720					Figure 1.15: It is not clear what does the annotation "circumference of the earth" represent in the plot. I believe it is part of the x axis but it would help the reader understand if the annotation was linked to the axis tick with an arrow [WGI TSU, France]	Noted. Figure format was revised.
56722					Figure 1.16: bringing elements from the caption in the figure as titles would help. For example (a) AR6 WGI Land and ocean regions - in entire report; (b)Typological land regions - in Chapter 8; © Typological Ocean regions - in Chapter 5 and 9; etc. // the order of the pannels don't read well (exchange c and d) // white numbers would read better than red numbers (pannel c) [WGI TSU, France]	Noted. Figure format was revised.
56724					Figure 1.17: the annotations "temperature anomaly…" are intuitively taken as title of the underlying plot (since this is the case for the first plot "global mean…"). It is quite confusing as the time scale on the Y axis does not correspond to 1979-1988 or 1996-2005. It becomes clearer when reading the caption. However, to avoid this type of confusion and have a more stand-alone figure, one could bring the annotation within the plot frame, smaller font size, and adding for example "based on temperature anomaly..." [WGI TSU, France]	Taken into account; Figure revised.

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56726					Figure 1.18: the message behind the figure is quite good but the current design might raise some questions in the mind of the reader, who tends to relate the three levels to the x axis (temperature). the RCP scenario numbers could be taken as " global temperature in...", the "modelled mean climate" and therefore the output of "different models" could be understood as being global temperature. Therefore if those two levels are independent from the x-axis, the separation should be clearer // specifying that the scenarios are RCP scenarios in the caption. Some editorial suggestions: clean the figure by removing the upper axis line/ticks and the right hand line [WGI TSU, France]	Taken into account; The figure was updated
56728					Figure 1.19: It it hard to understand the connection between the Dis as well as how they related to WGs and Chapters the way they are presented in this figure. The figure should ideally be redesigned differently. For more guidance, contact the TSU graphics officer. [WGI TSU, France]	Accepted. SOD Figure 1.28; revised and simplified.
56730					Figure 1.20: great Figure! The lower level is easy to follow and understand. The top level could probably be improved. For more guidance, contact the TSU graphics officer. [WGI TSU, France]	Accepted. SOD Figure 1.23; revised and simplified.
56732					Figure 1.22: The visual concept behind the original SYR SPM figure could be rethaught for AR6. For more guidance, contact the TSU graphics officer. [WGI TSU, France]	Not Applicable. Figure has been dropped.
56734					Figure 1.23: This figures contain a lot of layered information that might not be easy to grasp for a first-time reader. For more guidance, contact the TSU graphics officer. [WGI TSU, France]	Accepted. SOD Figure 1.24: revised and simplified. SSP-RCP matrix was added as second panel.
56736					Figure 1.25: It is unclear which line represents CH4 and and which one represents N2O. // The chemicals as listed in the figure cannot be individually distinguished in the plots and color gradient is not constant throughout the list. Another approach should be used depending on what is the take-home message of the figure. For more guidance, contact the TSU graphics officer. [WGI TSU, France]	Not Applicable. Figure has been dropped.
28578					This is a very impressive and worthwhile chapter. [Ian Watterson, Australia]	Noted. Thank you.
56738					Cross-Chapter box 1.5, Figure 1: if the left panel can be adapted, it would help to indicate the respective year in parenthesis when the results were published. [WGI TSU, France]	Not Applicable. Figure has been dropped. SOD Cross-Chapter Box 7.1 covers the discussion of emulators used in the WGI AR6.
56740					Figure 1.28: adding a sort of vertical time-scale/ time axis of when the scenarios were used (currently written in each plot) would be visually be interesting. For more guidance, contact the TSU graphics officer. [WGI TSU, France]	Noted. SOD Figure Box1.3, Figure 1. No action.
56742					Figures: general comments: according to the style guide, units have to be in ( ) and not in [ ] [WGI TSU, France]	Noted. Editorial. Will be addressed at the copy-editing stage.
46522					Suggest to introduce the following key framing for the report: thermodynamic vs. dynamic changes (e.g. Classius-Clapeyron vs. atmospheric circulation) [WGI TSU, France]	Rejected. This was considered and tried, but in the end we did not include it in the Second Order Draft as it was deemed to complex for this chapter. It is discussed later in the report, though.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
13786					IPCC reports have a long-standing tradition of narrowly defining risk. I would like the use of the definition provided by Ayyub (2014) and in part the ISO (2009) as follows: Risk should be associated with a system and commonly defined as the potential loss resulting from an uncertain exposure to a hazard or resulting from an uncertain event that exploits the system's vulnerability. Risk should be based on identified risk events or event scenarios. In 2009, the ISO provided a broadly applicable definition of risk in its standard (ISO 2009a) as the "effect of uncertainty on objectives" in order to cover the following considerations as noted in the standard. See Ayyub, B. M., Risk Analysis in Engineering and Economics, Chapman and Hall/CRC Press, second edition, 2014. [Bilal Ayyub, United States of America]	Important comment. Several similar comments indicate problems with the risk framing section. Section has been heavily revised and parts of it moved elsewhere in Ch 1.
17882					In order to find figures referred to, one needs to go back and forth while reading/reviewing the Draft. This is very inconvenient and tiresome. [Branko Grisogono, Croatia]	Noted
13788					IPCC reports have a long-standing tradition of narrowly defining uncertainty. Uncertainty is defined by Ayyub and Klir (2006) as information deficiency. Uncertainty presents itself in several types, and is a subset of knowledge deficiency that presents itself in varied categories, broadly termed ignorance including the occurrence of unseen events, i.e., an incomplete universal set in probabilistic modeling. See Ayyub, B. M., and Klir, G. J., Uncertainty Modeling and Analysis in Engineering and the Sciences, Chapman & Hall/CRC, 2006. Also, the editorial by Ayyub in the ASCE-ASME J. of uncertainty and risks in engineering systems (parts A and B) at https://ascelibrary.org/doi/10.1061/AJRUA6.0000001 [Bilal Ayyub, United States of America]	Noted. IPCC AR6 follows the IPCC Guidance Note on Treatment of Uncertainty. See SOD Box 1.1, including reference to Mastrandrea et al. 2010, IPCC.
29660					Many figures (Box 1 Fig.1.1, Figg. 1.6, 1.16, 1.18, 1.20, 1.23, 1.24, 1.25, 1.26, Box 1.5 Fig 1, Figg. 1.28, 1.29) are not legible, perhaps due to the low definition format for peer review. It is recommended for a clear reading to improve the image definition [luisa Sturiale, Italy]	The figures have been improved.
52700					I am missing an integrated and in-depth discussion about how model performance in present climate can be linked to the credibility of future projections. I think we definitely need such a discussion in Chapter 1, such that we can refer to it later in other chapters (e.g., 4, 8, 10, 11, 12). This discussion should link to the discussion of adequacy for purpose in the philosophy of science literature. A key paper has been published by Wendy Parker in 2009. As Wendy is CA of chapter 1 already (in the context of values), an extension should be relatively easy. In Chapter 10 we already refer to such a section, maybe our section could provide some guidance (or at least serve as a starting point for discussions). Currently such a discussion is completely missing, apart form emergent constraints and vague statements. That is, the report currently provides no line of argument about the question why we have any trust in our projections, which are strong extrapolations beyond what we have experienced. I strongly urge Chapter 1, 4, 10 (and possibly others) and the bureau to have a cross chapter discussion on this issue at LAM3. [Douglas Maraun, Austria]	Accepted. Section 1.4 is section 1.5 in the second order draft. A subsection 1.5.4.8 "model fitness for purpose" has been added.
13790					It is important to quantify uncertainties in risk estimates, benefit estimates and any associated costs for actions, and use an appropriate discount rates in order to perform appropriately the economics of climate management related strategies. [Bilal Ayyub, United States of America]	This comment applies mainly to WG3. WG1 does not assess economic costs/benefits.
17896					<=> What is the ocean reanalysis resolution used? [Branko Grisogono, Croatia]	Taken into account. Annex 1 has been revised.