Comment ID	From Page	From Line	To Page	To Line	Comment	Response
1537	0	0	0	0	I'm unsure about using the adjective 'enhanced' in the context of climate change (used extensively throughout the report). In my mind, it has a positive connotation, and according to Cambridge dictionary, it means to improve the quality, amount, or strength of something. According to Merriam-Webster it means to increase or improve in value, quality, desirability, or attractiveness, and according to the Oxford Learners Dictionary, it means to increase or further improve the good quality, value or status of somebody/something. In this context, climate change is a bad thing. [Rasmus Benestad, Norway]	Taken into account. The term "enhance" is widely used in the scientific literature and appears in the chapters of the report, however the term is avoided in the main text of the SPM, which is aimed at a broader audience.
1539	0	0	0	0	This draft, and past IPCC assessment reports, have not managed to include all relevant published studies on climate change, leaving gaps in the overview of the current knowledge. Maybe new tools and more support is needed to ensure objective and comprehensive reports, e.g. tools such as IBM's Watson (in medicine), google.scholar.com and other artificial intelligence-based search tools. There is a vast volume of publications, and it is impossible to keep track of all of it. The time for writing these assessment reports may also be too tight to manage all. My impression is that the inclusion of studies and papers in these assessment reports is somewhat subjective, and perhaps the selection of publications is dominated by a clique of close colleagues. I'm not sure that all the cited studies really merit an inclusion in this report, since I'm not convinced that all bring new information or can be regarded as supporting a clear message. Also, there is a fair deal of repeated passages. There are also relevant reports, in addition to SREX, SROCC, SR1.5, not cited as far as I could tell: AMAP (AACA and SWIPA) and the US 4th National Climate Assessment. [Rasmus Benestad, Norway]	Rejected. IPCC reports do not cite all relevant publications in the chapters. The mandate is to assess the available literature basis and provide the results of that assessment as a chapter in the report. Topics in each chapter are the result of the scoping and approval of the report outline. Please also note that the 2 rounds of review are opportunity to highlight policy-relevant gaps in the assessment.
1797	0	0	0	0	Many of my comments on the FOD concerned text that has now been removed (notably section 9.6.5). Has this been moved to Working Group 2? [Torbjorn Tornqvist, United States of America]	Noted. It was decided that Section 9.6.5 from FOD was out of scope for the chapter. Relevant material was shared with WGII but we can not comment if they have covered it. We thank you for your time on the FOD review.
90143	0	0	0	0	Luxembourg would like to thank the co-chairs the vice-chairs and the TSU of WG1 and in particular the authors for the present draft of the WG1 contribution to the AR6. We consider that report covers all the topics addressed in the outline and would like to encourage the authors to continue along these lines. We in particular acknowledge the difficult task of continue the work on the IPCC reports in period of CONVID-19 pandemic and would like to express our sincere gratitude to all the people who are dedicating their time in producing the IPCC reports. [Georges Gehl, Luxembourg]	Noted with thanks.
90145	0	0	0	0	We see the contributions of the different WGs to the AR6 as a continuation of the exploration of the findings presented in the three SRs that were already produce in this cycle and expect them to cover the open questions that were identified in these SRs. In addition, we expect the AR6 to present policymakers with the newest scientific findings published since these three SRs as well as the AR5. [Georges Gehl, Luxembourg]	Noted
90147	0	0	0	0	We fully support the new structure of AR6 compared to AR5 being thematically structured instead having chapters only assessing observations, and chapters assessing models. We recognize however, that this way of presenting the findings poses a particular challenge for the authors to remain consistent throughout the report and avoid duplicates. While we recognize the efforts to avoid this, we think there is still room to increase consistency and reduce redundancy through the report. This will in particular help to reduce the length of the SPM and the TS, which also includes too many specific technical details, which we consider not to be relevant for policy-makers even though they are interesting for specialists. We thus strongly advice the authors to review, revise and shorten the report to increase consistency and avoid duplication and will also give specific comments how to achieve this for the SPM. [Georges Gehl, Luxembourg]	Taken into account. Cross-chapter coordination strived to reduce the overlaps and duplicates between the chapter, improve the consistency and reduce the overall length of the report. Additionally, both the SPM and the TS have been significantly shortened during the revision process.
90149	0	0	0	0	We are surprised to find still a lot of placeholders for CIMP6 results in the SoD. Considering the fact that during the final government draft only governments can provide comments to the SPM, we are wondering how the review of the placeholders in the entire report should be performed. If the final government review could be opened also to these parts of text might be a way forward. [Georges Gehl, Luxembourg]	Noted. CMIP6 data was not always available at the time of the SOD. As far as possible, any comments on CMIP6 are backed up by peer-reviewed publications.
86823	0	0	0	0	Please consider if it is worth having cropland included as a "typologogical region" [Oyvind Christophersen, Norway]	Noted. Some of the typological domains included in the WG I report were included following consultation WG II chapters to identify regions of interest that WG I could generate assessments for. Cropland was not raised as a specific region of interest in this context and thus not included.
90151	0	0	0	0	We noted that several changed occurred in the way the AR6 WGI report addresses past, present and future warming compared to previous reports. This includes the use of a new temperature metrics (GMST instead of GSAT) a reassessed historical warming, the inclusion of storylines, the new assessment of the ECS, the way the quality of the CMIP6 results is discussed. While we fully support the fact that the report should assess and highlight the newest available science and highlight in particular new findings since the AR5 and the three SRs in this assessment cycle, there is a need to communicate these changes and their reasons to the target public. In particular, in the SPM, there is no reason given why these new approaches have been adopted and for the non-expert reader it is very difficult to understand if the changes presented are due to changes in physical parameters, advances in knowledge or different choices of metrics. We will give specific comments on this in the SPM and strongly encourage that whenever possible the reader should be given the possibly to compare the results of AR6 to previous reports. [Georges Gehl, Luxembourg]	Taken into account in the redrafting of Cross-Chapter Box2.3.
90153	0	0	0	0	We noted that projection results based on CIMP6 are generally warmer than CIMP5. While the report gives some indications of the reasons behind this, part of these differences are also based on different choices compared to previous models. CIMP6 is not based on RCPs but SSPs associated with Radiative forcing, a selection of models due to assessed ECs range (in some sections but not all) and the changes in which global temperatures are addressed in AR6 (see separate comment). In order to address these changes in detail and avoid any crisis of the IPCC, we would suggest explaining these changes and the reason of their choices in a cross-chapter box, which should be referenced, from the TS and SPM. [Georges Gehl, Luxembourg]	Taken into account. Cross-chapter BOX 1.5 provides some of relevant information. Chapter 4 Section 4.6.2 compares CMIP5 and CMIP6 forcings which has been elevated to the TS.
112681	0	0	0	0	An extrapolation of the current warming to warming in a scenario without the cooling effect of anthropogenic aerosols can be made through the equation ΔTnaa=ΔTnow(ERFtot/ERFghg), where ΔTnaa stands for ΔT, without anthropogenic aerosols (period 1750-2018), ΔTnow is the change in temperature compared to pre-industrial level (period 1750-2018), ERFtot is the total ERF and ERFghg the ERF of all greenhouse gases. With this equation using the best estimate numbers represented in AR6 WGI would look like this: 1.1/(2.5/3.6) =1.58C [Leon Simons, Netherlands]	Taken into account. The historic energy budget estimate is used as a line of evidence for ECS in Section 7.5

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
90155	0	0	0	0	Given the importance of when 1,5°C of global warming will be reaching in the framework of the Paris Agreement, we are surprised that the AR6 assesses that 1,5°C is reached about 10 years earlier than was assessed in SR1.5 without giving a clear indication of what this reassessment is based on. We have several issues with this assessment. First the reason given in the TS "the provision of enhanced estimates of the historical observational record" (L11-12) seems a bit simplistic for the communication of such an important result. Second when digging deeper in the chapter we went to read CH4.3.1 as well as CH2.3.1 and found that the AR6 uses a value of 0,99°C of increase of GSAT for the period 1880-2012, which is significantly higher than the 0.85°C GMST used in the lead up to the PA and underlying the decisions taken in this Agreement. We however were not able to find a clear explanation of this important change neither in text nor in Table 2.4. We strongly recommended the authors to give a clear and accessible explanation of this change given its policy relevance. Finally, we are not convinced that the value of 2030 to reach a warming of 1,5°C is consistent with the current warming rate. Starting from a value of 1,1°C GSAT for current warming and a warming rate of 0,2°C/decade, we would rather have a range of 2029-2038 for reaching 1,5°C including the uncertainty indications. We would thus expect rather a value around 2035 and we strongly urge authors got give an explanation while they assume that the value of 2030 is more appropriate. [Georges Gehl, Luxembourg]	Taken into account. HS5.3 in the revised SPM clarifies why the crossing time of 1.5ºC is occurring 10 years earlier than what is assessed in SR1.5. Additionally, the final SPM clarifies (in A1.2) why the observed warming is higher compared to AR5.
90157	0	0	0	0	We noticed that both the shift from temperature metric from GMST to GSAT and more importantly the re-estimation of historical estimated temperature, as explained in subsection 2.3.1.1.3, has led to assessed temperature of 1.10°C for GSAT for the period 2009-2018, whereas in the SR1.5 it was of 0.87°C in GMST for the period 2006-2015. The SPM gives the impression that this change is mainly due to the change in temperature metric, but BOX SPM.1 explains that that difference is only of 0,04°C. Has the temperature really risen by 0,2°C in years? Given the importance of the global mean temperature in the Paris Agreement, this difference needs to be explained in the SPM. This shift also has implication for projections. In the SR1.5 the projections with lowest emissions trajectories, stayed just below 1,5°C and were qualified as "no-overshoot" scenarios. This seems to us not being the case anymore in the AR6 but is left completely uncommented in the SPM. Can you confirm that all projections in AR6 need to be considered now as "overshoot scenarios"? This has also a direct implication on one of the main messages coming out of SR1.5, namely that limiting global warming to 1,5°C was still possible. With the re-assessment it seems that this message does not hold true anymore and this should made clear in the SPM, including why the assessment of this message has changed in the three year since the publication of the SR1.5. Finally, we think that the SPM would highly profit from a discussion of the impact of this re-assessment on the Paris Agreement temperature targets, which is done in subsection 2.3.1.1.3 and the main messages of this discussion should be include in the TS and the SPM. Also we strongly urge the authors, to include references to the AR5 and SR1.5 temperatures, and explanations how assessment have changed, so as to make it fully transparent how one can compare results from these different reports. [Georges Gehl, Luxembourg]	Taken into account in the redrafting of Cross-Chapter Box2.3.
130625	0	0	0	0	Entire report: could WGI to start a new helpful trend by minimizing the use of acronyms to strictly common, well-known acronyms only, and eliminating context and chapter specific acronyms and abbreviations entirely, for maximum readability at this crucial time in history. The way people read the reports is often to search for particular topics or regions, and then to read around instances. The usual 'define at first mention' does not work in this context. Acronyms simply impede access to the content. IPCC reports are very long and dense, they are different from normal shorter academic publications in many ways. If WGi could lead the way in this then WGII and III could follow. [Debra Roberts and the Durban WGII TSU, South Africa]	Taken into account. The guideline given to the chapters is to keep the amount of acronyms to a minimum. Please also note that the published report includes an annex with acronyms
130627	0	0	0	0	A cautionary note - the multiple baselines referred to are extremely difficult to understand for the non-scientific community. Ideally for consistent, powerful messaging, the baseline (and the warming measure that goes with it,(i.e. GMST or GSAT) should be the one in which current warming (as of 2017) is 1 deg C, the one SR15 is based on.. CCB 1.2 tries to clear this up, but only ends up making the argumentation more complex - so that we start seeing graphs centered around recent 'baselines' with negative warming before this baseline, and minor warming after. This is very confusing to any audience other than climatologists. [Debra Roberts and the Durban WGII TSU, South Africa]	Noted. We have tried to make the presentation clearer, but it is unfortunately true that this topic is complex and a source of multiple misunderstandings. Hopefully the last round of revisions have helped, as they have included a consistency check of baselines used throughout the report.
37775	0	0	0	0	Very minor typesetting issues. some hyphens are - others en-dash for from-to notation, and are sometimes white-spaced while others not. eg. P48L15,L20; some numbers are comma separated others not, some units missing white space. [Junhee Lee, Republic of Korea]	Editorial. The report will undergo professional copy-editing prior to publication
106149	0	0	0	0	The world is experiencing one of the most extremes of global pandemic in the form of COVID-19 this year. Can we elaborate the connections of this pandemic with the issues of changing climate? I think AR6, in general (if not specifically), need to address this big FAQ and provide knowledge-commentary on this nexus. One of the chapters could include this critical most FAQ/issue of this time that the world is facing. Leaving this for IPCC AR6 to provide some useful information in this line (if possible) [Atiq Kainan Ahmed, Thailand]	Taken into account. A cross chapter box on the effects of the COVID pandemic on emission, air quality and climate has been added to chapter 6 (Cross-Chapter Box6.1)
44965	0	0	0	0	NOTE: My PhD is in Science Education, and I do a lot of work with students/citizens/etc in the US who would be classified as "climate deniers." So all of the above comments are an attempt to help you improve your science communication for people that need to read this the most. [Catherine Linsky, United States of America]	Noted. Thank you.
86443	0	0	0	0	We would like to thank all of the authors, as well as everyone else involved in preparing this draft. We appreciate the enormous and thorough work done to produce this scientific assessment of the latest climate change related science, which is politically relevant without being politically prescriptive.We hope that our comments and suggestions will help further improve the report and make it more easily accessible for readers without a scientific background. We will mainly focus on the first draft of SPM. [Ala Taimar, Estonia]	Noted with thanks.
86211	0	0	0	0	Authors are requested to aim for clear, common English, with minimal jargon terms, especially in the various summary sections (SPM, Exec Summary), boxes, tables and figures, and the introductory and concluding sections of chapters. This is where the non-specialist readers will land. [Debra Roberts and the Durban WGII TSU, South Africa]	Taken into account. Guidelines were provided to the chapters to help improve the accessibility of the chapters. Furthermore, the key summary documents (SPM, executive summaries) have been developed in collaboration with communications experts and a comprehensive Glossary is provided as an Annex to the report.
63683	0	0	0	0	The concept "Sectoral assets" appears all along the AR6 so this is an important concept. But its meaning is not clear enough (geographical sector? economic sector? social sector?). For me this concept is very confusing, and I guess the same happened to other readers. Therefore, a solution is to define much better this concept or to use more specific words. Lines 45-53 on page 12, Chapter 12 defines some "sectors", but I am not sure if those are the "sectoral assets" that are named along all AR6. See also comments 2, 3, 12, 24, 27 and 60 [APECS, MRI, PAGES ECN, PYRN and YESS ECS group review, Canada]	TAKEN INTO ACCOUNT: We define "assets (system components with socioeconomic, cultural, or intrinsic value)" early within Section 12.3 to ensure that the reader understands our intent here. We also discussed this topic with the AR6 glossary but determined that the term is used somewhat differently across each WG, with the final recommendation being to define its use directly within the chapter.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
108233	0	0	0	0	(I put this under “entire report” as I am not certain where it shold best go.) It should be pointed out clearly in an appropriate place that mountain areas still generate a high amount of uncertainty, as accurate representation of atmospheric and surface processes over mountainous terrain would require a much higher resolution than what is available in GCMs and often also in RCMs. Precipitation and snow cover are especially difficult to model. On the other hand, precipitation falling in mountain areas is the dominant source of water for vast regions of the globe with high population densities and important agricultural areas. Modulation of the seasonal runoff by the snowpack build-up and melt aggrevates this problem when it comes to translating climate change into impacts. Due to problems that also exist in the observations and their analysis, even model verification is significantly more uncertain over mountainous terrain. These issues are addressed, however, only scattered in various parts of the Report; it wouild be good put all the pieces of the puzzle together in one place, too. [Petra Seibert, Austria]	Taken into account. Chapter 10 addresses many of the questions pointed out by the reviewer, such as the challenge of observations and modelling of mountain areas. Chapter 10 also include a Cross-Chapter Box on the Himalayan Mountains. However mountains are also treated in other chapters, because of their mandate. For example Chapter 9 assess glaciers and Chapter 12 has a section on Mountains to match the WGII assessment.
14811	0	0	0	0	Chapter 9 Lead Authors should scan all other chapters for all mentions of 'ice sheet' 'glacier' 'sea level rise' and other pertinent terms, and check that the sections containing these terms are accurate and consistent with Chapter 9 information. Also, to the extent possible, scan the report where ice sheets, glaciers and sea level should be mentioned - but aren't. I scanned entire report for 'ice sheet' and found several sections that were not entirely correct or consistent with Chapter 9 (e.g. Antarctica was neglected in discussion of 'polar ice sheets' and Greenland was described in a 'glacier' section). I have added my corrections to my Review in the relevant places but encourage Chapter 9 authors to undertake the same exercise, with more diligence than I have. [Jeremy Fyke, Canada]	Noted. We thank the reviewer for commenting on other chapters. Consistency across chapters has been checked by chapter 9 authors as far as possible.
3039	0	0	0	0	For any future report, please use continuous line numbering: It saves reviewers and authors weeks of typing, as it makes columns "D"+"F" of this sheet unnecessary; it also avoids the many errors in reporting page numbers, which I'm sure, must exist. [Daniel Farinotti, Switzerland]	Noted.
64735	0	0	0	0	A general suggestion for the current or next report. I hope there is a chapter on climate justice [Eman Abdelazem, Egypt]	Not applicable -- beyond the mandate of IPCC working group 1
86519	0	0	0	0	We urge authors to make sure that when UNFCCC definitions and issues are referred to, that the exact UNFCCC formulations are used. For example, we are surprised to see a relatively free interpretation of the Paris Agreement's global stocktake, that is not acceptable. [Ala Taimar, Estonia]	Taken into account. The presentation and discussion surrounding the Global Stocktake have been revised accordingly, as far as possible within the space available.
86521	0	0	0	0	CMIP6: we are worried about the many placeholders regarding CMIP6, we would need to review this information at some point and we are not clear how this can be done [Ala Taimar, Estonia]	Noted. CMIP6 data was not always available at the time of the SOD. As far as possible, any comments on CMIP6 are backed up by peer-reviewed publications.
1531	0	0	0	0	to make the report easier for the readers, tey messages could be ordered according to importance and level of certainty, starting with the most important and most certain. What is the take-away message of the chapters? Then simplify the sentences by stripping off some detail, which are found in the text they refer to anyway. More detailed information gets in the way, and if it’s meant to qualify the message, then it’s better that the experts provide a simple message rather than everybody tries to interpret the information for themselves based on varied backgrounds and capacities. The way the key messages are communicated so far will probably fail because thay are written in a way very few would use if they were to talk or write about climate change. I suggest using the US Fourth National Climate Assessment (2017) as an example. [Rasmus Benestad, Norway]	While this is an interesting suggestion, traditionally, the IPCC has put forward in the SPM information that is policy-relevant and then given its assessment of that information. This is what the government that commissioned this report have asked for. The US report is a valuable reference but their summary does not use the same approach [e.g. the use of the same uncertainty language for assessments as in the IPCC (e.g., the word "likely" does not appear at https://nca2018.globalchange.gov/)], and so their methodology may not be easily applied to this report.
1533	0	0	0	0	Many of the chapters have overlapping material. The report can be shortened and better structured by merging these sections with overlapping information. [Rasmus Benestad, Norway]	Taken into account. we have tried to reduce the length of the chapters to follow the length specified in the approved outline. Furthermore, there has been significant cross-chapter coordination efforts to improve cross-chapter consistency and reduce overlaps.
1535	0	0	0	0	It is important to stress the importance of open access data. Without them, we cannot really say if there is climate change and it’s difficult to adapt to future conditions. Also, it may be argued that it should be a human right for people to have vital data about their environment on which they depend. The importance of open data also is the case for this report, and the data should follow the FAIR principles. [Rasmus Benestad, Norway]	A process for data curation is ongoing and involves archival of input datasets, codes, and final datasets. Further information can be provided by the TSU.
66583	0	0	300	70	Differences between CMIP5 and CMIP6 scenarios are related both to different climate sensitivity and to the fact that the SSPs and RCPs are not completely comparable neither on a regional scale (as mentioned for instance in Ch 4) nor on a global scale as the forcing scenarios behind the same "nominal forcing levels" such as SSP2-4.5 and RCP4.5 are sometimes very different (different evolution of GHG levels with time). This implies that resulting climate projections based on these different scenarios can lead to large differences in results even if the nominal radiative forcing is the same. It would be good that this is made clear in the assessment as there are many places where comparisons between CMIP5 (and CORDEX) and CORDEX on the one hand and CMIP6 on the other are being made. Wyser et al (2020) shows that one of the GCMs used in both CMIPs, the EC-Earth model, get a much stronger climate change signal when forced by the new CMIP6 SSP-forcing compared to the corresponding RCPs. This difference in forcing has an even stronger impact on the results than the 1K increase in climate sensitivity in this model comparing the new CMIP6 version to the old CMIP5 one. Wyser, K., Kjellström, E., Königk, T., Martins, H. and Doescher, R., 2020. Warmer climate projections in CMIP6: the role of changes in the greenhouse gas concentrations from CMIP5 to CMIP6. Environ. Res. Lett., 15, 054020, DOI: 10.1088/1748-9326/ab81c2. [Kjellström Erik, Sweden]	Noted. Wyser et al.'s paper is referenced in several parts of the report. This paper helps explaining with one model that the difference in the climate projections between CMIP5 and CMIP6 corresponds partly to the differences in the scenarios, partly to the change in climate sensitivity of a subset of the models. Both factors seem to play a role. In any case, at the regional level, the results have been presented in a number of instances as a function of the global warming levels, as in the Mediterranean case study of Chapter 10, illustrating that in many cases the regional impact of a specific global mean temperature is similar between the two experiments.
64661	0	0	300	70	The organisation of the document prove to be a good way to convey the overall assessment, and I would like first to aknowledge the huge work that has been done. In the presennt form most chapters are too long, and many overlaps between chapters should be avoided. The indidual chapters need to be independant and complete, but they do not need to be exhaustive on all subjects the could cover. In particular the distribution for process understanding should be revisited between chapter 2 to 6 and chapter 7 to 9 and between those chapters and the regional and extreme chapters. [Pascale Braconnot, France]	Taken into account. 1) we have tried to reduce the length of the chapters to follow the length specified in the approved outline. 2), there has been significant cross-chapter coordination efforts to improve cross-chapter consistency and reduce overlaps.
64663	0	0	300	70	The different chapters have a section highlighting llimitations in the assessements or knowledge gaps. In the present form there is too much descrepancies in the way this is done, and the overall view is that it is not mature yet for an IPCC assessment. It resemble a shoping list and the point of view is too much WG1 community oriented. I would propose that chapter 1 includes all what is common to all the other chapters to avoid too much repetition between chapters, and that each chapter only highlights major specific points related to specific aspects covered in the chapter. It sounds also important that these sections more clearly identify which aspect of the assessment is affected by the limitation or knowledge gap, in a way that is useful for "policy makers". [Pascale Braconnot, France]	Taken into account. The "Final remarks" sections have been streamlined, although broadly kept in the individual chapters rather than folded into Chapter 1. Chapter 1 does give some overarching comments, coordinated with the other chapters.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
64665	0	0	300	70	Most of the results provided in the assessment are there thanks to the organisation of the climate community, the access to large datasets (observations, model or analyses tools), etc... and it is important everybody reading the AR6 report clearly understand where these resources come from and how they are provided. However there is too much of this in different places in the different chapters. Chapter 1 set the scene, and seems to be the place to gather all this. In each chapter it should be condenced somewhere in the first section explaining the different aspects covered by the chapter. Then, in the core of the different paragraph, this jargon should be avoided as much as possible, refering to facts, results, publications, etc.. and not to all these acronymes This would help reduce the length and also the effect of "promotion of activities" when the text should be an assessment and highlight the elements that are relevant for "policy makers". A solution could be to gather precision or needed detailes on these different databases and international working groups in the annexes on observations and modeling in addition to what is in chapter 1, so that each chaper refer to the same documents when needed. [Pascale Braconnot, France]	Taken into account. A summary of the models used in the WGI AR6 can be found in Annex II: Models.
64667	0	0	300	70	Chapter 1 highlights the role of the report for tge global stocktake as well as the risk framework. This should be better echoed in the executive summary of the different chapters, and should guide a little bit more the way the different findings are put into context. [Pascale Braconnot, France]	Rejected. This has been discussed, but in the end it was decided to retain discussion of the Global Stocktake in Chapter 1 only.
64669	0	0	300	70	There has been a lot of work for integrating the different elements in holistic chapters. As a paleo person, I am a little bit deapointed that I do not find a lot of figures mixing paleo, histoirical and future to show the complementary views between the different periods and what we learn when bringing these pieces together. The science is still presented in siloes somehow and if woud be interesting to jump a little bit more on the opportunity offered by the report outline to bring in a more consolidate view the combination of sources in the assessment where possible. The only figures (I might have missed some) with very different periods on the same plot are fig 1.3, 1.16, box 2.1, figs 2.2, 2.3, 2.1 2.22 2.30, 2.24, 5.1, 5.2, 8.21, 8.28, 9.9, 9.19, 9.32, fas 9.1. In most cases these figures are used to put the elements into context, but few of them are used to discuss processes, understanding or overall model evaluation (such figures exist for individual periods) [Pascale Braconnot, France]	Taken into account. Chapters now includes more integrative figures of the type requested.
64671	0	0	300	70	My previus remarks on bringin together very different periods on the same figure is also valid for the integration of different spatial scales around a similar process. [Pascale Braconnot, France]	Not applicable. Comment unclear
64673	0	0	300	70	Variability is an important object and recieved a lot of attention in different places, which is great. However there is a need throughout the report to clarify when variability (and which one) is considered as noise, and when it is the focus. The same holds for the internal variability and forced variability. It is a very difficult subject with lots of confusion around and misundestanding by people that are not specialists of climate variability. It is thus important that common basis are used by all chapters and that the specific aspect treated in the different sections is clearly stated. [Pascale Braconnot, France]	Talen into account. Considered in revisions to the report.
15009	0	0			The Report represent a huge amount of excellent work by knowledgeable and dedicated authors, and must be rated very satisfactory for its treatment of the science, and for its precise handling of the perennially difficult problem associated with predicting future scenarios and likely outcomes. [Fredric Taylor, United Kingdom (of Great Britain and Northern Ireland)]	Noted with thanks.
15011	0	0			The main chapters are tremendously complicated. Even an expert in the field, familiar with the various concepts and research methods, finds it very hard work to navigate. This is probably justified by the need for the Report to be seen to be detailed and comprehensive, which it does very well, but it also highlights the need for an accessible summary for policymakers, media and the educated general public (see below). [Fredric Taylor, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Guidelines were provided to the chapters to help improve the accessibility of the chapters. Furthermore, the key summary documents (SPM, executive summaries) have been developed in collaboration with communications experts. Note that to help navigate the report, we have developed a consistent set visual guides/roadmaps, made in collaboration with a graphics designer.
15013	0	0			It is appreciated that using acronyms serves to shorten the text, but their excessive use makes hard work for the reader and makes the report less readable, even by scientists accustomed to them. Acronyms should at least be avoided in section headings (unless defined there), and used only in sections which include a fresh definition. [Fredric Taylor, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. The guideline given to the chapters is to keep the amount of acronyms to a minimum and avoid using them in section headings. Please also note that the published report includes an annex with acronyms.
15023	0	0			After much burrowing in several chapters it is possible to find how the aerosol contribution to reducing the overall global warming has been derived in the literature and its error limits assessed in the Report, but the original research also stresses the uncertainty of the resulting numbers and their likely range. Assessing this clearly is a key purpose of AR6; at the moment the information is buried in complexity and detail. [Fredric Taylor, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. The aerosol ERF and contribution to temperature change is assessed in Chapter 7
50051	0		0		In the SPM and throughout the entire report, the term 'snow cover' is used without specifying which aspects of snow cover you are talking about (extent, duration, SWE, depth...) e.g. - Chapter 9, p80, line 3 - I think you are talking about extent and duration and not SWE This distinction is important for policymakers (e.g. SWE particularly important for water resource management). Please check the use of this term throughout the report and where possible, specify which parameter(s) are being referrred to. An example of where you did do this is Chapter 9, p 81, line 28. Alternatively, you could specify early in the report that when 'snow cover' is used, it means all three aspects of snow described in Chapter 9 (p78 line 15-21 - extent, duration and SWE) and ensure that that is the case throughout the text (which it currently isn't). [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. Although the reviewers point is well taken, many instances of this topic do not require this level of specificity, for example, when discussing process interactions with snow cover. As such, a comprehensive addition of specificity was not implemented.
50053	0		0		There are a number of places where conclusions are based on CMIP5 and awaiting an update based on CMIP6.Will these conclusions continue to hold true for CMIP6? It would be helpful in cases where results may be sensitive to change, pending results from CMIP6 models, that the report highlights this explicitly and acknowledges that a fuller set of analyses could affect the conclusions presented. [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Noted. CMIP6 data was not always available at the time of the SOD. As far as possible, any comments on CMIP6 are backed up by peer-reviewed publications.
50055	0		0		Climate sensitivity is an important topic and is likely to receive considerable scrutiny when the report is published, in particular because of the debate around the emerging high ECS values in CMIP6 models. The WGI discussion of climate sensitivity makes two notable changes since AR5 - 1) methodological, the removal of values direct from models and 2) a raising of the lower bound. In general we feel that the rationale for both of these developments needs further strengthening and would also perhaps benefit from bringing together into a single, short, summary section that lays out point by point the changes that have occurred and why they have occurred, for ease of reference. [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. The ECS assessment is better clarified in Section 7.5

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
50057	0		0		Throughout the report the detail of analysis on aerosols and their contribution to temperature rise in the short-term appears limited. In Chapter 4, negative forcing aerosols are conflated with SLCPs. There are several phrases in this chapter which seem to imply that it is too complicated to tease out the specific role of a reduction of aerosols on GSAT. Page 4-48 (lines 21-23) for example, which gives the results of the SSP3-7.0lowNTCF experiment that reduces concentrations of SLCFs relative to the SSP3-7.0 scenario, explains that in this scenario the GSAT anomaly 'is increased by a few tenths of a degree' but that this is smaller than the likely GSAT range from the CMIP6 model spread. Please clarify across the report the likely impact on GSAT of aerosol reductions specifically, and the trade-off between warming on short- and longer-term timescales. It will be important for policymakers to understand if any such impacts could result in reaching significant global temperature levels (e.g. 1.5C). This is covered to some extent in Chapter 6 and Chapter 7 but perhaps the cross-chapter working group could address this to ensure consistency and complementarity between the chapters that address aerosol impacts on Radiative Forcing. Suggest that Chapter 6 exec summary is significantly strengthened in terms of key messages about SLCFs. Suggest it would be useful to either have this information in one place, or more rigorously cross-referenced across chapters and with a summary statement in the SPM. Related to this, it would be useful to note the aerosol-forced temperature change relative to a pre-industrial baseline rather than 2020 as this is politically more relevant and otherwise a 2020 baseline could bias the discussion. The analysis should also ensure policymakers aren't misled by SLCF forcing theoretical experiments but to draw on scenarios that closely resemble rates of fossil fuel transition that would reflect real-world decarbonisation. [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Following SOD review comments and coordination with chapter 6, the FGD section 4.4.4 now considers the net impact of all SLCFs in the SSP scenarios. Chapter 6 provides the breakdown of GSAT change by SLCF component including separating the aerosol impact, so this provides the information the reviewer asks for. These results are included in the chapter 6 ES and considered by the SPM writing team.
50059	0		0		The revision of historical global observed temperature record in AR6 WGI (detailed in 2.3.1.1.3) has implications for the Paris Agreement (PA) temperature goals and it will be important for policymakers to understand if the PA goals remain valid in light of the revised observed temperature estimate presented here. It would be very helpful to include in the TS and SPM some lines from Ch 2, section 2.3.1.1.3 which explain how the reassessment of observed warming relates to the PA temperature goals. Suggest it would useful to also include a temperature estimate that is equivalent to that used in AR5 and is therefore relevant to the PA- this would help clarify the specific policy implications of the revised historical warming assessments. [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. In the final (approved) SPM, A1.2 provides this information: "The estimated increase in global surface temperature since AR5 is principally due to further warming since 2003–2012 (+0.19 [0.16 to 0.22] °C). Additionally, methodological advances and new datasets contributed approximately 0.1°C to the updated estimate of warming in AR6. Footnote 10: Since AR5, methodological advances and new datasets have provided a more complete spatial representation of changes in surface temperature, including in the Arctic. These and other improvements have also increased the estimate of global surface temperature change by approximately 0.1°C, but this increase does not represent additional physical warming since AR5."
79539	0		0		The 'Black Swan' event created by the current pandemic COVID-19 has caused emissions to drop in all countries. While the emissions may be back as activity resumes, can this natural experiment be used to recallibrate the models predicting the emission pathways? Since the results can vary from model to model, can the abrupt change be used for model tuning? [SAON RAY, India]	Taken into account. A cross-chapter box on the COVID related effects on air quality and climate is added in Chapter 6 (Cross-Chapter Box6.1)
23873	0		199		It is a very clumsy way that we have to write in our sci. comments. This format is far from being self-contained. How many times I wrote things in, yet I wanted to change, correct a word ot so, and then I had to re-type it. So backward in time, so much lacking the advantages of the modern era, inconvenient. [Branko Grisogono, Croatia]	Noted.
131585	0				Just a general comment: having all the figures at the end of chapters and not where they are supposed to be in the text, makes the review really difficult and unnecessarily complicated [Hans Poertner and WGII TSU, Germany]	Noted. Chapters are compiled as such for practical reasons during the drafting and reviewing process.
96001	0				It is unfortunate that placeholders can be found at multiple occasions throughout the report due to presently unfinished analysis. This complicates the review, but it also means that some of the IPCC's statements cannot be reviewed at all. We strongly urge the authors to strictly use material that has been peer-reviewed in these cases, and not to add any meta-analysis in order to fulfil the high review standards of the IPCC reports. Please consider an internal informal review like the ZOD in order to avoid [Nicole Wilke, Germany]	Noted. An internal review was conducted before FGD.
110337	0				The regional chapters contain a huge amount of redundant assessment between them. This is repetetive to the reader but a bigger challenge is that the assessment findings do not always map 1:1 which leaves the report open to possible citicism by those whoo wish to paly spot the difference. To the extent possible and practicable any one aspects should be assessed just once between these chapters with clear signposting between them. [Peter Thorne, Ireland]	Accepted. Regional cross-chapter coordination have addressed these overlaps and inconsistencies.
52481	0				[5] For the case of the CMIP5 models see MS15. In the case of the CMIP6 models, no information on the tropical all-sky LW radiative responses has been provided in the SOD, as would have been needed for a discussion of the TLR Discrepancy. In my comments on the FOD, I called for this issue to be addressed. Information on the net (LW+SW) global radiative responses (feedbacks, with opposite sign convention) is provided; see Figure 7.13(a). It can be seen that the CMIP6 global-mean net feedback is only a third of the Planck value. [Planck value given as 3.2 Wm-2 °C-1 (very likely range 3.1 to 3.2, page 7-59); model mean seen from the figure as 1 Wm-2 °C-1, with a S.D. of 0.2 and the with the largest outlier value being 1.9.] All the indications are that the CMIP6 models suffer from a serious TLR Discrepancy and for this reason are likely to give a serious overestimation of ECS. [J. Ray Bates, Ireland]	Taken into account. The estimates of ECS and TCR in CMIP6 models are not used in the assessment of ECS and scenario projections, and are furthermore discussed in Section 7.5.
131587	0				This is a Group Review and includes comments provided by Hans-Otto Pörtner, Elvira Poloczanska, Katja Mintenbeck, Sina Löschke, Andrés Alegria, Bastian Maus, Almut Niebuhr, Komila Nabiyeva, Daniel Belling, Vincent Möller [Hans Poertner and WGII TSU, Germany]	Noted
132355	0				When first seeing the AR6 WG1 outline, I did not expect to see any assessments in the Atlas section. I also expected that observed and projected mean regional changes would be assessed in Chapter 10. Since the present scope was agreed by Chapter 10 and the Atlas, I have no problem with it, but it would be useful to start the Atlas' ES by explaining what its scope and role exactly is. For instance: "The Atlas documents observed and projected changes in climate indicators, in coordination with other chapters (chapters 4, 10, 11, 12, ..). In particular, it provides analyses and assessments of regional changes in mean climate. [...]" [Sonia Seneviratne, Switzerland]	Noted. The Atlas ES preamble now clearly states the role of the Atlas with more detail including links to other chapters when describing its purpose in Atlas.1.1.
19459	0				Comments of the Russian Federation: In the IPCC AR5 WGI, its Chapter 9 was devoted to assessing the quality of the modern climate models, namely, their ability to reproduce the modern climate (model performance). There is no such chapter or section in the IPCC AR6 WGI. Some estimates of the quality of modelling of various parameters for different models can be found in respective chapters. However, it would be much helpful to see more ratings (like in the IPCC AR5 WGI where accuracy of model estimates of the surface temperature and precipitation was shown for each model in the Appendix). [Sergey Semenov , Russian Federation]	Taken into account. Chapter 3 does perform a multivariate relative performance assessment (section 3.8), although due to the multitude of diagnostics presented there, it is not possible to go into depth for individual diagnostics. It is clear though that CMIP6 models generally outperform CMIP5 ones.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
96003	0				It is very important that the IPCC provides a clear definition of the "pre-industrial period". The current text lacks clarity, it sometimes uses 1750, sometimes 1850-1900. The relation of the two periods is unclear (equivalence as suggested in SPM footnote 3 that states "1750 through the period 1850-1900" or the text in TS1.4 that notes differences and related consequences including for temperature, concentration and budget. We urge the authors to clarify throughout the WG I report. The use of the term "baseline" should be avoided as there is confusion if it refers to preindustrial conditions, or to a business-as-usual emission scenario, or to a mitigation scenario entirely without mitigation. [Nicole Wilke, Germany]	Taken into account. The report consistently uses time periods rather than references to a 'pre-industrial' period. 1850-1900 is our common baseline; see the revised Cross-Chapter Box1.2.
52483	0				[6] This section of the SOD refers to Bony et al. (2016), Williams and Pierrehumbert (2017), Vaillant de Guélis et al. (2018) and Li et al. (2019). These papers are concerned with physical mechanisms related to the iris effect, but none of them examines the validity of the empirical all-sky TLR Discrepancy found by LC11. [J. Ray Bates, Ireland]	Noted. The estimates of ECS and TCR in CMIP6 models are not used in the assessment of ECS and scenario projections, and are furthermore discussed in Section 7.5.
96005	0				Make temperature levels and time periods comparable: Since the AR5 where temperature levels 0.78 (0.72 to 0.85)°C for the period 2003-2012, already new temperature levels and reference periods were introduced in the special reports (e.g. SR1.5: (GMST) for the decade 2006–2015 was 0.87°C (likely between 0.75°C and 0.99°C). Now we find new temperature levels, such as 1) GSAT 1995-2014 relative to 1850-1900 of 0.91°C (Box SPM.2, Table 1 SPM-20:20-22) 2) GSAT 2009-2018 relative to 1850-1900 of 1.10°C (SPM B.2.1 SPM-10:5) We strongly encourage the authors to use as few as possible different warming levels. We also urge the authors to add a table or figure on these different warming levels used in SPM and TS to add transparency and enable readers to compare the different warming levels within and across reports. This table/figure should be added at least to Box TS.1 if not also raised to the SPM. We suggest identifying an "AR5-temperature" that is equivalent to the temperature scale used in the AR5 and that is relevant for the Paris Agreement. [Nicole Wilke, Germany]	Taken into account. All the temperatures provided in the SPM are now compared to 1850-1900. The observed temperature change in the final SPM is provided for the period 2011-2020 and 2011-2020 (see A1.2). The bullet point also explains the difference with temperature estimate in AR5. The cross-sectional box in the TS and the cross chapter box 2.3 includes graphical explanations of the updated temperature assessment.
52485	0				[7] It is noteworthy that on page 3-14, a decrease in skill in the CMIP6 relative to the CMIP5 models in reproducing the historical temperature record is acknowledged: “The CMIP6 results currently available suggest that CMIP6 models reproduce global-scale annual mean surface temperature change over the historical period less well than their CMIP5 counterparts.” [J. Ray Bates, Ireland]	Noted. This conclusion changed based on the full set of CMIP6 simulations available by January 31st 2021 and 3.3.1.1 now assesses "CMIP6 models also reproduce historical GSAT changes similarly to their CMIP5 6 counterparts (medium confidence)."
96007	0				Many statements in the report and its SPM provide a qualitative estimate of the human influence on an observed change associated with a quantitative uncertainty statement (likelihood) (e.g. "extremely likely a substantial contribution", "virtually certain that xx is predominantly driven by human...", "very likely the dominant cause", "very likely contributed", "very likely the main driver", "evidence that xx could not have occurred without human..."). Such statements become quite meaningless, if the level of influence is not quantified. In addition, since size of the likelihood and the stated level of attribution are interdependent, it is confusing to use many different levels. We urge the authors to provide more clarity, in particular in the SPM, including in Table SPM.1. [Nicole Wilke, Germany]	Taken into account. Quantities have been added in the revised SPM wherever possible. For example, 'Main driver of change' is defined as more than 50%. (Please note that Table SPM1 has been removed from the revised SPM, to shorten the document).
52487	0				[8] The Hourdin et al. paper states (p.590): “In fact, the tuning strategy was not even part of the required documenta-tion of the CMIP phase 5 (CMIP5) simulations. In the best cases, the description of the tuning strategy was available in the reference publications of the model-ing groups (Mauritsen et al. 2012; Golaz et al. 2013; Hourdin et al. 2013a,b; Schmidt et al. 2014). Why such a lack of transparency?” [J. Ray Bates, Ireland]	Noted. We include information on whether or not models were tuned to historical warming in Figure 3.4 in this report.
96009	0				Overlap between the chapters as well as between the AR6 and SROCC should be avoided as much as possible. One way to solve it would be to begin the relevant chapters/subchapters withe the main findings of the SROCC and only add new findings since then. An excellent example how it should be done is Ch2.3.3 (oceans). Instead of reporting the progress since AR5 please switch to SROCC whenever appropriate (ocean and cryosphere). [Nicole Wilke, Germany]	Accepted. Where possible progress is reported since the SROCC in chapter 9. Sometimes AR5 is also used where SROCC did not assess or the AR5 assessment is relevant.
52489	0				[9] Section 1.5.3.2 of Chapter 1 does provide a link (page 1-76, line 6) where some useful information on tuning can be found, but this is not equivalent to providing a coordinated assessment of this all-important topic. On page 7-105 it is acknowledged that “Efforts to explain inter-model differences in ECS would greatly benefit from increased transparency about the tuning choices made by individual modelling groups.” [J. Ray Bates, Ireland]	Taken into account. We include information on whether or not models were tuned to historical warming in Figure 3.4 in this report, and the topic is also assessed in Sections 3.2 and 3.3.1.1.
21771	0				There seems to be considerable overlap in the CDR / SRM assessment between 4 and 5 and I am not sure that the balance is quite right or that they are entirely consistent at this stage. [Peter Thorne, Ireland]	Taken into account. Further efforts have been made to reduce overlap and ensure consistency across the WGI Report chapters in the FGD.
96011	0				Please explain why the time periods chosen to describe the future in this report are only 20 years long while climate according to the WMO usually refers to 30-year periods. We would highly appreciate these time periods to be used throughout the entire AR6 including the Synthesis Report. Please see also our comment on the definition of "climate" in the Glossary. [Nicole Wilke, Germany]	Taken into account. Using 20-year periods goes back to AR4 and acknowledges that 30-year averages of the recent past would average over substantially changing states. Twenty years are hence an accepted compromise between resolution and noise.
52491	0				References [J. Ray Bates, Ireland]	Noted.
132365	0				It seems that the Atlas is including a lot of valuable information on model evaluation, in particular at regional scale for mean climate. Could this information be summarized in the Atlas' ES? [Sonia Seneviratne, Switzerland]	Accepted. Two ES statements are now included on model evaluation.
96013	0				Please maintain the definitions of near term (2021–2040), mid-term (2041–2060), and long-term (2081–2100) throughout the report. [Nicole Wilke, Germany]	Noted.
52493	0				Bates, J. R. (2016), Estimating climate sensitivity using two-zone energy balance models. Earth and Space Science, 3, 207–225, doi:10.1002/2015EA000154. [B16] [J. Ray Bates, Ireland]	Noted.
132367	0				I am missing a synthesis on model evaluation across the AR6 WG1 report. Could this be synthesized in a given location across topics (mean climate, water cycle, extremes, regional climate, carbon cycle, cryosphere, ocean, land ...)? [Sonia Seneviratne, Switzerland]	Taken into account. This is found in Section 3.8.2 for large-scale climate indicators.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
96015	0				Regarding the ensemble means of climate projections: A sample that has not been generated by a probability distribution does not allow sound conclusions to be drawn about any probability distribution. The climate projection ensemble is an ensemble of opportunity. In addition, many climate models include a lot of similarities. The combination of these two important properties of multi-model ensembles, arbitrary composition of the ensemble and non-random similarities between the models, means that the resulting climate change signal generated from such an ensemble does not behave like an independent, identically distributed random sample and also exhibits considerable redundancies. In particular, statistical inferences from a non-random sample (multi-model ensemble) on the population (actual climate signal to be expected) are not reliable. Weighting or averaging tends to smooth the results and should therefore not be taken into account. The only reliable information that can be drawn from the ensemble of climate projections is their range. Hence, it does not seem justified that the IPCC still provides ensemble mean/median values, and many experts might not understand the IPCC's approach which is inconsistent with the AR5 (WG I, Ch. 12.2.3, P 1040). We urge the authors to consider this and explain or revise their approach accordingly, e.g. in 04-22-33. [Nicole Wilke, Germany]	Noted/rejected. Box 4.1 does borrow from AR5 Ch12 page 1040 and assesses the literature since then. There is no contradiction here. Lack of model independence is explicitly discussed, including new research showing little effect of independence weighting on global temperature change. The author team disagrees with the statement that ensemble range provides reliable information; the range is more sensitive to outliers from, say, very sensitive models than is the median or the mean.
52495	0				Bony, S. et al. (2016) Thermodynamic control of anvil cloud amount. Proc. Natl. Acad. Sci. USA, 113, 8927–8932, https://doi.org/10.1073/pnas.1601472113. [J. Ray Bates, Ireland]	Noted.
96017	0				The AR6 WG I often refers to "multiples lines of evidence" without specifying them further. Such vague statements are not appropriate for the IPCC. Please provide the reader at least with a list of variables from which such evidence has been obtained in each case. [Nicole Wilke, Germany]	Taken into account. This is done for each individual assessment, and where a specific conclusion is referenced, however in places the simple fact that multiple lines of evidence are in use is what is relevant.
52497	0				Cho, H., C. H. Ho, and Y. S. Choi (2012), The observed variation in cloud-induced longwave radiation in response to sea surface temperature over the Pacific warm pool from MTSAT-1R imagery. Geophys. Res. Lett., 39 , L18802, doi:10.1029/2012GL052700. [J. Ray Bates, Ireland]	Noted.
96019	0				The FAQs 1.3 and 9.1 touch on issues related to tipping elements/points, but those terms are not mentioned. Either mentioning and contextualizing the terms within these FAQs or creating a separate FAQ on tipping elements would be advisable. [Nicole Wilke, Germany]	Accepted. Chapter 1 now includes extended discussion of these terms, in section 1.4.
52499	0				Choi, Y.-S., H. Cho, C.-H. Ho, R. S. Lindzen, S.-K. Park, and X. Yu (2014), Influence of non-feedback variations of radiation on the determination of climate feedback. Theor. Appl. Climatol., 115, 355–364. [J. Ray Bates, Ireland]	Noted.
96021	0				The individual chapters use different observational products for temperature, HADCRUT 4 or 5, HADISST. However these are not the only products available, and there is no justification given why a specific product has been used and why others are rejected and/or not mentioned. This might be also true for other observation based data, but we have not checked. [Nicole Wilke, Germany]	Taken into account. Further efforts have been made to improve consistency in this regard. Where the analysis relies upon work by others this cannot be rectified however for obvious reasons.
44053	0				We would like to thank the WGI AR6 author team, the Co-Chairs and TSU very much for their hard work! [Lamin Mai Touray, Gambia]	Noted with thanks.
52501	0				Christy, J.R. and R.T. McNider (2017). Satellite Bulk Tropospheric Temperatures as a Metric for Climate Sensitivity. Asia-Pac. J. Atmos. Sci., 53(4), 511-518. DOI:10.1007/s13143-017-0070-z [J. Ray Bates, Ireland]	Noted.
96023	0				The time frames chosen to describe the future in this report do not reflect the common understanding of most policy makers: in politics, 2030 is generally used for short-term goals. 2050 and beyond is referred to as long-term. We also do not find the rationale for choosing these periods convincing, as explained in a more detailed commentary on Table TS.4. To avoid misunderstandings, we ask the authors to spell out the time periods and name the years explicitly instead of using the nicknames "near/mid/long term". We would also very much welcome it if the periods used in this report were used consistently throughout AR6, including the synthesis report. [Nicole Wilke, Germany]	Rejected. The author team is very frequently asked to use more reader-friendly language, and the monikers for the time periods helps in that. The periods are explicitly defined in the appropriate places.
52503	0				Donahue, A. S., & Caldwell, P. M. (2018). Impact of physics parameterization ordering in a global atmosphere model. Journal of Advances in Modeling Earth Systems, 10, 481–499. https://doi.org/10.1002/2017MS001067 [J. Ray Bates, Ireland]	Noted.
96025	0				There is much overlap between Ch4 and Ch9 regarding AMOC, sea level, sea ice, and some statements differ. Apparently the projections of these topics are discussed in both chapters. For ocean temperature and ocean heat content: there is overlap between Ch2, Ch7 and Ch9. Please see also our comment on the Entire Report regarding the lack of consistency across chapters. [Nicole Wilke, Germany]	Accepted. Consistency across chapters has been checked. This is the case with ch 4 and 9 and ch 2, 7 and 9.
114713	0				There is a ongoing WGI - WGIII effort to develop/revise the defintions for net zero CO2, net zero GHG, carbon nutrality and GHG neutrality. These draft definitions are shared with chapters 1, 4, 5 and 7. Please consider these and update your chapter texts if needed. And please give feedback to the drafting team if you have comments on the suggested definitions. [Jan Fuglestvedt, Norway]	Taken into account. We have established several cross-working group teams of authors to help address overlaps and inconsistencies, and to ensure proper handshakes between the 3 working groups.
52505	0				Hourdin, F. et al. (2017). The art and science of climate model tuning. Bull Am Meteor Soc., 98, 589-602. [J. Ray Bates, Ireland]	Noted.
96027	0				There is much overlap between Ch9 and Ch2 (2.3.3 Oceans) regarding ocean temperature, sea level, salinity, and ocean circulation especially western boundary currents and ACC and AMOC and also overlap with Ch4 and partly Ch3. Please see also our comment on the Entire Report regarding the lack of consistency across chapters. [Nicole Wilke, Germany]	Noted. This is as scoped. Further efforts have been made on coordination.
114715	0				We need to clarify how we can refer to WGII and WGIII - given that WGI will be published first. [Jan Fuglestvedt, Norway]	Taken into account. As WGI is published before the other two WG reports. References to the other WG reports are set at the Chapter or Whole Report level, as defined by their approved outlines.
52507	0				Lindzen, R. S., Chou, M. D., and Hou, A. Y. (2001). Does the Earth Have an Adaptive Infrared Iris? Bull. Am. Meteorol. Soc. 82, 417–432. [J. Ray Bates, Ireland]	Noted.
96029	0				This report describes the intent or the purpose of figures in addition to the information in caption supporting the understanding figure. We appreciate this additional information and hope it will be added to all figures of the SPM and the TS. However, there is no need to explicitly state "The intent/purpose of the figure is to", it's enough to write "This figure shows/highlights/explains...". [Nicole Wilke, Germany]	Taken into account. The intent is now integrated in the figures of the SPM without mentioning that this is the intent. For the TS however, the word intent is still mentioned to avoid any ambiguity (because it is included in the caption)
114717	0				Stronger coordination of the format of the Executive Summaries are needed. Some start with an intro giving overview of teh chapters, while others go directly to a statement [Jan Fuglestvedt, Norway]	Taken into account. More specific guideline have been given to the chapters and all the ES have been reviewed by our scientific editor.
52509	0				doi:10.1175/1520-0477(2001)082<0417:DTEHAA>2.3.CO;2. [LCH01] [J. Ray Bates, Ireland]	Noted.

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132127	0				I have a major concern with the choice of observations realms covered by Chapter 2, which do not include "Land". This is inconsistent with the recent publication of an IPCC report on "Climate Change and Land". The Biosphere cannot be considered equivalent to Land. A substantial fraction of the land area is not covered by vegetation, and there is also biosphere in the ocean. Variables that could be covered under "Land" include soil moisture, runoff, lakes, soil heat storage, land surface temperatures and albedo, all of which are observed. [Sonia Seneviratne, Switzerland]	Rejected. See responses to numerous comments by same reviewer on same topic on chapter 2. Chapter 2 has discussed this repeatedly at length since receipt of FOD reviews and sees no way that retains narrative integrity to do this. Chapters 2-3-4 are also very concerned about implications of such a major rewrite adding fundamentally new material which would not benefit from any formal review. As noted in numerous responses edits have been made to more strongly emphasise terrestrial aspects.
96031	0				Throughout the report, there are quantitative figures provided for the recent warming level observed. Sometimes warming trends are given using ordinary least squares metric, sometimes the temperature was assessed by the difference of median temperature of two time periods (there are many time periods assessed). And there is also the difference in GSAT and GMST. This is extremely confusing and does not provide the clarity policy makers need with regard to the important quantification of temperature rise. We strongly urge the authors to revise at least the SPM and TS and ensure that the reader understands the diversity of information provided, also in relation to previous IPCC reports, the remaining Carbon budget, and in relation to the temperature goals of the Paris Agreement. We also suggest to add a table to the TS comparing the different warming levels to facilitate the comparison to earlier reports. [Nicole Wilke, Germany]	Taken into account in the redrafting of Cross-Chapter Box2.3.
114719	0				The use of GMST and GSAT will be important to clarify early in the report. It needs to be explained both in SPM, TS. In the main report, its main place to be discussed is defintely ch2, but a couple of sentences in ch1 are needed since the framing, context etc is given there. Could fit well in section 1.4 [Jan Fuglestvedt, Norway]	Taken into account. Section 1.4 now includes some words on this topic, as does Cross-Chapter Box2.3. However the need for distinguishing the two has lessened somewhat since the SOD (see Cross-Chapter Box2.3).
52511	0				Lindzen, R. S., and Y.-S. Choi (2011). On the observational determination of climate sensitivity and its implications, Asia-Pacific J. Atmos. Sci., 47, 377–390. [LC11] Li, R.L. (2019) A Positive Iris Feedback: Insights from Climate Simulations with Temperature-Sensitive Cloud–Rain Conversion. J. Climate, 32, 5305-5324 [J. Ray Bates, Ireland]	Noted.
80417	0				Dataset and region acronyms need to be homogenized across all chapters, TS, and SPM [Paola Arias, Colombia]	Accepted. Great efforts were undertaken to ensure cross-chapter consistency.
96033	0				To convert model results for global warming provided for the period 1995–2014 to pre-industrial an offset of 0.91°C is indicated in this report while the AR5 indicated 0.61°C for a period a decade earlier. AR6: "The observed warming in 1995–2014 relative to 1850–1900 is 0.91°C (0.78–1.05°C)." AR5: "The 1986–2005 period was approximately 0.61 [0.55 to 0.67] °C warmer than the period 1850–1900. " This would mean that the period 1995–2014 was by 0.3°C warmer than the period 1986–2005? Does the new value include the additional warming of the recent decade but also both the switch from GMST to GSAT and reassessment of the historical temperature? Does it, therefore, convert the AR5 to the AR6 temperature scale (including the switch from GMST to GSAT and the reassessment of the historical temperature)? Would it be possible to provide an offset for the AR6 values but in the AR5-temperature scale, i.e. considering only the additional warming of the recent decade? Please clarify this highly important issue including at SPM-20-21, TS-24-36, and TS-30-40. [Nicole Wilke, Germany]	Taken into account in the redrafting of Cross-Chapter Box2.3.
52513	0				Mauritsen, T. and Stevens, B. (2015). Missing iris effect as a possible cause of muted hydrological change and high climate sensitivity in models. Nat. Geosci. 8, 346–351. doi:10.1038/ngeo2414. [MS15] [J. Ray Bates, Ireland]	Noted.
132131	0				As mentioned,I have a major concern with the choice of observations realms covered by Chapter 2, which does not include "Land". Note that this choice is also inconsistent with much of the text of chapter 1, which clearly outlines that the Earth System can be subdivided in 5 realms: Atmosphere, Ocean, Cryosphere, Biosphere and Land (see from page 10, line 55 to page 11, line 1, and Section 1.5.1.1). However, Figure 1.2 would need to be edited in chapter 1 to subdivide the category "Land and biosphere" in two (one on"Land" and the other on "Biosphere"). [Sonia Seneviratne, Switzerland]	Taken into account. Terrestrial aspects have been bought out more clearly. However, the use of land as its own category has been discussed in depth across 2-3-4 and the decision made not to add a separate category for reasons of clarity and to avoid adding a very large change without the opportunity for formal review.
96035	0				We appreciate the authors' efforts to include the most recent knowledge in the report. However, we are very much concerned about the many instances in this report that contain placeholders, since the literature was not yet available at the time of writing. To ensure that the assessments that are added only after the SOD review can be reviewed at all, we strongly suggest an additional internal expert review similar to the ZOD review. [Nicole Wilke, Germany]	Noted. An internal review was conducted before FGD.
52515	0				Vaillant de Guélis, T. et al. (2018). Space lidar observations constrain longwave cloud feedback. Sci. Rep. 8, 16570. doi:10.1038/s41598-018-34943-1. [J. Ray Bates, Ireland]	Noted.
132133	0				As mentioned in previous comments, I am deeply concerned with the choice of the chapter 2 authors not to include "Land" as one of their considered Earth System realms. I had also commented on this point in the FOD, but this does not seem to have been taken into account. Note that this leads to the following sentence in TS (taken from the chapter 2 ES) which makes "land" totally disappear from the Earth's system:: "Directly observed atmospheric, oceanic, cryospheric and biospheric changes provide unequivocal evidence of a warming world". In addition, the chapter 2 ES does not provide any statistics of changes in climate over land, although most of our observational data are over land. This seems a bit gap when considering that one of the most used picture of the IPCC land report distinguishes long-term changes in temperature on global scale and over land. [Sonia Seneviratne, Switzerland]	See response to 132127

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89893	0				1. It is our view that WG1 authors , Co-Chairs and TSU have done a very good job so far for which they must be congratulated. We are very much appreciative for the hard work which went into this SOD. We are of the view that the SOD so far is sending some of the right signals for the most part. 2. We have some concerns related to the introduction and treatment of the new metric for global mean temperature, in terms of the approach of moving away from the GMST to the new GSAT and particularly the method used to constrain the new GSAT to be in line with the GMST. This is a major issue that is very confusing for us and it bring a lot of uncertainty which is not easily explained and which makes understanding the change, the usage and the reason for constraining the new indicator to fit onto the GMST, very difficult. It is very important that this new metric be relatable to the AR5 and therefore it would also be helpful for the authors to bring clarify on how the information presented on the GSAT compares with what obtained in AR5, because signficant decisions were made at the Paris Agreement based on the GMST as contaiined in the AR5. 3. We also have some concern with regard to the use of the year 1750 as a defining baseline related to pre-industrial and how to justify changing the baseline from that which we have already briefed policy-makers on. This will only act to create confusion and raise additional questions, including on the treatment of climate sensitivity. [Joanne Deoraj, Trinidad and Tobago]	Taken into account in the redrafting of Cross-Chapter Box2.3.
96037	0				We are concerned that this report is policy prescriptive in some formulations. We strongly urge the authors to either remove such text or to use other wordings. This includes recommendation of GHG metrics, recommendations regarding mitigation of SLCF, combination of AQ measures and climate policy, recommendation of the remaining C-budget as a means to quantify mitigation targets, recommendation of CDR in case of missed emission targets. [Nicole Wilke, Germany]	Taken into account. Policy prescriptive language throughout the report has been modified to use neutral wording
32293	0				The AR6 WG1 SOD is very promising and the outline seems efficient to highlight new features compared to the AR5 WG1 report. The regional chapters bring new synthesis upfront that should be directly used by other AR6 Working Groups and various stakeholders. [Eric Brun, France]	Noted, with thanks.
52517	0				Williams, I. N., and Pierrehumbert, R. T. (2017). Observational evidence against strongly stabilizing tropical cloud feedbacks. Geophys. Res. Lett. 44, 1503–1510. doi:10.1002/2016GL072202. [J. Ray Bates, Ireland]	Noted.
96039	0				We are very concerned about the fact that Ch4 and Ch7 seem to rate the quality of CMIP6 results very differently. While Ch7 clearly excludes some models that are labelled "too warm", Ch4 is relatively optimistic. For example, Ch7 distances itself from model ensembles, Ch4 does not. Strangely enough, the reason for the possible overestimation of warming (extratropical cloud feedback), is to be found in Ch7 and not in Ch4. It is very important that the authors of Ch4 and Ch7 coordinate better to provide consistent information. [Nicole Wilke, Germany]	Taken into account. Ch04 and Ch07 have coordinated very closely, including the use of Ch07-assessed TCR and ECS in the GSAT-change assessment in Ch04. It is the Ch07 mandate to provide the process understanding for ECS and TCR. The perceived "exclusion" of models in Ch07 concerns the use of the CMIP6 models as an independent line of evidence in assessing ECS and TCR -- they are not used for that task, but they are not excluded wholesale by Ch07. Language in Ch04 and Ch07 has been scrutinized such that the scope for misunderstanding is minimised.
32295	0				Since the cut-off date for the literature has been extended, new results will be published including some important ones exploiting additional CMIP6 simulations. We are confident that the authors will update some of the main findings of the report in coherence with the general comments made on the SOD. [Eric Brun, France]	Noted. Assessment has been updated with literature available until the cut off date.
96041	0				We consider illustrations a very important communication tool in IPCC reports and thank the authors for providing many helpful figures. To further enhance their usefulness, we would like to make some suggestions for improvement. Please ... ... do not introduce completely new concepts in figures without explaining them in the main text, ... do not use abbreviations without explanation in captions, as illustrations are often used independently of each other, ... adjust the lengths of the axes (e.g. Figure TS.26). ... explain all letters, shades, lines, dots, dots and lines in your illustrations. ... do not overload the illustrations and remember that the report must be readable without a magnifying glass (e.g. Figure TS.26, TS.23 and TS cross section box Fig. 2+3). [Nicole Wilke, Germany]	all these suggestions have been taken into account and the visual guideline document provided to chapters has been updated to reflect them
32297	0				At this stage, most chapters are too long and would benefit from cleaning. Part of it could be achieved by avoiding too many overlaps between the first chapters (2 to 4) and the process chapters (5 to 9), or between the process chapters and more regional chapters (10 to 12). This is true in particular for model evaluation, where part of the evaluation should be in the process chapters with the understanding of the causes (when possible) of mismatch between model and observation, or of improvement between CMIP5 and CMIP6 or improvement in regional simulations and downscaling. [Eric Brun, France]	Accepted. We have worked to remove overlaps in model evaluation between Chapter 3 and process chapters.
96043	0				We encourage all Working Groups to provide the figures/graphics in an integrated manner at the locations in the report where they belong, rather than at the end of the report. This would greatly facilitate the review. Thanks in advance, if you implement this plea for future reviews. [Nicole Wilke, Germany]	Noted. Chapters are compiled as such for practical reasons during the drafting and reviewing process.
32299	0				The different chapters seem still a little bit conservative in their content, trying to cover as much aspects as they can, but some of the messages that are only partially treated in different chapters could be stronger if the information was clearly visible in one place. The chapters would also be shorter, which would be better for capturing the attention of the reader. [Eric Brun, France]	Noted. The report follows the approved outline for its preparation (including length of chapters). Since the SOD, a lot of efforts have been dedicated to better cross-chapter coordination, to reduce inconsistencies and avoid overlaps. Please note however that some topics have to be covered in various chapters, in this case the technical summary is meant to integrate the findings from the various chapters.
96045	0				We highly appreciate the provision of information about the level of knowledge, limits to the assessment, uncertainty and confidence for most of the relevant statements. We consider such information to be crucial for understanding the assessment and for the credibility of the IPCC's work. It is well known that the perception of uncertainty varies widely depending on social, cultural and professional background. Therefore, when talking about knowledge gaps, limits to the assessment (Ch1), or using expressions like "deep uncertainty", please keep in mind how non-scientific audiences might perceive your statements or how they could potentially be twisted in polarized debates. Therefore, we would like to encourage the authors to carefully explain the reasons for the levels of uncertainty, for example if they are due to a lack of observational data before 1950 or 1970, and their scope, i.e. if an uncertainty/confidence level is relevant for a detail but does not affect an overarching finding. Please verify throughout the report. [Nicole Wilke, Germany]	Taken into account. This topic has been widely discussed in preparation of the final version of the report, and is hopefully now better covered and represented. Chapter 1 includes discussion on various sources of uncertainty, including "deep uncertainty", and some pointers for how they should be read and interpreted.

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32301	0				For many original analyses of the report, in the different chapters, a lot of important information is often missing in the legend. For example, how the significance of the trends or of the changes is assessed is not discussed most of the time. The method used to define the "robustness" or the "consistency" of the changes between models is generally not explained in the legends. The method used to regrid climate model outputs (algorithm, resolution of the destination grid, how land and sea points are dealt with etc..) is almost never described, while it may have some impacts concerning extremes or coastal areas. The sample of CMIP6 models used for each analysis is rarely given etc. [Eric Brun, France]	Taken into account. A consistent methodology for representing the significance of observation data or robustness/significance of projections has been developed for FGD. The methodological details are described in Cross-Chapter Box Atlas.1 and a short explanation has been systematically added to the relevant captions
132143	0				It is essential that the AR6 addresses clearly the question of the "global average temperature" definition and how this affects assessments. I suggest to introduce a new acronym distinct from either GMST and GSAT to refer to the concept "global average temperature" which is the term used in the Paris Agreement (e.g. Tglob or global warming (GW) if only refering to anomalies - note that GW was generally used in the IPCC SR15 for this purpose). Choosing instead either GMST or GSAT would else seem arbitrary. [Sonia Seneviratne, Switzerland]	Rejected. Instead Cross-Chapter Box2.3 has been redrafted to clarify.
96047	0				We note that WG I aims to become directly relevant to policy makers by also addressing the human dimension of physical and meteorological phenomena. We also highly appreciate the increased awareness of the information needs of the other two working groups, which will improve the quality of AR6. However, we are very concerned that in some cases the current assessment is presented in a way that seems to go beyond the mandate of WG I, namely the assessment of the physical science basis. This concern applies, for example, to Ch12, to the discussions on frameworks and values, and to the redefinition of the IPCC's risk framework (renaming hazard to CID, please see also our comments on this topic). Each WG should please remain within the area for which it is responsible and most competent in order to avoid conflicting information or duplications between WGs. On the other hand, it would be extremely helpful if the authors of WG I could make the report more policy relevant and useful by providing explanations of new approaches and methods to help the readers' understanding. At the moment, however, important information is missing, e.g. how the new temperature scale or the higher ECS should be interpreted in the political context of PA, please see our related comments. [Nicole Wilke, Germany]	TAKEN INTO ACCOUNT: We have continued to define and expand the use of the Climatic Impact-Driver framework across chapters of WGI and across all WGs of AR6. CIDs are now defined in the glossary and included in the Risk Guidance Document prepared for AR6 (IPCC, 2020). CIDs are used precisely to distinguish the generation of relevant climate information in WGI from its interpretation as beneficial or detrimental, which is context-specific and therefore determined in WGII. These documents make it clear that CIDs is not a replacement for 'hazard', but is a more generic term that can become 'hazard' when directly associated with a detrimental outcome (which is not universally the case). This implies a stronger role for WGII, in the end, as WGI is not the place to determine a general outcome of a climatic change. WGI also discusses frameworks and values (e.g., in CH10 and Section 12.6) because these are intrinsically linked to the creation of climate information, leading to potential biases that must be considered even in the physical science presentation of WGI. This recognition is also important as WGII and other groups utilize the resulting climate information for further risk assessment. In these ways we feel WGI is more policy- and decision-relevant, and leads to a more robust connection with WGII endeavours.
32303	0				Some of the methodological questions noted above might be discussed in a chapter, cross-chapter box etc., but if it is the case, the information would be hard to find. The readers cannot be expected to read the entire report, important information should be easy to find. [Eric Brun, France]	Noted. Report key findings and advances in science are highlighted in the summaries (TS and SPM), which refer back to the relevant parts of the main report. Furthermore, each chapter contains a visual roadmap at the start that highlight what key topics, boxes etc are contained within each chapter. We hope that this will make topics more accessible to interested readers.
96049	0				We strongly urge the authors to carefully verify each and every definition and any reference to issues and decisions related to the UNFCCC since these wordings are the result of negotiations and should please not be changed. The AR6 contains appropriate formulations regarding for example the global stocktake glossary that is even wrong by omitting the reference to Art. 2.1.c and mentions a "ratchet mechanism". Paris Agreement definition in the glossary should please cite verbatim from the agreed text and not use free language. [Nicole Wilke, Germany]	Taken into account, as far as possible within the limits of the text and glossary items.
32305	0				A technical annex with a description of all the relevant methods repeatedly used for the analyses through the report would be extremely useful. By the way, it is not clear whether the methods used for the original analyses of the report, to assess the significance of the trends, the robustness of model results, to regrid model outputs etc. are consistent across analyses and across chapters. If not, it is very unfortunate. [Eric Brun, France]	Noted. Cross-chapter coordination across WGI have taken place for consistent treatment of the methods used including the significance of the trend and the robustness of model results.
96051	0				We urge the authors to avoid the expression "baseline scenario" or "baseline" as introduced in 1.4.1 and TS.1.4. Although this might be a common term in the modelling community the expression will be confusing for non-scientists, in particular because the term is not consistently used across WGs, please see https://www.ipcc-data.org/guidelines/pages/glossary/glossary_b.html. [Nicole Wilke, Germany]	Rejected. We see the point, but this term is so central to the discussion of WG1 that it cannot be avoided. Rather, we have attempted to provide a clear definition and rigorous usage throughout the report. Section 1.4.1 opens with the definition: "Baseline refers to a period against which differences are calculated whereas reference period is used more generally to indicate a time period of interest, or a period over which some relevant statistics are calculated."
32307	0				The programs used to do all the original figures in the report, with all the steps (from pre-processing to plotting) could eventually be provided, which would mitigate the issues mentioned above. For the time being, trying to fully replicate many original analyses shown in the report is complicated given the incomplete information currently provided. It is an important question because the IPCC reports should beyond reproach with regard to replicability and reliability, especially at the time of the replication crisis. [Eric Brun, France]	A process for data curation is ongoing and involves archival of input datasets, codes, and final datasets. Further information can be provided by the TSU.
96053	0				When selecting specific wording, especially for section headings, please take into account the very different backgrounds and contexts of your diverse readership. Please also take into account that many readers may not be familiar with the WG structure of AR6 and expect information in the WG I report that will actually be available in another WG. A typical example of an opportunity to better managing readers' expectations is the topic of land use and land use change: the chapter and section headings imply that all physical/natural/life science aspects of climate change should be covered. And indeed, WG I assesses information on the ocean, the cryosphere and the hydrological cycle, but it is much less comprehensive in relation to land issues (terrestrial biosphere, soils, land use and land use change), as these are dealt with in other WG reports. On the other hand, some of the information on land is hidden" by more academic terminology, e.g. in the chapter on the carbon cycle. We encourage the authors to be as explicit as possible in their language to further improve the usability of the information provided. " [Nicole Wilke, Germany]	Taken into account. Chapters have tried to tried to make their content more accessible by carefully reconsidering the names of the their section headings. Additionally, a consistent set of visual guide/roadmap was developed for each chapter and they all include 'quick guides'. Those figures will, hopefully, help the unfamiliar readers to find the information they are looking for.

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32309	0				“Box” and “Chapter box” are two different ways to say the same thing, which can be confusing. It would be better to use only “Box”. [Eric Brun, France]	Taken into account:. The only terms used are "box" and "cross-chapter boxes". Boxes contain material relevant to several sections within a chapter while cross-chapter boxes are relevant to several chapters
132407	0				A forcing that is not receiving sufficiently attention in the report is land use / land cover forcing on climate, considering both biophysical (albedo, evapotranspiration) and CO2 effects. This would belong in chapter 7 because long-lived. However, note that the regional scale of biophysical land use forcing can be of relevance for comparison with some forcers (aerosols) considered in chapter 6. [Sonia Seneviratne, Switzerland]	Taken into account. These are assessed in Section 7.3 and in the biophysical feedback assessment of Section 7.4
32311	0				More explicit reference should be made to previous reports (SROCC, SRCCL, SR1.5, AR5). In addition, advances and changes to what was assessed in these reports should be mentioned more systematically. [Eric Brun, France]	Taken into account: the rule for the chapters is to start their sections with the assessment of the special reports. If a topic was not covered in the special reports, then the starting point is AR5. This structure should, in theory, enable an easy comparison with previous reports
32313	0				The units GC and GTCO2 must be standardized. We propose to keep only the GTCO2 unit where it is relevant. [Eric Brun, France]	Taken into account. Although both PgC and GtO2 are still used as this is a reflection on how topics are covered in the scientific literature, greater efforts for understandability have been implemented. The Technical Summary also now includes a conversion between the two.
22075	0				There remains a degree of constructive ambiguity between chapters 5 and 6 as to whether Methane constitutes a long lived or a short lived forcer. To an extent this is because it falls almost uniquely between these two stools (certainly in terms of the major forcers) but readers presently could easily to a degree play spot-the-difference between the various characterisations (of which there are many, particularly so in chapter 6) to construct an arguement of confused messaging. One way to deal with this would be to reduce the number of times quasi-definitional aspects are covered redundantly (an issue mainly but not exclusively pertaining to chapter 6) [Peter Thorne, Ireland]	Noted. Confusion regarding methane has been eliminated. Methane is well-mixed greenhouse gas as well a short-lived climate forcer
32315	0				References need to be more diverse, especially geographically. We have the impression on certain subjects that there is an under-representation of the countries of the Southern Hemisphere. In addition, many publications are also somewhat outdated and could be updated. [Eric Brun, France]	Taken into account. Where appropriate, efforts have been made to further improve regional diversity in the literature cited and to cite post-AR5 and post-AR6 Special Report literature where it supersedes earlier literature.
114751	0				"Emergence" is a concept that has been used in two meanings in SOD: 1) Emergence of human-induced climate change and 2) emergence of signal of mitigation. We need to coordinate the use of the concepts. [Jan Fuglestvedt, Norway]	Accepted. This is clarified in 1.4.2.2, and in 4.6.
114753	0				As pointed out by one of the CLAs during the last plenary, we need some extra efforts on adressing deep uncertainty; a relatively new concept (introduced in SROCC) but yet still a bit new in its appliciation [Jan Fuglestvedt, Norway]	Noted. Deep uncertainty has been addressed in more detail. Particularly covered in Box 9.4 and references therein.
114755	0				A common xWG box on attribution has been mentioned. I don't think the three WGs can have the same box on this, since the applications and perpectivs are different, But they can have coordinated boxes on this. Implemetation of this would benefit from bureau suport. [Jan Fuglestvedt, Norway]	Taken into account. A Cross-Working Group Box on Attribution is included in Chapter 1 in the Final Draft.
132165	0				Given the issues with the definition of global warming (depending on definitional choices) identified since the AR5, and the fact that this depends on the considered warming over the different components (ocean, land, sea ice), it is essential that the AR6 gives a key priority to the separate assessment of: 1) global warming over the oceans (without sea ice points), 2) global warming over the oceans in areas covered by sea ice at some point in pre-industrial time), 3) global warming over land points (without snow or ice-covered areas), 4) global warming over land points that had snow or ice at some point in the pre-industrial period) and 5) the combination of these statistics in different forms: a) Global warming total, b) global warming over land, c) global warming over the oceans. Being more explicit about the contributions of different Earth System's realms to the overall warming will help clarify many misunderstandings. [Sonia Seneviratne, Switzerland]	Taken into account. Several of these diagnostics are assessed in chapter 2.
37191	0				In order that there is no confusion or ambiguity over this report, the preface or induction to the report and to the SPM (because it might be read in isolation) need to include a statement that shows both the designated role of the IPCC and the IPCC's relationship to the UNFCCC. [John McLean, Australia]	Taken into account. This is presented in section 1.2.2.
114761	0				More coordination about the coverage of topics and interface is needed between ch6 and ch7 [Jan Fuglestvedt, Norway]	taken into account, coordination between chapter 6 and 7 has been reinforced.
132171	0				All three global chapters (2, 3 and 4) should be using land as one of the realms for subset of analyses: Atmosphere, oceans, land, cryosphere, biosphere. Land and biosphere are not synonyms, many land indicators are not related to biosphere: e.g. soil moisture, runoff, lakes, land heat storage, land surface temperature. Ignoring land is not acceptable after having a full report on "Climate change and land". [Sonia Seneviratne, Switzerland]	See response to 132127
114763	0				The difference between emission based ERF and abundance based ERF must be made more clear. This is not only an issue for Ch6 and Ch7. [Jan Fuglestvedt, Norway]	Done
22861	0				There is a large degree of overlap between chapter 10 and much of the rest of the report, but in particular chapter 1. There needs to be much improved coordination between chapters 1 and 10 and chapter 10 needs to in general far better link to the remaining chapters. [Peter Thorne, Ireland]	Taken into account. Chapters 1 and 10 have had extensive coordination during finalization of the report.
114765	0				Early in the process of writing WGI AR6 it was decided to use a core set of scenarios across the chapters. These are SSP1-1.9, SSP1-2.6, SSP2-4.5, SSP3-7.0, SSP5-8.5 (with additional scenarios where appropriate). It would strenghten the report if these are used throughout chapters. That will also support a better integration across chapters in the TS, SPM and also finally in SyR. [Jan Fuglestvedt, Norway]	Taken into account. It is not always possible to display all core scenarios, for example when ranges are shown or in the extension beyond 2100. Care has been taken to harmonise to the extent possible.
99919	0				Each of the 12 chapters included here start with a TOC, then an Executive Summary, then in many cases a roadmap for the chapter. In the interest of consistency, this type of figure should be included at the beginning of each chapter. Chapter 1 has a basic roadmap showing what and where within the chapter. Chapter's 2, 5, 7, 8, 9 and 12 each have more than just the basic roadmap, often including a visual depiction of the chapter topics in addition to the simple roadmap. Chapter's 3, 4, 10 and 11 have no roadmap or visual depiction of their contents. Since the reader of this report may be anyone from the average citizen or lay person to the policy maker to the highly educated scientist, might it not be a good idea to have something at the beginning of each chapter that would help these readers, at whatever level, better understand the topic of the chapter and it's role in the climate change issue? [Dan Helman, United States of America]	Accepted. A visual roadmap is now included for all chapters.

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114767	0				Given the selected core set of scenario we also need to consider again which to focus on in the TS and SPM. The general view was to show as many as possible (e.g. in time developments of GSAT) with the possibility of using vertical bars for 2100 along side the graph. But when it comes to maps we often choose a high and low. Should these be 8.5 and 1.9? I think we should take a holistic view on the report on the choice if scenarios that the chapters focus on. And I think we can we learn something from WGIII here. [Jan Fuglestvedt, Norway]	Noted.
99921	0				It strikes me that the use of IPCC calibrated language to reflect confidence in key findings is so critical to the understanding of all portions of the entire report, might it be an idea to include a modified version of Box 1.1, Figure 1.1 in a side bar or information box at the beginning of each chapter and any other section of the entire report where they are used. This would help to better explain exactly what each of the various likelihood qualifiers mean both verbally and as percentage intervals. [Dan Helman, United States of America]	While this is an interesting suggestion, the authors decided that the best use of their limited number of pages (as decided by the IPCC Plenary) was for each chapter to use the uncertainty language which is described in detailed in Box 1.1 (Chapter 1). In addition, the SPM and TS have footnotes that explain the IPCC uncertainty language.
114769	0				We need to follow what we agreed upon at LAM3 regarding labelling of the periods around 1750 and 1850-1900 [Jan Fuglestvedt, Norway]	Taken into account. This has been discussed and implemented for the final report.
87125	0				The work done so far by the authors on this Ar6 report is extremely good and we are very grateful . We wish to highlight a point here which encompasses the essence of the report in a sense which is a problem area for us. The treatment of of global mean tempearture is very confusing expecially because we are unable to make the connection to the approach taken in the AR5. We fear that in 'bias-correcting' GMST and changing to GSAT the connection to the Paris Agreement is lost and could be problematic for the policy makers. [Jacqueline Spence, Jamaica]	Taken into account in the redrafting of Cross-Chapter Box2.3.
114773	0				We had very useful webinars and BOGs on temperature trends and metrics and it is very important that this process is followed up and that clarity and transparency is secured. [Jan Fuglestvedt, Norway]	Taken into account in the redrafting of Cross-Chapter Box2.3.
78935	0				We thank the authors and the WGI bureau for this substantial work. It is enormous and an important information source bringing together essential information on many aspects of the climate system. We believe however that with a little more work on the SPM the messages will better reach the policymakers and the citizens and have more impact. [Martine Vanderstraeten, Belgium]	Taken into account. The SPM has been streamlined, clarified and simplified.
10329	0				The term "Little Ice Age" is used throughout the report. Please could the authors consider refraining from using this inaccurate term to describe a period of perceived climate change. The term is highly misleading for a number of reasons. Climate was nowhere near as cool as an actual ice age. The term was first used to describe the period since the early Holocene of glacier growth in Sierra Nevada, California by François E Matthes in 1939 (Matthews and Briffa, "The 'Little Ice Age': re-evaluation of an evolving concept" Geogr. Ann., 2005). The term has evolved to be associated with many different climate anomalies in different periods, anytime since the 13th century up to the start of the 20th century, including in past IPCC assessment reports. In this report I have noted the following periods being called "LIA" in different chapters: '1450-1850', '1400-1800', '1300-1850', and 'late 1700s to mid 1800s'. The evidence for it to have been coherently cool is debatable (Neukom et al., "No evidence for globally coherent warm and cold periods over the preindustrial Common Era", Nature 2019). Its continued use will sadly only cause further confusion within climate circles, and - more importantly - to those outside climate research (Lockwood et al, "Frost fairs, sunspots and the Little Ice Age", Astronomy and Geophysics, 2017). [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. The terms little ice age and medieval climate anomaly have been deprecated in the FGD.
10331	0				I would recommend someone, who is familiar with the previous assessment reports, do a keyword search for references to the ARs in the chapters to make sure that previous assessments are not mis-quoted. I have noticed a few over-enthusiastic interpretations of what has been previously said in AR1-5 being included in a few chapters, I suspect there are more in other chapters. [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Scientists involved with the previous reports have been encouraged to review the report. With that we hope that misinterpretation of previous IPCC findings have been identified by during the SOD review.
35419	0				The AR6 is well developed and offers tools that will allow us to delve into future studies on Climate Change and in decision-making on “the defining challenges of the 21st century: human-induced climate change” [Gladys Linares-Fleites, Mexico]	Noted with thanks.
36443	0				The details of cited papers are given in this report but not those of the expert judgement on which several chapters rely. (Chapter 3, 6, 7 and 10) explicitly mention expert judgement being relied upon and chapters 9, 10, 11 and 12 cite material that relies on expert judgement.) If the IPCC is to be open and transparent, as the "Principles governing IPCC work" states, then full details of the expert judgment must be provided. This should cover what questions were asked of experts, who the experts were and the replies of each of them. [John McLean, Australia]	Unclear what is being referred to as the expert judgement studies discussed in chapters are already explicitly cited in the corresponding report text. Note that the key conclusions of IPCC reports are expert judgements made by the report authors, stated using IPCC confidence language, and with supporting lines of evidence outlined.
10333	0				I strongly recommend the report does not use the term "Medieval Warm Period". It is an inaccurate term, and puts in the readers' mind that it was warm uniformly over some ill defined period (Neukom et al., "No evidence for globally coherent warm and cold periods over the preindustrial Common Era", Nature 2019). The previous IPCC report used "Medieval climate anomaly", so it is a retrograde step to go back to using MWP. The word "Medieval" refers to a historical period, 5th to 15th century, in mostly western Europe. To use the word in a term to associate with climate in other parts of the world is a rather old fashioned way of doing things, not fit for the 21st century. The references that point to some climate change during the "MWP" are not all referring to the same period that is defined by the IPCC. It worries me that disparate sources of information are being used to support the idea of a coherent warm period, when they actually refer to different periods within the same 400 or so year period. Besides which, the paleoclimate data in figures in this report show that temperatures were warmer in the centuries immediately preceding the "Medieval warm period". It is time to retire the term. [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. The terms little ice age and medieval climate anomaly have been deprecated in the FGD.
36445	0				Undertaking climate research in areas that might support the IPCC's previously stated opinion can be very lucrative financially and reputation wise. This makes the question of vested interests very important. The details of all IPCC authors should therefore declare how much climate research funding they or their employers have received since the last IPCC report and the titles of the research for each. It should be relatively simple to provide this information on the Internet. Perhaps the signed IPCC conflict of interest (COI) disclosure forms would suffice. But wouldn't it be true that government employees would likely be sacked if they opposed government policies? Doesn't that therefore mean that IPCC authors who are government employees have a vested interest in saying certain things in order to keep their jobs? [John McLean, Australia]	Noted. The IPCC has and follows a Conflict of Interest Policy.
106845	0				I don't understand why the "terminoloy" initial-condition large ensemble" is used in the entire report because those ensembles are just lots of realizations of classical historical/ssp runs. Nothing "new" but only "better". "Large ensemble" stands by itself. In addition, this term is very confusing because it is too close to "initialized simulations" referring to decadal forecast. Even if the "initial-condition large ensemble" term as been used in papers, I would defintely not use it in AR6. [Christophe CASSOU, France]	Rejected. Addition of 'initial-condition' makes clear the type of large ensemble that is being referred to.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
36447	0				In order to be open and transparent you need to show the basis of determining each instance where likelihood is expressed and each instance where the level of confidence is expressed. Readers should be told whether these were derived on a mathematical basis, a majority of models, a majority of "expert opinions" or some other method (which should also be detailed). [John McLean, Australia]	Chapter 1's Box 1.1, Figure 1.1 describes the IPCC uncertainty language that is used throughout the report including in the SPM, TS and other chapters. This uncertainty language has also been detailed in the scientific literature (e.g., Mach et al 2017). In Box 1.1, Figure 1.1 there is a list of the associated probability with each specific term (e.g., likely 66-100%).
36449	0				Every chapter of this report cites material that is designated 'submitted' or even "in progress" and in the majority of cases written by authors of that chapter of this report. I thought the IPCC would have learnt from the fiasco of 1995 not to cite material that has merely been submitted. Not only might such material be modified prior to its final publication and the specific data be modified or deleted before being published, but the wider scientific community has had no opportunity to consider and discuss it prior to its citing, nor have reviewers sighted it. Did the IPCC not learn from the fiasco of 1995 and the IAC review of 2010? [John McLean, Australia]	Rejected. As per standard IPCC procedure, journal articles that have been submitted but not yet accepted can be referenced in report drafts. They must, however, be accepted by the literature acceptance deadline in order to appear in published IPCC reports. The submitted articles can be made available to report reviewers upon request (if not already publicly available). They are checked for changes between their submitted and accepted versions.
114785	0				More use of the uncertainty language is still needed [Jan Fuglestvedt, Norway]	Taken into account. We have tried to include uncertainty language wherever possible.
22373	0				For the whole report to work in the envisaged manner it is important I think that chapters 5-9 start from not just AR5 / SR findings but also the findings from 2-4. Similarly 10-12 should start from in addition relevant findings of 5-9. This would reduce the propensity for redundant assessment being undertaken which is particularly marked in some cases (e.g. chapter 8 to 2,3 and 4) and becomes a bigger issue the furtehr into the report the reader travels. [Peter Thorne, Ireland]	Taken into account: guidelines issued to chapters is to start each section with the assessment of the special reports. If a topic was not covered in the special reports, then the starting point should be WGI AR5. The process chapters should build on assessments in preceding chapters but some information may have to be duplicated for chapters to be stand alone and to allow a user reading only the process chapter to understand the assessment.
37477	0				Your use of unpublished, unaudited HadCRUT5 temperature data lacks integrity. Not only is it failing to be open and transparent but is as deplorable as in 1995 when a paper was put together by IPCC authors at the last minute to provide some support for the arguments that the pivotal chapter was making. Didn't the IAC review of 2010 raise this objection and the IPCC agree to follow the recommendations of that review? [John McLean, Australia]	Rejected. Use of submitted literature in the SOD is entirely commensurate with IPCC adopted policies.
132201	0				In Chapter 11, we have tried to ensure a full traceability of our ES by providing summary paragraphs at the end of main subsections which include text that it then elevated to the ES. I would strongly recommend that other chapters proceed in a similar fashion. I found it dificult in many instances to identfy where text from a given ES was originating from. This may ultimately lead to a lack of traceability of the SPM material itself. [Sonia Seneviratne, Switzerland]	Taken into account. Full and accurate traceability for all Executive Summary (ES) statement indeed needed to ensure a fully traceable report. We have worked hard on improving that aspect in the revised ES statements that are missing this traceability.
110441	0				It would greatly help the reader if regional chapters could agree a sequence by which they progress around the regions in turn so that the progression is always the asme for a reader who may wish to dip in and out across multiple chapters. [Peter Thorne, Ireland]	Taken into account. Regional cross-chapter coordination have addressed this question. Some differences between the chapters still remain, for example the Atlas group AR6 regions in larger regions, but overall the inconsistencies have been resolved.
21869	0				I really like the way that chapter 5 has opened its knowledge gaps section and suggest that this or similar phrasing could be used at the start of the section for each and every chapter. [Peter Thorne, Ireland]	Taken into account. The guidelines given to chapters is to include any limits to the assessment (relevant topics that not be assessed). The use of the IPCC uncertainty language also reflect the state of knowledge on each topic being assessed.
132209	0				In the IPCC SR15 report we had an agreement to use the term "human-induced" rather than "anthropogenic" for communication purposes. In the current AR6 SOD the term "anthropogenic" seems more frequently used, but I would suggest to follow the same practice as in the IPCC SR15. [Sonia Seneviratne, Switzerland]	Taken into account. Greater focus on using terms such as human-induced or human-caused rather than anthropogenic in the SPM has been made.
132213	0				I would strongly recommend the following topic as a possible FAQ in chapter 8: "Is the water cycle intensifying?". To me the answer is "no", although this term if often used in the literature. I believe it would be an interesting FAQ. [Sonia Seneviratne, Switzerland]	Thanks for the suggestion. In the end, we have not added a FAQ on this question exactly, but we discuss intensification throughout the chapter. The FAQs we do have focus on elements of your question that have direct relevance for the general reader, i.e. "Will floods become more severe or more frequent as a result of climate change?" and "What causes droughts, and will climate change make them worse?"
34421	0				Two notable findings of this report are1) the narrower likely range of ECS, and 2) the higher temperature projections of the illustrative scenarios compared to the findings from the AR5. It is important that the reasons for each of these be clearly summarized where they appear in the report. For the ECS, there is a large discussion in Chapter 7 but there remain some gaps that make it hard for a reader to reproduce the result. For the temperature projections, there is not a discussion of why the 3 AR6 pathways lead to higher projections than the AR5 RCPs. Addressing each of these will improve the clarity of the report. [Haroon Kheshgi, United States of America]	Taken into account. Chapter 7 more fully discuses the ECS assessment and Chapter 4 presents a comparison of RCP and SSP pathways
132217	0				There are many instances of inconsistencies and overlaps between chapters, or some issues of material missalignment in some chapters. For instance: Overlaps and inconsistencies on climate extremes in chapters 11 and 12, overlaps and inconsistencies on water cycle extremes in chapters 8 and 11, too many assessments on climate extremes in the Atlas, which were not coordinated with chapter 11, FAQs on droughts and floods in chapter 8 while these topics are more strongly covered in chapters 11 and 12, etc., lack of coverage of "Land" as a realm of the Earth System in chapter 2. It is difficult to keep track of all of these issues at this stage, and some will certainly fall through the cracks. I would very strongly recommend that the author teams agree on a timeline at which to share early drafts of the chapters, at least including the ES texts and lists of Boxes and FAQs so as to harmonize the overall AR6 structure and the chapter-chapter flow. Personally, I would be in favor of aiming at exchanging these texts and outlines in late September to allow enough time for revisions and the harmonization of the text. [Sonia Seneviratne, Switzerland]	Thank you for your suggestions on how to proceed with harmonising material between chapters. Given the way the Report is laid out, it is virtually impossible to avoid overlaps while retaining the stand-alone readability of each chapter. However, significant effort has been put into resolving the issues you discuss. A you suggested, chapter material was shared at the end of September 2020 and many cross-chapter discussions followed through until the final submission of the FGD. In particular, water cycle extreme inconsistencies have been ameliorated between chapters 8 and 11, Chapter 8 retains FAQs on floods and droughts as these are central to consideration of water cycle change and impacts on society and ecosystems.

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99961	0				We would like to express our gratitude to the WGI AR6 author team, the Co-Chairs and TSU for their hard work. We are concerned over the use of global mean temperature, it is very confusing and cannot be traced back to the AR5. The report seems have lost its connection to AR5/ Paris Agreement by 'bias-correcting' Global Mean Surface Tempearture (GMST) and shifting to Global Surface Air Temperature (GSAT). It is important that this issue be resolved in a way that clear lines of sight to the AR5/Paris Agreement is maintained. [Caroline Eugene, Saint Lucia]	Taken into account in the redrafting of Cross-Chapter Box2.3.
379	0				It should be discussed whether the term „CO2 fertilisation" could be replaced by e.g. „CO2 exposure". Fertilisation seems to be overly optimistic while many associated processes e.g. stomatal closure and resulting, reduced transpiration may negatively impact plants in particular under hot conditions [Wolfgang Obermeier, Germany]	Rejected. This term is commonly used in the scientific literature and has been used in previous IPCC reports, for example the Special Report on Climate Change and Land.
52349	0				1. Introduction [J. Ray Bates, Ireland]	Noted.
52351	0				The IPCC publicises its reports as being "neutral, policy-relevant but not policy-prescriptive" [1]. The Second Order Draft (SOD) of the AR6 WG1 Report is here examined as to whether it is neutral and objective in its treatment of the centrally important and closely related areas of equilibrium climate sensitivity (ECS) and climate model projections to 2100 [2]. [J. Ray Bates, Ireland]	Noted. No action item.
83585	0				There are multiple instances (documented in specific comment below) where I think AR6 downplays significance of natural centennial and millennial cycles and their implications for current and future models. Part of the problem is that causes of such cycles are difficult to document (various possibilities such as ocean current variations, and solar-planetary linkages have been hypothesized but none are as yet anywhere near being proven). One of the logical problems we face is that physicists (eg atmospheric physicists) are reluctant to admit to a phenomenon unless the mechanism can be defined and modelled. By contrast geologists tend to be more amenable to the concept of an observed phenomenon for which explanation is still lacking. Two outstanding historical examples of discoveries not "allowed" by existing models of their day are (a) Galileo's heliocentric solar system. He had observation and a detailed mathematical description and model, but no physical explanation. It was some 60 years later that Newton published his theory of gravitational attraction thus providing Galileo's mathematical model with a basis in physics. (b) age of The Earth: by the late 19th century there was some geological consensus that the age of the Earth was around 100+ million years. Meanwhile, physicist Lord Kelvin deduced that the cooling of the Earth from a hypothetical molten body, together with measurement of thermal gradients near the surface of the Earth, indicated an age of about 20 million years. Both were wrong for good reasons; radio-isotopic dating and radioactivity as a source of heat were yet to be discovered. Learning from history I suggest it is important that observational evidence for natural centennial and millennial cycles of climate change be acknowledged and documented in AR6. Our credibility as scientists as judged in future decades may depend on it. I have made comments and offered external published references relating to, but not included in, specific chapters and segments of AR6 below. [michael asten, Australia]	Taken into account. Revised text is more circumspect.
38273	0				The Chinese government appreciates and thanks the efforts of the Bureau members, lead authors, and Technical Support Unit (TSU) of the Working Group I Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC AR6 WGI). We believe that WGI Contribution to AR6 in its current form basically reflects the new global knowledge of the physical science of climate change since AR5, and elaborates in a relatively balanced way conclusions assessed from the large-scale climate change information, physical processes of climate system and regional climate change information, which will provide an important scientific basis for the international community to further understand the basic facts, trends, impacts and causes of climate change. In order to further make WGI contribution a more scientific, comprehensive, balanced and rigorous report, we wish to make the following comments which are hoped to be adopted. 1. Regarding the correction of erroneous expressions and representations concerning Chinese sovereignty. On one hand, there are common-sense errors in the report regarding Taiwan Province of China (including but not limited to page 72 of Chapter 1, page 30 of Chapter 10, page 11 of Chapter 11, page 8 of Annex 3). All these must be corrected and we hope that such errors will no longer appear in future reports. On the other hand, a large number of figures in the report use maps with national borders. To avoid unnecessary disputes, it is suggested that WGI TSU replace all those maps with national borders in the report with maps without. The questionable maps include but are not limited to Figure 1.18, FAQ 1.4 Figure 1, Figure 5.16, Figure 5.19, Cross-Chapter Box 5.1 Figure 2, Figure 6.1, Figure 6.17, Figure 6.18, Box 11.3 Figure 3, Figure Atlas.6, Figure Atlas.9, Figure Atlas.28, Figure Atlas.31 and Figure Atlas.32. 2. Regarding a still more scientific, accurate and regular report. As the first release during the sixth assessment report cycle, the scientific conclusions of WGI Contribution will be an important basis for WGII and WGIII Contributions and the Synthesis Report. Problems with the present report are inaccuracy in some conclusions, confusion in the use of some concepts, insufficient balance of the Summary for Policymakers (SPM) and insufficient citation of new findings. For example, conclusions concerning the relationship between aerosol emissions and the East Asian monsoon, and classification of sources of Short-Lived Climate Forcers (SLCF) are inaccurate; concepts of Global Mean Surface Temperature (GMST), Global Surface Air Temperature (GSAT), climate system and the Earth system are confused; imbalance is found in SPM between the assessment conclusions of the biosphere and other climate system spheres, of the mitigation and adaptation and of high, middle and low emission scenarios in Chapter 12; and the simulations of the sixth International Coupled Model Intercomparison Project (CMIP6) and Shared Socioeconomic Paths (SSPs) are insufficiently cited in Chapters 3 and 12. In addition, some data or confidence statements in the report are inconsistent between chapters or with the underlying report. Given this, it is suggested to verify and correct them altogether. 3. Regarding the increased citation of new literature and literature from developing countries. We have noted the inadequacy in citing literature, especially new findings, from developing countries, which has caused some conclusions to be inconsistent with the facts. It is suggested to add references from developing countries to reflect the assessment conclusions in a comprehensive, balanced and objective manner. For example, the fact that Particulate Matter (PM) concentration and pollution episodes in northern China have decreased significantly should be added to	Taken into Account. 1) The IPCC is a UN organisation, which recognises Taiwan, China. 2) New findings in the WGI report have been explicitly highlighted in the first section of the TS, in addition to throughout the underlying chapters. As the IPCC is a UN organisation maps are shown without borders and are removed before publication. 3) As a result of the SOD review, the literature basis of the assessment has been strengthened and diversified. 4) Efforts have been made to significantly reduce the length of the SPM and TS and to simplify language where possible.
52353	0				It is shown that the SOD is not neutral in these areas. Specifically, it ignores important peer-reviewed evidence for low climate sensitivity, while advancing unsubstantiated evidence for high climate sensitivity without adequate scrutiny. In view of this serious lack of scientific objectivity, the SOD as it now stands is not suitable for acceptance as the basis of an IPCC report. This would be true in any political circumstances, but is especially true at a time when the world is experiencing the economic devastation caused by the Covid-19 pandemic. Efforts to recover from the Covid-19 crisis must not be jeopardized by an IPCC report that seriously lacks scientific impartiality. [J. Ray Bates, Ireland]	Rejected. Chapter 7 examines the evidence for both low and high ECS objectively from multiple lines of evidence

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83587	0				, I note and warmly endorse the statement at P3-8: "Where simulated and observed 53 changes are consistent, this can be interpreted both as supporting attribution statements, and as giving 54 confidence in simulated future change in the variable concerned. However, if a model's simulation of 55 historical climate change has been tuned to agree with observations, or if the models used in an attribution study have been select ed or weighted on the basis of the realism of their simulated climate response, this 2 information would need to be considered in the assessment and any attribution results correspondingly 3 tempered: an integrated discussion of evaluation and attribution supports such a robust and transparent 4 assessment." Excellent statement – it deserves to be highlighted in gold lettering in all discussions of the significance of natural cycles in global climate change. [michael asten, Australia]	Taken into account. More comparison of models tuned to historical warming and those not tuned in this way has been added to Section 3.3.1.1.
52355	0				Abbreviations and Acronyms [J. Ray Bates, Ireland]	Noted.
132229	0				There are major issues of cross-chapter coordination on the topic of droughts. In pre-LAM meetings, there was an agreement between regional chapters that chapter 11 would lead a cross-chapter team on this topic and provide the main assessment in chapter 11, which could be then referred to in other relevant chapters. Contributing chapters would inlcude chapter 12, chapter 8 and possibly also the Atlas. [Sonia Seneviratne, Switzerland]	The drought assessment in FGD was conducted by a cross-chapter working group to ensure consistency.
70021	0				An essential point to clarify for the FGD is the nomenclature used to refer to "global average temperature" (which is the term mentioned in the Paris Agreement (PA) in its most important sentence also cited in the ES of chapter 1; i.e. neither "GMST" nor "GSAT"). Because GMST and GSAT have precise definitions in the IPCC context/history but may neither necessarily reflect the intent of the policymakers within the PA, it would seem more neutral to use a different acronym to refer to "global average temperature", e.g. "GAT" (simple acronym of the text used in the Paris Agreement) or possibly "Tglob", which is rather intuitive and commonly used in the literature. Indeed, GMST and GSAT could be seen as different attempts to estimate the conceptual "Tglob". [Sonia Seneviratne, Switzerland]	See response to 132143
52357	0				AMIP = Atmospheric Model Intercomparison Programme (of the WCRP) [J. Ray Bates, Ireland]	Noted.
132231	0				A concept not addressed explicitly in the AR6 but which would need to be tackled more heads-on is the concept of "global water cycle intensification" which is ill-posed and a wrong characterization. It would seem useful for this topic to be clearly addressed in the report. [Sonia Seneviratne, Switzerland]	Thank you for this suggestion, but the concept is not directly posed in the WG1 Report, and tackling it "head-on" would raise its profile in perhaps an unhelpful way. The discussion of water cycle intensification appears in many chapters. There is discussion of water cycle intensification throughout Chapter 8, in the context of the thermodynamic and dynamic effects upon the water cycle. Hence I feel the topic is covered well in the Report, without putting undue emphasis on it.
52359	0				AR5 = Assessment Report 5 (of IPCC) [J. Ray Bates, Ireland]	Noted.
52361	0				AR6 = Assessment Report 6 (of IPCC) [J. Ray Bates, Ireland]	Noted.
52617	0				Plenty of acronyms are used in the report and it is difficult to remeber all of them. Would it be possible to spell them out when the mouse is on top of it? (an interactive pdf) [Gema Martínez-Méndez, Germany]	Taken into account. The guideline given to the chapters is to keep the amount of acronyms to a minimum and avoid using them in section headings. Please also note that the published report includes an annex with acronyms.
52363	0				ASR =Absorbed Solar Radiation [J. Ray Bates, Ireland]	Noted.
52365	0				B16 = Bates (2016) [J. Ray Bates, Ireland]	Noted
52367	0				CERES = Clouds and the Earth's Radiant Energy System (satellite instrument) [J. Ray Bates, Ireland]	Noted.
70033	0				In chapter 1, it is highlighted that "Broadly speaking, the climate system is divided into five realms: the atmosphere, the land, the biosphere, the cryosphere, and the oceans" (section 1.2.1.1). Why is chapter 2 only explicitly addressing 4 of these 5 realms, not addressing "land", e.g. CC box 2.2? This is particularly striking after having had a full IPCC special report on "climate change and land". Land is not limited to the biosphere. [Sonia Seneviratne, Switzerland]	See response to 132127
52369	0				CMIP = Coupled Model Intercomparison Project (of the WCRP) [J. Ray Bates, Ireland]	Noted.
52371	0				ECHAM = ECMWF-Hamburg (GCM) [J. Ray Bates, Ireland]	Noted.
52373	0				EBM = Energy Balance Model [J. Ray Bates, Ireland]	Noted.
20887	0				Foreword Every comment submitted on parts of the SOD (there are about 680) by the present reader is motivated by the belief that the WG1 report deserves to be read, and that all kinds of efforts are necessary to make it accessible to a large public. Of course it cannot be made available to everybody; however, between the limited number of those who are part of or close to the scientific world and the whole humanity, there is a considerable range. Getting as many people as possible to know about climate and climate change, well beyond the decision makers (who are not anticipated to read the document), this is what is at stake [philippe waldteufel, France]	Noted
105623	0				I would very much like to see each chapter include a sub-section that describes the weaknesses, data gaps, and unknowns that have been indentified in the models and/or data used to develop each chapter. The inclusion of confidence levels is very helpful, but that does not provide a roadmap for the future. To identify specific weaknesses, data gaps, and unknowns would help funding agencies know where fuding would provide the greatest impact. [Julian Levy, United States of America]	Taken into account. The guidelines given to chapters is to include any limits to the assessment (relevant topics that not be assessed). The use of the IPCC uncertainty language also reflect the state of knowledge on each topic being assessed.
52375	0				ECMWF = European Centre for Medium-Range Weather Forecasts [J. Ray Bates, Ireland]	Noted.
20889	0				Topics of comments submitted thereafter A • The report is believed to be too long. B • About chapter outline C • Two key words: assessment and confidence D • Overall coherency E • Improving support for readers F • Some editorial issues [philippe waldteufel, France]	Noted. See responses to specific comments
52377	0				ECS = Equilibrium Climate Sensitivity (to doubled CO2) [J. Ray Bates, Ireland]	Noted

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
20891	0				A1 The report believed to be too long. The most dissuasive feature of this SOD is that it is extremely long. When removing the contributions of figures and references, one is left with well over 2500 pages. Here are some suggestions: • Avoid repetitions. Some of them are unavoidable, e.g. summaries. However perhaps one can avoid to introduce frequent partial summaries; the case which comes to mind is the technical summary, where this happens systematically. Beyond using room, partial summaries carry a damaging message according to which reading the main text would become unnecessary. • Avoid digressions; some paragraphs tend to become chatty. • Restrain lengthy references to previous IPCC publications. While mentioning these publications is often mandatory, they are not to be considered as sacred tables of the law; neither are they to be taken recurrently as comparison points to proclaim how considerable has been the progress accomplished in recent years. Ask yourselves what the hoped for reader may be interested in. • Avoid cases where some topics are dealt with in some detail in a large number of chapters. An example which comes to mind is the improvement of space resolution in numerical models and the expected progresses thereof. [philippe waldteufel, France]	Noted. The report follows the approved outline for its preparation (including length of chapters). Chapters that were too long in the SOD have therefore reduced their length in the FGD.
52379	0				GCM = Global Climate Model [J. Ray Bates, Ireland]	Noted.
20893	0				A2 The report is too long (followed). A very good solution to this problem, adopted in the report, consists in creating "boxes" or "cross-chapter boxes". Why not a box on improved space resolution? At the same time try to combine boxes the content of which are very close (example: Box TS.1 and Cross Chapter Box 2.3). A large part of the document is devoted to the basic mission of IPCC, that is assessing scientific papers. There is little hope of saving room here; it remains to attempt to draft this scan across the literature in such a way it is not too boring. Undoubtedly it is difficult. Efforts are admittedly made throughout the text; improvements remain possible. [philippe waldteufel, France]	Partially taken into account. There was continued efforts across the report to avoid overly long chapters and overlaps of topics in the assessment across chapters. Note that the report summaries (TS and SPM) are independent from the chapters. As such, they provide a synthesise and integrate the information from the chapters. Therefore all content in the SPM and TS are grounded in the chapters.
52381	0				IPCC = Intergovernmental Panel on Climate Change [J. Ray Bates, Ireland]	Noted.
20895	0				B About chapter outline Although the outline decided by the Panel in September 2017 suffers some drawbacks (e.g. serious risk of repetitions), the present reader does not question this outline. But the SOD does not comply with it! According to the outline, annexes include "options for cross-WG integration including regional Atlas". In the SOD, we find nothing of this kind, but a 13th chapter (not present in the outline) named "Atlas". I explain in my comments on chapter Atlas several reasons why I think that the outline's scheme is better. I have identified parts of this chapter which might be combined in an Annex introducing the Atlas and the way to use it, while other parts of the existing Atlas chapter might be moved logically to existing chapters. [philippe waldteufel, France]	Noted. Following the adoption of the outline at an IPCC meeting (IPCC Expert Meeting on Assessing Climate Information for Regions Trieste, Italy, 16-18 May 2018) a possible remit for the WG I Atlas and a possible online "Interactive Atlas" were discussed. In subsequent lead author meetings the role was confirmed for the Atlas chapter to assess mean climate change and model evaluation for regions and the Interactive Atlas to enable exploration of some of the datasets underpinning the assessment findings. These developments have been widely welcomed.
111775	0				I do not see any FAQ related to tipping points, regime shifts, alternative states, tipping systems. I have not had the time to look at the entire report, so I cannot say whether this topic is addressed. If not, it is a mjor missing point. Please look at these references: Lenton et al, 2019. Climate tipping points — too risky to bet against. Nature (https://www.nature.com/articles/d41586-019-03595-0). Beaugrand et al, 2019. Prediction of unprecedented biological shifts in the global ocean. Nature Climate Change (https://www.nature.com/articles/s41558-019-0420-1?error=cookies_not_supported&code=b472e4ed-d1c4-4679-a250-a7d0716c6aee). Steffen eta al, 2015. Planetary boundaries: Guiding human development on a changing planet. Science (https://science.sciencemag.org/content/347/6223/1259855) [Alessandra Conversi, Italy]	Rejected. The AR6 WGI has a thorough assessment on tipping point related topics including potential for abrupt change, irreversibility over specific timeframes and low-likelihood high impact occurrences (See Table 4.10). An FAQ on this was not selected due to the complexity and broadness of the topic but note however that FAQ5.2 covers abrupt permafrost thaw and FAQ9.3 covers collapse of the AMOC.
52383	0				LCH01 = Lindzen, Chou and Hou (2001) [J. Ray Bates, Ireland]	Noted.
70049	0				Chapter 1 correctly points on page 10 (line 55)-page 11 (line 1) that there are 5 realms within the Earth's System: Atmosphere, Ocean, Land, Cryosphere and the Biosphere. However, Figure 1.2 is inconsistent with this statement and merges Land and Biosphere, although several land variables are unrelated to the biosphere (e.g. lakes, soil moisture, land surface temperature) and a substantial fraction of the land is not covered by vegetation. In addition, there is also biosphere in the ocean (algae). Even more striking, Chapter 2 ignores land altogether. This seems very strange and inconsistent with a comprehensive coverage of the Earth's System, particularly after having a full IPCC Special report that was dedicated to "Climate change and land". [Sonia Seneviratne, Switzerland]	See response to 132127

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
5025	0				Already under Executive summary, I suggest the following self-explanatory text is added right after the last term “policy making”. Societal discourses and summits on climate change are typically not informed by a unifying definition of sustainability and procedural support for strategically approaching it. This hampers effective cooperation across disciplines, organizations, sectors, and nations. There is a strong need to use a meta-level of generic structures to inform such cooperation as well as cohesive use of various tools, methods and concepts [1]. The needed metalevel is as intuitive as it is logical: basic and generic principles for social and ecological sustainability, formatted as boundary conditions for sustainable re-design of any practice at any scale [2]. For as long as the purpose ‘sustainability’ comes as organizational-specific narratives rather than as robust boundary conditions for re-design, no climate data, process instruments for dialogue and negotiations, or complexity-management algorithms, will help us. "Purpose-confusion in, means action-confusion out" no matter the contents of the black box in between. And vice versa. It is shown, also empirically, that a meta-level of robust boundary conditions for sustainable re-design enables: (i) Cross-sector modelling and validation of future scenarios where societal sectors are sustainable and climate-stable together, i.e., solutions in one sector not running in the face of another [3]; (ii) Improved economies from better risk-management, reduced costs and timely innovations [4]; (iii) Cohesive use of data and tools, not only IPCC data but all other data, tools, methods and concepts as well, e.g., UN SDGs, Planetary Boundaries, Circular Economy, and various Complexity-management tools; (iv) Managing trade-offs and goal-conflicts in a sense of “will to creatively act step-wise in cooperation”. Such boundary conditions have been developed and tested scientifically in an international effort among academics and practitioners in public as well as private sectors. The basic and generic boundary conditions are derived at the first level of approximation for sustainability, where uncertainty is as low, and comprehension as high, as it gets. We believe this is a crucial element for structuring of all the data from the IPCC document into hands-on strategic use, and that the previous lack of it explains the mismatch between the solid science of climate change on the one hand, and the disappointing confusion and slow progress of policy and real change on the other. [1] Systematic Leadership towards Sustainability, 2017. Special Volume, Journal of Cleaner Production, Volume 140, Part 1, Pages 1-386. Edited by Göran Broman, Karl-Henrik Robèrt, George Basile, Terrence Collins, Rupert Baumgartner, Tobias Larsson. [2] Göran Broman and Karl-Henrik Robèrt 2017. A framework for strategic sustainable development. J. Clean. Prod. Volume 140, Part 1, pages 17-31. [3] A strategic approach to sustainable transport system development - Part 1: attempting a generic community planning process model. K-H Robèrt et. al 2017. J. Clean. Prod. Volume 140, Part 1, Pages 53-61 [4] Karl-Henrik Robèrt and Göran Broman, 2017. Prisoner’s dilemma misleads business and policy making. J. Clean. Prod. Volume 140, Part 1, pages 10-16. [Karl-Henrik Robèrt, Sweden]	Rejected. While the topic is important, the text provided is beyond the scope of IPCC WG1.
20897	0				C1 Assessment From IPCC front internet page: "IPCC is the United Nations body for assessing the science related to climate change". From the "learn more" menu: "For the assessment reports, IPCC scientists volunteer their time to assess the thousands of scientific papers published each year to provide a comprehensive summary of what is known about the drivers of climate change, its impacts and future risks (...)" What does "assess" mean? Leaving aside the economical-financial domain, verbs cited as synonyms for assess are: measure, evaluate, gauge, judge, determine, test, check, analyse, estimate, review. It is readily seen that these words principally differ by the responsibility they confer to whoever is assessing –here the report authors) to give an opinion on the assessed matter or entity or document. Hence appears a fundamental ambiguity. Does an assessment imply a validation? My feeling is that in most cases the answer is negative: WG1 authors are neutrally minded when reporting on recent publications and developments. However, it may not be always the case; furthermore, chances are that readers will remain anyway under the impression that what has been assessed is "endorsed" by IPCC. Therefore, I would recommend an explicit clarification about what is meant by assessment. [philippe waldteufel, France]	The reviewer is kindly referred to Chapter 1 and specifically, Box 1.1, Figure 1.1 ; this figure fills out the information on the uncertainty language that is described in footnotes in the SPM and TS. This language has also been documented in the literature: Mach et al 2017. Box 1.1, Figure 1.1 has a diagram that illustrates the step-by-step process authors use to evaluate and communicate the state of knowledge in their assessment (Mastrandrea et al., 2010).
105633	0				The AR6 does not address the role population growth has on the growth of combined greenhouse gas emissions. It is becoming increasingly clear that the current rate of growth is unsustainable. AR6 needs to address population growth rate as it affects emissions and other climate-relevant factors. [Julian Levy, United States of America]	Rejected. Population growth is beyond the mandate of working group I, which is in charge of assessing the physical climate science. Socio-economic conditions are within the mandate of Working Groups 2 and 3.
52385	0				LC11 = Lindzen and Choi (2011) [J. Ray Bates, Ireland]	Noted.
132259	0				It is mentioned in the Chapter 12 ES that "Chapter 12 synthesizes knowledge from previous chapters". This is a signficant challenge. The AR6 synthesis is actually supposed to happen in the TS and SPM. Timewise, it is difficult for a chapter working on its text in parallel to other chapters to provide synthesis material. A better mechanism needs to be put in place to ensure that material from other chapters can be correctly integrated in chapter 12. Chapter 11 authors did not feel that this process worked out sufficiently well in the preparation of the SOD. This resulted in a lot of the chapter 12 material on extremes being inconsistent with the chapter 11 assessment. Regarding the integration of chapter 11 material in the FGD version of chapter 12, we agreed to have joint teams working on respective extremes and CIDs. We expect from chapter 12 to provide us a framework on how chapter 11 can provide informed input and feedback on the chapter 12 assessment, not only at regional level but also and more importantly at CID level given the chapter 11 structure. [Sonia Seneviratne, Switzerland]	TAKEN INTO ACCOUNT: Chapter 12 is unique in the history of WGI in the sense that it does have a mandate to pull together information from multiple chapters to provide climate information for impact and for risk assessment. WGI AR5 has taken substantial strides across all chapters to be more consistent, with each chapter including overlapping information as a reflection of the inter-related climate system. Between the Second-order Draft and the Final Governmental Draft the WGI authors have undertaken extensive collaborative review of findings to ensure consistency and traceback across the chapters. This includes Regional handshake teams for each region, specific thematic teams around key topics (e.g., drought, glaciers, relative sea level rise), enhanced connections to physical explanations in other WGI chapters within Section 12.2, and a traceback table associated with Table TS.5 that helps readers find information for each regional CID across chapters.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
20899	0				C2 Confidence From Box 1.1: confidence is a qualitative measure of the validity of a finding, based on the type, amount, quality and consistency of evidence (e.g. data, mechanistic understanding, theory, models, expert judgment) and the degree of agreement. This leaves a wide field to subjective elements. The word "finding" does not have a straight, simple meaning. In an English-French dictionary, 7 French words are proposed for translating findings. And of course there may be hesitations concerning the quality and consistency of evidence [philippe waldteufel, France]	Noted. Parallel to the preparation of the IPCC reports themselves, the confidence language and assessment mechanisms are discussed in the scientific literature. Here, we present how the framework is used, and adhere to it as close as possible. Clearly it is not a perfect method, but it is still found (here and in the literature) to provide the reader with transparency and insights into how the authors have arrived at their conclusions.
52387	0				LW = Longwave (radiation) [J. Ray Bates, Ireland]	Noted.
20901	0				C3 Confidence (followed 1) Hence I wonder about statements such as: "There is hence low to medium confidence in the exact role and quantitative impact of historical Arctic warming and sea-ice loss on mid-latitude atmospheric variability." (Chapter 10, page 24, lines 9-11). Is there a finding here? Or such as "There is high confidence that including all relevant forcings is a prerequisite for reproducing historical trends" (same chapter, page 59, lines 1-2): how to decide between "high confidence" and "very high confidence" in a statement which appears entirely certain and even tautological. Or "There is high confidence that ensembles for regional climate projections should be selected such that models unrealistically simulating processes relevant for a given application are discarded (...)" (same chapter, page 64, lines 35-36). The confidence is given here to a recommendation. Or "low confidence in how these factors will combine" (chapter 8 page 5, line 33) Several examples are taken from chapter 10 because chapter 10 authors are particularly generous in issuing confidence statements. [philippe waldteufel, France]	Taken into account. The use of uncertainty language has been substantially worked over for the FGD.
52389	0				MS15 = Mauritsen and Stevens (2015) [J. Ray Bates, Ireland]	Noted.
20903	0				C4 Confidence (followed 2) Back to box 1.1: the confidence/likelihood metrics are used " to communicate the degree of certainty in key findings, which is based on author teams' evaluations of underlying scientific understanding". They are aimed at increasing the trust in IPCC's work. In order for the confidence metrics to keep its efficiency, one should be careful in selecting and drawing up the sentences to which it applies. Concerning each of the 4 examples given above, I believe that there are reasons for avoiding to issue a confidence statement. Certainly there are other cases. [philippe waldteufel, France]	Noted. Parallel to the preparation of the IPCC reports themselves, the confidence language and assessment mechanisms are discussed in the scientific literature. Here, we present how the framework is used, and adhere to it as close as possible. Clearly it is not a perfect method, but it is still found (here and in the literature) to provide the reader with transparency and insights into how the authors have arrived at their conclusions.
52391	0				NCAR = National Centre for Atmospheric Research [J. Ray Bates, Ireland]	Noted.
20905	0				D Overall coherency Anybody willing to take a look at the whole SOD will be stricken by the specific attitude of authors concerned by regional climate features (chapter 10, 12, partially the Atlas chapter). Some elements of this attitude are a particular vocabulary (climate messages, distillation…), as well as the importance given to communication issues. There are others. A symptom of the resulting malaise is apparent in the SPM draft, which suffers a serious inconsistency (see my comment on SPM page 38 line 21). It seems that SPM authors did not find themselves able so far to build a structured and logical summary of the WG1 report including regional issues. The IPCC front internet page rightly stresses that the review by experts and governments is essential to "reflect a diverse range of views and expertise". However, when the views appear vastly different, risks are that this may weaken the credibility of the whole report. [philippe waldteufel, France]	Noted.
105641	0				Given the health and economic challenges of these times, it is my hope that reviewers will be given one more opportunity to review and comment on the AR6. Many people have been ill, locked out of their offices, or both. Another review would be very helpful, I believe. [Julian Levy, United States of America]	Rejected. While we fully understand the challenges posed by the Covid pandemic, it is unfortunately logistically impossible to organise another round of review. However, it should be noted that the SOD review was extended to address some of the side effects of the pandemic.
52393	0				OLR = Outgoing Longwave Radiation [J. Ray Bates, Ireland]	Noted.
17323	0				SRM (solar radiation modification) is used for all approaches that aim to modify solar radiation or terrestrial radiation. Cirrus clouds thinning (CCT) aims at modifying terrestrial radiation (e.g. Table 4.7) and when it's applied e.g. in Arctic winter (a likely scenario based on current knowledge) will not modify solar radiation. Therefore SRM is the wrong term to refer to CCT. A different term should be used throughout the report e.g. RM (radiation modification) or SRM/TRM (solar/terrestrial radiation modification), where the latter would allow to differentiate between SRM and TRM approaches and refer only to SRM approaches if necessary. Or another nomenclature could be used but using SRM for CCT is at the least misleading and for some ("likely") applications just wrong. [David Neubauer, Switzerland]	Taken into account. Text is revised and terminology is clarified in section 4.6.3.3. We agree with the reviewer comment, in principle. However, as discussed in the introductory paragraph of section 4.6.3.3, for consistency with the SR1.5, we include CCT in the SRM category. Further, the IPCC scoping document mandates us to assess climate response to "SRM". Hence, the introduction of other terms is not appropriate. It would skew the assessment if CCT was introduced as a separate category on the same level as SRM.
20907	0				E Improving support for readers • The glossary is useful. Some additions will be suggested • An acronym table is necessary. Right now 2 tables are present, one in the TS and one in chapter 6. A single table for the whole report might be best; it does not have to be as exhaustive as the one in chapter 6. My estimate suggests about 300 items. The acronym table might be lodged in a specific annex, or integrated to the glossary. • The tabulation of the boxes would be a valuable reference tool; 56 items in the SOD, title limited to a single line. • The tabulation of the tables would be definitely useful for some of them. The same is true for the figures, but there are too many of them to list them all. How about building a restricted list of the figures somebody would be happy to select in order to illustrate climate and climate change issues for friends? [philippe waldteufel, France]	Noted. Thank you for these suggestions. As is standard with IPCC reports, an acronym list is included as an Annex in the published version. On tabulation, various compilations of report material will be made available when the report is published (e.g., Summary Volume - SPM, TS and FAQs, SPM Headline statements). The report will have a dedicated website with functionality that will aid navigation between, and access to, report figures and tables.
52395	0				SOD = Second Order Draft [J. Ray Bates, Ireland]	Noted.

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132269	0				Chapter 11 focuses on projected changes at different global warming levels, while chapter 12 is focusing on changes as function of scenarios (in particular scenario RCP8.5/SSP5-8.5), In the FGD, the translation between scenarios and global wraming levels should be better explained in the AR6 WG1 report, possibly in a cross-chapter box between chapters 11, 12, 10, 4, and 1. It should also be clarified which information is of most policy relevance and should be given more weight in final assessments. [Sonia Seneviratne, Switzerland]	ACCEPTED: This was discussed at length during the pre-LAM period and cross-chapter box 11.1 which exactly addresses this comment has been included in Ch 11
20909	0				F1 Editorial issues: Executive summaries: why "executive"? What is called executive summary is usually the summary of a business plan, strongly oriented toward economics and financial matters rather than knowledge. In AR6, while one might assimilate to some extent the decision makers to business executives, the decision has (wisely) been taken to prepare simply for them a summary for policy makers. Executive summaries: why "summaries" Because it seems useful to summarize in a relatively short passage the main points of a larger body of text. In other words, nothing ought to go into a summary unless it is dealt with in the main text. A summary is not a foreword nor an inaugurating speech. This rule is complied with in most chapters, but not all of them. [philippe waldteufel, France]	The Oxford English dictionary definition of 'executive': "connected with managing a business or an organization, and with making plans and decisions". This would seem to be consistent with providing policy-makers (who are often in the executive branch of government) with important scientific information related to climate.
23213	0				Chapters 8 and 11 need to resolve issues over drought assessment overlap which are substantial and for the specific droughts as case studies in chapter 10 they need to be included. There is presently gross redundancy. [Peter Thorne, Ireland]	Taken into account in the FGD. Overlaps between chapters 8 and 11 on drought assessment are addressed in the FGD.
52397	0				SST = Sea Surface Temperature [J. Ray Bates, Ireland]	Noted.
68783	0				The WGI AR6 author team, the Co-Chairs and TSU must be for their hard work. In general, the SOD is well constructed. However, there is a major issue that I would like to highlight. The treatment of global mean temperature cannot be traced back to the AR5. By 'bias-correcting' GMST and shifting to GSAT, the report has lost its line of sight to the AR5/Paris Agreement. [Jeffers Cheryl , Saint Kitts and Nevis]	Taken into account in the redrafting of Cross-Chapter Box2.3.
70063	0				An important aspect not addressed in the report is the legal relevance of the IPCC assessments of confidence/likelihood of changes in the climate system. A paper currently in review in the journal "Studies in the History and Philosophy of Science" highlights that in a legal framework in US civil courts the standard of evidence "more likely than not" (i.e. >50%) is sufficient (Lloyd et al, in review, submitted before December 31, 2019, "The mismatch between scientific and legal standards of demonstration in climate science" - I can provide a copy of this article to the TSU and the chapter 1 authors). However, most assessments of the AR6 WG1 focus on "likely" or "very likely" levels. This shows that information that is less reliable than "likely" (66%) but that is strong enough to be ranked at the level "more likely than not" (>50%) would be very useful for societal decisions and policymaking. It would be useful to consider this point in the selection of statements in the Executive summaries, TS and SPM. [Sonia Seneviratne, Switzerland]	Noted. This is clearly a relevant topic, but would need to be part of the assessment at an earlier stage as most chapters have, as noted, focused their Executive Summary statements on areas where "likely" or "very likely" conclusions can be drawn.
20911	0				F2 Editorial issues (followed): Acronyms: the first time they are introduced in the report, the reader is entitled to discover at that occasion the full spelling of the acronym. It is often believed that capital initials help the reader to find his way. References: while quite naturally the report authors focus their attention on articles published later than AR5, this systematic bias may give the reader the feeling that nothing in the field of climate was known prior to 2013. This is misleading and should be corrected by mentioning a few tens of significant references. Examples given here: Moncrieff and Miller for CAPE, Oke for heat island, Lorenz for analogs. I am aware of pleading for additions at the same time I am finding the document too long. Maybe getting rid of figure TS.3 might compensate? The risk of being accused of arbitrary choices, encountered when building this figure, is decreased when one simply quotes published papers. [philippe waldteufel, France]	Taken into account. Acronyms have been written out in full where they are first introduced. Regarding AR5 references, the report is intended to build upon previous IPCC reports (including the literature they assessed), so it is generally unnecessary to re-cite such references. For Figure TS.3, we have included key publications in the history of physical climate science - it is always possible to add more, but we feel the current set are key publications that provide a good overview.
52399	0				SW = Shortwave (radiation) [J. Ray Bates, Ireland]	Noted.
52401	0				TLR = Tropical Longwave Response (GCM/Observational Discrepancy) [J. Ray Bates, Ireland]	Noted.
52403	0				TOA = Top-of-atmosphere [J. Ray Bates, Ireland]	Noted.
52405	0				TTT = Tropospheric Temperature Trend (GCM/Observational Discrepancy) [J. Ray Bates, Ireland]	Noted.
39607	0				Kenneth Richards provides lists of peer-reviewed papers which minimize the role of CO2 and insist on natural variability of climate, viz. 282 papers published in 2015: notrickszone.com/250-skeptic-papers-from-2015, 500 papers published in 2016: notrickszone.com/2017/01/02/crumbling-consensus-500-scientific-papers-published-in-2016-support-a-skeptical-position-on-climate-alarm, 485 papers published in 2017: notrickszone.com/2018/01/04/485-scientific-papers-published-in-2017-support-a-skeptical-position-on-climate-alarm, 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/, 440 papers published in 2019: notrickszone.com/2020/01/30/over-440-scientific-papers-published-in-2019-support-a-skeptical-position-on-climate-alarm. Most of them are not considered in AR6. In particular, the observation of (i) only +0.4°C since 1945 (Figure 2.11B), beginning of the acceleration of CO2 emission, (ii) the "pause" of temperature since 1993 in the low stratosphere (altitude 17 km), (iii) the absence of evolution of UAH MSU tropical temperature at 200-300 hPa which does not validate the hot spot predicted by models, (iv) the low ocean heat content after Wunsch and Heimat (2014), (v) his cyclical-like behavior shown in Fig. 10 of Laloyaux et al (2018) doi: 10.1029/2018MS001273 - other papers discussing this natural cycle, Schlesinger and Ramankutty, 1994, Ogurtsov et al 2002, Klyashtorin and Lyubushin 2003, Loehle 2004, Zhen-Shan and Xian 2007, Carvalo et al 2007, Swanson and Tsonis 2009, Scafetta 2009, Akasofu 2010, D'Aleo and Easterbrook 2010, Loehle and Scafetta 2011, Humlum et al 2011, Chambers et al 2012, Lüdecke et al 2013, Courtillot et al 2013, Akasofu 2013, Macias et al 2014, Ogurtsov et al 2015, Ollila 2017 - (vi) in Fig. 1(a) of Box 3.1, CMIP6 models are not validated by observations, (vii) CMIP6 models are unable to capture the increase of 11,300 km2 per year of sea ice extent in Antarctica (www.pnas.org/cgi/doi/10.1073/pnas.1906556116), (viii) based on infrared spectra of the atmosphere, http://dx.doi.org/10.1155/2013/503727 concludes to a radiative forcing of 2.6 W/m2 at doubled CO2 concentration whereas CMIP6 models use higher radiative forcings, (ix) ECS and TCR used in CMIP6 models are even not in agreement between themselves by a factor up to 3, they are much too high and ignore a list of not less than 120 peer-reviewed papers which reports climate sensitivity equal or lower than 1°C, notrickszone.com/50-papers-low-sensitivity, (x) in Fig. TS.17(b), the observations show an increase of sea ice extent whereas models show a decrease, (xi) Figure 1.7 shows that, independent on baseline choice, the projections of climate models are nearly all above observations in 2014, for all these reasons although only one could be sufficient, to tone down the alarmism of the projections of models is strongly recommended in AR6. [François Gervais, France]	Taken into account. i) The amount of warming over the entire period since 1850, including the period since 1945 is assessed in this report, in 2.3.1.1.3. Table 2.4, for example, shows an average warming of GMST of 1.04C between 1960 and 2020. ii) The causes of lower stratospheric temperature change are assessed in 3.3.1.2, which relates the reduced cooling since the 1990s to stabilization of stratospheric ozone concentrations. iii) Evaluation of simulated upper tropospheric temperature trends is covered in 3.3.1.2 which assesses with medium confidence that models overestimate observed warming in the upper troposphere. iv) and v) The cited references on ocean heat content focus on reanalyses which are subject to unphysical drift. Updated observational records do not show the kind of cyclical behaviour seen in Laloyaux et al., (2018) (Section 2.3.3.1). vi) Figure 1a of Cross-Chapter Box 3.1 includes multiple observational datasets. vii) Consistency of simulated and observed Antarctic sea ice extent changes are assessed in 3.4.1.2. Using updated observations the increase is not statistically significant. viii) More recent literature on the radiative forcing of a CO2 doubling is assessed in 7.3.2.1 - the assessed forcing is 3.93 +/- 0.47 W/m^2. ix) ECS and TCR in CMIP6 models are assessed in Section 7.5.6. Some models have ECS outside the assessed likely range based on multiple lines of evidence. x) A comparison of simulated versus observed change in Antarctic sea ice extent is contained in 3.4.1.2. xi) A like-for-like comparison of simulated and observed GMST changes shows that the observed warming to 2014 is close to the centre of the modelled range - see Figure 3.4b.
52407	0				WCRP = World Climate Research Programme [J. Ray Bates, Ireland]	Noted.

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52409	0				WG1 = Working Group 1 (of IPCC) [J. Ray Bates, Ireland]	Noted.
52411	0				WMO = World Meteorological Organization [J. Ray Bates, Ireland]	Noted.
70077	0				The current COVID-19 situation has led to unprecedented changes in emissions in the climate system (near total reduction of aviation, near zero commuting in many countries, much less economic activity, much less impacts from pollution), It would be very insightful to have an assessment of material from the recent literature on conclusions that can be drawn from this episode (e.g. Le Quere et al. 2020, Nature Climate Change). I would recommend the addition of a cross-chapter box on this question, e.g. in chapters 1, 6, 12 and/or the Atlas. [Sonia Seneviratne, Switzerland]	Taken into account. A cross-chapter box on the COVID related effects on air quality and climate is added in Chapter 6 (Cross-Chapter Box6.1)
52413	0				2. Evidence for low climate sensitivity ignored [J. Ray Bates, Ireland]	Rejected. Chapter 7 carefully explores the lower and upper bounds of ECS based on multiple lines of evidence
67775	0				The IPCC Working Group I (WGI) Contribution to the IPPC Sixth Assessment Report (AR6) provides an updated state of knowledge on physical science related to the climate system and climate change, based on the assessment of evidence available in the scientific literature related to the climate system. [Ruandha Agung Sugardiman, Indonesia]	Noted.
70079	0				The covid-19 situation has led to a substantial delay in the preparation of the AR6 WG1 report. As a result, there is now a long delay between the cut-off date for submitted papers and the cut-off date for accepted papers. We can expect that many relevant articles for the WG1 assessment will have been submitted after December 31, 2019 and still be accepted before the official cut-off date for accepted papers. This leads to a difficult situation given the lack of another expert review of the AR6 WG1 material. I would recommend to consider having an additional expert review of the report's material for key such instances (for instance a cc box on COVID-19 related literature). If any papers that were added after the SOD are clearly highlighted in the FGD, it may be possible to have a specific review of this material only (i.e. only key sections. boxes, ES and SPM statements that might have been added based on such literature). [Sonia Seneviratne, Switzerland]	Taken into account. The release of the report has been delayed and the cut-off date for scientific literature to be included in the report has been extended by 4 months.
82367	0				There are inconsistencies in the use of stippling to represent significance - e.g. Figures 2.11, 2.13 and 2.14 use it to indicate significance, while Atlas.13 and Atlas.14 use it to indicate a lack of significance. [Blair Trewin, Australia]	Taken into account. A common approach to representing significance and model agreement has been implemented across the WG I report and is documented in Cross Chapter Box Atlas.1.
52415	0				(a) Tropical Longwave Radiative Response [J. Ray Bates, Ireland]	Taken into account. This is discussed in Chapter 7, Section 7.4
67777	0				The document of WGI assesses the wide range of scientific literatures, contributing to an increased understanding of how the climate system works, and how it is changing in response to human activity. The assessment provides scientific information relevant for the global community to meet the challenge of climate change, including variability and changes at a regional level, and how impacts and risks to human and natural systems are changing over time. [Ruandha Agung Sugardiman, Indonesia]	Noted
70081	0				In the table of "cross-cutting themes" it would be useful to add an entry on "global average temperature" and highlight all chapters which are providing assessments related to this topic (e.g. the ccbox in chapter 2, several sections of ch1, section 11.2.6, ...). [Sonia Seneviratne, Switzerland]	Not applicable. Context unclear
52417	0				Clear evidence for low climate sensitivity was presented by Lindzen and Choi (2011, hereafter LC11). They carried out a regression analysis of monthly-mean top-of-atmosphere (TOA) all-sky radiative fluctuations as measured by satellite (with the CERES instrument playing an important role) against sea-surface-temperature (SST) fluctuations in the tropical band 20°S-20°N for the period 1985-2008. Their results (LC11, Fig. 10) show a large longwave (LW) radiative response (ΔFlux/ΔSST > 5 Wm-2K-1) with a large correlation coefficient (R > 0.8). This observed LW radiative response significantly exceeds the Planck response (3.2 Wm-2K-1) [3]. [J. Ray Bates, Ireland]	Taken into account. The fact that models are biased in their short term radiative response to natural temperature variations is accounted for in the assessment of tropical high cloud amount feedback (section 7.4.2.4.2). Studies that are more recent than LC11 are used.
67779	0				The WGI also includes assessment of the amount of carbon emissions in relation to climate and energy targets, interactions between land and the climate, and links between climate and air quality. These aspects need to be connected with the assessment of other WGs and strategies to mitigate the impacts of climate change and design effective climate change adaption policies. [Ruandha Agung Sugardiman, Indonesia]	Taken into account. We have established several cross-working group teams of authors to help address overlaps and inconsistencies, and to ensure proper handshakes between the 3 working groups.
90051	0				Having been involved in the IPCC process since the begining, it seems now the reports are more like “science to support UN FCCC” rather than “independent science” that provides an objective assessment to the global community. Special reports of the IPCC are there to help the policy process as requisitioned by the UN FCCC from time to time, but the AR cycle and particularly WGI is expected to provide an independent and objective scientific assessment that can trigger global actions even beyond the ambit of UNFCCC. [Govindarajalu Srinivasan, Thailand]	Noted. Comment only.
52419	0				LC11 compared this observed LW response with those given by the CMIP3 global climate models (GCMs) [4]. They found a serious discrepancy, with the average LW response of the GCMs lying below the Planck value. This GCM/Observational discrepancy will hereafter be referred to as the Tropical Longwave Response (TLR) Discrepancy. Such a discrepancy continues to be a feature of the CMIP5 models. As far as can be judged from the limited information provided, the TRL Discrepancy also continues to be a feature of the CMIP6 models [5]. [J. Ray Bates, Ireland]	Taken into account. The fact that models are biased in their short term radiative response to natural temperature variations is accounted for in the assessment of tropical high cloud amount feedback (section 7.4.2.4.2). Studies that are more recent than LC11 are used.
67781	0				Most of references originate from developed countries. It is suggested to have a more balanced contribution between references from developed and developing countries. [Ruandha Agung Sugardiman, Indonesia]	Taken into account. Where appropriate, efforts have been made to further improve regional diversity in the literature cited.
90053	0				In some Chapters, there seem to be a large number of pre-2011 references. whereas the focus required is on assessment of relevant literature since the publication of the AR5 WGI report. While it is understandable that some past literature needs to be linked for continuity, it would be good to ensure that in each of the WGI Chapters the references cited from per-2010 does not exceed an agreed limit of say ~20-30%. [Govindarajalu Srinivasan, Thailand]	Taken into account. Where appropriate, efforts have been made to cite post-AR5 and post-AR6 Special Report literature where it supersedes earlier literature.
52421	0				LC11 investigated the implications of the TLR Discrepancy for the estimation of ECS by inserting the observed and GCM radiative responses into a simple energy balance model (EBM) with a prescribed radiative forcing (3.7 Wm-2) corresponding to a CO2 doubling. Their results showed that the observed response gives an ECS of less than 1°C while the GCM responses give ECS values generally well in excess of 2°C. [J. Ray Bates, Ireland]	Taken into account. LC11 made unrealistic assumptions on extra-tropical feedback and hence obtained a very low ECS estimate.
67783	0				Visualization of key findings through the use of more tables and figures are very important and could be given more attention. [Ruandha Agung Sugardiman, Indonesia]	Taken into account. Chapters do the best they can to remain within the IPCC page limits. While there is a general wish to communicate the assessment visually, chapters can only include a limited amount of figures and tables. As a result, the chapter teams have decided to highlight the more relevant/important information in their tables and figures.

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70087	0				Because of the complexity of the definition of global average temperature and its dependency on several choices that can be made (e.g. GMST vs GSAT, blending of absolute temperatures vs anomalies, etc), it might be valuable for the Atlas to provide time series of Tglob using dfiferent estimates (GMST, GSAT; based on different model choices; including reanalyses; etc.). [Sonia Seneviratne, Switzerland]	Rejected. The Atlas provides overserved and projected data on global surface temperature as defined in Cross-Chapter Box 2.3. This includes the Chapter 4 constrained assessment.
52423	0				The reality of the TLR Discrepancy has been confirmed by Mauritsen and Stevens (2015, hereafter MS15). Again using monthly-mean CERES observations, they arrived at results very similar to those of LC11. They state that “the discrepancy between the [tropical all-sky LW] observations on the one hand and the models on the other is robust.” [J. Ray Bates, Ireland]	Taken into account. Mauritsen and Stevens (2015), however, shows that this bias does not necessarily means that ECS must be small.
67785	0				A number of researches have proven the role of 'Indonesian throghflow' in influencing the regional and global climate. On the other hand, the phenomenon is also influenced by the climate change happening globally (Please refer to e.g. https://link.springer.com/article/10.1186/s40562-018-0102-2). The WG1 contribution has not clearly informed on this aspect, and this should be referred to in relevant chapters (Chapters 4,9,and 10). [Ruandha Agung Sugardiman, Indonesia]	Rejected. Chapter 10 is a methodological chapter which have used a few examples to illustrate methodologies to construct regional climate information, but does not aim to be comprehensive on all processes and phenomena. In particular we have not assessed oceanic processes in depth. Please note however that the Indonesian throughflow changes are assessed in 9.2.3.
52425	0				This issue has been further studied by Bates (2016, hereafter B16). Using an extended EBM (Model B) that allows free variation of the tropical and extratropical radiative responses and includes dynamical heat transport, B16 arrived at an ECS estimate of 1°C. B16 also showed that the TLR Discrepancy may result in an even more serious overestimation of ECS by the GCMs than had been indicated by LC11. B16 further pointed out that the reason given in AR5 for not assessing the LC11 results as significant – based on a claim that the EBM they used was limited to the tropics (AR5, Section 10.8.2.2) – was invalid. The actual EBM used by LC11 was global. It corresponds to Model A of B16 with the extratropical radiative response coefficient set to its Planck value (see Appendix B of B16) [J. Ray Bates, Ireland]	Rejected. The B16 study is not comparable to the ECS as used and assessed here
65481	0				Suggest applying a consistent approach to the use of GSAT versus GMST. Since GSAT is stated to be adopted by WGI as the principal surface temperature indicator, we suggest using only GSAT. Where GMST is used, we suggest providing an explanation why. [Kushla Munro, Australia]	Taken into account in the redrafting of Cross-Chapter Box2.3.
67787	0				In terms of the division of regions mentioned in the various chapters (Atlas, Chapter 9, and Chapter 10), this report has not mentioned specifically of the 'Coral Triangle' region. Some researches has proven that this region is the center of world marine diversity, or 'the amazon of the sea'. And as part of the coastal areas, this region is also potentially affected by climate change. Considering its characteristics, and in addition to being a center of marine biodiversity, and besides millions of people depend on the ecosystem services of the Coral Triangle region, this region need to be mentioned in tha AR6 document. [Ruandha Agung Sugardiman, Indonesia]	Noted. The topics suggested are relevant to WG II and thus beyond the remit of the WG I report. Close consultation was undertaken with WG II chapters to identify regions of interest that WG I could generate assessments for and the Coral Triangle was not raised as a specific region of interest in this context.
38603	0				"Very good report" [Aribert Peters, Germany]	Noted with thanks.
52427	0				The above issues clearly required discussion in the SOD, but no such discussion is given. An appropriate place for a discussion would have been in Chapter 7, in the section headed “Tropical high-cloud amount feedback” (page 7-64). However, this section refers only in a perfunctory manner to the TLR Discrepancy (in lines 27-29) and gives no discussion of its ECS implications. The LC11 and B16 papers receive no mention, in this section or elsewhere in the SOD. [J. Ray Bates, Ireland]	Taken into account. Section 7.4 has been revised to refine the TLR discussion
52429	0				The main focus of the SOD section in question is on discussing physical mechanisms relating to tropical high cloud feedbacks, e.g., increased precipitation efficiency, a thermodynamic stability effect, convective aggregation [6]. Reference is made to an earlier Lindzen paper (Lindzen et al. 2001, hereafter LCH01). It is described as having been concerned with a “hypothetical microphysical process that has not been substantiated to date”. It appears that this reference to LCH01 is meant to justify the lack of reference to LC11. In reality, no such justification is possible, since LC11’s discovery of the TLR Discrepancy is an empirical finding, whose validity does not depend on the validity of any particular physical process. [J. Ray Bates, Ireland]	Rejected. LC11 made unrealistic assumptions on extra-tropical feedback and hence obtained a very low ECS estimate.
52431	0				(b) Tropical Shortwave Radiative Response [J. Ray Bates, Ireland]	Noted
52433	0				As stated, the TLR Discrepancy described above refers to the LW aspects. This is appropriate because TOA shortwave (SW) tropical radiative fluctuations are very weakly related to SST variations. Cho et al. (2012) and Choi et al. (2014) have shown that observational estimates of the tropical SW responses are dominated by noise due to random changes in clouds not caused by surface temperature changes. The observational results of LC11 and MS15 also show that the SW responses are substantially smaller and less well defined than the LW responses (see Table 1 of B16). It is therefore legitimate to focus on the LW response in the context of the TLR Discrepancy. [J. Ray Bates, Ireland]	Taken into account. Feedbacks are assessed in Section 7.4, including the TLR
37075	0				You cite a dataset called HadCRUT5 but it has not yet been published and is therefore unavailable for independent review. The citing of material that is unavailable to reviewers is deplorable and lacks integrity. [John McLean, Australia]	Rejected. Use of this product in this manner is consistent with stated policies on the matter.
38611	0				"Table of content for all chapters of report is essential, as well as an index" [Aribert Peters, Germany]	Noted. A list of the chapters, as well an index, will feature in the final, published report.
52435	0				(c) Satellite-observed tropospheric temperature trends [J. Ray Bates, Ireland]	Noted
52437	0				Using satellite microwave observations, Christy and McNider (2017) have found that, when the cooling effects of the El Chichon and Mt. Pinatubo volcanic eruptions are removed, the global lower tropospheric temperature trend in the period 1979-2017 is just under 0.1°C per decade. Since tropospheric temperatures are expected on physical grounds to increase faster than surface temperatures, it is reasonable to regard the above figure as an upper bound on the global surface temperature trend in the same period. A lower tropospheric temperature trend of 0.1°C per decade is entirely consistent with low ECS as measured by surface temperature. [J. Ray Bates, Ireland]	Noted. Tropospheric trends and their causes are assessed in Chapters 2 and 3
52439	0				Christy and McNider found that the corresponding mean tropospheric temperature trend in the CMIP5 GCMs is more than twice the above figure. This GCM/Observational discrepancy will hereafter be referred to as the Tropospheric Temperature Trend (TTT) Discrepancy. Just as in the case of the LC11 paper, the Christy and McNider paper received no mention in the SOD. [J. Ray Bates, Ireland]	Noted. Tropospheric trends and their causes are assessed in Chapters 2 and 3
52441	0				In summary of subsections (a), (b) and (c) above, the SOD’s claim (Chapter 7, p.7-7) that “All lines of evidence help rule out ECS values below 1.5°C” is erroneous. The fact is that the relevant evidence has been ignored. [J. Ray Bates, Ireland]	Rejected. The energy budget approaches that this comment pertains to are used as a line of assessment
38619	0				"Jet Stream and it influence on clima change is not considered in the report" [Aribert Peters, Germany]	Rejected. It is present in several chapters (2,3 and 8 at least).
52443	0				3. Evidence for high climate sensitivity advanced without adequate scrutiny [J. Ray Bates, Ireland]	Rejected. In this report high ECS numbers are deemed less likely based on multiple lines of evidence.

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95965	0				__Acknowledgement: We would like to express our deepest gratitude to the authors and all other experts involved in the preparation of this draft. We are extremely grateful for the enormous efforts that have been made to produce this comprehensive scientific assessment of the scientific basis of climate change, which is politically relevant without being politically prescriptive. We provide both detailed comments on individual statements and overarching advice on the overall draft. We trust that our comments are addressed across chapters if relevant, the TS, and the SPM, even if we only provide it once. We hope that our comments can help to further improve the quality of this report. We also encourage the authors to see them as an opportunity to better understand the challenges faced by their readers, many of whom do not have a scientific background. Thank you very much for addressing our concerns and making this report even more useful to policy-makers. [Nicole Wilke, Germany]	Noted with thanks.
52445	0				(a) The estimates of ECS and future warming presented in the SOD [J. Ray Bates, Ireland]	Noted
132319	0				On the Earth System's realms considered in chapters 1-4 and in particular chapter 2, and the fact that they do not include Land: Note that the GCOS Essential climate variables (ECVs) clearly highlight a list of Land variables, along with ocean and atmosphere variables (https://www.ncdc.noaa.gov/gosic/gcos-essential-climate-variable-ecv-data-access-matrix). It would seem very strange for the IPCC WG1 report to be inconsistent with the structure followed by the GCOS ECVs. [Sonia Seneviratne, Switzerland]	See response to 132127
70111	0				Given that regional information is a new focus within AR6 compared to AR5, it is important to highlight new findings with respect to regional information. As one example, the concept of "regional climate sensitivity" (RCS) could be better highlighted in the report. RCS builds on the breakdown of uncertainty sources for the regional response to radiative forcing based on the following equation: dXreg/dCO2 = dXreg/dTglob * dTglob/dCO2. This subdivides the forced regional response in two elements, the global climate sensitivity GCS (dTglob/dCO2) and the regional climate sensitivity RCS (dXreg/dTglob). We have found in a recent publication that inter-model spread in RCS contributes more to the intermodel spread in regional extreme responses in CMIP6 than the spread in GCS (Seneviratne and Hauser, Earth's Future, in press). This framework would be useful for many conceptual figures highlighting the sources of possible spread in projections (e.g. Figs. 1.10, 1.11 and 1.12). It is important to stress in the AR6 that uncertainty in RCS is an essential source of uncertainty in addition to that in GCS (ECS, TCRglob). Reference: Seneviratne and Hauser, Earth's Future, https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2019EF001474 . [Sonia Seneviratne, Switzerland]	Accepted. The reference is now included in sub-sections 10.1.2, where the concept is introduced, and 10.4.3, while the concept illustrated in the case study 10.6.4.
95967	0				_Accuracy of quantitative information: Ch01 dwells on the treatment of uncertainties and the special care required by the IPCC when communicating findings and uncertainties (1-26-16). However, the AR6 WG I report does not always follow these principles of careful communication throughout the report: Quantitative information is often given with inappropriate precision, suggesting an accuracy that does not correspond to the usually wide ranges of uncertainty. This applies, for example, to information on the remaining carbon budgets (given in steps of 0.1C) and projections for sea level rise and precipitation. We very much appreciate quantitative information whenever possible, but a very high granularity in decimal places suggests a level of knowledge that is often not realistic. It creates expectations from policy makers to which science cannot respond adequately, and it creates communication challenges when the IPCC revises its statements from one report to the next. Please revise the precision of quantative information throughout the report. [Nicole Wilke, Germany]	Taken into account. This as been propagated, and dealt with where possible. For carbon budgets, the view is that 0.1C steps are warranted so long as the uncertainty is given; see Ch5 and the TS.
52447	0				The SOD's findings on ECS and its projections of the global warming for a future high emissions scenario over 2090-2100 are summarized in FAQ7.2, Figure 1 (page 7-206). It is seen (and stated in the accompanying text on pages 7-7 and 7-119) that the ECS across the CMIP6 models is higher than that in CMIP5 models, with around 20% of them having an ECS larger than 5°C. It is stated that "The best estimate of ECS is 3 °C, the likely range is 2.5 to 4 °C and the very likely range is 2 to 5 °C. It is virtually certain that ECS is larger than 1.5 °C." [7]. [J. Ray Bates, Ireland]	Noted. The comment contains no concrete suggestions.
70113	0				Discussions between the regional chapters have shown that it would be useful to have a didactic cross-chapter box explaining why it is valid and useful to provide projections as function of global warming levels (GWL; such as what is done in chapter 11 and in part in the Atlas), and how the translation between global warming levels and time scales/scenarios can be done. The timing of given global warming levels in projections is provided in Chapter 4, but there is a need to explain why there is little scenario dependence when using this approach and what are advantages vs caveats of this approach. We can also explain there that this is essentially a change of coordinate from time to GWL and that times becomes the dependent variable, which provides a less deterministic perspective on climate projections. This would be a type of "user guide" for interpreting and using maps providing projections as function of GWL. An essential advantage is to focus on the variable of integration that is central to the Paris Agreement, namely the GWL. This new CC box could be located in ch11, ch10 or ch1. Its integration was supported by authors of the regional chapters in the pre-LAM breakout group discussions. [Sonia Seneviratne, Switzerland]	Accepted. This Cross-chapter Box is found in Chapter 11.
95969	0				_Communicating about past, present and future warming: We have very serious concerns about how the AR6 WGI report addresses past, present and future warming, including the confusing manner in which information regarding different temperature metrics (GMST, GSAT), new approaches (shift in historical warming and treatment of model projections), and about different warming levels (storylines, emerging knowledge), the new assessment of the ECS, the quality of the CMIP6 results, and related information, e.g. on the remaining carbon budgets, is communicated throughout the report. We regret the lack of considering the needs of the report's readership to get clear and comprehensive explanations for these innovations in order to be able to understand these highly policy relevant issues. In non-academic contexts, the progress of research, which of course goes hand in hand with a revision of past statements, could wrongly be interpreted as evidence of incompetence of previous authors or could erode confidence in information from science. We therefore call on the authors to give clear and understandable reasons for the new approaches and modified statements. Please consider also the more specific comments on this issue throughout the report. [Nicole Wilke, Germany]	Taken into account. The FGD has made every effort to characterize clearly the research progress since previous reports on past, present, and future warming, and how this progress has led to changes in the assessment compared to previous reports.
39137	0				Congratulations are in order for the entire WG I contribution-very substantive, especially because there are so many innovations (e.g., the addition of the Atlases, the treatment from global to regional, most especially in the projections and the provision of climate information for national and local use, the handshakes between and among the Working Groups, making it a wholisticapproach)! It is being suggested,however, that in some chapters, some sections/subsections, synthesis must be done, not literature reviews nd uncertainty language must be included as much as possible. [Lourdes Tibig, Philippines]	Thank you. Every effort will be made to quantify uncertainty where applicable and currently not present. We look forward to reading your specific suggestions.

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52449	0				The overall shift towards higher ECS leads to generally higher projected warming compared to earlier generations of models, by up to 2°C in some simulations. The CMIP6 multi-model ensemble range of projected warming by the end of the 21st century, relative to the period 1995–2014, is portrayed in the figure cited above as lying in the approximate range 3°C to 6°C, roughly 20% larger than the CMIP5 range (see page 4-5). It is stated that the best estimate of future warming does not rely on the latest models alone, but factors in other lines of evidence; nevertheless it is acknowledged that these other lines of evidence involve the use of the models. It is also acknowledged in Chapter 3 (page 3-8) that the SOD assessment of human influence on the climate system is primarily based on studies using the CMIP6 model simulations. [J. Ray Bates, Ireland]	Taken account. CMIP6 models are not used for projections of GSAT ranges, rather these are based on the assessment.
95971	0				_Detection of mitigation benefits: We are surprised by the assessment of the identification of mitigation benefits. The evidence of emission reductions in the global temperature signal seems to be based on the detection of a signal that emerges beyond natural variability. However, this does not seem to be the appropriate approach to detect mitigation benefits, since there are changes in the temperature, including its variability, due to GHG emission reduction that can indeed be detected. We suggest that the detection should be based on the assessment of the probability of a specific temperature signal with and without emission reductions, hence an assessment of the partial contributions of mitigation instead of focusing on 100% attribution as in the current draft. Such an assessment of partial contributions has been done by one of the papers cited (Marotzke 2019) that shows that the probability for a near-term warming trend reduction (2021-2035) compared to the recent past under a RCP2.6 scenario is 67% and thereby 40% higher than in a RCP4.5 scenario. This paper presents a clear mitigation signal to be expected even in the presence of natural variability that directly contradicts statements on the delayed detection of mitigation benefits. Please revise Section D4 and the underlying report in chapters 4 and 6. [Nicole Wilke, Germany]	Taken into account. However, 30% to 40% probability of emissions reductions causing trend reductions, in the sense referred to in the comment and in Marotzke (2019), would in the typical usage within detection and attribution approaches not be characterized as having been "detected". Higher probabilities would be needed. That said, new research using similar approaches but larger differences between scenarios has since become available, and the text in Ch04 as well as in TS and SPM has been modified with the aim of avoiding misunderstanding.
52451	0				(b) GCM tuning and the TLR and TTT Discrepancies [J. Ray Bates, Ireland]	Noted. Incomplete comment, so not clear what change is requested, but GCM tuning is assessed in 3.2 and 3.3.1. Meaning of TLR and TTT not clear.
89317	0				Please get a professional designer with a good feeling for colours to do a make-over of the colour scheme used for all the figures in the report. Many are horribly unattractive. It does make a huge difference for public communication! [Stefan Rahmstorf, Germany]	taken into account. The visual guidelines given to the chapters includes accessible and unbiased colour palettes for maps and graphs. However, there is a trade-off between the amount of variables that can be shown with an accessible colour palette.
95973	0				_Explaining the changes from AR5-CMIP5 to AR6-CMIP6: We strongly urge the authors to revise and harmonize references to the changes between CMIP5 and CMIP6 across the report. The ECS of some important CMIP6 models is effectively 'rejected' - in some sections but not all - since it is not found to be consistent with the assessed ranges of the ECS [7.5.6]; so these CMIP6 models are assessed to be too warm (although 'emergent constraints' are also a debatable method which, by design, cannot rule out higher ECS) and the AR6 disregards their results by calling them "raw output" - which is in sharp contrast to previous reports - and replaces them by "storylines"? The AR6 uses "the assessed range of GSAT rather than the raw output of unconstrained projections" linked to the statement that "the upper end of the projected warming range increases, due to models with higher equilibrium climate sensitivity in CMIP6, compared to CMIP5" in the TS. This is complemented by the even more puzzling sentence "Low-probability high-warming storylines are here assessed for a level of warming consistent with the upper bound of the assessed very likely range." The authors should please consider the reception of such statements by the audiences of the IPCC, i.e. non-scientists. We appreciate the scientific progress and are well aware of progress in knowledge. However, these new approaches are extremely challenging in terms of communication. We therefore ask the authors to provide clear and comprehensive explanations, possibly in a cross-chapter box, including the following aspects: relation of SSP to RCP; changes in the ECS concept and values between CMIP5/AR5 and CMIP6/AR6; changes in greenhouse gas and aerosols concentrations/emissions and in radiative forcing (ERF, IRF) between CMIP5 and CMIP6; changes in the temperature signals in AR5 (Paris Agreement) and AR6 together with explanations of the reasons for these changes. This is necessary to enable communication to policy makers and the public of the stronger warming and associated climate signals in AR6. People working at the science-policy-interface need clear, robust and comprehensible explanations from experts. We strongly urge the authors to provide such information in a comprehensible manner, including in the SPM and the TS, in order to maintain trust in climate science in general and the IPCC in particular. [Nicole Wilke, Germany]	Accepted. A cross chapter box on emulator projections is added in Chapter 7. This Chapter also compares results to CMIP6 models in Section 7.5, and provide an easy to understand FAQ 7.3 on models, climate sensitivity and projections. Chapter 4 has been revised to examine the RCP and SSP differences in detail, supported by the emulators
52453	0				Any belief that GCM projections are simply an expression of the laws of physics, representing what “the science” tells us, was dispelled by a remarkable paper on model tuning by Hourdin et al. (2017). This paper, written by GCM experts, was the outcome of a workshop on model tuning organized under the auspices of WMO’s World Climate Research Programme. The paper openly acknowledged that tuning is an intrinsic and fundamental part of climate modelling and that there has been a lack of transparency in relation to it in previous IPCC reports [8]. [J. Ray Bates, Ireland]	Noted. This paper is assessed in Section 3.2.

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95975	0				_Historical global temperature: There has been a shift of the historical temperature of global warming due to the provision of improved estimates of the historical observational record as explained in subsection 2.3.1.1.3. This shift is by far more crucial than the switching from GMST and GSAT. The current global warming level was assessed as about 0.87°C in the SR1.5 SPM A.1.1 (GMST, 2006-2015). Now, 3 years later, we learn in SPM B2.1 (SPM-10:5) that this level is about 1.10°C (GSAT, 2009-2018). The shift from GMST to GSAT explains about 0.04°C, which is discussed in great detail in Boxes in Box SPM.1, Box TS.1 and Cross-Chapter Box 2.3. The remaining offset of almost 0.2°C of global warming in 3 years need still to be explained upfront, both in the SPM and the TS. This shift of the historical temperature has huge implications for many messages which are highly relevant for policy makers, such as: 1) The new assessment of the historical temperature of global warming raises questions about the temperature targets of the Paris Agreement. Paragraph 2.3.1.1.3 (2-40:6-17) provides useful information about how this re-assessment relates to the temperature goals of the PA that should be raised to the TS and SPM, e.g. in Boxes SPM.1 and TS.1. We strongly suggest identifying an "AR5-temperature" that is equivalent to the temperature scale used in the AR5 and that is relevant for the Paris Agreement. Otherwise there will be a lot of confusion about these drastically new assessments and their policy implications. 2) A much earlier timing of reaching 1.5°C global warming (e.g. SPM, section C1; TS-70:8-10) than in the SR1.5. The TS mentions the re-assessment very briefly, but neither explains nor quantifies this offset. The SPM is silent about the reasons for the earlier timing. When following the line of sight to CH4.3.1 4-36 L26-32 and finally CH2.3.1 2-40 L6-17 we learn that the enhanced observational record states the warming over the period of 1880-2012 as 0.99°C GSAT as opposed to 0.85°C GMST from the AR5 that was used in the Structured Expert Dialogue informing the PA. We were neither able to comprehend this important change which affects the timing of 1.5°C so significantly by reading this text nor by looking into Table 2.4. We urge the authors to reiterate this section and assure that changes here will also be incorporated in other parts of the report. In addition, this 2030 estimate seems not to be consistent with the current warming rate (0.2 C/a for 40 GTCO2/a). Starting from the GSAT levels above pre-industrial values given for 2009-2018 as 1.10 °C (SPM-10 L5 and Box TS.1 Table 1 TS-24) and adding the warming rate of 0.2°C per decade results in 1.5°C temperature rise for the time period of 2029-2038 even for GSAT. We urge the authors to revise this relation or at least explain how this is linked to the CMIP6 projections. In addition, this message is strongly misleading since it is only true for the re-assessed temperature scale, but not for the AR5-temperature-scale that is relevant for the Paris Agreement. 3) Due to this offset the AR6 seems to mainly take into account overshoot scenarios, even for low emission scenarios: from Box SPM.2 Table 1 (SPM-20:15-35) it follows that GSAT reaches 1.71 (1.41, 2.01)°C. Even if the shift from GMST to GSAT is taken into account, this assessment is significantly different from the one provided in the SR1.5 in which many no or low-overshooting scenarios were discussed. It needs to be explained, including in this table, how the temperature scale relates to the Paris agreement. 4) The reports states that for pathways with rapid decreases to net-zero and negative CO2 emissions trends in surface air temperature would	Taken into account in the redrafting of Cross-Chapter Box2.3.
52455	0				Given the open, honest and in-depth discussion of tuning in that paper, it is insupportable for any subsequent IPCC report to revert to the status quo ante in its presentation of GCM projections. Unfortunately, this SOD shows all the signs of so reverting; FAQ 3.2 (Are Climate Models Improving?) is illustrative in this respect. The topic of GCM tuning deserves a full chapter to itself. Instead, it is discussed only in a cursory manner in Section 1.5.3.2 of Chapter 1 and on pages 7-105 to 7-106 of Chapter 7 [9]. A transparent assessment would have pointed out that the values of ECS and global warming at 2100 given in Subsection 3(a) above are to a very large degree the outcome of tuning choices made by the model designers so as to have GCM parameters lying [in the words of Hourdin et al (2017)] in an “anticipated acceptable range”. [J. Ray Bates, Ireland]	Rejected. Tuning is also assessed in Section 3.2, where Hourdin et al. (2017) is cited, and 3.3.1. Also, we note that this report does not rely on solely on CMIP6 models for climate projections - other lines of evidence are also used (see Box 4.1).
132329	0				There is an issue of traceability of the chapter 12 material if it is supposed to synthesise material from other chapters and in particular chapters 11 and 9. How can this traceability be ensured and documented? What are the mechanisms for checking the consistency of this material? [Sonia Seneviratne, Switzerland]	TAKEN INTO ACCOUNT: Between the Second-order Draft and the Final Governmental Draft the WGI authors have undertaken extensive collaborative review of findings to ensure consistency and traceback across the chapters. This includes Regional handshake teams for each region, specific thematic teams around key topics (e.g., drought, glaciers, relative sea level rise), enhanced connections to physical explanations in other WGI chapters within Section 12.2, and a traceback table associated with Table TS.5 that helps readers find information for each regional CID across chapters.
95977	0				_Lack of consistency across chapters: It is highly appreciated that the structure of the report in AR6 is more user-oriented than in previous reports. We had hoped that the new structure of AR6 compared to AR5 (not having chapters only assessing observations and on the other hand chapters assessing only models) would present climate - and policy - relevant topics in a more focused and more thematically structured way. Unfortunately, this has not yet been fully achieved even for highly policy-relevant information; please see our individual comments throughout the report. Although we are aware this new structure poses a particular challenge for the author team, we urge the authors to avoid overlapping and duplication and to maintain consistency in the statements. The current draft in our view also includes too many specific details (of course very important for the colleagues working in this field) which are not all relevant to the AR6. Parts of the text read more like a detailed review since the 2000s and not an assessment. We urge the authors to review, revise and shorten the report in this respect. [Nicole Wilke, Germany]	As part of the work of this cycle an informal guidance document for WGI on ES statement has been drafted and distributed to all the authors to address the point you raise. The consistent use of the uncertainty language is an important goal of this report. Thank you for indicating that you have made individual comments. Indeed, it is easier to address this issue with specific cases. The SPM is being redrafted for the FGD draft and one of the goals is to hone its policy relevancy; another aim of this next draft it for the SPM’s length to be reduced.
52457	0				The most important tuning target for CMIP6 models has been to achieve approximate global TOA radiative energy balance. This is done through tuning the parameterizations of the physical processes that determine the Absorbed Solar Radiation (ASR) and Outgoing Longwave Radiation (OLR). Achieving the required global balance between ASR and OLR is a delicate process that involves error compensation between the two components (Hourdin et al., p. 599). The more ambitious goal of tuning the ASR and OLR so that they respond correctly to variations in surface temperature, thus giving realistic radiative responses (or feedbacks) is one involving a much higher level of complexity. [J. Ray Bates, Ireland]	Noted.
23019	0				To better manage the matrix problem and reduce overlaps it would be worthwhile ensuring all sections in chapters 5 onwards start any section not just with AR5 and SR findings but also recapping the relevant findings from 2 through 4. Then in regional chapters this would be 2 through 9. There are an alarming number of cases where chapters repeat a substantive assessment undertaken elsewhere often coming to contradictory findings. Having a policy of starting substantive assessment sections with a recap of relevant findings from other chapters would be a way of both policing this issue and providing a better service to the reader. [Peter Thorne, Ireland]	Taken into account. There has been significant cross-chapter coordination efforts to improve consistency and reduce overlaps.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
95979	0				_Long-term perspective and abrupt changes: There is a lot of information on the long-term perspective of climate change beyond 2100 available in the underlying report. We strongly encourage the authors to include this relevant information also in the TS and SPM to allow policymakers, who usually do not read underlying chapters, to be informed comprehensively. In particular we urge the authors to include such information including on AMOC, SLR, marine ice sheet instability, permafrost, large scale circulation pattern and precipitation. [Nicole Wilke, Germany]	Taken into account. In the final (approved) SPM, B5.3 provides sea level projection for 2150 and figure spm.8 e shows the 2300 projections. Relevant sections in the TS also contain very long term projection information (for example, Box TS.4).
52459	0				MS15 showed that it is possible to tune the parameterization of the cloud-rain conversion rate in convective clouds in the ECHAM GCM so as to reduce the TLR Discrepancy and thereby reduce the ECS. However, Li et al. (2019) investigated tuning the same parameterization in the NCAR GCM and obtained results contradictory to those of MS15. The issue is clearly model-dependent, illustrating the difficulty of eliminating the TLR Discrepancy and reducing the ECS in current GCMs in a manner that is physically robust. [J. Ray Bates, Ireland]	Noted. MS15 was able to tune the model to match the observed TLR, despite having an ECS above 2C. Li et al. (2019) obtained an increase in ECS.
14829	0				Paleo-drought and paleo-floods are discussed in chap1à and 11 (in particular in box11.2). However there is hardly any connection the information in these two chapters. It would have been nice to show more coherence between the chapters. [Marie-France Loutre, Switzerland]	It is unclear what "chap1à" is. Assuming this is meant for Chapter 8, the assessments between the two chapters are consistent.
95981	0				_Modification of risk framework: We appreciate the use of the risk framework that had been established in previous IPCC reports as well as the highly appreciated cross-WG discussion to develop a common risk framework including the clarification, that climatic drivers are not only negative as suggested by the previous term "hazard". According to the glossary, "impact" and "risk" are both based on the same conceptual approach (resulting from climatic drivers, exposure, and vulnerability) and "impact" is referring to "realized risk". From this, it follows that for the present and past, in particular for observations, the term "impact" must be used while for the future the term "risk" is required. This is however not implemented in the report although the communication of risk/impacts is a key area for the IPCC. We wonder, if there is a misunderstanding, either on our side or on the authors' side, and would appreciate a feedback. We strongly urge the authors to use the terms "risk" and "impact" in a consistent manner and in line with the definitions provided in the glossary. The new expression CID in this report only refers to impacts but neglects the link to risks. We therefore strongly urge the authors to use the expression "climatic drivers" throughout the report to avoid misunderstandings and confusion. This also applies to the TS and the SPM. Please see also our related comments on risks and impacts including on the glossary. [Nicole Wilke, Germany]	TAKEN INTO ACCOUNT: The reviewer's point is well taken, and we have been deliberate in the use of impact and risk and considered the time periods associated with these terms' usage. We agree with the reviewer's formulation of impacts as 'realized risk', but disagree that there is any hard rule that impacts can not be discussed in the future and risk can not be discussed in the past. For example, a changing climatic impact-driver can lead to projections of a future impact, and the probability of this occurring is a risk. Likewise, in the recent past there was a risk profile of extreme events that is somewhat different than the actual impacts that occurred -- we see this in model simulations of the current climate that show alternative series of events were possible (this is also why we can define a 1-in-100 year storm even in situations where that storm hasn't occurred in the past 100 years (due to its probabilistic nature).
109805	0				This might seem like a nitpicky comment, but I think it would be important to use the terms aerosol (carrier gas + the condensed-phase particles) vs. aerosol particles (the condensed phase particles suspended in the carrier gas) precisely. Specifically, to use the term "aerosol particles" when referring just to the particles (e.g. in terms of their composition). [Ilona Riipinen, Sweden]	Rejected. Too detailed for the Report. Terms are used generally
52461	0				This difficulty is further compounded by the fact that the ECS given by a GCM depends strongly not only on the physical aspects of the sub-grid scale parameterizations, but also on the purely computational aspects. Specifically, changing the order in which the parameterizations are applied can induce differences in the net climate feedback that are as large as the inter-model spread in the CMIP5 GCMs; this has been shown by Donahue and Caldwell (2018). That paper also is not referred to in the SOD. [J. Ray Bates, Ireland]	Noted. Paper is outside of scope of the ECS lines of evidence
95983	0				_New approach to the ECS and the TCR: These two important quantities are no longer mainly based on GCM simulations in the AR6. Instead, these GCM data are downgraded as "raw" and at least three other "lines of evidence" are blended with GCM information whose results are used in so-called “emergent constraints”. The explanation provided in the TS-78-12 to TS-79-5 is insufficient to explain such a fundamentally different approach and it is not comprehensible for lay people. On the contrary, it might raise doubts about the quality of GCMs and climate projections altogether. One might also wonder about the robustness of previous reports' statements on the ECS. We therefore strongly urge the authors to consider the communication challenges of this new approach and to properly explain what has been done. [Nicole Wilke, Germany]	Taken into account. The ECS assessment is performed in Ch07 and the TCRE assessment in CH05. The result of this assessment has entered the assessment of GSAT change performed in CH04. Furthermore, the GSAT assessment has been informed by recent papers constraining future GSAT change by past observations and is fully traceable to the literature. However, a clearer explanation has been developed in the chapters and the TS in the FGD to try to address these concerns.
52463	0				The elimination of the TLR and TTT Discrepancies, both of which are reliably established and strongly ECS-related, was not discussed in the SOD. This is an extremely serious omission. If it is not possible to tune the GCMs so as to eliminate these discrepancies, this should be openly acknowledged. The lack of discussion of this topic is, by itself, sufficient to make the SOD unacceptable. [J. Ray Bates, Ireland]	Rejected. Both aspects are discussed in Section 7.4 and CMIP6 discrepancies are discussed in Section 7.5
132337	0				I would strongly recommend Chapter 12 to provide lists of indices of most relevance under each CID and sector and how they can be computed from WG1 data. This list would provide a valuable extension compared to the ETCCDI indices. This information could be provided in tables that list relevant indices and how they are defined. The Atlas could then compute observed and projected changes in these indices. Chapter 11 could help with this selection of impact-relevant indices. [Sonia Seneviratne, Switzerland]	TAKEN INTO ACCOUNT: Section 12.3 notes that there is a large number of potential indices for many CIDs. These are further distinguished when tailored to specific sub-sectors (e.g., maize crops and soybean crops have different extreme heat thresholds). Section 12.3 therefore cites papers that review multiple indices to aid the reader, and connects to tables in other WGI chapters that may list specific indices (e.g., the drought indices in Chapter 11). It is not practical to include all of these indices explicitly within CH12 or to create new IT tools to calculate these, but readers are empowered to find and create these for their own needs.
95985	0				_Overshoot scenarios: We miss the discussion about overshoot in various occasions in this report. In the SR1.5 this important issue was extensively discussed. In particular, we found this discussion important, since the lower emission scenarios in this report also reach temperatures of about 1.7 °C for the time period of 2041-2060 (c.f. Box SPM.2, Table 1). Hence, this report only looks at overshoot scenarios, and scenarios limiting global warming to 1.5°C without overshoot are not discussed at all. What is the reasoning behind? Is this only because of the shift of historical temperature of 0.1°C as discussed in 2.3.1.1.3? Since this topic is highly policy-relevant, we request the authors to please revise and add more explanation why this report does not discuss scenarios that are consistent with all temperature goals of the Paris Agreement. Also, it would be very helpful to explicitly state the overshooting character of the scenarios investigated in this report. [Nicole Wilke, Germany]	Taken into account. It must be noted, though, that assessment of future global temperature change performed here is based on a relatively small number of scenarios, as explained in Ch01 and Ch04. Of these scenarios, both SSP1-1.9 and SSP1-2.6 involve some increase and later decrease in their radiative forcing. Other scenarios have not been simulated with comprehensive climate models. Furthermore, Ch04 ES stated already in SOD and repeats that in FGD that in combination with climate sensitivity in the lower range, SSP1-1.9 avoids crossing 1.5 °C altogether. This information is included in Box SPM2, Table 1. The issue is now discussed in the text more prominently.
52465	0				4. Conclusions [J. Ray Bates, Ireland]	Noted

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
95987	0				_Reference Periods: The period 1995 to 2014 is neither modern nor a generally accepted reference period. Firstly, according to the WMO-definition of climate a reference period is normally at least 30 years long and, secondly, from a climate service point of view it is unfavourable to move reference periods into the future with every assessment report. Therefore IPCC reference periods should follow the WMO Technical Regulations, which would be 1961-1990. (Please see https://library.wmo.int/doc_num.php?explnum_id=4166, including P 11, Ch 2, paragraph 3, last sentence "...the period from 1961 to 1990 has been retained as a standard reference period for long-term climate change assessments.") The IPCC creates considerable communication challenges, if each new IPCC report comes with its own reference periods, since findings can neither be compared across IPCC reports nor with WMO information. This is problematic for many users of IPCC reports including national agencies that update their adaptation choices based on IPCC reports. In addition, please define the reference periods used in this report in the glossary. [Nicole Wilke, Germany]	Taken into account. Overall, this report uses year ranges rather than words to describe reference periods. The need for a number of reference periods comes from differences in data availability, time spans of model simulations, as well as from external considerations such as the ones given here. In the main report we have opted to be comprehensive rather than limiting ourselves to a few periods only, while the TS and SPM use a reduced set of reference periods - mainly relative to the common baseline of 1850-1900.
52467	0				It is of the utmost importance that the IPCC should follow its own guidelines and ensure that the reports it presents to policymakers and the public are scientifically neutral and rigorously objective. [J. Ray Bates, Ireland]	Noted
132341	0				I was very suprised to see that Chapter 12 overlooked an important WMO activity which is fully aligned with its objectives, namely the "Expert team on sector-specific indices" (ET-SCI, https://climpact-sci.org/about/project/). The ET-SCI has determined a list of relevant sector-specific indices and their definitions (https://climpact-sci.org/indices/). Chapter 12 should document and assess this activity and use relevant material from it (e.g. choosing indices selected by ET-SCI to be computed by the Atlas for the AR6 WG1 assessment) [Sonia Seneviratne, Switzerland]	TAKEN INTO ACCOUNT: Section 12.3 now refers to the ET-SCI as one of the efforts building up indices and tolerance threshold information that can be used in climatic impact-driver analyses.
95989	0				_Storyline and narrative approaches: The AR6 WGI introduces the new concepts of storyline and narrative approaches (e.g., Ch1 and Ch10) as a complementary instrument "to mitigate the 'confidence straitjacket' imposed by purely probabilistic evaluation" (1-30-27) , to aid the representation of issues that are associated with high or "deep" uncertainty. We appreciate the efforts to distil multiple lines of evidence. Yet, we are strongly concerned about the new approaches of WGI and their presentations. What is an "effective narrative"? What are "storyline approaches"? These expressions suggest fiction rather than science, as previously presented by IPCC WG I. Please explain these approaches with care, including referring to their scientific robustness and avoiding the impression of arbitrary narratives. The current version of the glossary entry is not helpful since it uses very soft qualifiers (“usually”, “can”,...). In addition, the findings gained through this approach are not always tagged with a disclaimer that would indicate that they are based on alternative methods including plausibility and common sense, i.e. including non-scientific methods, e.g. when it comes to regional information. We are very concerned that this new approach might not be consistent with the IPCC's high scientific quality standards and might jeopardize the integrity of the IPCC and the credibility of the assessment. We urge the authors to be extremely transparent whenever applying such methods. Please see also our comment on Box TS.2. [Nicole Wilke, Germany]	Taken into account. Storyline approaches have been used in previous IPCC reports (e.g., case studies, SR1.5 Ch3 Cross-Chapter Box 8), and have long appeared in the literature of Working Groups II (e.g., in disaster risk management) and III (e.g., scenario-storylines). Since AR5 storyline approaches have increasing been used/discussed in physical climate science literature (e.g., physical climate storylines - see the glossary). Given the diversity across IPCC WG domains, the glossary definition for storylines is general by necessity. Great care has been taken in the writing of report text discussing/featuring storylines. They are presented as a tool for communicating scientific information, highlighting that any specific storyline is only one of multiple plausible future outcomes (hence the term 'storylines' plural rather than 'storyline' singular). Further, the specific set of circumstances that a given storyline is conditional upon (e.g., climate sensitivity being high) is always made clear. The physical climate storylines in the report are rigorously constructed using high quality scientific information (can be from multiple lines of evidence) and so represent physically plausible outcomes.
103925	0				For all the report, wherever there are long tables present that run on several pages, repeating the hearder row on each subsequent page would enhance the reader friendliness of the report. [Philippe Tulkens, Belgium]	Noted. Editorial. Thank you for the suggestion. This should be the case in the final, formatted version of the report.
52469	0				This Second Order Draft does not present a neutral, objective assessment of equilibrium climate sensitivity or of the reliability of model projections of future warming. On these grounds, the SOD should not be accepted by the IPCC as the basis of an AR6 report. [J. Ray Bates, Ireland]	Taken into account. Assessments have been revised
95991	0				A comprehensive assessment of the achieved progress in CMIP6 compared to CMIP5 is partly done in Ch3 although the focus of Ch3 lies in the human impact on climate. However, in none of the subtitles the reader finds these assessments, they are hidden within. Ch3 reports several relevant quantities where no progress was found (for instance CMIP6 reproduce observed warming less well than CMIP5, and CMIP6 overestimate decadal internal variability, the temp bias for the deep ocean doubled in CMIP6 and so on). On the other hand it is frequently stated that there was improvement in CMIP6 compared to CMIP5 (for instance Ch9, Ch4) but without giving further information to support this statement. A statement in the ES of Ch3 regarding the quality of the progress between CMIP6 and CMIP6 and the most prominent changes in the models is missing. Please add this information also in the SPM and the TS. [Nicole Wilke, Germany]	Taken into account. More statements on evaluation of CMIP6 models have been added to the ES of Chapter 3, and there is an updated paragraph on differences between CMIP5 and CMIP6. These assessments have been carried up to the TS and SPM.
103927	0				A linkage beween climate change and biodiversity (IPCC and IPBES) would be needed as the two are intrisically impacting one another and only bringing them together offers a complete overview to a very complex setup. [Philippe Tulkens, Belgium]	Taken into account. Biosphere is now more strongly stressed.
110839	0				Consider adding the nitrogen cycle to the table of Cross-cutting themes in AR6 WGI. (Chapter 5, Section 6.2.2.7) [Claudia Steadman, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. This was considered but ultimately not added to the Chapter 1 cross-cutting themes table as it was considered too specific. The topics in this table are much more broad, for example Land-use would be a theme where aspects of the nitrogen cycle would feature.
52471	0				Notes [J. Ray Bates, Ireland]	Noted.
7673	0				“Comment : In the FAQ part, to ease communication and visibilty, it would be great to have experts’ point of view on the current situation. But I’m not talking about a complexe and hard to get point of view, I’m talking about a simple, clear and short point of view. It would be great to have their answers to the following question : as an human being who knows more than most of us on climate change, what do you feel about what’s going on ?” [Antony Desmeaux, France]	Rejected. This would be beyond the mandate of the IPCC report, which must remain neutral and cannot be policy-prescriptive.
95993	0				For climate services it is unfavourable to change the reference period with every IPCC report (here recent past is defined as 1995–2014). For taking adaptation measures and for communication to the public it is important, that the climate change signal is computed by using fixed time periods when updating the IPCC report. WMO gives recommendations on the reference period which is binding for national meteorological service in their official duties. It would be highly beneficial if the scientific community could consider this, especially the authors of Ch4 (e.g. 04-05-19). [Nicole Wilke, Germany]	Taken into account, where possible. In the main report we have opted to be comprehensive rather than limiting ourselves to a few periods only, while the TS and SPM use a reduced set of reference periods - mainly relative to the common baseline of 1850-1900. Availability of observations and consistent model simulations, and the choices made in the literature we assess, are however additional constraints in some places.

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103929	0				The take up of carbon by the ocean has different amounts throughout the different chapters: chapter 5 pg 6, line 45 and 46 states '23% was taken up by the ocean (2.5 ± 0.6 PgC yr-1)', chapter 5 pg 90, line 32 states '24% was taken up by the ocean', chapter 5 pg 7 line 20 and 21 states: ' ocean continuing to take up 23 ± 6% of the global anthropogenic CO2 emissions', FAQ 5.4. states that 'about a quarter was absorbed by the ocean', chapter 2 states pg 73 lines 1 and 2 : 'SROCC concluded that the global ocean absorbed 20-30% of toral CO2 emissions since the 1980s', SROCC states that ' about one third was taken up by the ocean', chapter 5 pg 13, line 41: 'oceans (24%)', chapter 5 pg 14, line 29: ' regulated by the negative feedback of ocean (22%)', chapter 5 page 24, lines 1 to 7 'The total increase of CO2 stored in the ocean interior (net anthropogenic and natural CO2 uptake and storage changes has been evaluated as 140 ± 22 (±2σ) PgC in the year 2007, that is 28 ± 5% of total anthropogenic CO2 emissions (Gruber et al., 2019a). As reported in SROCC (Section 5.2.2.3.1), the ocean CO2 inventory has increased by 29 ± 5 PgC (26 ± 5%) between1994 and 2007 with a mean annual storage rate of 2.2 ± 0.4 PgC yr-1, which corresponds closely to the global mean ocean-atmosphere flux estimate of 2.1 ± 0.6 PgC yr- 1, in proportion to the atmospheric CO2 increases of 31 ± 1% for the same period (Gruber et al., 2019a) (Table 5.1)., chapter 5 pg 23, line 13 'uptake fraction of 24+/_5% of total CO2 emisions', chapter 5 section 5.4.2. line 34 and 35: 'the ocean continued to absorb esentially the same ratio (26+/_5%)', chapter 5 pg 170 'The airborne fraction that drives this historical climate forcing (about 44%) is largely regulated by the negative feedback of ocean (22%)', etc. Consistency throughout the report should be ensured. There might be good reasons for these differences in numbers (possibly the differences in time scales) but they need to be cross checked for consistency. [Philippe Tulkens, Belgium]	Taken into account. A new Cross-chapter box in Chapter 5 has been added to address this issue. Cross-Chapter Box 5.3: The Ocean Carbon-Heat Nexus and Climate Change Commitment
52473	0				[1] www.ipcc.ch [J. Ray Bates, Ireland]	Noted.
95995	0				In all chapters, biosphere and soil topics, which are brought up but not covered in detail, should be referenced to the following reports of WG 2 and WG 3. This could prevent that the limited extent, with which biosphere and soil topics are covered, creates an impression of lesser importance of biosphere and soils in the natural climate system. [Nicole Wilke, Germany]	Accepted. Cross-references have been added in several places.
52475	0				[2] Chapter 4, page 4-5: "The uncertainty ranges for the period 2081–2100 continue to be dominated by the uncertainty in equilibrium climate sensitivity and transient climate response (very high confidence)." Chapter 7, page 7-106: "The high climate sensitivity leads to generally higher projected warming in CMIP6 compared to CMIP5." [J. Ray Bates, Ireland]	Noted. No action item.
95997	0				In many instances this report only refers to findings of the AR5 and simply ignores the SRs that have been published by the IPCC in the meantime. This might be due to changes in the author teams but is not useful for the readers of the report who need to know the relation to the SRs as well. We therefore strongly encourage the authors to refer to the SRs in all cases where a topic has also been dealt with there. Especially significant changes between the reports require explanations. [Nicole Wilke, Germany]	Taken into account: the rule for the chapters is to start from the special reports. If a topic was not covered in the special reports, then the starting point is AR5.
52477	0				[3] Terminology and sign conventions. In the present comments, the Planck radiative response (or feedback) is taken as a positive quantity. This is in accord with basic physics and is the sign convention used in a large part of the climate literature. It is also in accord with the sign convention used in the SOD Glossary, where the Planck response is the main component of the quantity denoted α in the definition of "Climate feedback parameter". However, within the main text of SOD, the opposite sign convention is frequently used (e.g., Equation 7.1, Box 7.1). There is a strong argument for adhering to the Glossary's physics-based sign convention everywhere. [J. Ray Bates, Ireland]	Rejected. The sign convention established in Box 7.1 is adopted
21759	0				In general many of the figures would not be suitable for use as stand-alone items. With some effort at insertion of titles, labels etc. the figures could be made substantively more accessible and a valuable resource for outreach, communications, and education. [Peter Thorne, Ireland]	Taken into account. Figure have been revised with that in mind and visual guidelines have been given to the chapters.
95999	0				In the report different units are used, corresponding to carbon emissions, concentrations, etc.: CO2 concentrations, GT CO2, Pg C. Please explain the relations between the units and please try to use the same units as often as possible. Some examples: 1) TS-37 L53: Instead of using cumulative CO2 emissions it would be much easier to provide the associated CO2 concentrations in ppm. We strongly urge the authors to do this extra-effort for the sake of usability of the report, in particular in the SPM and in the TS, thank you very much in advance. [Nicole Wilke, Germany]	Taken into account. The reason for two different units is that the carbon cycle literature uses units of PgC, while more sector-specific or policy-related literature uses units of GtCO2, it was decided to include both units in the revised SPM and TS. A conversion is found in the TS.
52479	0				[4] The CMIP3 models were those used in the IPCC's Fourth Assessment Report. LC11 examined these models' radiative responses when they were run in both CMIP mode (SST determined from a coupled ocean model) and AMIP mode (observed SST used). Serious discrepancies between the GCM and observational responses, with the GCM values lying well below the Planck response, were found in both cases. See Table 1 of Bates (2016) for a summary. [J. Ray Bates, Ireland]	Rejected. The assessment does not rely on models being unbiased.
76817	1	1	1	1	One aspect that hasn't come out clearly in the SOD is an assessment of the modes of climate variability and how these are changing. This is true for all modes of variability, though ENSO gets a short mention but with a much weaker statement than what was in the SPM of SROCC on ENSO. The SROCC approval process also demonstrated that many countries wanted information on the IOD, but this was not assessed thoroughly in SROCC so not much could be put in the SPM about the IOD even though it was requested by policy makers. It would be a shame if AR6 also does not cover the modes of variability adequately (including the important information from palaoeclimate archives that is needed to understand these) and if it does not have clear messages in the SPM about the current assessment of knowlegde on these modes. [Nerilie Abram, Australia]	Taken into account. Observations, model evaluation and attribution of changes in modes including ENSO and the IOD are assessed in Sections 2.4 and 3.7.
76819	1	1	1	1	Congratulations to all of the author team and the IPCC for the work that has gone into producing the AR6 SOD. I very much look forward to seeing how this develops into the final product. [Nerilie Abram, Australia]	Noted with thanks.
115567	1	1	1	1	One issue that I could not find in the entire report is the climate importance of the Asian tropopause Aeroal layer (also aclled ATAL). This aerosol layer is very likely anthropogenic also many aspects are not known (vernier et al, BAMS, 2018) It occurs in summer in association with the south Asian monsoon and has an important impact on local climate including precipitation and droughts. [Rolf Müller, Germany]	Noted with thanks. Taken into account in the FGD in Chapter 6. The Asian Tropopause Aerosol Layer (ATAL) is discussed in 6.3.5.2. Transport of NH3 into the upper troposphere lower stratosphere (UTLS) in the Asian monsoon region is also discussed in 6.3.3.4.
111759	1	1	1	1	Thank you very much for the incredible work that you did… I wish that I could have done more… And I feel terrible for not providing more feedback… I thought that that the revision were due for the 15th of June... Congratulations for this achievements and all the best for finalizing the reports [Sébastien Guillet, France]	Noted with thanks.
65479	1	1	20	17	Suggest authors use language from the Paris Agreement when referring to the goals and purpose of the Global Stocktake. When referring to the Paris Agreement please make sure that the references are consistent with the text of the Agreement and referenced correctly. A more consistent approach should be applied through the entire report. Clear distinctions should be made between references to the collective goals and aim of the Paris Agreement, and references to individual countries' emission reduction commitments through Paris Agreement commitments such as Nationally Determined Contributions. [Kushla Munro, Australia]	Taken into account. The presentation and discussion surrounding the Global Stocktake have been revised accordingly, as far as possible within the space available.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
74003	1	1	200	70	In my review I was mainly trying to comment those parts of the text that are 1) withing my expertise and geographical area of my interest 2) that could be misinterpreted by people who refers to this report in the future and uses it as a background for decision making. [Elena Kozlovskaya, Finland]	Noted
19351	1	1	232	45	The report overall well written and covers mostly all the key scientific aspects. Further in Chapter -6 which is on Short-Lived Climate Forces (page 31, line1 19 -31) very little distinction is made between ground level and upper level ozone which is important to assess the impact of future climate change on human health. Examination ground level ozone and its longer term trends on regional scales will provide a more robust analysis of the impacts of interactions between climate, air quality and health for future years. It woudl be good if it can be addressed in the second draft. [Pushp Raj Tiwari, United Kingdom (of Great Britain and Northern Ireland)]	Noted. It is made clear in Chapter 6 that ground-level ozone is a pollutant while free tropospheric ozone influences climate
45021	1	1	300	70	Thanks for this impressive piece of work [Christophe Deissenberg, Luxembourg]	Noted with thanks.
110953	1	1			It can be useful to have an active list of contents for the PDFs for quick access to different sections of the chapter. [Ruksana Rimi, Bangladesh]	Taken into account. This was implemented for FGD. The final report webpage will also include interactive features to aid navigation.
112243	1				This comment concerns the IPCC calibrated language as outlined in footnote 1, and I assume it is not feasible to consider changes at this stage given that this is fundamentally affecting statements throughout the report and it consistent with previous reports. Nevertheless I'd like to point out that it is inconsistent and misleading to use overlapping probability ranges for the different terms denoting likelihood. For example, if a statement is considered to be true with 99.5% probability, one should clearly use the term "virtually certain". However, since all the terms down to "more likely than not" reach all the way to 100%, one might equally use "more likely than not", which dilutes the precision of the terminology. In fact it is in my view not useful to state that the probability of a statement being true is between 50% and 100%: It would be either around 50% ("about as likely as not"), something very close to 100% ("extremely likely"), or something inbetween, e.g., around 70% ("more likely than not"). Narrow, non-overlapping ranges of probability values associated with each term would still make sense, but I am convinced the overlap is not proper. [Helge F. Goessling, Germany]	On the uncertainty language itself, it has been documented in the peer-reviewed literature(Mach et al 2017) and agreed upon by a number of previous cycles' negotiating sessions, and thus would not be easily changed mid-cycle. This "uncertainty" language (explained in Box 1.1 in Chapter 1) gives a range of probabilities for all likelihood statements. It would seem that this comment refers to the SPM's first footnote. The reviewer is kindly invited to see, Chapter 1's Box 1.1, Figure 1.1, adapted from Mach et al 2017. It shows that the term "more likely than not" refers specifically to, and is understood by the governmental delegations as, the range of probability from 50-100%. This is the only likelihood term that refers to such a broad an overlapping range (nearly 50%).
68837	1				Paleoclimate information has been successfully distributed across the WG1 report, as envisaged by the scoping documents. The Paleo BOG has now developed key messages to consolidate and convey the most policy-relevant paleoclimate content in support of the findings in the summary documents (TS & SPM). The Paleo BOG thanks the CLAs in advance for their help in advancing the paleo key messages within their chapters. [Darrell Kaufman, United States of America]	Taken into account in redrafting the chapters. Paleo messages are now more clearly articulated.
50067	2	1	3	38	Suggest including mentioning climate variability more clearly in this introduction section - this comes up repeatedly later in the SPM and it would be helpful if the introduction highlights the importance of the interaction between long-term trends and variability. [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. We believe that this comment refers to the SPM Box.1. This box has been removed from the SPM FGD and placed in the TS. Note however that that, in the final (approved) SPM, natural variability is defined in a footnote where it first appears (footnote 28).
771	5	27	5	30	First time appearing on p.5, chapter 1- consider the topic of ocean de-oxygenation . Not only ocean lelel rise, ocean acidification, but also the widespread increase of oxygen minimum zones. Some of the impacts were discuss in SROCC (The Ocean and Cryosphere in a Changing Climate) and mentioned on p. 19 of this report (as on Ch. 5), but are not highlighted enough in the discussion. [Baruch Rinkevich, Israel]	Noted. Ocean acidification and deoxygenation are addressed in Section 5.3
141	10	54	11	3	The text refers to the "physical climate system," raising the issue of the composition of this system. By the definition of terms, a "physical system" is composed of "parts," each of which is an example of a "concrete" object. The text explains that the physical climate system is divided into five "realms." They are: "the atmosphere, the land, the biosphere, the cryosphere and the oceans." Each such "realm" is an example of an "abstract" object, leaving the parts of which the physical climate system is composed unidentified. If identified, the totality of these parts would form the statistical population underlying the climate models that are referenced elsewhere in the SOD. (new paragraph) In a methodological error that dates back to Arrhenius's pioneering investigation into the effect upon the physical climate system from increasing the atmospheric carbon dioxide concentration, global warming climatologists have never identified the parts of the physical climate system. Thus, there is not now and has never been a statistical population underlying any of the climate models. (new paragraph) This state of affairs raises an epistemological issue. At issue is whether, in the absence of this statistical population, it is possible for an official of a regulatory agency to regulate the outcomes of the events of the future for the physical climate system. This issue has turned out to be resolvable and has, in fact, been resolved. The researcher who has resolved is this expert reviewer. I am Sidney Oldberg (email address: terry@knowledgetothemax.com). A file that is currently on my computer contains a proof of the contention that, in view of the non-existence of this statistical population it is currently impossible for an official of a regulatory agency to regulate the outcomes of the events of the future for Earth's climate system. For an official to do so is impossible as, in the absence of the statistical population underlying each model, runs of these models provide this official with no information about the outcomes of the events of the future given the outcomes of the events of the present for the physical climate system. (new paragraph) To place a statistical population under each of the models that were subsequently built, Arrhenius had to identify a partition (collection of non-overlapping parts) of the time-coordinate of spacetime, each element of which located the Earth and its atmosphere in a specific interval in time. The Earth and its atmosphere in a specific interval in time is an example of a concrete object. Arrhenius did not identify this partition and neither did the global warming climatologists who followed Arrhenius. (new paragraph) The lack of this partition is inconsistent with the message that is sent to officials of regulatory agencies by the text of the SOD. Were this text to be published, publication of it would mislead officials of regulatory agencies into thinking that they are currently capable of regulating the outcomes of the events for the future though they are not. [Sidney Oldberg, United States of America]	Noted. This discourse is better suited for the scientific literature, and then for assessment in a later report. For AR6 WG1, the choices made by the scientific community are presented in Chapter 1, and borne out in the assessment findings of later chapters - based on the literature.
130629	15	32	15	32	Comment to entire report: In CCB1, or else the text around it, should discuss the Paris Agreement in the light of current knowledge. Based on currently observed impacts it seems clear that not even 1degree warming can be considered ‘safe’, 1.5 is dangerous, and by all indications 2 would be a disaster. Check new messaging up until the point of publication. It is important that the IPCC is not limited by the wording of the Paris Agreement. The IPCC should inform these other processes. Given current knowledge, the IPCC cannot be limited by the “well below 2˚C” wording. IPCC has to continue to present evidence of what the world will look like at 1, at 1.5, at 2, and beyond, and what level of emissions are involved. [Debra Roberts and the Durban WGII TSU, South Africa]	Taken into account. This is a difficult topic, as the IPCC should indeed assess and present knowledge independently of the Paris Agreement, while staying relevant. Also, WG1 does not assess what is "dangerous", but presents the (physical) implications of various levels of global warming. The wording in Cross-Chapter Box1.1 and elsewhere have been thoroughly worked through.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
4163	27	35	29	8	The quantification total CO2 sequstration in in Monsoon region by silicate weathering in laterite formation and Carbon sequstration in Evergreen forest is very important in climate change mitigation measures and is poorly studied. Laterite is a soil and rock type rich in iron and aluminium and is commonly considered to have formed in hot and wet tropical areas by intensive and prolonged weathering of the underlying parent rock. Tropical weathering (laterization) is a prolonged process of chemical weathering which produces a wide variety in the thickness, grade, chemistry and ore mineralogy of the resulting soils. The majority of the land area containing laterites is between the tropics of Cancer and Capricorn. Chemical weathering is also strongly linked to climate because chemical weathering of silicate rock consumes CO2 and over geological time has played a key role in climate regulation. The dissolution of 1mol of CaAl2Si2O8 will consume 2 mol of CO2. Thus, silicate weathering results in a net consumption of CO2. It is widely accepted that chemical weathering of Ca–silicate rocks could potentially control long term (50–100 Ma episodicity) climate change by providing feedback interaction with atmospheric CO 2 drawdown by means of the precipitation of carbonate, and that in contrast weathering of carbonate rocks has not an equivalent impact because all CO 2 consumed in dissolution of carbonates is returned to the atmosphere by the comparatively rapid precipitation of carbonates in the oceans (CaCO 3 + CO 2 + H 2 O = Ca 2 +2HCO 3) (Berner et al., 1983;Elderfield, 2010; Urey, 1952). Thus, the proportions of silicate and carbonate weathering at the earth's surface are important in long term global CO 2 balances (Berner et al., 1983). Even though there is still some debate in the scientific community, authors generally consider that increased rock weathering for the last 300–400 Ma caused a decrease in the atmospheric concentration of CO2 (Knoll and James, 1987; Berner, 1992, 1994). [Ramkumar Narendran, India]	Noted with thanks. CO2 sequestration by silicate weathering is assessed in Chapter 5 (FGD) (please see 5.6.2.2).
37777	47	29	47	30	Just a political concern. The name "Sea of Japan" (aka East Sea) is controversal in some countries, please review using some politically sensitive terminology when found needed. [Junhee Lee, Republic of Korea]	Noted. Neutral naming of geographical ocean regions has been implemented to avoid politically sensitive terminology.
87379	79	33	79	34	Please better deifine "fast varying". Since the AMOC is cited, I assume it is referring to centuries, since this system is usually taking time to collapse, as highlighted in the model projections (> one century) [Didier Swingedouw, France]	Not applicable, we cannot identify the part of the report on which the comment is based.
112881	173				In the top comment of figure 1.8 it is written: "Internal climate variations can temporarily mask or enhance long-term trends over a decade or more" The picture shows only decadal examples. The addition "or more" is vague and it is not discussed. As explained above, the failure of properly reconstructing the decadal-scale is already a severe problem for properly determining the physical reliability of the models, which are proven to be inadequate in properly interpreting climate change. But now it is stated that the discrepancy between the models and the data can be also "more" than the decadal scale. So, one wonders how long this discrepancy could be: 15 years, 20 years, 30 years, 50 years, 100 years.... There is a need to provide an upper limit and to quantify this scale. In fact, the scientific method requires a criterion to determine whether the models are inadequate in interpreting the data. By the way, in addition to the Arctic sea ice extent, also the Antarctic sea ice extent should be shown. This is important because the Antarctic sea ice extent increased since 1980 instead of decreasing as in the Arctic. Thus, I ask to add the model predictions for the Antarctic sea ice extent. [Nicola Scafetta, Italy]	Taken into account. Responses of global climate models for integrating periods beyond 20 years are found to be in good agreement with the applied forcing (Chapters 3 and 7, and earlier assessment). Internal variability in the models is also discussed and assessed, based, among other things, on Initial Condition Ensembles. The comment in Figure 1.8 refers specifically to the influence of decadal trends on the observed evolution of the climate, a feature which is also present in the climate models but where the models will not represent "reality" since patterns of variability such as sea-surface temperatures, winds, currents, clouds etc. will be different.
30595	SPM-12	33	12	34	This statement only refers to the decade between 2009-2018. It does not refer to a "continuing" rate. [nina bednarsek, United States of America]	Not applicable, we cannot identify the part of the report on which the comment is based.
26121					General comments. There are some discrepancies between different chapters in the key statements. For instance, in the chapter 2 one can read "Since 1750 concentration of well-mixed GHG (CO2, CH4, N2O) leads to ERF of 2.9±0.5 W/m2." (page 2-4). At the same time the authors of the chapter 7 estimated the GHG contribution to ERF at a level of 3.64 W/m2. They wrote (at the page 7-5) that ~90% of this amount (or 3.22±0.38 W/m2) comes from the well-mixed GHG. Certainly, the difference between 2.9±0.5 W/m2 and 3.22±0.38 W/m2 is not significant. However, it seems to me that AR6 as the integral assessment should use the same fingers in its different chapters. The second example is as follows. The assessment of the aerosol ERF in 2018 relatively to 1750 is -1.2 (-0.4 to -2.0) W/m2 in the chapter 2 (p.2-4), but it is -1.1 (-1.8 to -0.5) W/m2 in the chapter 7 (p.7-6). So, the careful cross-chapters' check is necessary. [Alexander Polonsky, Russian Federation]	Accepted. Numbers harmonised across Chapters 2 and 7. Chapter 7 provides the main ERF assessment
783					Suggest to discuss in SR6 in details the impacts of climate change on the spead of diseases and on the development of pandemic situations, including simulations on the impacts of temperature increase (and other climate change drivers) on the speread of air-born diseases. In addition, analyses can also be devoted on the impacts of pandemic situations on CO2 released to the atmosphere. The Corona virus situation raises multiple quries on the relationships of pandemic situations and climate change. [Baruch Rinkevich, Israel]	Taken into account. A cross chapter box on the effects of the COVID pandemic on emission, air quality and climate has been added to chapter 6 (Cross-Chapter Box6.1). Note that the effect of climate change on spread of disease is beyond the scope of WGI but is assessed in WGII.
116751					Please avoid using a confidence language in parenthesis at the end of a long sentence or a paragraph, it is very confusing and the reader cannot understand for which aspect of the assessment you express this level of confidence. Be more explicit. [Valerie Masson-Delmotte, France]	We have tried to provide concise and clear statements with the appropriate uncertainty language throughout the report.
104723					RCP 8.5 and its later equivalent are grossly unlikely scenarios and more of an academic excersize. Several published papers have actually cautioned the use of this scenarios as the outcomes cannot be used for anything. Even less so for policy recommendations. As for smoking, the reader should be cautioned everytime this scenario is at hand because it has very little to do with reality. Something like "RCP8.5 is considered as a worts case scenario wth a small likelihood. It is therefore very unfit to be included in discussions about policies" [Jan Lindstrom, Sweden]	Noted. WG1 does not assess the feasibility of scenarios (this is done by WG3), but rather uses the full range of available results. Note that the warming seen in SSP5-8.5 could be the result of emissions following SSP3-7.0 but with high climate sensitivity, for instance. This is discussed in several places, e.g. in the context of "low probability, high warming" eventualities. Hence, SSP5-8.5 is retained throughout the report, but not presented as a "business-as-usual" or similar type scenario - only as one of several pathways assessed.
44051					For one variable/phenomenon, there are many parts distributed in the different chapters about its description in different aspects and it is difficult for the readers to have a quick and comprehensive understanding. [Lijuan Li, China]	Noted. This is an ever-present challenge for such a broad report. There are tables of cross-cutting topics in Chapter 1, and synthesized assessment in the Technical Summary; hopefully they can be of help to the reader.
111895					For places developing the concept of a cumulative carbon emission budget associated with stabilising global temperatures at particular levels, as established in the AR5, unified units should be adopted, as my opinion, the most convenient would be for all GHG in GtCO2 eq., instead of other option also used like GtC. It should be the same as in annual emission presentation, it concerns especially the figures. Nice in Fig. 1.26 - GtCO2, resp. for GHG in GtCO2eq. Finally, it is not so often at least what I was able to see. [Tomas Halenka, Czech Republic]	Taken into account. Although both PgC and GtO2 are still used as this is a reflection on how topics are covered in the scientific literature, greater efforts for understandability have been implemented. The Technical Summary also now includes a conversion between the two.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
107033					I'm reminded of Churchill, who famously said of a report, "This paper, by its very length, defends itself against the risk of being read." [David Burton, United States of America]	Noted.
107035					Pervasive throughout this report is the assumption that manmade climate change is net-harmful. Yet the best evidence shows that's untrue. Arrhenius was right: "By the influence of the increasing percentage of carbonic acid in the atmosphere, we may hope to enjoy ages with more equable and better climates, especially as regards the colder regions of the earth, ages when the earth will bring form much more abundant crops than at present, for the benefit of rapidly propagating mankind." (Worlds in the Making, 1908.) Yet this report treats eCO2 as a problem to be solved, and largely ignores the benefits. [David Burton, United States of America]	Rejected. The WGI IPCC report makes a balanced assessment of the scientific literature related to the physical characteristic of climate change. For example, Chapter 12's assessment of Climatic impact-drivers assessment changes in physical climate that could lead to either positive or negative impacts.
23837					Please see the comment above, which is mostly concerned with the Figures! It is very difficult to run through about 200 pgs. Back & forth to look a fig. and text, every now and then. This make the overall report hardly readable, not to mention how inconvenient this is for Reviewers, especially in these hard time times of pandemic affair. [Branko Grisogono, Croatia]	Noted. Chapters are compiled as such for practical reasons during the drafting and reviewing process.
107037					We are currently enjoying a climate optimum. It is indisputable that the warming, so far, since the depths of the Little Ice Age, has been highly beneficial, and that the benfits of eCO2 (elevated CO2) on agriculture and natural ecosystems have been even more beneficial. Here are 20 references about the "greening" of the Earth, especially in arid regions, due to eCO2: http://sealevel.info/greening_earth_spatial_patterns_Myneni.html [David Burton, United States of America]	Rejected. 'Optimum' is subjective and depends on the beholder. The mandate of the IPCC WGI is to objectively assess the scientific literature related to the physical climate basis of climate change. Impacts on agriculture and ecosystems are within the mandate of WGII.
107039					The evidence is compelling that manmade climate change is modest & benign, and CO2 emissions are beneficial, rather than harmful. There's scant hard evidence that additional warming will cause significant harm. As Mae West said, "too much of a good thing can be wonderful." The major harms are all hypothetical, and mostly implausible. [David Burton, United States of America]	Rejected. The mandate of the IPCC WGI is to objectively assess the scientific literature related to the physical climate basis of climate change. Impacts on human and ecosystems are within the mandate of WGII.
107041					The major benefits of eCO2 are proven and very important, and they've been measured by thousands of high-quality agronomy studies. Between 15% and 20% of current agricultural yields are directly attributable to the 48% increase in CO2 level. If we didn't have that productivity boost, mankind could make up for the loss by putting additional land to agricultural use, but the amount of land needed would be enormous. Converting ALL the world's rainforests to agricultural use would almost suffice. [David Burton, United States of America]	Noted. CO2 fertilization is covered in the WGI report and also previous reports such as the Special Report on Climate Change and Land. Impacts on agriculture is the within the mandate of WGII.
64545					The use of the risk terminology introduced in chapter 1 (CC-Box 1.3) needs to be carefully checked throughout the entire report. The term "risk" is used in several chapters, but often not consistent with the definition in the risk guidance document. The term "hazard" should be replaced with "climatic impact driver" unless the detrimental aspect of a climatic impact driver is to be emphasized. [Jana Sillmann, Norway]	Taken into account. We have revised the risk framing and its introduction in Chapter 1, in collaboration with the authors of the framing document on climate risk.
23843					Please see the comment above. [Branko Grisogono, Croatia]	Noted
107043					The tremendous benefits of eCO2 have been measured for all major crops, and most minor ones. All fruits, vegetables, nuts & trees benefit tremendously from eCO2. So do all major grains. eCO2 is most beneficial for C3 crops, but has also been shown to also be highly beneficial for the two most important C4 crops, corn / maize and sugarcane. Here's a graph showing typical yield curves for C3 and C4 crops, vs. CO2 level: http://sealevel.info/C3_and_C4_Pflanze_vs_CO2_Konzentration_2018.png [David Burton, United States of America]	Noted. CO2 fertilization is covered in the WGI report and also previous reports such as the Special Report on Climate Change and Land. Impacts on agriculture is the within the mandate of WGII.
107045					eCO2 not only boosts crop productivity in good growing conditions, it boosts yields even more in poor crop years, such as during droughts. That's one of the reasons drought-triggered famines are now almost non-existent, for the first time in human history: https://ourworldindata.org/famines Here's a graph: https://sealevel.info/Famine-death-rate-since-1860s-revised-annot1_1908x954b.png [David Burton, United States of America]	Noted. CO2 fertilization is covered in the WGI report and also previous reports such as the Special Report on Climate Change and Land. Impacts on agriculture is the within the mandate of WGII.
107047					It is impossible to overstate the benefit to mankind of ending drought-triggered famines. It is a very, very Big Deal. Famine used to be a scourge comparable to war and epidemic. For comparison: WWII killed 2.7% of the world's population, and the catastrophic 1918 flu pandemic killed about 2% of the world's population. But the global drought and famine of 1876-78 killed about 3.7% of the worlds population! [David Burton, United States of America]	Noted. CO2 fertilization is covered in the WGI report and also previous reports such as the Special Report on Climate Change and Land.
107049					eCO2 is not the only factor which has helped to end drought-triggered famines, but it is an important one. For example, here's a study of wheat: http://www.ncbi.nlm.nih.gov/pubmed/26929390 [David Burton, United States of America]	Noted. CO2 fertilization is covered in the WGI report and also previous reports such as the Special Report on Climate Change and Land.
107051					Corn / maize is a C4 plant, yet it, too, benefits dramatically from eCO2. Here's a study: https://www.tandfonline.com/doi/abs/10.1080/00103624.2018.1448413 [David Burton, United States of America]	Noted. CO2 fertilization is covered in the WGI report and also previous reports such as the Special Report on Climate Change and Land.
107053					Here's a FACE (Free Air CO2 Enrichment) study of rice: https://europepmc.org/abstract/med/26228872 They compared 380 ppmv CO2 to 550 ppmv & found a 30% grain yield improvement, even though FACE studies typically underestimate the benefits. [David Burton, United States of America]	Noted. CO2 fertilization is covered in the WGI report and also previous reports such as the Special Report on Climate Change and Land. Impacts on agriculture is the within the mandate of WGII.
107055					Here's a study of soybeans. Soybeans and other legumes are particularly important sources of vegetable protein, and, fortunately, legumes benefit especially dramatically from eCO2. That's one of the reasons that eCO2 is especially helpful for mitigating protein shortages among the world's poorest people. [David Burton, United States of America]	Noted. CO2 fertilization is covered in the WGI report and also previous reports such as the Special Report on Climate Change and Land. Impacts on agriculture is the within the mandate of WGII.
64047					It would also be advisable to track the progress of the whole ecosystem not only from the distinction or decrease view point but also, the evolution of adaptable spieces of certain animals whether terrestial or marine and the evolution of totally new spieces of new animals, should be considered. The disruption of ecosystem should also be reported within the the actual status quo sincethe begining of januaru 2020. This report has a unique property that can never be repeated again, this is the COVID-19 impact on the present and projectional reports. Thereby; I advice an additional Chapter in the report tracking all posiitive and negative impacts of COVID-19 on the ecosystem in general and climate change impact and drivers in various regions with special elaboration on the alternation of expected peojections while specifiying how we can invest on the positive impacts in overcoming crisis that were considered sentenced to end. A graphical and tabular relations between the before and after crisis is advisable and highly recommented. If no delay in the release of this report is presumed, then the COVID-19 era should be added as an Annex or side report, withrecommendations and referencing to the actual report. [APECS, MRI, PAGES ECN, PYRN and YESS ECS group review, Canada]	Taken into account. A cross chapter box on the effects of the COVID pandemic on emission, air quality and climate has been added to chapter 6 (Cross-Chapter Box6.1). Note that the effect of climate change on animals is beyond the scope of WGI.
107057					Thousands of other peer-reviewed studies of the benefits of eCO2 for nearly all crops are cataloged at the indispensible CO2Science.org web site, here: http://co2science.org/data/plant_growth/plantgrowth.php [David Burton, United States of America]	Noted. CO2 fertilization is covered in the WGI report and also previous reports such as the Special Report on Climate Change and Land. Impacts on agriculture is the within the mandate of WGII.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
53553					The entire report could put more emphasis on low-likelihood high-impact regional scenarios, not only in the long-term due to the possibility of high global warming levels in case of low mitigation and high climate sensitivity (CH4), but also in the near-term due to the possible additivity of forced and internally-generated climate variations at the regional scale (cf. Figure 8.25 for instance). The interactive atlas could be very useful to illustrate and assess more systematically such scenarios. [Hervé Douville, France]	Taken into account.
64049					All conclusions are generally vague and so generalized with precise data or numerical values or precise statistical boundaries. This would be misleading or not leading at all for policy makers and strategists. So, further eleaboration is required when referring to conclusions. Moreover; Very broad time eras are used as comparative references which should be sliced to have more credible and reliable statistical dataupon which clear projections could be built. In addition; short and long term projections should be available, not only long term projections. Note also that clear criteria or guidelines upon which the projections are made should be well identified in a separate annex, since all projections seems as extrapolation to historical and actual information in literature and not new observations by any means. Furthermore; no clear modeling system is available, which makes comparing data of various regions irrelevant, since we cannot compare different models each with its own conditions and rules. [APECS, MRI, PAGES ECN, PYRN and YESS ECS group review, Canada]	Taken into account. Detailed information on data and modelling systems used for Figures and Tables is available through data tables in chapter appendices. The WGI report assesses not only long-term (2081-2100) but also near-term (2021-2040) and mid-term (2041-2060) changes. Refer to Cross-Chapter Box 1.2 for the detailed information regarding modern and future reference periods. The claimed lack of specificity stands in stark contrast to the actual comprehensive provision of information based on the published literature, across the entire WGI report.
107059					It is also a shame that this report continues to characterize prospective warming by comparison to the "pre-industrial" Little Ice Age, rather than by comparison to current temperatures, especially since pre-industrial temperatures aren't known with good confidence. The “1.5 °C of warming,” which the IPCC has proposed as the target beyond which the Earth must not be allowed to warm doesn’t actually mean 1.5 °C of warming. It actually means only about 0.5 °C of warming, because you call “1.5 °C” is referenced to an estimate of the average temperature during the chilly Little Ice Age, rather than to current temperatures, to make the number sound bigger. That's subordinating robust science to a political narrative. [David Burton, United States of America]	Rejected. Cross-Chapter Box1.2 and Cross-Chapter Box2.3 now clarify this. Also, the term little ice age has been deprecated.
116019					We need to improve the coordination of approaches related to key knowledge gaps and limits to the WGI AR6 assessment across chapters, it is too heterogeneous at the moment (length, style, choice of approach). [Valerie Masson-Delmotte, France]	Taken into account. The guidelines given to chapters is to include any limits to the assessment (relevant topics that not be assessed). The use of the IPCC uncertainty language also reflect the state of knowledge on each topic being assessed.
53555					Climate change "acceleration" is emphasized by CH9 but does not appear as a key message in the SPM due to the lack of systematic assessment and/or consensus across chapters. This may deserve further coordination and thoughts. [Hervé Douville, France]	Noted. References to increases in rates have been added where relevant (e.g. for sea level rate) and the time period has been specified for the duration of the rate of change. Strictly speaking, acceleration refers to the rate of change of velocity.
107061					Nearly as bad is the failure of this report to characterize the effects of prospective warming in practical terms. Most farmers would scoff at the notion that a degree or two of warming would harm agriculture, because in most places 1°C of warming can be fully compensated for simply by planting 6 to 7 days earlier in the spring: https://sealevel.info/Des_Moines_vs_Winnipeg_climate.png Most warming is expected to be in the form of milder winters and longer growing seasons at high latitudes, where it is obviously beneficial. Tropical climates will be little affected, which is nice, because they're warm enough already. [David Burton, United States of America]	Noted. CO2 fertilization is covered in the WGI report and also previous reports such as the Special Report on Climate Change and Land. Impacts on agriculture is the within the mandate of WGII.
53557					Given the WG1 structure, CH5/7/8 should be cautious about assessing the interactions between carbon/energy/water cycles, including the water constraints on CDR and the latent heat flux influence on surface warming. [Hervé Douville, France]	Taken into account. A new Cross-chapter box in Chapter 5 has been added to address this issue. Cross-Chapter Box 5.1: Interactions between the carbon and water cycles, particularly under drought conditions.
107063					None of the major supposed indirect harms from global warming actually coming to pass, so far: not sea-level rise, nor storms, nor droughts. Even polar bears and corals are doing fine. [David Burton, United States of America]	Rejected. Chapter 2 clearly notes impacts across atmosphere, oceans, cryosphere and biosphere leading to a conclusion of unequivocal change.
53559					CH10/11/12 represent a major step forward compared to the AR5 WG1 but there may be a hiatus between CH10, which nicely assesses the complexity of delivering reliable regional climate information and the multiple related methodological issues, and CH11/12 that mostly show (global) maps based on raw global model outputs. [Hervé Douville, France]	Noted.
23865					on the above and more. Namely, how bad style is to have so many papers cited that are submitted only [expecting the authors to be published/reviewed among themselves]. As a counter example, 'Tellus A Series', Q1 in oceanography and Q2 in meteorology & climatology, highly discourages citations of manuscripts that have been only submitted. Such practice should deploy IPCC 6th Report too. If this is meant to be a peer-review approach, then there should be no significant weight on tentative/plausible works in future. [Branko Grisogono, Croatia]	Rejected. As per standard IPCC procedure, journal articles that have been submitted but not yet accepted can be referenced in report drafts. They must, however, be accepted by the literature acceptance deadline in order to appear in published IPCC reports. Journal articles labelled as 'submitted' were not yet accepted at the time the Second Order Draft was compiled.
107065					The best long coastal sea-level measurement records show that sea-level trends have been almost perfectly linear since the 1920s. There's been a very slight acceleration in some places, and a very slight deceleration in others, but in most places it isn't statistically significant, and it is so tiny that it is of no practical significance anywhere. For instance, here's the highest-quality measurement record in the Pacific, with a very typicla trend, and data through March, 2020: https://sealevel.info/1612340_Honolulu_vs_CO2_thru_2020-03_annot1.png Linear regression yields a trend = +1.504 ±0.206 mm/yr, and quadratic regression yields acceleration = -0.00300 ±0.01382 mm/yr^2. [David Burton, United States of America]	Rejected. See, for example, Dangendorf et al. (2019) for a detailed discussion of tide-gauge based accelerations on a regional basis.
116281					While "habitability" is identified as a cross chapter theme, it is not cleary apparent in chapter assessments, key findings, TS and SPM. For instance, SRCCL had statements related to "novel climate conditions" (without any analogue in recent variations or in other regions), but I cannot find an assessment of this aspect in this report (chapter 4?). [Valerie Masson-Delmotte, France]	Taken into account. Mention in Table 1.6 has been harmonised with treatment in chapters. There would, however, not be the context for an assessment of habitability in Ch04.
105531					As a paleoecologist I was at first dissapointed to see that there was no specific chapter summarizing the progress in paleoecology. But after much thought, I have come to see this change, along with much re-organization throughout the report, as desirable. Fifty years ago, I did not even begin science as a paleoecologist, but as an ecologist. Then, I was soon overtaken by realization that, unlike the prevailing view of ecologists at that time, our planet is not in a status quo, but was always changing. After that realization, I could not study anything without the hunger for information on the history of that thing. As a result, I now believe that the study of any variable, whether in the atmosphere, ocean, or on land, requires a knowledge the the history of that variable, if such a history can be asertained. Thus, it is appropriate for the history (paleoecology) to be discussed within the evaluation of that variable and its probable future. [Kenneth Cole, United States of America]	Noted. No specific changes requested or made.
107067					Nor are storms worsening. Here's a paper about the decrease in typhoon destructive potential: https://www.nature.com/articles/ncomms8182 [David Burton, United States of America]	Rejected. The paper referred here suggests increasing intensity.

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107069					Strong tornadoes have declined even more dramatically. Here's a NOAA graph: https://www1.ncdc.noaa.gov/pub/data/cmb/images/tornado/clim/EF3-EF5.png Here's an article: https://web.archive.org/web/20190331105309/https://www.woodtv.com/weather/bill-s-blog/strong-to-violent-tornadoes-in-the-us-trending-downward/1148127409 [David Burton, United States of America]	Noted. The approved SPM feature the following material on cyclones. A.3.4 It is likely that the global proportion of major (Category 3–5) tropical cyclone occurrence has increased over the last four decades, and the latitude where tropical cyclones in the western North Pacific reach their peak intensity has shifted northward; these changes cannot be explained by internal variability alone (medium confidence). There is low confidence in long-term (multi-decadal to centennial) trends in the frequency of all-category tropical cyclones. Event attribution studies and physical understanding indicate that human-induced climate change increases heavy precipitation associated with tropical cyclones (high confidence) but data limitations inhibit clear detection of past trends on the global scale. {8.2, 11.7, Box TS.10}"
35135					The sub-division of the Holocene have recently been ratified (e.g. Walker et al., 2019) into Early, Middle and Late Holocene with associated time intervals. I notice the mid-Holocene is often used in reference to paleo records with a different time period than that by Walker et al. (2019). Given this formalization, I believe we should use the formal sub-divisions for consistency. REFERENCE: Walker, M., Head, M.J., Lowe, J., Berkelhammer, M., Björck, S., Cheng, H., Cwynar, L.C., Fisher, D., Gkinis, V., Long, A., Newnham, R., Rasmussen, S.O., Weiss, H., 2019. Subdividing the Holocene Series/Epoch: formalization of stages/ages and subseries/subepochs, and designation of GSSPs and auxiliary stratotypes. Journal of Quaternary Science 34, 173-186. [David Harning, United States of America]	Noted. Efforts to clarify have been made but the interest in the mid-Holocene period as defined is because it is a target for PMIP and needs to be defined as such for consistency with underlying literature.
107071					Droughts have also declined somewhat; here's a graph: https://sealevel.info/Fraction_of_the_Globe_in_Drought_1982-2012_fig5c.png Source: https://www.nature.com/articles/sdata20141 [David Burton, United States of America]	Rejected. The graphic that the reviewer is referring to is based on meteorological droughts, i.e. only precipitation deficits. The assessment for agricultural and ecological droughts (mostly related to soil moisture changes and related water-balance metrics) shows a larger number of regions with increasing agricultural and ecological droughts (see regional drought tables in Chapter 11 and cited references).
130623					Need to take the new knowledge linked to issues such as GMST/GSAT, revision of data sets, baselines etc and translate what it means for AR5, Paris Agreement, SR1.5 etc to help policymakers understand the implications. Line of sight to past IPCC/UNFCCC products is critical if the science is to be useful in advancing policy development. [Debra Roberts and the Durban WGII TSU, South Africa]	Taken into account in the redrafting of Cross-Chapter Box2.3.
107073					What's more, drought impacts have declined even more, because eCO2 makes plants more water-efficient and drought-resistant, by improving CO2 uptake relative to stomatal conductance. "There have been many studies on the interaction of CO2 and water on plant growth. Under elevated CO2, less water is used to produce each unit of dry matter by reducing stomatal conductance." Here's a paper: http://www.sciencedirect.com/science/article/pii/S0168192310003163 [David Burton, United States of America]	Rejected. The in-depth assessment of the cross-chapter box 5.1 shows that there is low confidence that CO2 physiological effects in plants would alleviate drought responses: "Increased CO2 concentrations alleviate the effects of water deficits on plant productivity (medium confidence) but there is low confidence on its role under extreme drought conditions. There is low confidence that increased WUE by vegetation will substantially reduce global plant transpiration and diminish the frequency and severity of soil moisture and streamflow deficits associated with the radiative effect of higher CO2 concentrations"
115009					We are currently enjoying a climate optimum. It is indisputable that the warming, so far, since the depths of the Little Ice Age, has been highly beneficial, and that the benefits of eCO2 (elevated CO2) on agriculture and natural ecosystems have been even more beneficial. Here are 20 references about the "greening" of the Earth, especially in arid regions, due to eCO2: http://sealevel.info/greening_earth_spatial_patterns_Myneni.html [David Burton, United States of America]	Noted. No specific changes requested or made.
31811					I think an harmonization between the chapters regarding the use of the time the projections are presented (either GWL or time frames), the scenarios (RCPs or SSPs) that are used and lines of evidence (GCMs or RCMs) is necessary. This would also help to promote cross-Working Group consistency [Izidine Pinto, South Africa]	Taken into account. Greater efforts have been made to harmonise the approach between presenting results across global warming levels and scenarios. For example, Chapter 11 now has the following Cross-Chapter Box: Cross-Chapter Box 11.1: Translating between regional information at global warming levels vs scenarios for end users.
107075					The global trend in fires is down, too, but fires have more to do with forestry & land management practices than with climate. So you can't credit global warming for the decline, just as you can't blame global warming for Australia's very preventable fires. https://earthobservatory.nasa.gov/images/145421/building-a-long-term-record-of-fire https://earthobservatory.nasa.gov/images/90493/researchers-detect-a-global-drop-in-fires Excerpt: "...MODIS [satellite instruments have measured] a decrease in the total number of square kilometers burned each year. Between 2003 and 2019, that number has dropped by roughly 25 percent." Here's NASA's graph: https://sealevel.info/NASA_building_a_long_term_record_of_fire.png [David Burton, United States of America]	Noted. The chapter 12 assessment of fire weather covers "Weather conditions conducive to triggering and sustaining wildfires, usually based on a set of indicators and combinations of indicators including temperature, soil moisture, humidity, and wind. Fire weather does not include the presence or absence of fuel load. . Note: this is distinct from wildfire occurrence and area burned."
115011					The best long coastal sea-level measurement records show that sea-level trends have been almost perfectly linear since the 1920s. There's been a very slight acceleration in some places, and a very slight deceleration in others, but in most places it isn't statistically significant, and it is so tiny that it is of no practical significance anywhere. For instance, here's the highest-quality measurement record in the Pacific, with a very typical trend, and data through March, 2020: https://sealevel.info/1612340_Honolulu_vs_CO2_thru_2020-03_annot1.png Linear regression yields a trend = +1.504 ±0.206 mm/yr, and quadratic regression yields acceleration = -0.00300 ±0.01382 mm/yr². [David Burton, United States of America]	See response to 107065

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4165					All existing numerical models describing the evolution of global biogeochemical cycles at the geological timescale are based on the work by Walker et al. (1981). These authors argue for a direct dependency of continental silicate weathering on climate (silicate weathering increases with temperature and runoff, both enhanced under higher values). At the geological scale (106–109 years), the main factors driving the climate, in close connection with silicate weathering, are the solar constant, CO2 degassing rate, and continental configuration. Walker et al. (1981) proposed a law (model) to link quantitatively global mean temperature, CO2 degassing rate, and CO2 consumption by continental weathering. In this model, the rate of continental weathering was controlled by temperature and runoff. Another model was proposed by Raymo (1991) in which chemical weathering was not controlled by temperature but by tectonic effects. Orogenesis induces a lowering of atmospheric CO2 pressure through chemical weathering processes. This leads to lower temperatures that create glaciated environments, again increasing erosional processes. However, this hypothesis leads to the existence of long-term disequilibria between the CO2 outgassing and the consumption by continental silicate weathering. There is no doubt that the increasing number of studies dealing with chemical weathering during recent decades is related to increasing concern about global climate change [Ramkumar Narendran, India]	Taken into account. Chemical weathering is covered in Chapter 5 of the report.
107077					Depending on which temperature index you choose, global temperatures are believed to have been rising at an average rate of between 0.06°C and 0.16°C per decade since 1958 (the start of the Mauna Loa CO2 measurement record), as atmospheric CO2 level rose from 315 ppmv to 413 ppmv. Graph: https://sealevel.info/GISS_vs_UAH_and_HadCRUT_1958-2018_woodfortrees_annot2.png [David Burton, United States of America]	Noted. No specific changes requested or made.
115013					The presumably mostly-anthropogenic warming over the last half-century was slight and very slow, in comparison with past natural changes in the Earth's temperatures. For instance, we know from ice core isotope analyses that over the last 100,000 years the Earth has experienced dozens of natural “Dansgaard-Oeschger events” in which temperatures changed at rates as rapid as several degrees per decade. Those much larger & more rapid natural temperature changes are known to have been globally synchronous, though less abrupt in the southern hemisphere, and they persisted for hundreds or (more typically) thousands of years. Nobody knows with certainty why they occurred, but we do know that those very large, abrupt temperature changes did not cause mass extinctions. Mankind, polar bears, corals, and nearly every other existing species of animal and plant all survived those sharp climate changes. That suggests we needn't fear that the current (comparatively slight) warming trend could be catastrophic for them. [David Burton, United States of America]	Noted. Impacts of climate change are assessed by Working Group II.
4167					The importance of parameters controlling Chemical Weathering of Rocks should be evaluated and included in climate models (Dupré et al., 2003). Garrels and Mackenzie (1971) observe that an estimate of solution bicarbonate derived from the chemical weathering of silicate rocks “can be achieved if it is assumed that, on the average, silicate minerals produce one bicarbonate ion and two silica ions for each molecule of carbon dioxide”: Despite the influence of other geological and geomorphological factors, chemical weathering at the Earth's surface is strongly controlled by climate. Thus, a measure of weathering intensity determined from soils or sediments should provide information about the climatic conditions associated with their formation. Available geochemical and mineralogical data on modern fluvial and marine muds from different regions of southern Africa and its Atlantic continental margin are used to review the links between sediment composition and climatic properties together with the possible causes of variance. Although river muds may not be generated exclusively in a single sedimentary cycle and erosion and weathering processes do not necessarily take place in a spatially homogeneous way, significant relationships between mineralogical and geochemical signatures of river mud and rainfall in the corresponding catchment area were recognised. Our study shows that the composition of clay is strongly influenced by climatically-driven weathering, whilst coarser mud fractions tend to be more affected by provenance, grain size, hydraulic sorting, and recycling. In the marine environment the climatic signal may be lost even in clay, because of hydraulic fractionation, authigenic mineral growth and mixing with foreign particles. Given the ubiquitous character of fluvial muds, and the easy and non-expensive methods available for separating and analysing clay fractions, their geochemical fingerprints represent a most precious source of information concerning climate. Any geochemical parameter used as a regional proxy of climate, however, still requires that the diversity of geological, geomorphological, and biological factors that affect its value are cautiously considered. [Ramkumar Narendran, India]	Taken into account. Chemical weather is covered in Chapter 5 of the report.
107079					The warming effect of increased CO2 level diminishes logarithmically, so the current exponential trend in CO2 level causes a temperature forcing which asymptotically approaches linear. In fact, for the last 25 years the CO2 forcing trend (log of CO2 level) has been almost perfectly linear, and only slightly more than linear for the last forty years: https://www.sealevel.info/co2.html?co2scale=2 [David Burton, United States of America]	Taken into account. This is discussed extensively in Section 7.3 and taken into account for the calculations
37705					The changes in structure of the whole report from AR5 are very much welcome in light of readers' interests. But, some topics may be scattered in many places and intersted readers may have difficulties locating those places, e.g., with reagrd to key words such as ENSO, monsoon, event attribution, etc. It would be very nice to have an index for the whole WGI report. [Masahide Kimoto, Japan]	Taken into account, partially. An index of terms has not been developed, however a table of cross-cutting topics is presented in Chapter 1 and there is synthesis in the Technical Summary that refers back to the relevant sections in underlying chapters.
107081					As long as that linear CO2 forcing trend continues, its effect on temperatures should also be linear. Even if all the warming is attributed to anthropogenic causes (GHG emissions and aerosol/particulate air pollution abatement), that's not a worrisome trend, because the warming over the last forty years has obviously been benign. [David Burton, United States of America]	Taken into account. The linearity is discussed in Section 7.3.
107083					Moreover, the exponential increase in CO2 emissions and levels cannot continue past the late 21st century, due to resource constraints, and due to accelerating removal of CO2 from the atmosphere by negative feedbacks. Here's a paper: https://www.sciencedirect.com/science/article/pii/S0016328715300690 The inconsistency of that observation-based conclusion with the high climate sensitivities baked into the CMIP6 models calls those models into question. [David Burton, United States of America]	Taken into account. ECS is assessed from multiple lines of evidence in Section 7.5 and the CMIP6 high ECS discussed.
107085					The presumably mostly-anthropogenic warming over the last half-century was been slight and and very slow, in comparison with past natural changes in the Earth's temperatures. For instance, we know from ice core isotope analyses that over the last 100,000 years the Earth has experienced dozens of natural “Dansgaard-Oeschger events” in which temperatures changed at rates as rapid as several degrees per decade. Those much larger & more rapid natural temperature changes are known to have been globally synchronous, though less abrupt in the southern hemisphere, and they persisted for hundreds or (more typically) thousands of years. Nobody knows with certainty why they occurred, but we do know that those very large, abrupt temperature changes did not cause mass extinctions. Mankind, polar bears, corals, and nearly every other existing species of animal and plant all survived those sharp climate changes. That suggests we needn't fear that the current (comparatively slight) warming trend could be catastrophic for them. [David Burton, United States of America]	Noted. Impacts of climate change are assessed by Working Group II. [duplicate of comment 115013]
81233					Thank you to all the authors for the work done [Fatima Driouech, Morocco]	Noted with thanks.
116051					Please pay attention to self citation in all chapters, boxes, etc. [Valerie Masson-Delmotte, France]	Taken into account. Has been carefully checked.
87381					The use of in situ is inconsistent in the report, sometimes written in-situ or without "-". The correct way might be "in situ" in itlalic since this is a latin locution. [Didier Swingedouw, France]	Editorial. The report will undergo professional copy-editing prior to publication

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7257					Now I feel that it is weak to link climate information/climate service with risk assessment to support adaptation decision making. [Yinlong Xu, China]	TAKEN INTO ACCOUNT: It is not clear what the reviewer is suggesting as a revision. Chapter 12 shows how climate information may be connected to sectors, associated with vulnerability (and related tolerance) thresholds, assessed by region to feed regional decision making, and connected into a climate services framework. The use of climatic impact-drivers also more clearly defines the role of climate information in a broader risk assessment framework (that comes together with vulnerability and exposure information in WGII).
116057					Check references to emergence across chapters and use in the SPM/TS. In chapter 1, it could be good to explain the differences between detection, attribution and emergence (in plain language) [Valerie Masson-Delmotte, France]	Accepted. This is clarified in 1.4.2.2, and in 4.6.
7259					There is still a potential to incease the integration of the report, for example, I think that the linkage of Chapter 3 and Chapter 11 is not well designed, I checked that there are totally 8 times of 'human influence' used in the executive summary of Chapter 11, is there any possibility to improve the description of human influence on weather and climate extreme events in Chapter 3 for the integrity of the context? [Yinlong Xu, China]	Taken into account. Cross-Chapter Box 3.2 serves as a bridge between Chapters 3 and 11 and has been updated in the Final Government Draft. The phrase "human influence" is intentionally used multiple times in the executive summary of Chapter 3 because it is the focus of the chapter.
32859					We may consider having a preceding page of succinct key messages before the current detailed Executive Summary. The Key messages can be driven from sharpening the bolded first statements of each paragraph of the Executive Summary. Also, some chapters portray the implications of key climate change indicators, the lead authors may consider recommending some measures to arrest these drivers if applicable. [Aaron Werikhe, Uganda]	Rejected. The executive summaries are meant to highlight the key messages of the chapters and the key part of each executive summary statement is already highlighted in bold. The IPCC's mandate is to be policy relevant but not policy-prescriptive.
116059					For the statements on the slowdown in the rate of warming in 1998-2012 in the text (CCB in ch 3, SPM A2.3), could it be possible to give an order of magnitude of the change in RF due to respectively solar and volcanic activity during this period (quantitatively) (and maybe highlight this period in the RF figure of chapter 2). [Valerie Masson-Delmotte, France]	Taken into account. In the final draft, Figure 2.2 is now cited in Cross-Chapter Box 3.1 to illustrate the best estimate of the forcing updates. Nonetheless, we now assess "while there is medium confidence that natural forcing that was missing in CMIP5 contributed to the difference of observed and simulated GMST trends, confidence remains low in the quantitative contribution of net forcing updates." i.e. confidence is low in the quantitative contribution of RF changes.
7261					Comments for SPM, L3-6, page SPM-2, I suggest to change the present sentence of The Working Group I (WGI) contribution to the IPCC's Sixth Assessment Report (AR6) provides an updated state of knowledge related to the climate system and climate change, based on the assessment of evidence available in the scientific literature related to the climate system (the atmosphere, ocean, land surface, cryosphere and biosphere) as The Working Group I (WGI) contribution to the IPCC's Sixth Assessment Report (AR6) provides an updated state of knowledge related to the change of climate system (the atmosphere, ocean, land surface, cryosphere and biosphere) based on the assessment of evidence available in the scientific literature advanced from AR5. The reason for this suggestion is that for the concept of 'climate system' and 'climate change', they are not parallel, climate change is just the additional context of the climste system, we would focus on this addional part in this assessment report. [Yinlong Xu, China]	Taken into account. This part of the introduction has been rephrased.
7263					Comments for SPM, L37-38, page SPM-4, the comments here is also related to Figure SPM.2 in page SPM-46. Here we say Evidence of the biosphere's response to a warming climate is consistent with these observed physical indicators, while in Figure SPM.2 it is just shown Cherry Blossom, why? Cherry Blossom can be a representative of whole biospher? [Yinlong Xu, China]	Not applicable. This figure has been removed from the revised SPM, to shorten the document.
7265					Comments for SPM, L17-24, page SPM-5, in this paragraph it is said that a discernible human influnce on the climate has been identified in SAR, and AR5 concluded that human influence on the climate system is clear, the evidence for human influence on climate system has progressively strengthened in TAR, AR4, and SREX. Could we specify what is the progress exactly in each report from TAR to SREX? Now we feel that the description like this here is too general. [Yinlong Xu, China]	Not applicable. This part has been removed from the revised SPM, to shorten the document.
89441					I want to congratulate all authors for their hard work and contributions to this excellent SOD. It is a bit lengthy and some findings could be streamlined, but by and large it is in a very good shape. [Carl-Friedrich Schleussner, Germany]	Noted with thanks. We have tried to reduce the length of many parts of the report (e.g. SPM, TS).
116065					Better integration of urban related aspects is needed, especially on links between climate change and air quality aspects, and reflected in the TS (a dedicated box?) and the SPM. [Valerie Masson-Delmotte, France]	Taken into account. HS11.5 in the SPM and box TS14 in the TS are specifically covering urban topics.
7267					Comments for SPM, L35-37, page SPM-10, could we specify the description of 'in some regions and seasons'? I suppose that the policy-makers and the public prefer to know exactly which regions (like specified as Mediterranean, southwestern United States and Australia in line 9 of page SPM-10) and which season (spring, summer, autumn, or winter)? [Yinlong Xu, China]	Not applicable. Sentence removed from revised SPM.
89443					There is one issue of overarching relevance that needs to be addressed. Through correcting short-comings with historical warming estimates used in the AR5, the assessment of warming over the historic period is ~0.1°C higher now than in the AR5 that has informed the Paris Agreement. This is a pure change in metric that does not affect the impact assessment that has informed the Paris Agreement (see also decision 10/CP.21). This shift leads to an unintended shift in the goalposts of the Paris Agreement without the necessary line of sight towards the Agreement. Thus, the report runs the risk of becoming policy prescriptive as it is not up to the scientists to choose which GMT metric should inform the PA and the policy process. I commented on this further in Box SPM2 and respective other areas. [Carl-Friedrich Schleussner, Germany]	Taken into account. Following the SOD review, changes in GSAT and GMST were assessed and are found to differ by at most 10% from one another (high confidence), but conflicting lines of evidence lead to low confidence in the sign (direction) of any difference in long-term trend. {Cross-Section Box TS.1}
99171					overall the length of the chapters make it very hard to access the information. While I am trained in the field, I find the level of detail overwhelming and ask the authors to cut back and make the report accessible [Daniela Schmidt, United Kingdom (of Great Britain and Northern Ireland)]	Taken into. The revised report follows the approved outline for its preparation (including length of chapters). Same chapters were indeed too long and have been shortened.
7269					Coomments for SPM, L21 page SPM-38 to L22 page SPM-44. For the whole Section D, I feel that the context on adaptation is weak, there are totally 5 sub-sections for Section D, but D.1-4 is mainly concerning mitigation, just D.5 is concerning adaptation, while there is still very limited context. I think that it is far away from "A new emphasis in AR6 is climate information relevant to impacts, adaptation, risk assessment..." as stated in line 35 of page SPM-34, Box SPM.3: Synthesis of regional changes. I checked the context of the follow-up chapters, there is a lot of dicussion on climate information and adaptation in Chapter 10 & 12, for example, so I think there is a great potential to expand Section D for the linkage of climate information/climate service and adaptation. [Yinlong Xu, China]	Taken into account. The structure of the SPM has been completely revised. Now the 3rd section (Climate Information for Risk Assessment and Regional Adaptation) focuses on information relevant for adaptation and the 4th section (limiting climate change) on mitigation.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
7271					Comments for SPM, L17-18, page SPM-44, I cannot understand why to say 'one size fits all' here? Even the user's need is diverse, but is doesn't mean there is no universal issues that could be addressed here. For example, scientifically speaking, it can be summarized what is the new features of climate change in regional level, which is closely related to how to and to what extent to make plan to build the climate resilience according to the new status of changed climate; technically speaking, how to work out high-quality user-friedly climate datasets with multi-resources for risk assessment for adaptation decision making, there is still a lot of things that could be discussed here. [Yinlong Xu, China]	Not applicable. Bullet point removed from revised SPM.
23911					All the papers submitted, yet nearly published, should be called as 'accepted', instead of 'submitted'; others should be abandoned from the Report. [Branko Grisogono, Croatia]	Rejected. As per standard IPCC procedure, journal articles that have been submitted but not yet accepted can be referenced in report drafts. They must, however, be accepted by the literature acceptance deadline in order to appear in published IPCC reports. Journal articles labelled as 'submitted' were not yet accepted at the time the Second Order Draft was compiled.
129641					The United States submitted its notification of withdrawal from the Paris Agreement on November 4, 2019. The withdrawal will take effect one year from the delivery of this notification. The comments provided on this report are expert comments on scientific and technical issues. They do not reflect any statement on or change in the U.S. position with respect to the Paris Agreement or climate change policy. [Trigg Talley, United States of America]	NOTED.
129643					These comments reflect the input of individual U.S. Federal and non-Federal expert reviewers and, as such, do not necessarily reflect official statements of U.S. climate policy. [Trigg Talley, United States of America]	NOTED.
100717					Badger, M.P.S., Chalk, T.B., Foster, G.L., Bown, P.R., Gibbs, S.J., Sexton, P.F., Schmidt, D.N., Pälike, H., Mackensen, A., Pancost, R.D., 2019. Insensitivity of alkenone carbon isotopes to atmospheric CO2 at low to moderate CO2 levels. Climate of the Past 15, 539-554. [Matthew Kohn, United States of America]	See response to 100547
113005					Unfortunaterly I could review only the first two chapters [Nicola Scafetta, Italy]	Noted.
129645					The following priority topic areas arose from technical review of the second-order draft chapters and first-order drafts of the Summary for Policymakers and Technical Summary: - Need to keep the focus on physical, biogeochemical, and ecological sciences [SCOPE] - How to include risk-based framing and address hazards/climate impact drivers [RISK] - Issues with evidence assessment and confidence statements [CONFIDENCE] - Need to highlight what's new since the AR5 and Special Reports [PROGRESS] - Representation of knowledge gaps [GAPS] - Problems with terminology, technical jargon, and clarity [PRECISION] - Technical issues, including ensemble consistency [ENSEMBLES], characterization of drought [DROUGHT], and Global Mean Surface Temperature vs. Global Surface Air Temperature [GSAT] - Problems with report length, integration, key message distillation, and consistency/redundancy [ACCESSIBILITY] Details regarding these concerns are provided in the whole document and line-by-line comments, tagged with the bracketed shorthand above to indicate elevated importance. There is no implied priority order. [Trigg Talley, United States of America]	Noted.
80751					Highly recommned changing the labelling of SSP scenarios and using for the second number temperature instead of radiative forcing. The latter concept being difficult to understand outside the climate scientific community [Yamina Saheb, France]	Rejected. Cross-chapter BOX 1.5 introduces the detailed concept of the SSP-RCP combination used across WGI report. The comment fails to notice the large uncertainty persisting in "converting" the radiative forcing into temperature change, due to the uncertainty in climate sensitivity.
100719					Burls, N.J., Bradshaw, C.D., De Boer, A.M., Herold, N., Huber, M., Pound, M., Donnadieu, Y., Farnsworth, A., Frigola, A., Gasson, E., von der Heydt, A.S., Hutchinson, D.K., Knorr, G., Lawrence, K.T., Lear, C.H., Li, X., Lohmann, G., Lunt, D.J., Marzocchi, A., Prange, M., Zhang, Z., 2020. Simulating Miocene warmth: insights from an opportunistic multi-model ensemble (MioMIP1). for Paleoceanography and Paleoclimatology. [Matthew Kohn, United States of America]	See response to 100547
129647					[SCOPE] Tightening the communication among the three Working Groups to ensure internal consistency and proper treatment of cross-cutting themes is a laudable objective. In its present form, however, this has resulted in whole sections of chapters of the draft WGI report that are out of scope for an assessment of the physical science of climate change, including -- but not limited to -- content on: policymaking and social understanding (1.2.2), values-context in knowledge creation and communication (1.2.3), 'effective messaging' of climate information (Figure 10.23), and the likely utility of different types of climate information (FAQ 10.1). In addition, the cross-chapter boxes -- some with more than a dozen additional authors -- create a problem in focus and in length of the report. Multiple sections of this report should be significantly revised or removed. Including this integrated content in WG1 only serves to obfuscate the essential information about the state of the earth's climate and climate change. [Trigg Talley, United States of America]	Rejected. The key point made in the sections referenced is that even physical science information and assessment is made in a context, and should be mindful of its own messaging. While observations and modelling can be said to be context-free and objective, the questions asked of the IPCC are not, and fulfilling our mandate requires consideration also of the external context into which our assessments will be delivered. Hence, while the clear majority of WG1 presents and assesses pure physical science evidence, we consider it in scope (and in line with the approved outline) to discuss also the topics covered in sections 1.2.2, 1.2.3 and parts of Chapter 10.
89457					This sentence (page 21, line 50) and last sentence of previous paragraph (page 21, L47-48) highlight a trend throughout the chapter of lots of text about 'uncertainties'. This may be understood by scientists, but probably not by other readers. In the end I don't think having this language throughout the text adds much clarity, especially as topic and concluding sentences for paragraphs. [Edward Schuur, United States of America]	As this comment was registered as one for the entire report, it is not immediately clear which p 21 line 50 is being referred to. There is no line number 50 on p 21, in the SPM, TS or Chapter 1. On the uncertainty language itself, it has been documented in the peer-reviewed literature(Mach et al 2017) and agreed upon by a number of previous cycles' negotiating sessions, and thus would not be easily changed mid-cycle. This "uncertainty" language (explained in Box 1.1 in Chapter 1) gives a range of probabilities for all likelihood statements.
100721					Cane, M.A., Molnar, P., 2001. Closing of the Indonesian seaway as a precursor to east African aridification around 3-4 million years ago. Nature 411, 157-162. [Matthew Kohn, United States of America]	See response to 100547

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129649					[RISK] Part of the stated aim of the WGI report is to provide information about potential impacts in a way that maps onto the risk assessment that occurs in the WGII and WGIII contributions to the AR6 and the Synthesis Report.This aim, however, is at times incompatible with the practice of only bubbling up (e.g., to the chapter ES and/or the SPM/TS) information about impacts that can be traced back to scientifically mature lines of evidence for which uncertainties are well-characterized -- e.g., emphasizing only the more likely part of the range, providing a range based only on certain types of models and not others, or downplaying areas where uncertainties are large enough to permit catastrophic outcomes but consensus is lacking. For those topics that have an outsized importance for societal risk, either because of low probability but high consequence outcomes that cannot yet be ruled out scientifically, and/or because of the potential for thresholds, surprises, or cascading impacts, the report should make a greater effort to ensure these topics are not lost in the chapter and full report summary sections, along side assessing and communicating reasons for lower confidence or lack of agreement among lines of evidence. Prominent examples of topics for which this is the case include sea-level rise and carbon cycle feedbacks. In addition, to better support risk framing, the WGI report should improve how it characterizes uncertainty and predictability with respect to the combined influence of model uncertainties and natural modes of variability on regional-scale climate extremes. Specifically, showing probability density functions of future regional temperature and precipitation extremes as simulated by climate models provides a spurious sense of rigor, and overstates certainty and predictability, in that these may fail to adequately account for the modulating factors of ENSO, decadal-scale variability, and other natural modes that play a large role in determining regional-scale climate. [Trigg Talley, United States of America]	Noted. Deep uncertainty relating to sea level is shown also in the TS and SPM with low confidence ranges beyond the usual likely ranges (for which there is medium confidence)
89459					A search indicates there are 171 instance of the word 'uncertain' (or words containing). The main text runs through page 103. As mentioned in another comment of mine, many of these uses appear in the beginning (topic) or concluding sentences of paragraphs. Be aware of what this does to the message presented; I believe that IPCC style would guide towards using this language less, but instead assigning the confidence language instead to indicate how much science has been done on each particular subject. Page 34 Line 30 is a particularly humorous use of 'uncertain' and confidence language togther, and again Page 55, Line 31. [Edward Schuur, United States of America]	As this comment was registered as one for the entire report, it is not immediately clear which Chapter or section was being referred to; the 171 instances of the word “uncertain” do not seem to match the SPM, TS or Chapter 1. On the uncertainty language itself, it has been documented in the peer-reviewed literature(Mach et al 2017) and agreed upon by a number of previous cycles' negotiating sessions, and thus would not be easily changed mid-cycle. This "uncertainty" language (explained in Box 1.1 in Chapter 1) gives a range of probabilities for all likelihood statements.
100723					Denk, T., Grimm, G.W., Grímsson, F., Zetter, R., 2013. Evidence from "Köppen signatures" of fossil plant assemblages for effective heat transport of Gulf Stream to subarctic North Atlantic during Miocene cooling. Biogeosciences 10, 7927-7942. [Matthew Kohn, United States of America]	See response to 100547
129651					[CONFIDENCE] The SPM, Technical and Executive Summaries, and underlying chapters’ text in many instances do not follow IPCC guidelines in assigning medium and high confidence, which require multiple lines of evidence and sufficient agreement. Currently, the basis of the confidence statements is very uneven across topics, with many examples of assigned high confidence that are unsubstantiated, inadequately referenced, or understating the underlying complexity and uncertainty (e.g., cloud feedbacks, aerosol-cloud interactions, carbon sink capacity, land-based mitigation, AMOC, tropical cyclones). There are many instances of reliance on a single publication or lack of inclusion of other relevant publications while claiming medium and high confidence. In addition, there are multiple statements where levels of confidence are inappropriately assigned to facts where no assessment has been performed. There are SPM messages that have a higher confidence than the underlying chapters. [Trigg Talley, United States of America]	Taken into account. By nature of the SOD review, all confidence levels in the chapters have been revised and checked for consistency according to the literature.
80245					From the reading of several chapters (e.g. 2, 3) of the present report, it seems that results from the WMO/UNEP Assessments on the state of the OzoneLayer (2014, 2018) are not fully considered. For example, regarding the impact of ozone depletion on climate, the exectutive summary of the most recent Assessemnt provides the following statements : 1. New studies strengthen the conclusion from the last Assessment that lower stratospheric cooling due to ozone depletion has very likely been the dominant cause of late 20th century changes in Southern Hemisphere climate in summer. These changes include the observed poleward shift in Southern Hemisphere tropospheric circulation, with associated impacts on surface temperature and precipitation. 2. Changes in tropospheric circulation driven by ozone depletion have contributed to recent trends in Southern Ocean temperature and circulation; the impact on Antarctic sea ice remains unclear. 3. No robust link between stratospheric ozone depletion and long-term surface climate changes in the Northern Hemisphere has been established. It would be good to see some coherence between IPCC reports and WMO/UNEP Assessments on the state of the ozone layer. [Sophie Godin-Beekmann, France]	Taken into account. Chapter 3 now cites and assess the 2018 WMO Ozone Assessment, and the topics of ozone influence on lower stratospheric temperature and Southern Hemisphere circulation are assessed. The lack of an ozone influence on the NAO/NAM is also discussed. Chapter 8 also assesses ozone influence on Southern Hemisphere circulation and hydrology. Chapter 2 does not cover the question of trend attribution.
89461					Many of the sections start with "Since AR5..." or some variation of that. The chapter (and the report as a whole) will have to figure out a way to make this point without repeating the statement everywhere. But - a more important point is that there have been 3 special reports since AR5: 1.5, SRCCL, SOCCR. These reports provided more up to date information on a number of topics found in this chapter. However, statements such as on Page 46, Line 5-6 are somewhat rare, especially referring to the special reports rather than AR5. To me, those special reports are a better reference point if subjects were covered there, and so more statements like the example mentioned here would be helpful to put even newer material in this report into context. [Edward Schuur, United States of America]	Taken into account: guidelines issued to chapters is to start each section with the assessment of the special reports. If a topic was not covered in the special reports, then the starting point should be WGI AR5.
100725					Foster, G.L., Royer, D.L., Lunt, D.J., 2017. Future climate forcing potentially without precedent in the last 420 million years. Nat Commun 8, 14845. [Matthew Kohn, United States of America]	See response to 100547
129653					[PROGRESS] The SPM, Technical Summary, and Executive Summaries, as well as some of the chapters themselves, should focus more strongly on clearly stating the advances and relevant new science outcomes since AR5 and the three Special Reports in the AR6 cycle -- providing explanations for progress based on adequate evidence or changes in assessment from AR5 to AR6, and communicating assessment through concluding statements. [Trigg Talley, United States of America]	Taken into account. Progress since the last reports is now more explicit throughout the report, especially in the TS introduction, where key updates since AR5, SR1.5, SROCC and SRCCL are highlighted.
100727					Frigola, A., Prange, M., Schulz, M., 2018. Boundary conditions for the Middle Miocene Climate Transition (MMCT v1.0). Geoscientific Model Development 11, 1607-1626. [Matthew Kohn, United States of America]	See response to 100547

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129655					[GAPS] WGI AR6 introduced a structural change in the ordering of chapter content: leading uncertainties are now enumerated in one or more dedicated sections at the end of each chapter. The current structure can leave many readers with an unintended sense of doubt in the interpretation of the scientific assessment. That impression is especially pronounced when the section consists of a bulleted list without introductory or closing context, without reference to any peer-reviewed literature, and without reference back to any specific sections of the chapter (see, e.g., Section 8.7). Adding references back to chapter contents (Section 10.7) or peer-reviewed literature (Section 9.7) does not alleviate this overall impression. The authors are urged to systematically move such material to the beginning of chapters, as it appeared in WGI AR5 (e.g., Section 12.2.2 of that report); this may apply to more than one section of each chapter (e.g., also Section 8.5). Chapters will then close addressing subject matter in question, and the reader will be assured that such enumerated key uncertainties have been thoroughly considered throughout; indeed, it is an explicit purpose of the report's confidence terminology to address those. [Trigg Talley, United States of America]	Taken into account. The guidelines given to chapters is to include any limits to the assessment (relevant topics that not be assessed). The use of the IPCC uncertainty language also reflect the state of knowledge on each topic being assessed.
23929					Equations [various boxes, etc.], similar to Figures that I already commented, are far away from [sub]sections where they are referred to and discussed at length. Hence, it is inconvenient to check those equations simultaneously with the corresponding text. [Branko Grisogono, Croatia]	Noted.
100729					Goldner, A., Herold, N., Huber, M., 2014. The challenge of simulating the warmth of the mid-Miocene climatic optimum in CESM1. Climate of the Past 10, 523-536. [Matthew Kohn, United States of America]	See response to 100547
129657					[PRECISION] Vague language, poor writing, and jargon severely obscures intended messages in certain sections. There are poorly written and inaccurate definitions found throughout the report that either detract from the overall clarity or result in incorrect statements being made on important topics. For example, an 'increase' or 'decrease' in "drought" is mentioned repeatedly without regard for needed specificity (e.g., area, duration, extent, severity). This lack of specificity applies to other variables/terms throughout the document. In addition, there are inconsistencies in how certain terms are used and applied from one place to the next within the text. The lack of clarity extends to figures that have axes mislabeled or not labeled at all. Some terms (e.g., GTP, GWP*, TCRE, ZEC in Chapter 5) are not defined. [Trigg Talley, United States of America]	Taken into account. The SPM text now clearly distinguishes between changes in 1) agricultural and ecological droughts (primarily based on soil moisture, complemented by evidence from water-balance studies and indices combining precipitation and atmospheric evaporative demand), 2) meteorological droughts (precipitation deficits) and 3) hydrological droughts (streamflow deficits)
100731					Harris, E.B., Kohn, M.J., Strömberg, C.A.E., 2020. Stable isotope compositions of herbivore teeth indicate climatic stability leading into the middle Miocene Climatic Optimum, in Idaho, U.S.A. Palaeogeog., Palaeoclim., Palaeoecol. [Matthew Kohn, United States of America]	See response to 100547
113019					As a general editorial note, n-dash should be used for time ranges, not hyphen. [Diego Miralles, Belgium]	Editorial. The report will undergo professional copy-editing prior to publication
116091					There is a need for a cross chapter approach to the issue of "extrapolating recent trends", with a discussion of changes in radiative forcing (ozone recovery; stabilisation of aerosol RF in recent decades; trends in RF; different changes in drivers of regional changes including SLCF and land use for different regions; considerations of multi decadal variability) to also reflect outcomes of assessments on attribution and detection. This could also be reflected in the TS or SPM. [Valerie Masson-Delmotte, France]	Taken into account. Cross-chapter coordination has been reinforced for extrapolating recent trends
129659					[ENSEMBLES] The inconsistent basis for future global and regional projections is a major challenge in interpreting the WGI AR6 assessment findings. The use of additional constraints to weight the CMIP6 model ensemble is discussed in Box 4.1, but is inconsistently applied in Chapters 4, 8, 10, 11, and 12. Recommend that all projections use a consistent methodology for all figures and calculations that needs to be justified clearly and transparently. In cases where different approaches are necessitated because of the lack of suitable diagnostics or experiments from some models, this too needs to be clearly stated including the specifics of what selections have been made. [Trigg Talley, United States of America]	Taken into account. However, it must also be noted that not all quantities of interest scale with GSAT change, that regional some model performance is independent of performance in GSAT change (e.g., Beusch et al., GRL, 2020), that substantial assessment is requested as a function of time and scenario, and that some regional processes leading to higher climate sensitivity cannot categorically be deemed unrealistic (e.g., Zelinka et al., GRL, 2020). Ruling out a model entirely because of high ECS is hence not justified. That said, the difference between diagnosing and assessing the CMIP6 ensemble has been made clearer in the FGD, as has the challenge inherent in using the CMIP6 ensemble in the assessment.
100733					Herold, N., Seton, M., Müller, R.D., You, Y., Huber, M., 2008. Middle Miocene tectonic boundary conditions for use in climate models. Geochemistry, Geophysics, Geosystems 9, doi:10.1029/2008GC002046. [Matthew Kohn, United States of America]	See response to 100547
113021					The general use of global mean surface temperature (GMST). I believe this is really near-surface AIR temperture. Confusing; in fact, wrong. [Diego Miralles, Belgium]	Rejected. The reviewer is incorrect here in their assertion. Accounted for in Cross-Chapter Box2.3 revisions.
116093					There is a need to address carefully the issue of changes in rates of changes in a consistent manner across chapters and in the TS and SPM. This is related to references to "acceleration". In my view, there are different situations : one situation where a variable showed no trend, and the onset of an increasing trend (emergence?); one situation where a variable was changing at a given rate over several decades, and the rate over a different period is different (the rate is decreasing or increasing); and one situation where the rate of change is steadily increasing (second derivative positive over several decades, acceleration of an ongoing change, different from the onset of a change). [Valerie Masson-Delmotte, France]	Taken into account. References to increases in rates have been added where relevant (e.g. for sea level rate) and the time period has been specified for the duration of the rate of change. Strictly speaking, acceleration refers to the rate of change of velocity.

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129661					[DROUGHT] The high-confidence statements in SPM B.5 about “increased drought potential” and “tendency towards drying” could be too easily misunderstood and/or misrepresented as conclusions about historical changes of (frequency, intensity, or duration of) actual drought, when in fact they refer (by traceback to Chapter 11) only to one of the multiple drivers (“atmospheric evaporative demand,” AED) of certain kinds of drought. In particular, depletion of soil moisture by increased AED is opposed by CO2 fertilization (medium confidence, Chapter 11). Additionally, here and elsewhere, references to drought and drying require specification of one or more observable quantities (e.g., precipitation amount, soil moisture amount, streamflow volume, plant productivity). Similar flaws are present in SPM C.5.4 statements about the future. The SPM B.5 and C.5.4 statements should be appropriately modified or removed, and supporting text (in TS, Chapter 11, and perhaps other chapters) should be edited accordingly. [Trigg Talley, United States of America]	Taken into account. The SPM text now clearly distinguishes between changes in 1) agricultural and ecological droughts (primarily based on soil moisture, complemented by evidence from water-balance studies and indices combining precipitation and atmospheric evaporative demand), 2) meteorological droughts (precipitation deficits) and 3) hydrological droughts (streamflow deficits). As assessed in the cc-box 5.1 and highlighted in ch11, there is only low confidence in the role of CO2 physiological effects on plant responses during droughts: "Increased CO2 concentrations alleviate the effects of water deficits on plant productivity (medium confidence) but there is low confidence on its role under extreme drought conditions. There is low confidence that increased WUE by vegetation will substantially reduce global plant transpiration and diminish the frequency and severity of soil moisture and streamflow deficits associated with the radiative effect of higher CO2 concentrations"
100735					Herold, N., Huber, M., Müller, R.D., 2011. Modeling the Miocene Climatic Optimum. Part I: land and atmosphere. Journal of Climate 24, 6353-6372. [Matthew Kohn, United States of America]	See response to 100547
129663					[GSAT] Chapter 2 proposes the use of Global Surface Air Temperature (GSAT) rather than the blended air-ocean Global Mean Surface Temperature (GMST) in documenting observed and modeled changes in near-surface global temperatures. In essence, rather than obtaining the necessary climate model outputs to match the procedure used to calculate GMST from observations, the proposal is to apply a constant adjustment factor of +4% to the blended observation-based trend so that it comports with near-surface air temperature output from climate models. This approach is highly problematic. Models produce the variables necessary to calculate both GMST and GSAT. Long-term observational datasets do not. And thus, it is not clear what the advantages are of using an estimated and unobservable GSAT trend over the observable GMST trend. Furthermore Box 2.3 misrepresents both the confidence level and the scientific findings in the literature regarding GSAT choice as the main IPCC warming metric. As a result, the SPM message on GSAT vs GMST is inaccurate. No published paper argues for adopting GSAT for all purposes in the entire AR6 report and only a few papers suggest multiple temperature metrics. There are very few papers on the policy relevance of GSAT vs GMST and they recommend using GMST for reporting observed warming and improving model comparisons with observations. The proposed change to GSAT as the principal surface temperature metric throughout this report is unwarranted and unsupported by multiple, robust lines of evidence, including comparisons of models and observations. Reported GSAT increases since preindustrial are not documented in the published literature. This approach should be re-evaluated and reconsidered to better reflect an assessment of the evidence base for the use of GMST vs GSAT in reference period and trend calculations. [Trigg Talley, United States of America]	Taken into account in the redrafting of Cross-Chapter Box2.3.
100737					Konrad, W., Royer, D.L., Franks, P.J., Roth-Nebelsick, A., 2020. Quantitative critique of leaf-based paleo-CO2 proxies: Consequences for their reliability and applicability. Geol. J. 2020; 1-17. doi:10.1002/gj.3807 [Matthew Kohn, United States of America]	See response to 100547
116097					Check the use of the term "plausible" throughout the report. It is sometimes used to describe scenarios. There is an ongoing debate in the literature on the "plausibility" of scenarios. This needs to be addressed very carefully (x WG consistency is needed). [Valerie Masson-Delmotte, France]	Accepted.
116353					eg CCB on Pliocene, new publications on Eocene)? [Valerie Masson-Delmotte, France]	Comment unclear - stub text with insufficient context. To extent ascertainable we do include a Cross-chapter Box on Pliocene and we do now include the ECO.
129665					[ACCESSIBILITY] The assessment contains a significant amount of information, and structuring such in a cohesive manner is a formidable challenge. The current draft has shortcomings that cannot be overcome by a technical edit alone, though that too is needed. U.S. reviewers offer structural improvements to reduce length, help with key message distillation, improve logic flow, enhance consistency, and reduce redundancy — taking into account the scope and integration afforded by the plenary-approved outline. [Trigg Talley, United States of America]	Noted. Thank you for your useful suggestions. The FGD report is shorter than the SOD, we have reduced overlaps, improved cross-chapter consistency and tried to improve the overall accessibility of the report.
100739					Krapp, M., Jungclaus, J.H., 2011. The Middle Miocene climate as modelled in an atmosphere-ocean-biosphere model. Climate of the Past 7, 1169-1188. [Matthew Kohn, United States of America]	See response to 100547
129667					The authors need to carefully review and intercompare the severe storm and extreme weather part (flood, drought) for how the state of the science is presented, then ensure there is consistency at least between Chapters 8 and 11 and perhaps other chapters. [Trigg Talley, United States of America]	Noted. The final assessments of flood and droughts in the FGD are conducted by cross-chapter teams including authors from all relevant chapters
100741					Miller, K.G., Browning, J.V., Schmelz, W.J., Kopp, R.E., Mountain, G.S., Wright, J.D., 2020. Cenozoic sea-level and cryospheric evolution from deep-sea geochemical and continental margin records. Science Advances 6. [Matthew Kohn, United States of America]	See response to 100547
116101					For the timing of reaching different temperature levels, here and in Chapter 4, I suggest to provide a range of years (not a single year). There is a need for a concise description of reasons for changes compared to AR5 and SR (observed warming level + method GSAT + assessed transient response). Applying the exact same method on datasets from AR5, and each change since AR5 (observed warming; GSAT vs hybrid approach; CMIP6 compared to CMIP5; assessed transient response in AR6 compared to AR5) would be very helpful. [Valerie Masson-Delmotte, France]	Taken into account. A large effort has been made to explain changes in assessment of when certain temperature levels are crossed. SOD already always gave an uncertainty range. This includes also applying approaches from AR5 and SR1.5. However, because of the scenario and climate-sensitivity dependence of threshold-crossing timings, no single range can be provided, and the ranges can be very asymmetric. Hence a central estimate must be provided.
129669					The 14-page section entitled "What are the limitations for projecting water cycle changes" in Chapter 8 on 'Water Cycle Changes' -- which documents the precipitation prediction challenges in generating projections of changes in the global and subcomponents of the water cycle -- should be moved to Chapter 4, and generalized to be a section on limitations for projecting climate changes, inserted between Sections 4.5 and 4.6 as a preface to the "Implications of Climate Policy" narrative. [Trigg Talley, United States of America]	Taken into account. It is not Ch04's mandate to deal with the entire water cycle, because that is covered in Ch08. However Ch04 in its FGD makes proper reference to the Ch08 section, as well as dealing more explicitly with adequacy for purpose in general.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
100743					Molnar, P., Cane, M.A., 2002. El Niño's tropical climate and teleconnections as a blueprint for pre-Ice Age climates. Paleoceanog. 17, 11-11-11-11. [Matthew Kohn, United States of America]	See response to 100547
55431					In chapter 1 (sec. 1.4.4) storylines are introduced as a major new way to complement quantitative information, but apart from chapter 4 it is actually not really used to develop stories but just mentioned as a methodology. It would be great if the example in chapter 4 could be further developed including extremes (ch11) and CIDs (ch12) so that the promise in chapter 1 thatt information will be complemented is actually fullfilled. Especially as the information from ch4 is also in the TS. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. In the FGD, several more chapters and the TS feature the use of storylines to illustrate climate changes including, for example, Chapter 9 Box 9.4 - high end sea level rise, Chapter 10 Box 10.2: Storylines for constructing and communicating regional climate information.
129671					[PRECISION] The usage of the term "committed" should be defined upfront in several ways to ensure the document's different audiences understand what it implies. [Trigg Talley, United States of America]	Taken into account. Several definitions of "commitment" are defined in the glossary, and made clearer in the context in which they are used.
100745					Pound, M.J., Haywood, A.M., Salzmann, U., Riding, J.B., 2012. Global vegetation dynamics and latitudinal temperature gradients during the Mid to Late Miocene (15.97–5.33Ma). Earth-Science Reviews 112, 1-22. [Matthew Kohn, United States of America]	See response to 100547
129673					The IPCC is supposed to do an assessment of published literature; it is not supposed to do research. Yet, in many places, there are no references to literature and the material appears to have been developed by the authors themselves. Also there is a lot of pertinent literature that has not been included. Additiinal citations are provided in the line-by-line comments as appropriate. [Trigg Talley, United States of America]	Noted. Thank you for the line-by-line comments.
100747					Royer, D.L., 2016. Climate Sensitivity in the Geologic Past. Annual Review of Earth and Planetary Sciences 44, 277-293. [Matthew Kohn, United States of America]	See response to 100547
55435					Box 1.1 and figure in the box is very helpful but it would be good if it would include explicit words on how different lines of evidence are combined and how that leads to more (or less) confidence. Ch11 describes how quality of the evidence is assessed but that seems to include already combination of lines of evidence. Ch 10 talks about distillation of evidence but only in the context of regional message construction but the process seems to apply much more broadly. Given the emphasis of different lines of evidence in AR6 this could be better linked and strengthened. In other words, how does the synthesis precess work depicted under "Sources of information" in figure TS.7 in the technical summary? [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. It is challenging to represent the entire assessment process, but in the revised version of text and Figure we now include examples to show how lines of evidence are combined and used.
129675					The term "precipitation" or "rainfall" is often used when it really means precipitation or rainfall amount. Precipitation has many characteristics because it is intermittent and it should not be treated as a continuous variable. The intensity, frequency, duration, and type are every bit as important as amount. But precipitation is never assessed comprehensively. It is piecemeal throughout. At the very least, all places where precipitation is mentioned the word "amount" should be added if appropriate. [Trigg Talley, United States of America]	Taken into account in the FGD. Precipitation "amount" is mentioned in the FGD appropriately. In addition to precipitation amount, frequency and intensity of precipitation is also assessed in the FGD (8.3.1.3 and 8.4.1.3).
100749					Sosdian, S.M., Greenop, R., Hain, M.P., Foster, G.L., Pearson, P.N., Lear, C.H., 2018. Constraining the evolution of Neogene ocean carbonate chemistry using the boron isotope pH proxy. Earth Planet. Sci. Lett. 498, 362-376. [Matthew Kohn, United States of America]	See response to 100547
129677					Frequently the report is very cavalier with regard to use of model results without any commentary on whether the models are useful or can even simulate the quantity in question. Models are uniformly poor at simulating patterns and total amount of precipitation (double ITCZs, etc.), and also they all do intensity and frequency poorly. Models alone are a poor basis for projections in related quantities, and the uncertainties should be properly reflected in the assessment. [Trigg Talley, United States of America]	Taken into account. Adequacy for purpose is dealt with more explicitly in the FGD.
100751					Super, J.R., Thomas, E., Pagani, M., Huber, M., O'Brien, C., Hull, P.M., 2018. North Atlantic temperature and pCO2 coupling in the early-middle Miocene. Geology 46, 519-522. [Matthew Kohn, United States of America]	See response to 100547
129679					The WGI report makes note of the potential for land use and land use change to impact surface albedo in several sections (e.g. 2.2.5, 2.2.7, 4.6.3.2, 5.A, 7.3.2), primarily focusing on the historical net cooling effect of forest conversion to agriculture and settlement. However, only in passing does the document reference the substantial potential for contemplated afforestation and increases in forest management intensity to impact surface albedo, as a result of climate mitigation measures. There is a growing literature on this dynamic that is worth noting, perhaps in Chapters 3, 4, and 5, because these dynamics could significantly shift land use effect on surface albedo from historical trends, and reduce the radiative forcing benefit of carbon sequestration. Policymakers would benefit from a better understanding of these trade-offs. For example, Jones et al. (2015) incorporated albedo impacts from land use change into the Global Change Assessment Model (GCAM) to identify potential effects on energy sector GHG reductions and carbon prices. They find that incorporating albedo into climate policy targets (4.5 Wm-2 scenario) requires decreasing fossil fuel emissions by up to 1.5 PgC/yr by 2070, a 12-i67 % change in fossil fuel emissions. Favero et al. (2018) found that, under a 2100 carbon price of US$147 tCO2-1, albedo effects reduce global forest climate mitigation potential by 46%. They further found that pricing albedo changes on a CO2-equivalent basis encourages optimal location of forest area expansion, lower levels of forest expansion, decreases forest optimal rotation, and increases in forest carbon-equivalent density. McGlynn et al. (in prep) found that, under policy limiting global warming below 2°C, the unexpected damages from ignoring albedo reach 22% of 2100 climate damages, with unexpected temperature change reaching 0.27°C. Accounting for albedo effects increases 2100 carbon prices by 36%, and requires the industrial sector to reach zero greenhouse gas emissions a decade earlier (2060 rather than 2070). Thompson et al. (2009) first looked at the effects of albedo on optimal forest age under climate policy for a single stand. Mykleby et al. (2017) estimated these trade-offs with respect to optimal forest rotation age in different climatic and vegetation regions in North America, identifying a latitudinal dividing line between areas that resulted in net climate benefits of expanding forest area vs. net climate damages. Citations follow: Favero, Alice, Brent Sohngen, Yuhan Huang, and Yufang Jin. 2018. Global Cost Estimates of Forest Climate Mitigation with Albedo: A New Integrative Policy Approach.Environmental Research Letters 13 (12): 125002. https://doi.org/10.1088/1748-9326/aaeaa2. Jones, Andrew D., Katherine V. Calvin, William D. Collins, and James Edmonds. 2015. Accounting for Radiative Forcing from Albedo Change in Future Global Land-Use Scenarios. Climatic Change 131 (4): 691-703. https://doi.org/10.1007/s10584-015-1411-5. McGlynn, Emily, Favero, Alice, Bastien Olvera, Bernardo Adolfo. In prep. The problem with pricing ""carbon"": exploring forest-driven albedo effects in DICELAND. Mykleby, P.M., P.K. Snyder, and T.E. Twine. 2017. Quantifying the Trade-off between Carbon Sequestration and Albedo in Midlatitude and High-latitude North American Forests. Geophysical Research Letters 44 (5): 2493-2501. https://doi.org/10.1002/2016GL071459. Thompson, Matthew P., Darius Adams, and John Sessions. 2009. Radiative Forcing and the Optimal Rotation Age. Ecological Economics 68 (10): 2713-20. https://doi.org/10.1016/j.ecolecon.2009.05.009. [Trigg Talley, United States of America]	Noted. The WG1 report is not about mitigation. Regardless, the potential for land-use change to mitigate global warming is very limited.

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8593					Terminology on "SSP 'pathways'" vs "SSP scenarios" to distinguish between the shared socio-economic pathways and the ScenarioMIP scenarios is going to be a source of confusion throughout the entire report if not addressed. (Also the term "SSP pathway", sometimes used, is redundant). If it is not too late, I would suggest using a distinct, or at least clear, name for the ScenarioMIP SSP-SPA combos that does not invite confusions with the 'pure' SSPs. [Robert Kopp, United States of America]	Taken into account. For WG1, SSP-RCP combination is currently used as discussed in Chapter 1.
100753					Steinthorsdottir, M., Coxall, H.K., de Boer, A.M., Huber, M., Barbolini, N., Bradshaw, C.D., Burls, N.J., Feakins, S.J., Gasson, E., Henderiks, J., Holbourn, A., Kiel, S., Kohn, M.J., Knorr, G., Kürschner, W.M., Lear, C.H., Liebrand, D., Lunt, D.J., Mörs, T., Pearson, P.N., Pound, M., Stoll, H., Strömberg, C.A.E., 2020. The Miocene: the future of the past. for Paleoceanography and Paleoclimatology, in review. [Matthew Kohn, United States of America]	See response to 100547
129681					Worldwide, agriculture and land use impacts account for about 25% of total greenhouse gas (GHG) emissions, but research suggests that best management practices for soil health, sustainable agricultural production, forestry, and other land uses, including restoration of natural areas, could make the global agricultural footprint climate-neutral through carbon sequestration and reduced methane and nitrous oxide emissions: - The potential of organic and sustainable production systems to contribute to carbon dioxide mitigation and community resilience to climate change - The potential for land-based photosynthesis and soil carbon sequestration as a biological carbon dioxide removal strategy - Benefits of improving air quality (reduced aerosols) to public health and community resiliency. In addition, the IPCC is encouraged to include new information gained from the impacts of the coronavirus pandemic and associated suspension of non-essential travel and some other economic activities on climate change drivers. Nationwide and global responses to the COVID-19 crisis has reduced GHG emissions in China by an estimated 25% (Wright, 2020), caused a 50% reduction in nitrogen oxides in California (Gohd, 2020), and visibly reduced NO2 levels over Italy and China (Ghosh, 2020). Worldwide, the largest reduction in CO2 release in the last 50 years is predicted for 2020 by the Global Carbon Project (Nasralla et al., 2020). The SPM and underlying report should analyze these phenomena, and their potential to inform strategy and policy to retain and continue GHG reductions during economic recovery after the pandemic subsides. The COCID-19 crisis offers humanity an opportunity to develop a ""new normal"" that permanently reduces GHG emissions while regenerating more sustainable and equitable regional, national, and global economies. Citations follow: Ghosh, I., 2020. Emissions on lockdown: China and Italy. World Economic Forum. Accessed April 5, 2020 at https://www.weforum.org/agenda/2020/03/emissions-impact-coronavirus-lockdowns-satellites/. Gohd, C., 2020. Shutdowns from coronavirus create blue skies in California, could inform future pollution control. SPACE.COM. Accessed April 5, 2020 at https://www.space.com/coronavirus-california-emissions-reduced-blue-skies-ozone-increase.html. Nasralla, S., V. Volcovici and M. Green, 2020. Coronavirus could trigger biggest fall in carbon emissions since World War Two. Reuters, April 3, 2020. Accessed April 5, 2020 at https://www.reuters.com/article/us-health-coronavirus-emissions/coronavirus-could-trigger-biggest-fall-in-carbon-emissions-since-world-war-two-idUSKBN21L0H. Wright, 2020. There's an unlikely beneficiary of coronavirus: The planet. Accessed April 4, 2020 at https://www.cnn.com/2020/03/16/asia/china-pollution-coronavirus-hnk-intl/index.html. [Trigg Talley, United States of America]	Taken into account. A cross chapter box on the effects of the COVID pandemic on emission, air quality and climate has been added to chapter 6 (Cross-Chapter Box6.1). Note that the role of management practices in sectoral effort to mitigate climate change is beyond the scope of WGI but is assessed in WGIII.
100755					Stoll, H.M., Guitian, J., Hernandez-Almeida, I., Mejia, L.M., Phelps, S., Polissar, P., Rosenthal, Y., Zhang, H., Ziveri, P., 2019. Upregulation of phytoplankton carbon concentrating mechanisms during low CO2 glacial periods and implications for the phytoplankton pCO2 proxy. Quat. Sci. Rev. 208, 1-20. [Matthew Kohn, United States of America]	See response to 100547
129683					[RISK] Risk-relevant terminology, particularly "hazard" and "disaster", should be reviewed for consistency across the report in accordance with standards in relevant fields and practice. For example, a disaster occurs when capabilities are overwhelmed, whereas a hazard can occur even if it can be successfully managed. [Trigg Talley, United States of America]	TAKEN INTO ACCOUNT: In WGI we discuss the relevance of WGI Climate information for disaster risk management, but recognize that the determination of a given disaster must incorporate system vulnerability and exposure (which interact with response capabilities). The climatic impact-driver framework was developed based in part on approaches developed within he Sendai Framework (on disaster risk reduction), with a focus on climate information that is relevant to sectors but the determination of beneficial or detrimental outcomes left to WGII (see Figure 12.1).
100757					Super, J.R., Thomas, E., Pagani, M., Huber, M., O'Brien, C.L., Hull, P.M., 2020. Miocene evolution of North Atlantic sea surface temperature. Paleoceanography and Paleoclimatology. [Matthew Kohn, United States of America]	See response to 100547
129685					[ACCESSIBILITY] Though comprehensive and a valid assessment of the state-of-science, the WGI AR6 volume is so long as to be impenetrable. Each chapter is like a stove-piped Special Report. There are vast redundancy and consistency issues that are addressed in the line-by-line comments. Though efforts to coordinate across chapters are formidable -- especially in light of current communications constraints induced by pandemic -- significantly more effort must be made to reduce redundancy and girth of the entire report. For example, the Summary for Policymakers is indeed intended for decisionmakers/stakeholders and their staff, none of whom would have the time or energy or intellectual grit to wade through such a complex, detailed document. Consider re-labeling the SPM as the Technical Summary, and craft a much shorter SPM that is more accessible to a lay reader -- say, 20 pages instead of 60. Reduce the number of SPM graphics from 11 to 5 that best convey central messages. In so doing, you increase the odds of SPM approval in the allotted time at P-54. Strike the current Technical Summary from the WGI contribution to the AR6, recouping 232 pages, and publish it as a spin-off Technical Paper since it is obviously based solely on the AR6 literature. This ensures that author efforts are not in vain, while achieving the ultimate goal of an SPM that can be read and understood by policymakers in a day instead of a week. [Trigg Talley, United States of America]	Taken into account. Cross-chapter coordination strived to reduce the overlaps and duplicates between the chapter, improve the consistency and reduce the overall length of the report. Additionally, both the SPM and the TS have been significantly shortened
72087					I know this is a traditional way of representing data, but when you use stippling to indicate a sign consistency or significance level between models, it makes it hard to see the underlying pattern. Instead of stippling the significant data, if you would shade the insignificant data (the part that is less clear and a little bit less important), you can focus on the significant part. This might be difficult to do in this report, but it's an idea for future reports. [Elke Zeller, Republic of Korea]	Taken into account. The stippling/hatching methodology was revised for FGD. One of the aspect of this new methodology is to obscure "problematic" areas (e.g. insignificant areas, areas with lack of model agreement etc) with a consistent symbol: hatching for projections and crosses for observations. This leaves the colour in the robust areas un-obstructed. This methodology has been applied throughout the report. See Cross-Chapter Box Atlas.1 for more details.

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100759					Warny, S., Askin, R.A., Hannah, M.J., Mohr, B.A.R., Raine, J.I., Harwood, D.M., Florindo, F., 2009. Palynomorphs from a sediment core reveal a sudden remarkably warm Antarctica during the middle Miocene. Geology 37, 955-958. [Matthew Kohn, United States of America]	See response to 100547
116375					Coordination across chapters is needed on aerosol radiative forcing in CMIP6 as well as the response of CMIP6 models to volcanic forcing. I cannot find a clear comparison of the radiative forcing in simulations compared with the one estimated in ch 2 for the historical period. [Valerie Masson-Delmotte, France]	Taken into account. Chapter 4 now presents this comparison
129687					[ACCESSIBILITY] The AR6 is intended to present information new since AR5. However, the Atlas devotes a great deal of space to detailed summaries of previous findings in AR5 and recent Special Reports. Furthermore, content in the Atlas is duplicative of or better placed in AR6 WGI report Chapters 2, 3, 4, 10, and 12. Given the great length of the WGI report and its mandate to be additive, recommend a minimum of duplicative content. Likewise information that could be placed in other chapters (e.g., on global trends, the Arctic) should be consolidated to prevent readers from missing it. [Trigg Talley, United States of America]	Noted. Summary information in the Atlas from previous IPCC reports has been streamlined to focus on the important context for the Atlas assessment. With respect to Chapters 2-4, these provide a global assessment of change and the Atlas focuses on the regional aspects, e.g. including regional observational datasets, to provide additional details. With respect to the other regional chapters (10-12) Atlas authors engaged actively in cross-chapter regional teams to ensure lack of overlap and consistency of the assessment across the four regional chapters (and regional aspects of other chapters, e.g. Chapters 8 and 9).
100761					Williams, A.P., Cook, E.R., Smerdon, J.E., Cook, B.I., Abatzoglou, J.T., Bolles, K., Baek, S.H., Badger, A.M., Livneh, B., 2020. Large contribution from anthropogenic warming to an emerging North American megadrought. Science 368. [Matthew Kohn, United States of America]	See response to 100547
116377					Cross chapter coordination is needed related to the understanding of larger extratropical cloud feedbacks in the subset of CMIP6 models that have a larger equilibrium climate sensitivity (chapter 7), and related implications (model-data comparisons for diverse aspects, model behaviour etc). [Valerie Masson-Delmotte, France]	This is expanded on in Chapter 7, section 7.5
100763					Witkowski, C.R., Weijers, J.W.H., Blais, B., Schouten, S., Damste, J.S.S., 2018. Molecular fossils from phytoplankton reveal secular pCO2 trend over the Phanerozoic. Science Advances 4. [Matthew Kohn, United States of America]	See response to 100547
109723					Since reviews go out to a wider audience, and since having an ability to navigate around the content within each chapter would help in the process, can future drafts sent out for review be formatted with bookmarks? Having the ability to locate any place in a given chapter and return to the TOC would be an asset. Thank you! [Eric Nolan, United States of America]	Taken into account. We have tried to implement that for the compiled version of the FGD and the final formatted version will include links to the subsections.
83101					There are a number of related concepts discussed across the report that need better cross-chapter coordination: (1) Storylines / Narratives; (2) High-end Scenarios; (3) Deep Uncertainty. This coordiation should include cross-referencing of the relevant Chapter and Cross-Chapter Boxes. In particular, how do these three relate to each other? I think we can probably consider (2) as being a subset of (1) and a means to provide information to the user in situations where (3) applies? Could we, for example, re-name Box 9.2 "High-end storylines of future sea-level change" (rather than referring to "high end projections", which doesn't really fit into any of the existing IPCC concepts introduced in Chapter 1). [Matthew Palmer, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Since the SOD, we have worked a lot on cross-chapter coordination and have made considerable efforts to improve the consistency across the report. More specifically, Box 9.2 now refers to storylines.
100765					Zhang, Y.G., Pearson, A., Benthien, A., Dong, L., Huybers, P., Liu, X., Pagani, M., 2019. Refining the alkenone-pCO2 method I: Lessons from the Quaternary glacial cycles. Geochim. Cosmochim. Acta 260, 177-191. [Matthew Kohn, United States of America]	See response to 100547
131999					I appreciate the effort made by WGI authors to construct a useful interface and handshake with WGII. There are still some issues to be solved, such as the defnition of and connection to temperature values and other climate variables as used in impact studis, even the Paris agreement. The interface with [Hans Poertner and WGII TSU, Germany]	NOTED: It appears as though the final sentence of the reviewer's comment has been cut off. Between the SOD and FGD there has been considerable effort to increase interaction across WGI chapters and between WGI and WGII to ensure a strong handshake and consistency in regional climate information. This included efforts based around each continental region (incorporating contributing authors from corresponding WGII Regional Chapters) and around specific CIDs (e.g., drought, glaciers, coastal flooding). Assessments now provide more information by Global Warming Level in a nod to the Paris Agreement and mitigation targets, and we have developed Section 12.3.1 to show how there is a multitude of specific temperature thresholds that may be relevant even to particular sub-sectors (e.g., maize thresholds are different than soybean thresholds), but that there are overall patterns in the types of temperature thresholds that are examined as well as graduating levels of threshold even for a given system (as in critical and limiting temperatures for crops). We have also enhanced our use of heat-humidity indicators for human health. These efforts combine to provide more useful WGI information for WGII assessments by sector and by region.
83103					I can't help but think that the discussion of storylines in Chapter 1 (and elsewhere) is unnecessarily complicated and I have concerns that the information provided will not be understood by many. A key question would seem to be: in IPCC AR6, what flavour(s) of storyline will we focus on and make use of? The main driver for this would seem to be to present possible scenarios (in the broadest sense of the word) that lie outside the assessed likely or very likely ranges and also as a means to encourage users to consider outcomes that lie outside of the assessed ranges (be that ECS, sea-level rise, temperature rise etc). In that regard, perhaps the discussion/presentation can focus on how these are used (consistently) across the report, rather than comparing various approaches (e.g. Figure 1.11, which I don't understand TBH). [Matthew Palmer, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Indeed the presentation and usage of storylines has been complex, and changed during the development of the report (this is a relatively new topic for WG1). Hopefully the current presentation in Chapter 1 is clearer, and the usage more consistent. However, sub-communities of WG1 (and the underlying literature) still use the term in varying ways, and this will to some degree be reflected in the report too.
116383					Cross chapter coordination is needed to check the numbers reported for the lifetime of CH4 and N2O (ch 2, 5, 6). [Valerie Masson-Delmotte, France]	Accepted - Cross-chapter coordination took place during the preparation of the FGD
116385					coordination is needed between ch 5 and ch 6 on the effects of air quality (esp O3) on land carbon sinks. [Valerie Masson-Delmotte, France]	Taken into account. Cross-chapter coordination has been reinforced for effects of air quality on land carbon sink

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17827					Methane lifetime is listed as 9.6 years three times in Chapter 5, ~9-12 years in Table 6.1, 12 years in Chapter 6, FAQ6.1, Figure 1, 12.4 years in Table 7.15. I understand this is the difference between the chemical lifetime & the perturbation lifetime, but it would be good to cross-reference and clarify which lifetime should be used for what purposes (e.g., the 12.4 year perturbation lifetime is definitely more appropriate for pulse-based emissions metrics). [Marcus Sarofim, United States of America]	Accepted - the lifetime of CH4 has been checked and made consistent across the report.
116131					There is a need for having an overview of the assessment related to the effect of volcanic eruptions, what has changed since AR5, what are insights from understanding past variations (incl from last millennia) (direct effects, effects through modes of variability, effects on ocean heat uptake), and how it can affect future change (near term predictability, rates of warming, timing when reaching certain levels of warming not accounted in SSP, etc). Bringing the various elements together is needed (TS?) to make sure that this is correctly reflected in the TS and SPM, possibly using a storyline approach (not yet the case). [Valerie Masson-Delmotte, France]	Accepted. Now assessed in Cross-Chapter Box 4.1.
34727					Preamble – Need for Perspective: The COVID-19 pandemic is (at the time of writing) leading to a serious global human and economic COVID-19 emergency; in contrast, a rigorous, objective analysis of actual climate trends points to a prudent program of mitigation and adaptation over the coming decades, but not to a climate emergency. [Jim O'Brien, Ireland]	Noted.
116391					Cross-chapter coordination is needed on issues related to fire weather, links to emissions and air quality (also / SRCCL) (what is observed; paleo context; projections; feedbacks etc) (ch 2, 3?, 4, 5, 6, 11, 12) so as to build consistent messages and reflect them in the TS and possibly SPM. Links with ENSO are also relevant. [Valerie Masson-Delmotte, France]	Accepted. Great efforts were undertaken to ensure cross-chapter consistency.
34729					Preamble – Lack of Scientific Accuracy, Neutrality and Objectivity: In the context of the global human and economic devastation from the COVID-19 pandemic, it is absolutely essential that AR6 is rigorously accurate, neutral and objective in its scientific conclusions so that global climate action is proportionate in cost, scale and timing. As will be demonstrated in the comments which follow, the AR6 SOD (Second Order Draft) does not meet expected standards of scientific accuracy, neutrality or objectivity, particularly in its conclusions. This indicates a lack of internal IPCC WG1 governance. Accordingly it is suggested that, after assimilating these and comments from other Expert Reviewers, a Third Order Draft should be prepared and should be circulated for Expert Review before AR6 is published. This may mean a 6-month delay on AR6 publication, but quality should not be jeopardised by haste. [Jim O'Brien, Ireland]	Rejected. The mandate of the IPCC is to provide policy relevant but policy non-prescriptive information. The WGI community have contributed enormous efforts in unprecedented circumstances to produce the report to a timeline 3 months delayed as a result of the COVID-19 pandemic.
116393					Cross-chapter coordination is needed on issues related to fire weather, links to emissions and air quality (also / SRCCL) (what is observed; paleo context; projections; feedbacks etc) (ch 2, 3?, 4, 5, 6, 11, 12) so as to build consistent messages and reflect them in the TS and possibly SPM. [Valerie Masson-Delmotte, France]	Accepted. Great efforts were undertaken to ensure cross-chapter consistency.
19371					I read through Chapter 2, scanned the technical summary (TS), read the summary for policy makers (SPM), and looked over Annex II and the Atlas. The work that went into these documents is truly impressive, and I realize that the goal of this report is a comprehensive summary of climate science as it relates to our changing world. However, the report is extremely obtuse and complex, so that I fear it's potential impact will be affected. I'm sure it is too late to change the overall structure, but that is my primary reaction to the report. [Steve Colman, United States of America]	Noted. No specific changes requested or made.
34731					Layout of this Document: This document first comments on 16 key scientific issues concerning the entire SOD, and then references these under the relevant chapter headings, page and line numbers. [Jim O'Brien, Ireland]	Noted.
78253					It would be useful to provide a comparison of key findings from AR6 with AR5 and the Special Reports, with a brief explanation or indication of where detailed explanations can be found, on the difference. For example, it would be helpful to explain why the carbon budget needed to keep within temperature goals has changed significantly between AR6 and the SR1.5. Sea level rise are measured in different base periods, and it is difficult to grasp if the projected SLR by 2100, relative to pre-industrial levels, has worsened or improved relative to previous projections and reports. [Leonie Lee, Singapore]	Taken into account: the rule for the chapters is to start their sections with the assessment of the special reports. If a topic was not covered in the special reports, then the starting point is AR5. This structure should, in theory, enable an easy comparison with previous reports
34733					The 16 Key Scientific Issues with the AR 6 SOD; [Jim O'Brien, Ireland]	Noted.
111789					I would strongly suggest to streamline the way in which the Paris Agreement's goals and targets are referred to, particularly temperature levels. In the legal literature, among diplomats and in WG3 ch14 (on "international cooperation") 1.5C and 2C aren't interpreted as two distinct targets/goals, but as part of one "long-term temperature goal"/LTTG (well below 2°C above preindustrial levels and pursuing efforts to limit the temperature increase to 1.5°C). Of course it often makes sense to refer either to 1.5C or 2C, but it's probably better to work with a different term then. e.g. "temperature threshold". [Oliver Geden, Germany]	Taken into account. We have attempted to refer consistently to the "aims of the Paris agreement", "well below 2C", and similar, as a single goal, while presenting 1.5C and 2C results as global warming levels only.
116397					The final sections of chapters on limits to the assessment, of ways forward related to current gaps, would benefit from a more consistent approach (length, style, tone). [Valerie Masson-Delmotte, France]	Taken into account. The guidelines given to chapters is to include any limits to the assessment (relevant topics that not be assessed). The use of the IPCC uncertainty language also reflect the state of knowledge on each topic being assessed.
90799					Please use the correct countries borders to avoid misinterpretation of results. [Omar Chafki, Morocco]	Noted. Country borders have been removed from all maps to avoid the possibility of any misinterpretation.

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34735					#1 – Inappropriate GSAT Temperature Dataset The SOD for the first time adopts what it admits to be artificially-derived Global Surface Air Temperature (GSAT) dataset, which produces a 1.1°C temperature anomaly, the highest of any dataset, since 1850-1900 (SPM p2, TS p23). The SOD itself (SPM p2) admits that no such documented database exists, an extraordinary admission. (a) Problems with Calculation of GSAT: There are a number of robust technical reasons against using GSAT; (a) it is inappropriate to use ERSSTv5 as a proxy for SST, because of the way that ship SST data is homogenized, it actually largely reflects nighttime marine air temperature trends over decadal and longer periods, not SST trends; hence it is unjustifiable to adjust the GSAT trends of those datasets (GISTEMP and NOAA) upwards, and (b) the 4% upward adjustment reflects not just observational evidence but also CMIP5 and CMIP6 model simulations of the historical period, which appear to produce a different pattern of SST warming from that which actually occurred, and so do not provide an acceptable guide to marine air temperature versus SST trends. Furthermore, in AOGCMs, the relationship of SST to marine air temperature warming actually reflects the simulated relationship between ocean skin temperature and air temperature, since models do not simulate the complex structure of temperature gradients between the ocean skin and the model's top ocean layer (of typically 10 m depth), which is taken to represent SST. Therefore, only observational estimates of the warming difference should be used. These are, as stated, 2-4% for post 1979 re-analyses. But, comparing HadNMAT2 with HadSST4, these are zero or slightly negative over the whole historical period. So an adjustment of no more than 2% is justified, even for those GMST datasets that are not already in effect adjusted to GSAT (which GISTEMPP and NOAA are). (b) Distortion due to the Urban Heat Island (UHI) Effect: It is noted that GSAT inherently includes global land temperatures which are now significantly distorted due to the Urban Heat Island (UHI) and other natural effects. The SOD needs to clarify that UHI is a local temperature amplification due to building proximity, etc, above and beyond global warming. The Chapter 2 (Ch2 p40) Table 2.4 provides crucial evidence of this distortion in that for every dataset, there is a significant difference between Land and SST temperature anomalies. For HadCRUT5 and NOAA Global the 1880-2018 difference is as large as 0.7°C, which is almost as much as the observed global warming over that time period, which raises a very serious question as to accuracy. This is also very evident in Figure TS12, Part C, on page TS184, where it is shown that the land temperature exceeds that of SST by 0.55°C, predominantly due to the UHI effect. The UHI effect is also investigated by Connolly et al in their paper "Urbanization Bias III, Estimating the extent of bias in the Historical Climatology Network Datasets", Open Peer Review J, 2014, 34 (Climate Science), Version 01, at https://globalwarmingsolved.com/2013/12/summary-urbanization-bias-papers-1-3/#conclusions. They analyzed 100-year records of rural versus urban stations globally and found that the US	Taken into account in the redrafting of Cross-Chapter Box2.3. UHI effects are assessed in chapter 2.
116143					Chapter 5 is using the notion of "emergent feedback", this would need a definition and be introduced in ch1 (with other aspects : emergence, time of emergence, emergent constraints) and in the glossary. [Valerie Masson-Delmotte, France]	Rejected. We did not manage to include this in Chapter 1, but reference Chapter 5.
132017					Prominently, in the SPM and chapter 1 a conversion table between temperatures used, scenarios used should be included, considering the need to put the diverse reference to climate in the literature into context. E.g. what are the temperatures of the Paris agreement in light of the modifications in this report? A guide to conversion might be included in the annexes. [Hans Poertner and WGII TSU, Germany]	Not applicable. Following the SOD review, changes in GSAT and GMST were assessed and are found to differ by at most 10% from one another (high confidence), but conflicting lines of evidence lead to low confidence in the sign (direction) of any difference in long-term trend. {Cross-Section Box TS.1} As a result, GSAT is no longer the principal metric of the report and a conversion table is not applicable. Instead, the term 'global surface temperature' is now used interchangeably, in reference to both global mean surface temperature and global surface air temperature throughout the revised SPM.

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34737					#2 – Oversensitivity of Climate Models: Despite SOD claims to the contrary, the CMIP5 models used in AR5 were oversensitive, in that these, based on reliable global satellite data, demonstrably over-estimated temperature increases in recent decades by a factor of up to 2 to 3. This over-sensitivity had already becoming apparent in the 2013 AR5 Figure 11.25(a), and in the missing "predicted tropical hot spot" depicted in the Supplemental Material of its Chapter 10, Figure 10.SM.1. These CMIP5 model defects are explained further by Christy in his paper at: https://www.thegwpf.org/content/uploads/2019/10/Christy-2019A.pdf, with similar views expressed by Spencer at https://www.drroyspencer.com/2019/12/cmip5-model-atmospheric-warming-1979-2018-some-comparisons-to-observations/ and McKitrick at https://www.drroyspencer.com/2019/11/comments-by-ross-mckitrick-on-the-continuation-of-climate-model-failure/. The CMIP5 models were also severely criticised by Hourdin et al in their paper "The art and science of climate model tuning", Bull Am Met Soc, 98, 589-602, pointing out the lack of transparency in model tuning, illustrating these were freely tuned to give results falling in an "anticipated acceptable range". The CMIP6 models are no better in that respect. In that context, it is inexplicable that the CMIP6 models should have 20% higher sensitivity, the validity of which the detailed SOD text (TS p31) itself queries. It is an interesting SOD admission that the CMIP6 models (Ch3 p14) less well represent historic temperatures than CMIP5 models, which again greatly undermines the validity of CMIP6 models and any projections based thereon. The SOD even admits (Ch4 p36) that the higher warming rates of CMIP6 models compared to CMIP5 are unlikely to happen. Surprisingly, to crown it all, the SOD admits (Ch1 p87) that the CMIP6 models are not fit for purpose. The SOD (SPM p5, TS p9) claims that projections published since the 1980s were in close agreement with previous models. However, as outlined above, observations based on satellite data show that the actual temperature rise was 2 to 3 times less than predicted in the AR5 models, The SOD estimate (TS p108) of about 0.1°C/decade rise in global temperatures is in agreement with satellite observations, see for example the Christy & McNider paper: https://link.springer.com/article/10.1007/s13143-017-0070-z. The SOD claims that C&S America, W Antarctica and W Europe have warmed by 0.2-0.3°C/decade, and that the Arabian Peninsula, Central Asia and E Europe by 0.3-0.5°C/decade are then clearly local and natural influences (much likely due to UHI) which clearly are not global climate effects. See for example Lüdecke et al "Decadal and multi-decadal natural variability in European temperatures" at https://www.sciencedirect.com/science/article/pii/S1364682620301115?dgcid=author. This is an area in which the SOD is not being objective in confusing local/regional UHI effects with global warming. The SR1.5 central estimate of warming of 0.2°C/decade was rebutted in the Bates paper "Deficiencies in the IPCC's Special Report on 1.5 Degrees – Revised and Updated Version", a paper by Prof J Ray Bates, published by the GWPF, January 2019, see www.thegwpf.org/content/uploads/2019/01/Bates-2018b.pdf. He concluded that SR1.5 provided no real evidence for an increased rate of	Rejected. Based on the full set of CMIP6 simulations now available and updated observations, Section 3.3.1.1 assesses "The CMIP6 multi-model mean GSAT warming between 1850-1900 and 2010-2019 and associated 5-95% range is 1.09°C (0.66 to 1.64°C). Cross-Chapter Box 2.3 assessed GSAT warming over the same period at 1.06°C (0.88 to 1.21°C). So some CMIP6 models simulate a warming that is smaller than the assessed observed range, and other CMIP6 models simulate a warming that is larger." i.e. the multi-model mean estimate of historical warming agrees closely with observations. That said, we accept that observations may be useful in more closely constraining climate projections, and multiple lines of evidence (not just CMIP6 simulations) are now used to derive GSAT projections in Chapter 4.
112817					The term "climate impact driver" is confusing. In WGII the word "impact" is reserved for observed/realised impacts, whereas the term "risk" would be used for potential future "impacts". I would strongly suggest reconsidering this -- even "climate impact/risk driver" would already be much better. Alternatively, you could consider "climate driver" (I realise this may cause confusion with the drivers of climate change itself, but I think it will generally be clear in the context -- whereas the confusion between impacts and risks will really complicate the flow to WGII (and also hamper user perspectives in general, where climate is often handled in terms of risk assessments, e.g. in the context of the "physical climate risk" aspect of the Taskforce on Climate-related Financial Disclosures) [Maarten van Aalst, Netherlands]	TAKEN INTO ACCOUNT: The reviewer's point is well taken, and we have been deliberate in the use of impact and risk and considered the time periods associated with these terms' usage. We agree with the reviewer's formulation of impacts as 'realized risk', but disagree that there is any hard rule that impacts can not be discussed in the future and risk can not be discussed in the past. For example, a changing climatic impact-driver can lead to projections of a future impact, and the probability of this occurring is a risk. Likewise, in the recent past there was a risk profile of extreme events that is somewhat different than the actual impacts that occurred -- we see this in model simulations of the current climate that show alternative series of events were possible (this is also why we can define a 1-in-100 year storm even in situations where that storm hasn't occurred in the past 100 years (due to its probabilistic nature). The 'Climatic impact-driver' term has been widely discussed across WGs and is now incorporated in the IPCC Risk Guidance materials (IPCC, 2020). As the reviewer noted, 'climate drivers' could be confusing as it is used to describe a force exerted on the climate system itself (e.g., a change in solar output). We have hyphenated "impact-driver" to emphasize that this is the operational term, and "climatic" is the type of impact-driver that we look at in WGI. Risk may be considered the probability of all impacts, but we care about these CIDs because they have the ability to cause a specific impact in a specific sector (see Section 12.3), so we do not need to introduce 'risk' into this definition to make CIDs relevant for risk.
32947					when entering the shortcut for the first time I suggest include shortended term in the bold font. For example: Essential Climatic Variable (ECV) [Tomasz Walczykiewicz, Poland]	Rejected. Editorial. Thank for you the suggestion but we feel this is unnecessary.

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34739					#3 –Over-Estimation of ECS and TCR: The oversensitivity of the CMIP6 climate models outlined above means that the SOD estimates of ECS (~3°C) and TCR (~1.8°C) continue to be too high and undermine any reasonable estimates of a remaining "Global Carbon Budget" to meet the Paris Agreement commitments. It defies belief that these ECS and TCR estimates are higher and wider in range than those of AR5, as illustrated in FAQ7.2, Figure 1 (Ch7 p206), and even more so that these have not been narrowed in the 41 years of (very expensive) climate research since the original Charney estimates of 1979. It is quite strange that the SOD admits that the CMIP6 models are not used to calculate ECS and TCR (SPM p24, TS p78), and indeed the admission that the current figures might be based on group-think (Ch7 p7, p103). It correctly accepts that the uncertainties in ECS and TCR make projections towards 2100 meaningless (Ch4 p87), and it follows that any projections beyond 2100 better belong to the field of science fiction. Why does IPCC continue to ignore the much lower estimates of ECS and TCR by world-class scientists including Richard Lindzen, William Happer, William van Wijngaarden, John Christy, Roy Spencer, J Ray Bates, Nic Lewis, Judith Curry, Nicola Scafetta, Henrik Svensmark and Nir Shaviv, to name just some? See for example Richard Lindzen's summary paper: http://co2coalition.org/publications/on-climate-sensitivity/, which concludes than an ECS in excess of 1.5°C is precluded. The Lewis and Curry paper: https://journals.ametsoc.org/doi/10.1175/JCLI-D-17-0667.1?utm_source=CCNet+Newsletter&utm_campaign=a24cafd790-EMAIL_CAMPAIGN_2018_04_24&utm_medium=email&utm_term=0_fe4b2f45ef-a24cafd790-20156641& puts ECS at 1.5-1.7°C, while the Christy & McNider paper http://www.sealevel.info/christymcnider2017.pdf estimates ECS as 1.1°C. Also J Ray Bates' milestone paper "Estimating Climate Sensitivity using Two-Zone Energy Balance Models", Earth and Space Science, 3, 207-225, seen at https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2015EA000154 calculates a tightly-constrained ECS value in the neighbourhood of 1°C. The Harde paper, Radiation Transfer Calculations and Assessment of Global Warming by CO2 (2016), https://www.hindawi.com/journals/ijas/2017/9251034/ found that a CO2 climate sensitivity larger than 1°C seems quite improbable, whereas a value of 0.6–0.8°C, depending on the considered solar anomaly, fits well with all observations of a changing solar constant, the cloud cover, and global temperature; in that case CO2 contributed 40% and the sun 60% to global warming over the last century. Both Nicola Scafetta's paper: http://www.ijege.uniroma1.it/rivista/ijege-19/ijege-19-volume-01/on-the-reliability-of-computer-based-climate-models/ijege-19_01-scafetta.pdf and Henrik Svensmark's paper https://www.thegwpf.org/content/uploads/2019/03/SvensmarkSolar2019.pdf	Taken into account. Chapter 7, Section 7.5 assesses both TCR and ECS from multiple lines of evidence. The models are not used as a line of evidence so the premise of the comment is wrong
34741					#4 - The ERF/GWP of Methane: The SOD (SPM p9, Ch6 pp5 & 41) puts an upward revision of the short-wave forcing of Methane (CH4) since AR5. This is running contrary to the latest emerging science on the minimal influence of Methane, as described below. A recent investigation, based on detailed measurement of actual radiative forcings of the principal GHGs through high-definition spectroscopy, by Van Wijngaarden and Happer, ("Methane and Climate", http://co2coalition.org/publications/methane-and-climate/) confirms that contribution of CH4 to increased forcing is minimal and therefore that CH4 is almost irrelevant as a GHG. This paper is a summary version of their more detailed paper "Dependence of Earth's Thermal Radiation on Five Most Abundant Greenhouses Gases" of February 2020, awaiting publication. Also a recent collaboration between the Universities of Oxford, Reading (both UK), Wellington (NZ) and CICERO (Norway) has established strong arguments that the ERF of CH4 due to its being a Short-Lived Climate Forcer (SLCF, Ch 6)) needs to be revised downwards, summarized in the six papers cited below: These papers are: (a) Allen, MR et al. (2016) A new use of Global Warming Potentials to compare cumulative and short-lived climate pollutants. Nat. Clim. Change, 6, 773–776, (b) Allen MR, Shine KP, Fuglestvedt JS, Millar RJ, Cain M, Frame DJ and Macey AH. (2018) A solution to the misrepresentations of CO2-equivalent emissions of short-lived climate pollutants under ambitious mitigation. Climate and Atmospheric Science, 1:16 ; doi:10.1038/s41612-018-0026-8 (c) Lauder, A. R. et al. (2013). Offsetting methane emissions—an alternative to emission equivalence metrics. Int. J. Greenh. Gas Control , 12, 419–429 (d) Pierrehumbert, R. T. (2014). Short-lived climate pollution. Ann. Rev. Earth Planet. Sci., 42, 341–379, (e) Shine, K., Fuglestvedt, J., Hailemariam, K. & Stuber, N. (2005). Alternatives to the global warming potential for comparing climate impacts of emissions of greenhouse gases. Clim. Change, 68, 281–302 and (f) Shine, K. P., Berntsen, T. K., Fuglestvedt, J. S., Skeie, R. B. & Stuber, N. (2007) Comparing the climatic effects of emissions of short- and long-lived climate agents. Philos.Trans. R. Soc. A. 365, 1913–1914. The latest research on the ERF/GWP of Methane will require a significant downward re-evaluation of its role in the sensitivity of the CMIP6 models in AR6. These results have particularly important implications for the agricultural sector in ensuring that it can feed the planet's growing population. [Jim O'Brien, Ireland]	We appreciate the reviewer pointing is to the paper "Dependence of Earth's Thermal Radiation on Five Most Abundant Greenhouses Gases". Unfortunately, it cannot be cited since it is not published in the peer-reviewed journal.
6327					It is very disconcerting that this assessment, in its current draft form, indicates that the 1.5°C warming level relative to the pre-industrial level is expected to occur around 2030, about ten years earlier than indicated in SR1.5, which was published just two years ago. This raises questions related to the definition of the pre-industrial level and to the rate of warming projected by the CMIP6 models. Specific comments on these issues are made for particular chapters, but the essence of them is set out in comments 2 to 5, in view of the risk to the IPCC's reputation that is posed by a substantially revised projection that may turn out to be mistaken. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Noted. We are aware of the ramifications of this result (which has also been somewhat updated since the SOD), and have provided thorough explanations of why the crossing times have changed since SR15. See e.g. Cross-Chapter Box2.3, and sections linked from there.

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34743					#5 – Ocean Heating and pH: The SOD claims that recent ocean heating is unprecedented over recent millennia (SPM p12, Ch2 p65, Ch7 p5, Ch9 p21) and implies that current earth system warming (Ch7 p5) is a matter of concern. However it fails to compare this with the likely energy budgets in the previous Minoan, Roman and Medieval Warming Periods. The SOD it admits lack of historic data from the paleoclimate (TS p34) and that modern ocean temperature data below 2000m is very sparse (Ch2 p65, Ch 9 p21). It is to be noted that the Resplandy et al paper on which SLROCC was principally based was found to be statistically flawed and was later retracted: Retraction Note: "Quantification of ocean heat uptake from changes in Atmospheric O2 and CO2 Composition", Nature, 573, 614 (2019), https://www.nature.com/articles/s41586-019-1585-5. It is to be also noted that the ECMWF reanalysis of ocean upper 300m heat content indicated a higher ocean heat content in 1950 compared to now: "CERA 20-C: A coupled reanalysis of the 20th century", Laloyaux P, et al, Journal of Advances in Modelling Earth Systems, 2018, 10, pp 1172-1195. Similarly, Zanna et al found in their reconstruction of historical ocean heat transport and storage that the ocean absorbed as much heat during the (mainly natural) warming period of 1921-1946, as during 1990-2015, see: https://www.pnas.org/content/116/4/1126. Furthermore, Gebbie and Huybers have documented deep cooling in the Pacific from the end of the Medieval Warming Period to the onset of the Little Ica Age, which revises downwards Earth's overall heat budget since 1750 by 35%, see https://science.sciencemag.org/content/363/6422/70.abstract. There is regular ongoing data on ocean temperatures by Humlum in www.climate4you.com, the latest being at http://www.climate4you.com/Text/Climate4you_April_2020.pdf, pages 20 and 21, where he concludes that the temperature of the global oceans down to 1900 m depth has been increasing since 2011 by only about 0.05°C. It is also seen that this increase since 2013 dominantly is due to oceanic changes occurring near the Equator, between 30°N and 30°S. In contrast, for the circum-Arctic oceans north of 55°N, depth-integrated ocean temperatures have been decreasing since 2011. Near the Antarctic, south of 55°S, temperatures have essentially been stable. This is further elaborated in Humlum's "State of the Climate 2019", seen at https://www.thegwpf.org/content/uploads/2020/05/State-of-the-climate-2019.pdf. Overall, ocean temperatures warrant much further IPCC attention. Thinking laterally, has IPCC considered the possibility of localised ocean warming, such as the South Pacific "Blob", also being naturally-driven by the release of geothermal heat through submarine volcanic eruptions, see https://saltbushclub.com/2020/04/28/south-pacific-blob/#more-1413 and https://www.sciencemag.org/news/2019/05/ship-spies-largest-underwater-eruption-ever? These papers seriously question the SOD conclusion ocean heating, and indicate that there is nothing unprecedented about current ocean warming.	Rejected. The use of sub-period labels in the CE in the FGD has been deprecated. Assessments of OHC and pH changes combine paleo and instrumental records and take full account of uncertainties.
6329					Specific impacts of climate change occur or will occur when climate variables such as surface air temperature reach specific absolute values, not values relative to an uncertain pre-industrial level, or an approximation such as the 1850-1900 average, estimates of which may change as scientific progress is made. The impacts of future climate change that the Paris Agreement seeks to limit are not reduced or increased by a reduction or increase in the estimated pre-industrial temperature level. It has been argued, for example by Hawkins et al.(2017) and Simmons et al. (2017), that targets for limiting future climate change should be framed in terms of change relative to a recent well-observed period rather than a much less certain pre-industrial level, although the latter needs also to be known for assessing loss and damage due to past change and the ability of models to reproduce that change. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Noted. This topic is the subject of discussions between WG1 and WG2, and also internally in WG1. See e.g. the discussion in Cross-Chapter Box1.2, and the various discussions of Global Warming Levels in later chapters (11 and 12).
34745					#6 – Sea Level Rise: The SOD claims Global Mean Sea Level (GMSL) has risen faster since 1900 than in any century in the last 3 millennia (SPM p12, TS p40, Ch2 p6 & 68, Ch7 p5, Ch9 p5 & 7). Land-based observations (going back 100 years) confirm that GMSL continues at 1-2mm/y without any acceleration. Satellite figures going back only to 1993 point to a reasonably linear ~3mm/y trend. While there has hitherto been no explanation for the apparent discrepancy, neither dataset points to any multi-annual acceleration in GMSL of any significance, which indirectly confirms the absence of any link to rising GHG levels. These conclusions have been documented in the following papers: (a) Mörner, Wysmuller & Parker, J. Mari. Sci., Res. Ocean, 2019, 2:1, 1-5), (b) N.-A. Mörner, A. Parker, D. Easterbrook & P. Matlack-Klein (2018). Estimating future sea level changes, avoiding misguiding exaggerations, and recommending present coastal management. IRJES, 7 (4), 19-25 and(c) N.-A. Mörner (2018). The illusive flooding of New York City. Journal of Environmental Sciences, 1 (2), 1-11. Sea level data derived from both tide-gauges and altimetry collated by Humlum are given in www.climate4you.com and are updated monthly, the latest being. http://www.climate4you.com/Text/Climate4you_April_2020.pdf, pages 36 and 37. Tide-gauge readings since 1900 average 2.09mm/year, while satellite altimetry since 2003 indicates 3.16mm/year. This is further elaborated in Humlum's "State of the Climate 2019", see https://www.thegwpf.org/content/uploads/2020/05/State-of-the-climate-2019.pdf. Both datasets show inter-annual variability, possibly linked to El Niño activity, which may erroneously imply some acceleration, such as described by Nerem et al, in https://doi.org/10.1073/pnas.1717312115. A recent unpublished paper by Thomas Wysmuller on the divergence of tide-gauge and satellite sea-level data concludes that (a) long-term (100-year) tide gauges show generally straight-line linear trends, with local tectonics being the major factor underlying the upward or downward direction of reported shoreline sea level, (b) satellite altimeter readings since 1993 show generally straight-line linear trends, but in an upward direction ~2.5 times greater than the upward trend observed in tide gauges located in tectonically inert zones, (c) as there is only one ocean, differences must arise out of instrumentation or software used to analyze it, and that (d) satellite altimeter instrumentation may have resolution problems, but software issues eclipse them, which are now being pinpointed. The SOD notes (Ch 9 p104) recent US East Coast flooding (and apparent sea level rise). This is predominantly due to sinking land mass, not climate change, see: https://tidesandcurrents.noaa.gov/sltrends/sltrends.html. A recent paper by Curry found that the recent gradual rise in sea level was within the range of natural variability seen over recent millennia: "Sea Level and Climate Change", Special Report by Judith Curry, Climate Forecast Applications Network, November 2018.	Rejected. There is extensive evidence in the literature for an acceleration both in the tide-gauge record beginning in the late 1960s (e.g., Dangendorf et al., 2019) and in the satellite record (e.g.,. WCRP Global Sea Level Budget Group, 2018). GMSL acceleration is assessed in 2.3.3.3. In addition, it is further supported by the sea-level budget presented 9.6.1, which not only shows an increased in observed GMSL contributions when comparing the periods 1901-1990, 1971-2018, 1993-2018 and 2006-2018, but also a consistent increase in the sum of the budgeted components over the same period.

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6331					SR1.5 addressed this issue in part. In section 2.1 it states "In summary, this report adopts a working definition of '1.5°C relative to pre-industrial levels' that corresponds to global average combined land surface air and sea surface temperatures either 1.5°C warmer than the average of the 51-year period 1850–1900, 0.87°C warmer than the 20-year period 1986–2005, or 0.63°C warmer than the decade 2006–2015." These three definitions were equivalent for the datasets used in SR1.5, but are no longer equivalent using the latest versions of datasets, HadCRUT5 in particular. The SOD uses the first of the three definitions in arriving, in Chapter 4, at the revised, earlier estimate of the date of reaching the 1.5°C limit. One of the latter two definitions would, however, be more appropriate from the viewpoint of setting a more stable target for limiting future climate change. This would amount, in effect, to interpreting the Paris Agreement in terms of the pre-industrial level approximated by the 1850-1900 temperature as it was estimated at the time of the Paris Agreement. This would result in a later date of reaching the 1.5°C limit, closer to but still earlier than indicated in SR1.5. Note also that Chapter 2, page 40, refers to the Structured Expert Dialogue that informed the Paris Agreement and states that the Agreement was predicated upon an estimate of 0.85°C for the warming from 1880 to 2012. This value is close to SR1.5's figure of 0.87°C for the warming from 1850-1900 to 2006-2015, and much further away from the latest estimates of the 1880-2012 warming of 0.95°C for GMST and 0.99°C for GSAT given in Chapter 2. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. The expanded and redrafted Cross-Chapter Box2.3 through taking a more holistic view helps to clarify the issues around these metrics explicitly and should be much clearer to the reader.
86203					While the use of the term "Climate Impact Drivers" in WGI is explained in the SOD - if this terminolgy is not aligned and supportive of the WGII approach to impact assessment then policy makers are going to be confused. So need to ensure that this is discussed between the two WGs to find an approach that works for both and also enables understanding in the policy community. [Debra Roberts and the Durban WGII TSU, South Africa]	TAKEN INTO ACCOUNT: We have continued to define and expand the use of the Climatic Impact-Driver framework across chapters of WGI and across all WGs of AR6. CIDs are now defined in the glossary and included in the Risk Guidance Document prepared for AR6 (IPCC, 2020). CIDs are used precisely to distinguish the generation of relevant climate information in WGI from its interpretation as beneficial or detrimental, which is context-specific and therefore determined in WGII.
99259					when writing the team should consider that many people will be hopping between sections. As such, abbreviation should be kept to a minimum and repeated at the beginning of major sections to increase readability [Daniela Schmidt, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. The guideline given to the chapters is to keep the amount of acronyms to a minimum. Please also note that the published report includes an annex with acronyms
34747					#7 – State of the Cryosphere – The Arctic The SOD claims an unprecedented loss in Arctic sea ice over the last 1000 years (SPM p13, TS p37, Ch1 p10, Ch2 p56, Ch9 p5). Observations show that, while Arctic sea ice has been declining since satellite records began in 1979, the September minimum sea ice extent has been broadly stable since 2007, see http://ocean.dmi.dk/arctic/icecover_30y.uk.php. The March maximum sea ice extent has also been broadly stable since 2005. Recent studies (eg Connolly, Connolly and Soon, Hydrol Science Journal, Vol 62, pp1317-1340) and https://globalwarmingsolved.com/2013/11/is-the-arctic-melting/ have interpolated a similar warmer Arctic temperature anomaly in the 1930-1940s (likely related to the AMO, also a period of strong El Niños), followed by cooler anomalies from 1945 to 1978, during which two episodes Arctic sea ice is inferred to have grown and shrunk respectively. Elevated Arctic temperatures in the 1930-40s is also evidenced in Humlum's http://climate4you.com/ and in particular in: http://www.climate4you.com/Text/Climate4you_April_2020.pdf, page 30. This is also elaborated further is his "State of the Climate 2019" at https://www.thegwpf.org/content/uploads/2020/05/State-of-the-climate-2019.pdf. Other historical reconstructions by Tamo, Fortin and Gajewski found that Arctic temperatures were 1-2°C warmer during most of the first millennium and in particular during the Medieval Warming Period, see: https://www.tandfonline.com/doi/pdf/10.1080/15230430.2019.1640527. Similar results showing that the Arctic was up to 6°C warmer 9,000 years ago were reported by Mangerud and Svendsen, see: https://journals.sagepub.com/doi/full/10.1177/0959683617715701, a result also replicated by Willem van der Bilt et al, see: https://ui.adsabs.harvard.edu/abs/2019GeoRL..4614732V/abstract. The SOD claim that current Arctic ice loss is unprecedented over the last 1000 years does not stand up. There is significant evidence to the contrary. It may not be unprecedented even in the last 100 years. Incidentally, polar bears are thriving, See https://www.thegwpf.com/?s=crockford and https://www.thegwpf.org/content/uploads/2015/06/Arctic-Fallacy2.pdf. [Jim O'Brien, Ireland]	Noted. Sea ice trends over periods as short as 2007-2020 are not discussed in this report, as they are very sensitive to conditions at the starting and end point. Direct reconstructions of pan-Arctic sea-ice coverage and reanalysis driven by available temperature data do not support the claim that sea-ice area in the 1930 to 1940s was even remotely as small as it is today. We do not discuss temperature reconstructions of the first millennium and 9000 years ago. The remaining uncertainties give rise to us only assigning "medium confidence" to the assessment of these long-term variations, in line with this comment.
6333					The rate of warming projected by the CMIP6 models is (for the multi-model average) 0.7°C over the 26 years from 1995-2014 to 2021-2040, or 0.27°C/decade, which is quite considerably larger than both the warming deduced from observations over the past four decades and the warming projected by the CMIP5 models. AR6 needs to demonstrate more convincingly that the CMIP6 models reproduce faithfully the observationally-based estimates of warming rates over the past forty years, and if so, explain convincingly why the models predict on average a warming rate for the next ten years that is some 50% larger than that over the past forty years as estimated using all observationally-based datasets other than HadCRUT5. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. A thorough assessment of the performance of the CMIP5 and CMIP6 models in simulating observed global surface temperature trends over the 1998-2012 period is contained in Cross-Chapter Box 3.1. An assessment of simulated and observed global surface temperature changes over the full historical period is contained in 3.3.1.1, now including a quantitative comparison of simulated and observed changes between 1850-1900 and 2010-2019. The multi-model mean warming agrees closely with the observations in this metric.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
34749					#8 – State of the Cryosphere – Greenland The SOD claims that the Greenland ice sheet state is unprecedented over centuries (SPM p13, TS p39, Ch1 p10, Ch2 p61, Ch9 pp6 & 49). The SOD quotes an ice melt of 3800Gt without pointing out this to be insignificant (<1%) within the total ice mass, and is therefore within natural variability. Observed fluctuations in Greenland's temperatures since 1851, based on re-analysis by KNMI, show current temperatures to be similar to those as far back as the 1880s. Not unsurprisingly, Greenland shows a similar historical temperature trend as the Arctic, with a previous warmer period in the warm 1930-1940s, the previous time the AMO was in warm phase, as it presently is, see https://www.the-cryosphere.net/12/39/2018/tc-12-39-2018-supplement.pdf. Recent analysis by Axford et al reveal that the Greenland ice sheet was smaller than today for most of the last 10,000 years, reaching its peak about 1850, see: https://www.sciencedirect.com/science/article/abs/pii/S0277379119302021. Another analysis by Schweinsberg et al found that the most pronounced glacier expansion in West Greenland occurred within the last 2,000 years, see: http://www.glyfac.buffalo.edu/Faculty/briner/buf/pubs/Schweinsberg_et_al_2019.pdf, also that a reconstruction of ice sheet temperatures shows that current temperatures are not unusual in the last 10,000 years, and were probably 2.9°C higher in the Early Holocene about 8,000 years ago. More anecdotally, it is worth recalling that Greenland is so called because the Vikings inhabited a then-green Greenland from 985 to 1385, until they had to abandon it at the onset of the Little Ice Age. Recently, abandoned WWII planes were found intact under 100m of snow and ice. According to NASA observations, the Jakobshavn Glacier in Western Greenland, after being in retreat for decades, is advancing since 2016/17. Overall, contrary to the SOD claim, there is nothing unprecedented in the ice sheet status of Greenland, not alone in recent centuries, but over the last 10,000 years. [Jim O'Brien, Ireland]	Rejected, the historical context of Greenland state is discussed in sections 2.3.2.4 and 9.6.2 and the more recent ice sheet changes in 9.4.1. Given the large volume of ice of the Greenland ice sheet, even small changes compared to the total volume of the ice sheet can lead to significant sea level changes. The mass loss of Greenland ice sheet of 4040 [3470 to 4610] Gt over the period 1992-2018 is about 15% of sea level rise in that period and in the period 1901-2018 the mass loss of Greenland ice sheet contributed about 24% of the observed sea level. (see table 9.5). Furthermore, the reviewer seems to confuse fluctuation in atmospheric temperature with fluctuations in ice sheet volume. Those are different processes with different drivers and time scales. Moreover, it is completely normal and expected to find WWII planes under deep snow, it just means they crashed in the accumulation area of the ice sheet, where the surface mass balance is (by definition) positive and therefore snow is accumulating year after year. The planes would be buried regardless of the mass balance status of the ice . Last, the assessment looks at the ice-sheet wide picture and on long timescale. As a result, it is not contradictory to local or temporary readvances of some glaciers.
6335					SR1.5 used several observationally-based estimates of warming from 1850 to the present day. Some important figures, especially in Chapter 4, use only the HadCRUT5 dataset. This could be rationalised as HadCRUT5 is the latest such dataset, but it can also be pointed out that HadCRUT5 is a dataset that is so new it is has not, at the time of writing this comment, been released to users in general, and thus not been subjected to broad scrutiny. It can also be pointed out that according to Table 2.4, HadCRUT5 gives a much larger trend from 1980 to 2018 than any of the other datasets included in the table, and a much larger trend than the ERA5 and JRA-55 reanalyses, for which figures are not provided in Table 2.4. Central estimates are 0.97°C for HadCRUT5 and between 0.61 and 0.74°C for the other datasets in Table 2.4. ERA5 and JRA-55 give 0.72°C and 0.70°C degrees respectively for GSAT, and 0.71°C and 0.67°C respectively for GMST. The use of HadCRUT5 alone in the key figures in Chapter 4 is hard to justify given these figures.l22 [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. HADCRUT5 is only used in one Figure in Chapter 4 (Figure 4.2) and is a dataset included in the WGI assessment. The assessment of observational datasets are found in chapter 2 and in Annex 1 on observational products.
86207					If multiple baselines need to be used for scientific purposes/consistency then need to think strategically about what is carried forward to SPM to avoid confusing policy makers. [Debra Roberts and the Durban WGII TSU, South Africa]	Taken into account. The SPM uses only one baseline, and a few reference periods, as guided by comments on the SOD and FGD.
34751					#9 – State of the Cryosphere – The Antarctic The SOD claims that the Antarctic has lost ice mass since the early 1990s, but further down the page correctly admits that there is no significant trend (SPM p13, Ch1 p10, Ch2 pp58 & 63, Ch9 pp6 & 45). Similar conclusions come from Humlum's "State of the Climate 2019", see https://www.thegwpf.org/content/uploads/2020/05/State-of-the-climate-2019.pdf. A 2000-year reconstruction of Antarctic temperatures shows a warm period from 300-1000AD, and a cool period from 1200-1900AD; recent slightly warmer Antarctic temperatures are not unprecedented and may be related to activity of the 91 geothermal hotspots recently discovered under the West Antarctic ice, see www.clim-past.net/13/1609/2017/cp-13-1609-2017.pdf]. Recent research by Lüning, Galka and Vahrenholt also confirms a cooling trend in the Antarctic since 600, warmer than now in the Medieval Warming Period, the recent slight warming being insignificant in the millennial context, see:https://ui.adsabs.harvard.edu/abs/2019PPP...532j9251L/abstract Overall, there is no significant trend in the Antarctic ice mass, not alone since 1990 (as the SOD claims), but over the last 2,000 years. [Jim O'Brien, Ireland]	Rejected. The chapters and the SPM do not state that the Antarctic ice sheet has not lost mass. Maybe the reviewer confuses Antarctic sea ice and the (essentially grounded) ice sheet? In any case, multiple independent observations using different satellite measurement technologies, and in situ measurements, unambiguously show that the Antarctic ice sheet has lost mass since the early 1990s. This is consistently reported across the chapters in the SOD and also in the revised versions. Furthermore, given that most of the ice losses are driven by discharge of ice into the ocean, atmospheric processes (warming) are not really the most relevant parameter to focus on when discussing Antarctic ice losses.
6337					Trends are commonly quoted as a rate, such as deg C/decade for temperature and mm/yr for sea level. This helps compare estimates made over periods of differing lengths. However for temperature, tables in Chapters 2 and 4 show net changes in temperature rather than rates of change of temperature. This makes comparison more difficult, as the changes shown are for periods of different length. It would be helpful in future if the IPCC authors and CMIP designers would settle on standard 30-year WMO climatological periods. In the meantime, consideration could be given to reporting rates of temperature increase rather than net temperature changes. Note that although the glossary states "In this report, the word trend designates a change, generally monotonic in time, in the value of a variable", which is what is done for the temperature tables in Chapters 2 and 4, a search of a few other chapters for the word "trend" reveals that trends are in numerous places quantified by quoting a rate of change, not a net change. Either the definition in the glossary needs to be broadened, or there needs to be a change everywhere that a trend is quoted as a rate. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Chapter 4 mainly assesses climate changes in near-, mid-, and long-term period relative to recent past or preindustrial period. Thus, net changes are more adequate to be used than trends in the strict sense; the target audience presumably prefers not having to perform the scaling operation mentally. (By a similar reasoning, climate sensitivity is usually given as a temperature difference instead of the more generally applicable temperature difference per ERF unit). There are trade-offs in the choice of length of a reference period; 20-year have for several IPCC reports served as a good compromise, both muting internal variability and avoiding too large changes within the reference period. Definition of trend in glossary has been examined for greater consistency with standard use of the term.
98497					Has a colorblind person looked closely at the figures? In figures where color is used to convey information, the chosen colors do not have enough difference in saturation for colorblind individuals to see the distinctions. Sometimes stippling or cross-hatching solves the problem. [Emily Romano, United States of America]	Taken into account. The IPCC visual guidelines given to the chapters include using accessible and unbiased colour palettes for all audiences.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
34753					#10 – State of the Cryosphere – Glaciers The SOD claims unprecedented melt in Glaciers (Ch9 p6). Glaciers need to be seen in their historical context. A retreating glacier at the Lendbreen Pass in central Norway's recently yielded artefacts from the Roman and Medieval Warming Periods. A retreating glacier in Breioamerkursandur in southeast Iceland has revealed stumps of 3,000 year-old trees. Similar finds have been made in Alaska, Patagonia and Switzerland. It appears therefore that glaciers started to grow some time before the onset of the Little Ice Age, reaching a maximum about 1850. Despite 170 years of retreat, many glaciers still exist as an historical anomaly. As mentioned above, glaciers in Greenland are growing. The SOD claims unprecedented melt in glaciers. The facts show that there is nothing unprecedented about glacier melt, it is a natural cycle. [Jim O'Brien, Ireland]	Rejected, the historical context of glacier waxing and waning is discussed in sections 2.3.2.3 and 9.5.1. Chapter 2 sates with medium confidence that current global character of glacier mass loss is highly unusual in the context of at least the last 2000 years and Chapter 9 states with medium confidence that for all regions with long-term observations, glacier mass in the decade 2010 to 2019 is the smallest since at least the beginning of the 20th century. It is further shown with both in-situ and satellite observations that the glacier mass loss rate in the last decade (2010-2019) is the highest since observations started. Glaciers have contributed about 40% of the observed sea level rise in the period 1901-2018 which underlines the importance of glacier restreet in the 20th and 21st century. Furthermore, global trends do not prevent individual glaciers from experiencing opposite trends locally. Additionally, the fact that glaciers are revealing artefacts cannot necessarily be used as proof that they were more retreated in the past. Glaciers are dynamic features where an artefact deposited in the accumulation zone will be buried by snow and transported to the ablation zone where it will be subsequently uncovered.
6339					The words observation, observed and observational need to be used with much more care. "Observed GMST" crops up more than once, and is simply wrong. GMST is not an observable. It is a quantity that is inferred from a set of observations. "Observations (HadCRUT5)" also appears. It too is wrong. HadCRUT5 is not a dataset of observations. It is a dataset of temperature anomalies derived (over land and sea ice) from monthly averages of observations, mostly of maximum and minimum temperatures, and includes interpolated or extrapolated values for grid squares which contain no analysed observations. "Observational" or "observationally-based estimates" are the words that should be used in many cases, as is done in places already. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Efforts have been made to correct this throughout the text.
98499					Since the report doesn't come out for a year, when a reference says "submitted" or "in press" I assume someone will go back through a year from now just before this report goes public and replaces those papers with the actual reference, assuming by that time the paper has been accepted and published? [Emily Romano, United States of America]	Noted. Submitted journal articles that are not accepted by the literature acceptance deadline (31 January 2021) will be removed from the report, while the details of those that are accepted by the literature deadline will be updated for the Final Government Distribution. References for in press articles (i.e., accepted but not yet published) will be updated if the corresponding articles are published before the report is.
34755					#11 – State of the Cryosphere – NH Snow Cover The SOD claims a reduction in NH snow cover since 1978 due to an anthropogenic influence since the 1950s (SPM p13, Ch2 p59). Records show that, while NH Spring-time snow extent has been decreasing, NH Fall and Winter snow cover extent has actually been steadily increasing since 1967, see https://notalotofpeopleknowthat.wordpress.com/2016/05/09/can-we-trust-snow-extent-data/. This trend is also found in Humlum's "State of the Climate 2019" at https://www.thegwpf.org/content/uploads/2020/05/State-of-the-climate-2019.pdf. Furthermore, the 2019/2020 NH winter is one of the snowiest on record, according to the Finnish Meteorological Institute, see globalcryospherewatch.org. Contrary to the SOD claim, year-round data on NH Snow Cover does not indicate an anthropogenic effect. [Jim O'Brien, Ireland]	Rejected. Based on multiple lines of evidence, chapter 9 concludes that the NOAA snow cover record, which suggests increasing NH snow cover in the autumn since 1967, is not confirmed by all other available datasets, and it is physically inconsistent with the observed temperature trends. It is therefore not correct to state that autumn and winter NH snow cover trends are positive.
100547					In developing paleoclimate reference states, the Miocene Climatic Optimum should be included. I've talked a lot with Darrell Kaufman about this, and he agrees (as do other chapter leaders) that this is desirable. So, the following comments focus on how to accommodate that across the entire report (insofar as possible) [Matthew Kohn, United States of America]	Accepted. We now include reference to the MCO for those indicators for which an assessment can be made (CO2 and temperatures) and it informs the assessment of ECS in chapter 7.
6341					Related to comment 7 above, the references to reanalysis data are not always consistent. Reanalyses are observationally-based datasets - if they were not derived by assimilating observations they would be model simulations. This is recognized in places, such as by including reanalysis datasets in Annex 1, but not everywhere. The physically-based model used in producing a reanalysis can of course be a source of weakness as well as strength, but the same can be said of the mathematical models used to spread information into observation-void regions in datasets such as GISTEMP or HadCRUT5. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Chapter 1 has an improved discussion of reanalyses and efforts have been made to improve consistency across the remaining text.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
34757					#12 – So-called “Extreme Weather Events”: The SOD predicts more future Weather Extremes (SPM p14, Ch11 p6). However, rigorous objective analysis of historical incidences over recent decades and centuries of rainfall, floods, droughts, hurricanes, tornados, heat-waves, forest fires and coral bleaching reveal surprisingly little evidence of any upward trends, even a decline is some cases. It is remarkable that HH Lamb (“Climate, History and the Modern World”, 1982 and 1995, pp268-269) documented extreme weather events in the global cooling period of the 1960s and 1970s. An analysis Kelly “Trends in Extreme Weather Events since 1900 – An enduring Conundrum for Wise Policy Advice”, Kelly MJ, Journal of Geography and Natural Disasters, Vol 6, Issue 1, http://dx.doi.org/10.4172/2167-0587.1000155) found strong evidence that the first half of the 20th century had more extreme weather than the second half, despite the claim that anthropogenic global warming leads to more weather extremes. The SOD claims large-scale precipitation changes since 1950 (SPM p10, Ch8 p5). One of the longest-range studies available on rainfall is a paper by Murphy et al (“A 305-year continuous monthly rainfall series for the island of Ireland (1711-2016)”, by Conor Murphy et al, Clim. Past, https://doi.org/10.5194/cp-14-413-2018), found inter-decadal and centennial natural variability of precipitation in Ireland was much larger than previously thought. Another paper by Noone et al (“A 250-year Drought Catalogue for the Island of Ireland (1765-2015)”I, International Journal of Climatology, 37, (Supplement 1), pp 239-254, 2017, DOI: 10.1002/joc.4999) describes Ireland as drought-prone, and that recent decades were unrepresentative of the longer-term drought climatology. The Wijngaarden and Syed “Changes in Annual Precipitation over the earth’s Land mass excluding Antarctica from the 18th century to 2013” (2015), seen at https://www.researchgate.net/publication/284131660_Changes_in_Annual_Precipitation_over_the_Earth's_Land_Mass_excluding_Antarctica_from_the_18th_century_to_2013, based on precipitation measurements made at nearly 1000 stations with at least 100 years of observations located in 114 countries, concluded that most trends exhibited no clear precipitation change and that the global changes in precipitation over the Earth's land mass excluding Antarctica relative to 1961-90 were estimated to be: -1.2. ±. 1.7, 2.6. ±. 2.5 and -5.4. ±. 8.1% per century for the periods 1850-2000, 1900-2000 and 1950-2000, respectively. A study by Heim (“A Comparison of the Early 21st Century Drought in the US to the 1930s and 1950s Drought Episodes”, by RR Heim Jr, pp 2579-2592, DOI:10.1175/BAMS-D-16-0080.1, Dec 2017), confirms that 21st century droughts in the US were less severe than those of the 1930s and similar to those of the 1950s. For Australia, the rain-fall anomaly of 1900-2017 for New South Wales indicates a high prevalence of droughts, http://www.bom.gov.au/climate/change/index.shtml#tabs=Tracker&tracker=timeseries&tQ=graph%3Drranom%26area%3Dnsw%26season%3D0706%26ave_yr%3D0.	Rejected. Chapter 11 assessment includes more than 1900 papers.
100549					Note: I've listed additions of text under the "substance" category because these are dominated by adding significant material relevant to the MCO. I've listed most notes, etc., that do not affect changes in text as "editorial" unless they bring in new concepts or recommendations of content. [Matthew Kohn, United States of America]	See response to 100547
116677					I have found inconsistent references to insights from short time scales (weather forecast, response to eruptions) on feedbacks (in ch 3, 6, 7). Please check. [Valerie Masson-Delmotte, France]	Taken into account. Chapter 3 FGD does not cover insights from weather forecasts for feedbacks, and while the response to volcanic eruptions in CMIP6 models is assessed, insights for feedbacks aren't assessed. So no overlaps on the topic of insights for feedbacks are apparent between Chapter 3 and subsequent chapters in the final draft.
64709					A general suggestion for the current or next report. I hope there is a chapter on climate justice [Eman Abdelazem, Egypt]	Not applicable -- beyond the mandate of IPCC working group 1
6343					Projections are mostly referred to simply as "projections" but in places, including some section headings, they are referred to as "future projections". The latter terminology should be weeded out. The glossary makes it clear that a projection is a potential future evolution of the quantity or quantities under consideration. "Future projections" is ambiguous wording, as it could be used to refer to projections that will be made in the future, say as part of CMIP7, just as "past projections" would be used to refer to projections published in earlier IPCC assessment reports. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Accepted
83911					Overall, the Figures in the Report are not acessible to color blind people. Although its tough to use symbols in all the Figures, but it might be a good idea to test figures in black and white/grey scale to check acessibility of the Figures. At the IPCC webpage, it would be great the use of an interactive tool that may show the color/variable in each curve. [Marco Tulio Cabral, Brazil]	Taken into account. The IPCC visual guidelines given to the chapters include using accessible and unbiased colour palettes for all audiences. Noted regarding the final point of this comment.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
34759					#13 – Insufficient Consideration of Alternative Climate Drivers: The SOD does not objectively consider other explanations for climate change. Specifically, the SOD (TS p8) continues to underplay and underestimate Internal Variability and fails to investigate natural causes of climate change, beyond a very cursory mention of galactic cosmic rays in Chapter 7 (Ch2 p12, Ch7 p47). The key (but rather weak and unsubstantiated) SOD finding is buried deep in Chapter 3 (Ch 3 p19) to the effect that it is "extremely likely that human influence is the main driver of the increase in global mean surface air temperature causing more than half of global warming in 2010-2019 relative to 1850-1900". Yet throughout the SOD there is little attempt to understand or determine any natural causes which must logically have caused the other half (or more) of the warming in that time. It is also an extraordinary statement in that, de facto, the warming up to 1950 must have been predominantly natural, or is IPCC slipping into the self-illusion that all warming since 1850 is human-caused (as it did in SR1.5)? The fact that UNFCCC mandate is to address "dangerous anthropogenic interference with the climate system" (Ch2 p12) has regrettably biased its climate research away from any natural causes, and prevents any objective circumspect analysis. It is very regrettable that the SOD does not have a Chapter dedicated to the analysis of natural events such as ENSO, El Niño, La Niña, AMO, PDO, etc, and even how these might be related to solar geomagnetic storms, earthquakes, tsunamis, volcanic eruptions, shifting magnetic north pole, etc. The SOD notes solar dimming from the 1950s to the 1980s (Ch6 p43), but fails to connect it with the global cooling that took place over that period. The fact that solar radiation has since brightened points to it having a greater natural impact on climate than is accounted for in the SOD, another example of natural variability being ignored. The SOD makes no mention of the pioneering work of Scafetta on "Solar and Planetary Oscillation Control on climate change; hindcast, forecast and a comparison with the CMIP5 GCM's" (2013) at https://arxiv.org/pdf/1307.3706.pdf, and his work on "Solar Oscillations and the Orbital Invariant Inequalities of the Solar System" (2020), https://link.springer.com/article/10.1007%2Fs11207-020-01599-y. In these his empirical model based on observed rhythms of planetary oscillations outperforms the GCMs by better hind-casting the observed 1850-2012 climatic patterns. He concludes that (1) about 50-60% of the warming observed since 1850 and since 1970 was induced by natural oscillations likely resulting from harmonic astronomical forcings that are not yet included in the GCMs; (2) a 2000-2040 approximately steady projected temperature is predicted; (3) a 2000-2100 projected warming ranging between 0.3°C and 1.6°C, which is significantly lower than the IPCC (AR5) GCM ensemble mean projected warming of 1.1°C to 4,1°C, (4) an equilibrium climate sensitivity to CO2 doubling centered on 1.35°C, and varying between 0.9°C and 2.0°C. The SOD summarily dismisses the pioneering work of Svensmark and Shaviv (Ch7), without understanding the solar/cosmic ray amplification processes and their demonstrable influence on climate over millennia and centuries. His work is summarized in "Force Majeure, the Sun's Role in Climate Change" (2019), see https://www.thegwpf.org/content/uploads/2019/03/SvensmarkSolar2019-1.pdf. The demonstrated greater solar	Rejected. A thorough assessment of non-anthropogenic drivers of climate has been conducted throughout the WGI report across multiple chapters. The results of which are stated in the final SPM, approved by 195 governments states, specifically in A.1.3 that "The likely range of total human-caused global surface temperature increase from 1850–1900 to 2010–201911 is 0.8°C to 1.3°C, with a best estimate of 1.07°C. It is likely that well-mixed GHGs contributed a warming of 1.0°C to 2.0°C, other human drivers (principally aerosols) contributed a cooling of 0.0°C to 0.8°C, natural drivers changed global surface temperature by –0.1°C to 0.1°C, and internal variability changed it by –0.2°C to 0.2°C.".
116679					Please check all references to "impacts" (a special meaning in the IPCC context, see glossary), and replace by "effects" or "consequences" if relevant. [Valerie Masson-Delmotte, France]	The word impact is not used in the SPM except in "Climatic Impact Drivers"
34761					#14 – Confusing Advice on Mitigation and Adaptation: The SOD (SPM p42) admits that even severe mitigation will not cause any detectable reduction in GSAT in the next 25-30 years. This conclusion seems to (a) contradict SOD model projections and (b) call in question any mitigation action, therefore implying adaptation as a more logical strategy. The SOD notes that even with severe CO2 mitigation, global temperature levels will continue to rise for decades or even centuries (Ch1 p40). This admission indicates that climate strategy should be primarily based on adaptation, not mitigation (Ch4 p75). The SOD similarly notes that it will be impossible to quantify any effects of mitigation (Ch4 p77), which again points to adaptation being the key climate strategy going forward. On the other hand, the SOD indicates that CO2 emissions must go to net zero (Ch 1 p4, Ch5 p8, Ch7 p20) to halt global warming. Any serious consideration of net zero will show that it is technically unachievable, economically unaffordable and socially undesirable. The SOD statement of course inherently assumes the CMIP6 models are correct, which they are not, even by IPCC's own admission. These statements raise huge question marks over IPCC's guidance on future direction of climate policy. On the one hand, it is recommending severe mitigation and virtually impossible compliance with the Paris Agreement; on the other hand, it is saying that mitigation is virtually useless, recommending adaptation instead. Incidentally, will IPCC be advising that the Paris Agreement milestones of 1.5°C and 2°C be revised upwards in the light of the SOD adoption of the GSAT with its inflated temperature database? All of the above comments raise questions of IPCC's ability to recommend a practicable global climate action strategy. [Jim O'Brien, Ireland]	Taken into account. A "delay" in seeing the benefits of mitigation should not be incorrectly interpreted as "never" or "impossible" to see. The key message is that scenarios do not differ from each other significantly in the short term. This is because the forcing-related signals are smaller relative to internal variability in the short term. In the longer term (mid to end of century), the differences in scenarios are very clear as the signals become much larger than internal variability. The key role played by internal variability in the short-term was also reported in earlier assessments. This problem is very similar to the statistical problem of detection of historical climate change where the analysis of signal to noise ratio plays a crucial role. The important development in AR6 is that the time for detection of the scenario differences could be now quantified because of the availability of large ensemble simulations. The masking of signal by internal variability is a pervasive problem in climate science. Another good example for the challenge posed by internal variability would be the estimation of the year when 1.5 or 2 deg C threshold in global mean warming would be crossed. Thus, the fundamental role played internal variability has been known for long but the quantification of its role in masking the mitigation benefits is new in AR6. This quantification does not negate the importance of mitigation. Instead, it points to the need for early mitigation: the appropriate key message would be "It will take a few decades before emissions reductions are reflected in GSAT trends; therefore strong mitigation must start now for unambiguous earlier attainment of PA goals ".Text is revised in FGD. 2) It should be noted that IPCC assessments are policy relevant and they are not policy prescriptive. 3) The revised
112073					There is a need for consistency checking for those figures and results from different chapters which can be reproduced with the Interactive Atlas. A number of comments have been provided for different chapters to ensure this coordination. [jose manuel gutierrez, Spain]	A consistency check has been made by the Atlas team to ensure the main results displayed in figures in other chapters are reproduced in the Interactive Atlas.
116681					Coordination across chapters is needed on aspects related to "global dimming" and "brightening" and implications (including on trends). There is a need for consistency across chapters, and avoiding duplication. [Valerie Masson-Delmotte, France]	Taken into account. This is now better coordinated

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34763					#15 – Need to openly acknowledge Scientific Uncertainty: There are honest appraisals of the SOD scientific uncertainties detailed in some chapters (Ch 1 pp102-3, Ch2 pp91-93, Ch3 pp82-83, Ch4 pp5 & 99, Ch 8 pp 108-109 and Ch 9 pp 108-110). The same acknowledgement of scientific uncertainty should be included in all other chapters and summarized prominently in the TS and SPM. [Jim O'Brien, Ireland]	Chapter 1's Box 1.1, Figure 1.1 describes the IPCC uncertainty language that is used throughout the report including in the SPM, TS and other chapters. It is also referred to in footnotes in the SPM and TS. This uncertainty language has also been detailed in the scientific literature (e.g., Mach et al 2017).
112075					It would be good to harmonize the different chapter figures providing visual abstracts of contents. Different formats (schematic vs visual) are used now. [jose manuel gutierrez, Spain]	Accepted. The final visual roadmaps are now consistent as they have been redrafted in collaboration with a graphics designer.
116683					References to the Paris Agreement need to be harmonized. There are occurrences where text refers to "temperature targets", "the temperature goal", "the thresholds", "aspirations", "the most agressive targets". [Valerie Masson-Delmotte, France]	Taken into account. We have attempted to harmonize the presentation of these key terms.
34765					#16 – Beneficial Effect of Increased CO2 Levels: On the positive side, it is good that the SOD appreciates (Ch2 p77, Ch3 p6) that increasing CO2 level is beneficial to the greening through photosynthesis, and therefore is beneficial to feeding the global population as it heads towards 9-10 billion. This has been verified by several researchers, the first being Myneni, who established from satellite observations that there had been a very significant greening of the planet between 1982 and 2015; "The Greening Earth", Prof Ranga B Myneni, Dept of Earth & Environment, Boston University, 2013. Further studies have shown that the increased CO2 level also reduces water requirements of agriculture; multiple references are available on: www.co2science.org. Extensive further details of the beneficial effects are available on the US Climate Coalition's Petition to the EPA for Repeal of its 2009 Endangerment Finding, see http://www.co2science.org/articles/V23/mar/EPAPetitionCO2ScienceMarch2020.pdf. See also the paper on "The scientific case for vacating the EPA's Carbon Dioxide Endangerment Finding" by Michaels et al on https://cei.org/sites/default/files/Endangerment-Paper.pdf. The SOD notes (Ch8 p104) the greening of the Sahara and Sahel regions some 11k-5k years ago, a phenomenon which is now happening again due to increased global greening due to somewhat-elevated global CO2 levels. For balance, the AR6 should recognise in a balanced way the positive effects of slightly increasing global CO2 concentration. [Jim O'Brien, Ireland]	Noted.
116173					In order to reduce duplication across chapters, facilitate integration across chapters, and reduce length of descriptive text in the TS, could it be possible to develop a new cross-chapter Annex, related to regional trends (observations, detection, attribution, role of modes of variability, near term, long term projections, identified or projected emergence, as a function of scenario and /or level of warming)? [Valerie Masson-Delmotte, France]	Rejected. There was not enough time to develop such an integrated annex although the infographic in the TS builds across multiple dimensions expressed in this comment, which are traceable to the separate chapters and annexes on these topics.
67535					Proposed version by Richard Rosen: (I have edited the pre-existing draft text to make it clearer and more precise.) PREAMBLE: This SPM summarizes our current understanding of climate science and its implications for the likely future of climate change, based on multiple lines of evidence, including many independent scientific analyses of observations of the climate system, the paleoclimate archives, the theory and understanding of physical, chemical and biological processes, and simulations using computer-based models of the climate system. This introduction focuses on the evidence base and how that evidence compliments new analyses of changes in the regional climate. It also discusses the core concepts and definitions used throughout AR6 WGI with a focus on risk and plausible events that would have a high impact on the world, but which are very uncertain as to their chance of occurrence. A significant innovation in this AR6 WGI report is the Atlas, which includes an online interactive tool with flexible spatial and temporal analyses of observed and projected climate change information. Two centuries of climate science research have increased our knowledge about how Earth's climate varied naturally prior to human interference in it, and how it has responded to human-caused impacts. These advances are the result of more and higher quality observations of the history of the climate system, improvements in theoretical understanding of the relevant physics and chemistry of the climate system, and the development of more comprehensive computer-based climate models. Due to these multiple lines of evidence and analysis, clear measurable human influence on the climate system since the mid-20th century is now an established fact. (Figure SPM.1, Figure SPM.2) Human-induced climate trends are superimposed on natural climate variability over the course of decades, during which that variability is modified. These trends are more pronounced at regional scales than at the global scale since by definition the global impacts are an average of all regional impacts, and are relatively larger for most water-cycle variables, including precipitation and ice melting, than for temperature. The recent (40 year) increase in the average surface temperature over land, especially in the tropics [poles ??? – the temperature changes more at the poles, no?], and the extent of the decline in Arctic sea ice by the end of the summer are already clearly discernible from natural variations that occurred prior to human interference in the climate system. In terms of the future possible emergence of new human impacts on climate, the relative strength of internal natural variability and human-induced trends will depend on the region, the effect being considered, and the overall level of global warming caused by cumulative greenhouse gas emissions. Factors the affect the climate and that also affect natural and human systems are changing with the amount of global warming. Since AR5, the previous version of this report, there has been considerable progress in understanding the needs of readers of these IPCC reports leading to better facilitation of user engagement and in applying co-design and co-development processes to generate climate change-related information that can be acted upon. [give some examples of these better processes] The construction and communication of climate change-related information for use in risk assessments is strengthened by the use of multiple lines of evidence and analysis, and the consideration of low-likelihood but potentially high-impact climate altering events. (SPM Box.3)	Noted with thanks but the introduction has been significantly revised and shortened so these specific edits have not been incorporated.

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67537					Most of this report is poorly written and confusing, even to experts like myself on climate change. First of all, it is far too long and repetitive. This guarantees that very few people will read it, and, certainly, very few policy makers. So why not make it much more accessible? Each chapter should be greatly reduced in size. Secondly, most of the figures and tables are confusing and hard to read because many of the labels for the vertical and horizontal axes are either not clear, not accurate, not complete, or all three. A technical editor should try to comprehend each table, and fix all problems. Thirdly, a consistent base period, 1850-1900, should be used throughout. When more recent base periods are used, the reader always has to add up at least two numbers to get totals for changes since the 19th century. Fourly, the ranges and uncertainty bands presented for any given issue as a result of modeling are often laughably broad. Usually, it will be clearer to the reader if only the mean values of the models is presented and discussed. Reporting such large uncertainty bands makes the entire report and all the key findings seem very uncertain. Fiftly, many of the more technical sectors are not comprehensible to anyone who has not run models like those reported on, even other scientists. Either boil the technical discussions down to simple English, or eliminate them. No one but the authors will miss most technical sections. Finally, change the structural rules, and put all references as numbered footnotes. A sentence, even if well written, is very hard to read with two or more references stuck in the middle of it in parentheses. In general, then, the report is far too repetitive, and far to poorly written for policy makers to be able to find the few key findings that they will want to focus on. The authors seem to forget that they are not writing the report for themselves, as a long academic paper. It is supposed to be accessible to the public to motivate them to act immediately to mitigate climate change. The basic science of climate change is basically quite simple at the global level, but one would never know that from reading this draft report. [Richard Rosen, United States of America]	Noted. Some of what is requested here is indeed presented in the Technical Summary, other points have been addressed in preparation of the final reports. The length of the report is a consequence of the large source material and overall volume of climate science literature. Uncertainty bands are, generally, presented in a transparent way based on common definitions.
116689					Coordination across chapters is needed on aspects related to global and regional monsoons; ITCZ; Hadley and Walker circulations. There are duplications and I am not sure that conclusions are always consistent. [Valerie Masson-Delmotte, France]	Thank you, and agreed. It is hard to avoid duplication, given the structure of the WG1 Report, so the primary goal has to be consistency. There has been extensive cross-chapter discussion in the process of developing the FGD to help ensure consistency in conclusions and Executive Summary statements. Consistency between chapters is much enhanced in the FGD, compared to the SOD.
17619					The deep uncertainties associated with climate science are not sufficiently communicated. The balance of the literature summary points always towards AGW, neglecting too often internal and external natural variability as a possible key driver. Example Hegerl (Clim Change 2018) "the ongoing discussion on the cause of that so-called hiatus reveals that decadal variability in the large scale climate is still poorly understood." Natural variability also has centennial and millennium cycles, which are not considered key drivers in the model ensemble projections. Example Knutti (Nature Geoscience 2017) : "...natural variability superimposes on the forced trend and causes uncertainty even for multidecadal trends". There are many more examples to show that the report does not give a fair balanced summary of the deep uncertainties explicitly mentioned in the relevant literature and the report neglects natural variability as possible key driver. Clearly groupthink and tunnel vision is very active at work when preparing the report. [ferdinand meeus, Belgium]	Noted. Deep uncertainty has been addressed in more detail. Natural variability has also been assessed (e.g., 9.2.3.1; 9.3)
115667					I suggest to consider land use (pressure on land) as an additional cross cutting theme. It builds on SRCCL and is also relevant for cross-WG integration (having in mind issues related to food security and preservation of ecosystems and biodiversity). [Valerie Masson-Delmotte, France]	Taken into account: within the boundaries of WGI and the literature, aspects of land use appear in several WGI chapters, notably chapters 5 & 8.
116691					Coordination across chapters is needed on aspects related to changes in SST warming patterns, especially between insights from model evaluation (chapters 3-9), and importance of changing SST patterns for state dependent feedbacks (chapters 7, 8) (this is not currently addressed in the TS). [Valerie Masson-Delmotte, France]	Taken into account. Many coordinated efforts were undertaken following the SOD review on this topic.
17621					The narrative of the report displays key characteristics of "groupthink and normal science" as described by T.S.Kuhn in "The structure of scientific revolutions". There is a tendency in most chapters to avoid mentioning the deep fundamental and structural uncertainties associated with climate science although explicitly mentioned in the relevant literature. As a consequence , alternative (opposing) scientific views are not sufficiently represented. [ferdinand meeus, Belgium]	Noted. Some of this is indeed addressed in Chapter 1, however we do not agree (or have not been presented with an argument demonstrating) that specific scientific views that are borne out by recent literature are not sufficiently represented.
39637					Annex IV is missing [Nyein Chan, Myanmar]	Noted. This annex does not exist anymore, the other annexes have been re-numbered
17623					In view of increased knowledge after AR5 about internal and external natural variability on multidecadal to millennial scale (chapters 3.5 and 3.7) this report fails to justify that climate models are fit for purpose. Most models are tuned through parameterization to the 20th century climate records (Voosen in Science 2016) . Tuning is done untill there is a good historical fit with the available climate data. The historical fit is often achieved with conflicting parameterisation techniques (clouds, aerosol, ocean heat distribution,..) among the various models (Hourdin "Art and Science of climate model tuning" in BAMS 2017) .The reality of this conflicting starting situation of the models, makes climate projections for the future highly questionable and not sufficiently reliable for policy making. This important aspect of conflicting parameterisation and tuning is missing from the report. Should be part of key messages in the Summary for Policymakers. It is not acceptable that this aspect is not mentioned. It is key for good decision making. [ferdinand meeus, Belgium]	Taken into account. Model tuning is assessed in Sections 3.2 and 3.3.1.1, which also notes that only a subset of CMIP6 models were tuning to historical warming, and cites Hourdin et al. (2017). Moreover, global surface temperature projections in this report draw on multiple lines of evidence, not only CMIP6 projections (Box 4.1).
113111					I would strongly recommend that someone writes a Box about terrestrial evaporation ('evapotranspiration') in the report, because there has been plenty of literature about observing, trends and model benchmarking in the last decades that is left undiscussed. It is not even treated in the chapter specifically dedicated to the water cycle. Now that is a GCOS ECV, this feels like an important missing piece in the report now. There are coauthors in the report capable of doing this; if you find no volunteers, please reach out to me and I can suggest someone or do it myself. [Diego Miralles, Belgium]	Noted with thanks. Taken into account. Since SOD, the Chapter 8 FGD has considerably improved the assessment of observed changes and projections of evapotranspiration (8.3.1.4 and 8.4.14).
17625					There is clearly AGW-groupthink and tunnel vision at work in preparing the report. A good example of this selection bias process is the story of the 5 hottest years 2014-2018 where the main cause is natural variability El Nino and less CO2- driven- AGW. This El Nino natural variability cause is not mentioned in the Technical Summary and not mentioned in Summary for Policymakers. Altough Chapter 3-P86 Line 12 states clearly "El Nino event in 2014-2016 led to 3 consecutive years of annual record GMST". Not mentioning El Nino "natural variability" in the technical summary and the Summary for Policymakers to explain the 5 hottest years 2014-2018 is unacceptable. [ferdinand meeus, Belgium]	Taken into account. Due to space limitations, the fact that the 2016-2020 period was the warmest since 1850 is no longer included in the SPM. Due to space limitations we were unable to include discussion of the causes of warming in the past five years in the TS.

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112089					Different chapters use different stippling/hatching combinations, definitions and thresholds (e.g. 80% in the Atlas vs 90% in Ch4 for weak model agreement) to communicate uncertainty. This is done now differently in many chapters. While some flexibility on this would be needed, having such large heterogeneity is very confusing for readers. Some urgent coordination on this would be required. [jose manuel gutierrez, Spain]	Taken into account. A consistent methodology for representing the significance of observation data or robustness/significance of projections has been developed for FGD. The methodological details are described in Cross-Chapter Box Atlas.1 and a short explanation has been systematically added to the relevant captions. This increases the consistency across chapters and traceability of the methodology
112091					While there is strong integration of the Interactive Atlas with some Chapters (in particular Ch12), there is little integration and cross-references with other relevant chapters where similar figures are reproduced. This needs to be coordinated in order to detect and document differences (different datasets, or single vs multiple members) and to check consistency for identical products. This could also have the benefit of allowing double checking and identifying problems/bugs. [jose manuel gutierrez, Spain]	A consistency check has been made by the Atlas team to ensure the main results displayed in figures in other chapters are reproduced in the Interactive Atlas and that differences such as using single or multiple members for each model in ensembles does not change these main results and the conclusions drawn from them.
6365					HadCRUT5 is referred to in various place in the SOD as HadCRUTv5 or HadCRUT5.0. A single name should be used, preferably HadCRUT5, as its predecessor was known as HadCRUT4 and HadCRUT5 is the name used in the title of the scientific paper relating to it. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. HadCRUT5 is used across chapters.
115677					It is possible for the FGD to consider adding a specific component to the assessment related to emerging climate science literature related to the consequences of the COVID-19 outbreak. This would need to take the form of a cross-chapter box, clearly highlighting that the box has been added after the SOD review. The box would be communicated together with the next SPM version for governement review for transparency. Examples of relevant recent papers : Le Quere et al, Nature Climate Change (2020); Shi and Brasseur, GRL, 2020. This could be introduced in Chapter 1. The definition of "surprises" in the glossary may consider "pandemics". Aspects related to discontinuities in observation systems may be relevant for WGI. [Valerie Masson-Delmotte, France]	Taken into account. A cross-chapter box on the COVID related effects on air quality and climate is added in Chapter 6 (Cross-Chapter Box6.1)
105441					Please ensure that Executive Summary confidence and certainty assertions are traceable to the associated sections which are being refered. In some instances, the confidence and uncertainty statements are only made in the Executive summary, but missing in the section text. For example, in Chapter 12, Page 7, line 15 there is a confidence level assertion, but there is no confidence level statement in the whole of the associated section of 12.3 (page 7, line 21). The Executive Summary statements should not be a new conclusion but should be based on a finding within the main text. [Zelina Ibrahim, Malaysia]	TAKEN INTO ACCOUNT: We have revised the Executive Summary and provided traceback to the main text sections within the chapter. Confidence statements are drawn largely from the summary bold text at the bottom of each section, and in some cases there is a synthesis of multiple statements in the ES.
44513					check the use and definiton of "Typological regions" (introduced in Ch1) across all chapters, there are inconsitentcies in the use (or not use) of this classification. For instance, in Ch12 "Typological regions" are not used/referred to, but there is a Ch12 section on Specific zones and Hot spots, which contains some of the regions that are included in CH1 definiton of "Typological regions" [Jana Sillmann, Norway]	TAKEN INTO ACCOUNT: The "Specific zones" in CH12 are defined according to the Cross-Chapter Papers of WGII, and are distinct from the typological regions discussed elsewhere in WGI as the latter is a geographic subset that may be used to calculate aggregate values (e.g., monsoon regions or mountains as distinct from surrounding areas). Specific Zones in WGII are meant to capture common climatic impact-driver responses that defy simple AR6 region or continental geographies. This is described at the top of Section 12.4.10. For example, semi-arid areas exist on all continents and have similar CID profiles that would otherwise be overlooked in the continent/AR6 organization of Section 12.4.
115681					The use of scenarios needs to be harmonized across chapters. Chapter 1 introduces that they are used "consistently" across the report, but in practice some chapters give more prominence to some scenarios. This also needs to be coordinated with WGII and WGIII. [Valerie Masson-Delmotte, France]	Noted. When revising chapters there has been an effort in using a consistent set of scenarios when possible. Chapter 1 introduces the new SSP scenarios used throughout the report. This is again presented in the TS and SPM. However individual chapter, although focusing on SSPs sometime still assess RCP simulations because either simulations nor papers were not available for all the SSPs.
116193					Chapter 4 shows a strong signal for heat stress in projections. Could this variable be also calculated from observations (ch 2) and could attribution be performed (chapter 3) so as to have a full picture for this aspect? [Valerie Masson-Delmotte, France]	Rejected. Chapters 2 and 3 are wary of adding such a substantive set of material that would not be reviewed.
116705					Of course, each chapter has a different approach to the assessment. I find the following approach easiest to follow, in a given section : summary of the starting points (eg what was in AR5, AR6 SR). Then, introduction of main knowledge developments, and assessment of evidence in the literature. Then, a summary statement, helping the reader to understand which earlier findings have been strengthened, revised, challenged, and what is novel (with use of the confidence language). I find confusing when it is done the other way round, assessing literature (including literature already assessed in earlier reports), developing a conclusion, and then adding "by the way, this previous report agreed with this finding". [Valerie Masson-Delmotte, France]	Taken into account. The TSU has strongly advised the chapter to follow that structure for their assessment (previous report as starting point, new findings, conclusion/assessment) and has highlighted the problematic areas in that regard, during the internal review.
115685					Please check carefully all references to the notion of "acceleration", provide a definition in the glossary, and use the term consistently. Example in chapter 1 : "changes to the state of the climate system have accelerated since AR5". [Valerie Masson-Delmotte, France]	Taken into account. Each use of 'acceleration' has been carefully checked to see if this is the appropriate term. Unnecessary to include 'acceleration' in the glossary as its mathematical definition is well-known.
93671					Consider the use of a Cross-Chapter Box to address inherent Indigenous rights, Indigenous knowledge, Indigenous science, and climate justice. Emphasize the importance of establishing IK as a line of evidence, and providing space for Indigenous voices in IPCC reports in alignment with the Indigenous peoples platform (see comment #8). [Bridget Doyle, Canada]	Taken into account. The importance of Indigenous knowledge for construction of regional climate information is highlighted in Section 10.5. Other topics pointed out by the reviewer such as climate justice and indigenous rights are not within the scope of IPCC WGI. Climate justice is treated in IPCC WGII.
36327					Suggestion to include in the report a mention COVID-19 in terms of its impacts, risks and opportunities it provides to the ongoing efforts on understanding and addressing climate change [PENDO MARO, Belgium]	Taken into account. A cross chapter box on COVID related air quality and climate effects has been added in Chapter 6 (Cross-Chapter Box6.1)

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93673					Consider a Cross-Report Box that speaks to the existing and potential roles and contributions Indigenous people make to climate science, mitigiation, and adaptation. The IPCC has taken steps to incorporate Indigenous people in the AR6, but there is plenty room for improvement. A Cross-Report Box could provide greater visibility and recognition of inherent Indigenous rights, Indigenous rights as recognized by international law (UNDRIP), and climate justice. Identify the need for including Indigenous knowledge, traditional knowledge, and Indigenous science in global climate science, mitigation and adaptation strategies. Recongize Indigenous voices who have been calling for systemic change and a paradigm shift away from polluting economies for centuries. Recognize the reciprocal relationship Indigenous people have had with the earth for millenia, and how biodivsersity is best protected and enhanced in areas managed by Indigenous people. Showcase global Indigenous leadership in climate governance and climate diplomacy. [Bridget Doyle, Canada]	Taken into account. The importance of Indigenous knowledge for construction of regional climate information is highlighted in Section 10.5. Other topics pointed out by the reviewer such as climate justice and indigenous rights are not within the scope of IPCC WGI. Climate justice is treated in IPCC WGII.
116457					Could it be possible to include carbon cycle feedback uncertainties in chapter 4 projections (coordination is needed x ch 3, 4 and ch 5) (quantitatively, but also qualitatively, about processes not resolved in models, and knowledge on their potential sign and magnitude). T [Valerie Masson-Delmotte, France]	Accepted. Chapter 04 has been expanded through a brief comparison of emissions- and concentration-driven projections.
93675					The COP has recognized the necessity of including Indigenous knowledge and practices when addressing and responding to Climate Change. The Local Communities and Indigenous Peoples platform was established in part to facilitate the meaningful and holistic integration of knowledge, technologies, practices and efforts of local communities and Indigenous Peoples into the UNFCCC process. Consequently, it is dissaponting to see a lack of Indigenous knowledge and recognition of Indigenous Peoples across AR6 WG reports. The IPCC should be responding to the COP by ensuring that Indigenous knolwedge is represented in all future reports. [Bridget Doyle, Canada]	Taken into account. The importance of Indigenous knowledge for construction of regional climate information is highlighted in Section 10.5.
116715					Coordination across chapters is needed on aspects related to jet stream, meandering, blocking. There are duplications / inconsistencies / lack of references to Chapter 10 CCB where relevant. [Valerie Masson-Delmotte, France]	Accepted. Cross-chapter coordination has resolved these issues for the FGD. However we are not sure on which Cross-chapter Box the reviewer refers to.
115693					Please chose between reference to "the oceans" or "the ocean" and apply this consistently in all chapters. Geographically, there are different ocean basins. However it is common practice to refer to "the ocean" as the interconnected body of salt water and a component of the climate system. SROCC used "the ocean". [Valerie Masson-Delmotte, France]	Accepted. 'the ocean' is now consistently used throughout the report.
116205					Coordination across chapters is needed on monsoons, including ch 2, 3 for aspects related to the paleoclimate context, to avoid duplication and enhance coherency. [Valerie Masson-Delmotte, France]	Thank you, and agreed. There was extensive monsoon-focused cross-chapter discussion between chapters 2, 3, 8 and others in the process of developing the FGD. We believe the consistency and coherency around monsoons is much improved in the FGD, compared to the SOD. A certain amount of duplication is unavoidable, given the structure of the WG1 Report and the need for each chapter to be read alone.
36335					Congratulations to the Authors and all who contributed to the making of this report. It is a great collaborative piece of work. I am honoured to be one of the reviewers. [PENDO MARO, Belgium]	Noted with thanks.
88049					Please make sure that the potentially misleading term "ice caps" is, in accordance with a AR5 decission (see AR5 WG1 Glossary), is not used in AR6. The same holds for "mountain glacier" if they are not explicitly addressed separately from glaciers not sitting on mountains which, in turn, meets the problem of defining mountains (see SROCC Ch2). [Georg Kaser, Austria]	Accepted. The term ice caps is no longer used in AR6.
89843					Please provided quantitative information (e.g. a range) for all changes in climate variables. The Executive summaries are full of qualitative statements (e.g. "very likely to increase") of little or no value without quantification. [Rowan Sutton, United Kingdom (of Great Britain and Northern Ireland)]	As mentioned in the SPM and TS, Chapter 1's Box 1.1, Figure 1.1 describes the IPCC uncertainty language that is used throughout the report including in the SPM, TS and other chapters. This uncertainty language has been detailed also in the scientific literature (e.g., Mach et al 2017). In Box 1.1, Figure 1.1 there is a list of the associated probability with each specific term (e.g., likely 66-100%).
88053					As glaciers are subject of respectve sections in Ch9, Ch12, Ch 1, Ch2, Ch3,and Ch8 there is a series of repetitive text portions or even "re-inventions" (particularly Ch12) of statements on glaciers throughout AR6 WG1 SOD. In any case, there is need to pay much attention on harmonizing at least glacier numbers and references under the lead of Ch9. [Georg Kaser, Austria]	Accepted. Harmonisation of glacier text and numbers has been done as far as possible.
18427					I believe that the texts on glacier variations in the ch. 2 and ch. 9 should be merged and placed in the ch.9 [Olga Solomina, Russian Federation]	Rejected. Scoped in both chapters by the parties. Further efforts have been made to ensure they are complementary to one another.
115709					Chapter 1 (page 29, line 49) suggests that the IPCC assessment process seeks to evaluate all relevant peer-review literature. Different chapters made different choices about this (for instance, some papers were examined and discarded possibly in case of assessed low quality). It could be relevant to be more transparent on such choices. [Valerie Masson-Delmotte, France]	Taken into account. Typically many more publications are considered than end up being cited in the report (e.g., exclusion of similar research to that already cited for brevity).
116221					Cross-chapter coordination is needed on interplays between energy, water and carbon surface fluxes. [Valerie Masson-Delmotte, France]	Accepted - Cross-chapter coordination took place during the preparation of the FGD