

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
130599	0	0	0	0	In SPM p4,line 7 indicate that developments of observation, theory and modeling but have seen any assessment on climate change theory development in TS. [Panmao Zhai, China]	Noted. A bulleted list is now presented in the TS with major update and or new results since the AR5. Advances in climate theory are described in TS.1.2.2 Climate Model Performance.
105127	0	0	0	0	It is a pity that there is no figure on model evaluation in the TS. A figure showing the improvements of climate model in simulating key variables for present, recent and past climates would be very relevant in the TS. [Masa KAGEYAMA, France]	Taken into account. Model progress is now addressed in Figure TS.2.
106151	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]	COVID-19 is now addressed in the TS introduction and in the last paragraph of section TS.3.3.3.
87285	0	0	0	0	TS is way too long: 232 pages [Marcel Berk, Netherlands]	The TS has been substantially redrafted to be more synthetic; the text length has been reduced by nearly 10 pages and >20 figures were dropped or were made more synthetic.
99333	0	0			For me, the summary part starting 140 31ff does not add much as it repeats the earlier clear message. Would the space better be used to highlight regional difference, thereby providing information which allows assessing inequalities of hazard distribution? [Daniela Schmidt, United Kingdom (of Great Britain and Northern Ireland)]	The overall region summary is now highlighted in TS.4.1 Generation and Communication of Regional Climate Change Information and the region by region summary is in TS.4.3.1 Common Regional Changes in Climatic Impact-Drivers. This has allowed the region section to be more compact and allows for much earlier comparison among regions.
131907	0	0			The concept of climate sensitivity needs careful explanation [Hans Poertner and WGII TSU, Germany]	Taken into account. A Core concept box (Box TS.1) has been added.
99215	0	0			there are minor repetition of information in the regional discussion between continents versus Arctic/Mountain. Please retain these to make it possible to read subsections and not the entire TS given its length [Daniela Schmidt, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The TS has been substantially redrafted to be more synthetic; the text length has been reduced by nearly 10 pages and >20 figures were dropped or were made more synthetic. TS.4 was the section that underwent the most synthesis.

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54757	0		0		Maps / Observed and Future Changes: It would be helpful if small maps illustrating the sub-continental regions were included with the tables showing observed and future changes in different regions of the world (Section TS.4.3 and tables TS.13 through TS.21). This could be extracted easily from Box TS.5 Figure 2. [Nancy Hamzawi, Canada]	Not applicable, regional tables deleted to save space.
54759	0		0		Figures: Strongly recommend that all IPCC figures be produced in a way that facilitates extracting separate panels cleanly for use in slide-show briefings. Some TS figures have clearly been produced in poster-format. While we support the production of posters by the IPCC as an additional communication product, figures in IPCC reports should be created in a way that each panel can be used in a stand-alone fashion and each figure should be limited to conveying a few key messages. Poster style figures require extensively long captions and time to explain and therefore cannot easily be used in briefings. [Nancy Hamzawi, Canada]	Nearly all the TS figures have been re-worked to be user friendly, and as far as time allowed to be, stand alone figures that can be used in presentations.
132135	0				The TS totally ignores "Land" as an Earth System realm (e.g. page 59, lines 5-6). This is the result the choice of the chapter 2 authors not to include "Land" as one of their considered Earth System realms, with which I am deeply concerned. I had also commented on this point in the FOD, but this does not seem to have been taken into account. Note that this is inconsistent with text in chapter 1 (pages 10-11, and Section 1.5.1.1) as well as with the publication of a full IPCC report on "Climate Change and Land". [Sonia Seneviratne, Switzerland]	Agreed. This is now addressed in Table TS.2 and TS.2.6 Land Climate, Including Biosphere and Extremes .
106025	0				As I expect the authors are aware, many parts of the TS appear to be a collection of statements that were extracted from individual chapters and assembled into this draft, a consequence of the time available for this draft. This appears to be especially true in the regional subsections of TS4.3. There will be a big challenge in moving from that collection into a coherent, well-organized document, which should perhaps be done first before then responding to review comments, as some of the text commented on may no longer be part of the TS after that reorganizing. [William Gutowski, United States of America]	The TS has been substantially redrafted to be more synthetic; the text length has been reduced by nearly 10 pages and >20 figures were dropped or were made more synthetic.
113731	0				WG1 or WGI: Need to be consistent [Jan Fuglestedt, Norway]	WGI is used throughout now.
131909	0				The TS is very long, dense and in many places repetitive plus has a considerable number of figures. Suggest a short more focused TS would be preferable with key figures only [Hans Poertner and WGII TSU, Germany]	The TS has been substantially redrafted to be more synthetic; the text length has been reduced by nearly 10 pages and >20 figures were dropped or were made more synthetic.
131911	0				The TS jumps between GSAT and GMST which is confusing for readers [Hans Poertner and WGII TSU, Germany]	Now this is explained in the Cross-section box TS.1 and then the term global surface temperature is used.

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131913	0				In many parts the TS seems to simply repeat chapters - or is written in the style of a chapter - this makes it difficult for the reader to find key information eg marine heatwaves are found in TS-2.7.5 and TS.2.3.1 [Hans Poertner and WGII TSU, Germany]	The TS has been substantially redrafted to be more synthetic; the text length has been reduced by nearly 10 pages and >20 figures were dropped or were made more synthetic. Marine heatwaves are assessed globally in TS.2.4 and then regionally in TS.4.3.2.9 Ocean.
113881	0				The TS contains a lot of useful and relevant information. But I sometimes struggle with the structure and flow. It has a great potential but tightening and checking for overlaps and consistency are needed. Some parts seems to be a bit too much copy and paste from Executive Summaries and more work on integration and flow is needed. [Jan Fuglestedt, Norway]	The TS has been substantially redrafted to be more synthetic; the text length has been reduced by nearly 10 pages and >20 figures were dropped or were made more synthetic.
113883	0				I think we can be more clear on use of assessed range for global mean temp change (based on multiple lines of evidence from ch7) vs the use of other variables from CMIP not being constrained. [Jan Fuglestedt, Norway]	This has been addressed in Cross-section box TS.1.
113885	0				Storylines is mentioned as an approach, but is - as far as i can see - but used less than what can be expected [Jan Fuglestedt, Norway]	Storylines are used now in Cross-section box TS.2 (new).
113887	0				Some topics are based on assessment in one or two chapters, but the TS has potential for more integration and pulling contributions together. The new structure of AR6 WGI report makes this aspect of TS more important for achieving an integrated and more holistic assessment than what the chapters can provide alone. [Jan Fuglestedt, Norway]	The TS has been substantially redrafted to be more synthetic; the text length has been reduced by nearly 10 pages and >20 figures were dropped or were made more synthetic.
113891	0				A box on effects of COVID could fit in TS. This could cover effects on emissions (with links to WGIII), atmospheric concentrations, detectability in climate variables vs natural fluctuations; it would need to cover SLCF and LLGHG - and thus builds on several chapters. There will not be much literature available in time specifically on COVID effects, but existing knowledge and literature can still give a basis for a pedagogical box on what can be detected and not detected. Furthermore, such a box could also discuss if the COVID situation changes the relevance of the scenarios (i.e. a blip or long term structural changes; and the scenario thinking). The box would benefit from broad participation across several chapters + WGIII and WGII. [Jan Fuglestedt, Norway]	COVID-19 is now addressed in the TS introduction and in the last paragraph of section TS.3.3.3.

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97509	0				For orientation, a graphical overview over the different Working Groups could be integrated to visualize which part of the IPCC covers which topic and how relations in between different parts are. This seems especially useful as orientation is difficult through the overlapping of topics of the different working groups (The graphic could look like the orientation given here: https://www.ipcc.ch/about/structure/). [Nicole Wilke, Germany]	The purpose of the TS is to provide a concise technical summary of the WGI report, hence the suggestion has not been taken into account. Aspects related to the integration of the AR6 WGI report are introduced in the framing chapter (section 1.1.3).
97511	0				Many subsections are concluded with summaries presenting the main findings in a very condensed form. In particular this is done for TS.2 (2.2.3, 2.3.6, 2.4.4, 2.5.4, 2.6.4, 2.7.7) and TS.4 (TS.4.1.3.1., TS.4.2.4, TS.4.3.3., TS.4.3.13.3). In TS.3.X subsections there are also summarizing paragraphs included. We appreciate these summaries very much, however we think it would be much more helpful to aggregate the summaries of one section (e.g. TS.2) in one summary instead of providing summaries for every subsection (x.x.x). Please revise. [Nicole Wilke, Germany]	Section summaries are now provided.
97513	0				Please explain what "climate model" means. The TS sometimes refers to GCM, sometimes to ESM, please clarify. [Nicole Wilke, Germany]	Related definitions are provided in the Glossary. The TS text has been revised to specify that Earth system models include additional biogeochemical feedbacks. Emission driven simulations are introduced in TS.1.3.1.

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97515	0				The abbreviation CID or CIDs for "climate impact driver(s)" is used on page 110 for the first time, while this important term is used many times before. Please introduce the abbreviation directly at page 12 and use it afterwards, or don't use the abbreviation at all. [Nicole Wilke, Germany]	Now CIDs are defined in the introduction: Box TS.1 Core Concepts Central to This Report
97517	0				The information regarding CH4 is scattered throughout the TS, please revise. There is no clear information about the state of knowledge for the observed trend and including the resumed growth. Please revise and provide this important information in the TS. The information on TS-27 regarding the oxidising capacity and the OH concentration is not comprehensible. [Nicole Wilke, Germany]	The corresponding paragraph in section TS2.2 has been revised. Information linked to CH4 is provided where relevant in sections TS2 and TS3, and in Box TS7.
97519	0				The navigation in the report is difficult, in particular for those with less background knowledge about the climate system or those who are not familiar with the IPCC. For example, the placement of topics in specific chapters not always obvious from their titles. It is also difficult to identify cross cutting topics across chapters. To this end the table on Cross Cutting Issues is particularly helpful. We suggest to provide additional support to the readers, e.g. title might be extended with hints on the content. the placement is logical, readers with less background knowledge of the climate system might not search for the topic of sinks and sources of biosphere and land use under this title. Therefore, the title might be extended with hints on the content. [Nicole Wilke, Germany]	The introduction of the TS addresses this now with links to the relevant sections.
2975	1	1	210	30	TS has too many tables and figures. Sugestion is to reduce some tables and figures. [Zong Ci Zhao, China]	Comment taken into account. Both the number of tables and figures have been reduced by about 40%.

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100231	1	1	232	1	references??? [Carlye Peterson, United States of America]	Rejected. Following past practice (e.g., AR5), the TS does not contain references only line of sight to the chapters.
50541	1	1	232	17	Please provide greater clarity on whether the SSP scenarios emission scenarios or concentration pathways, and explain the distinction between these. The SSPs are frequently described here as "emission scenarios" but results are presented from concentration-driven CMIP6 projections. [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Comment taken into account. The description of the core set of scenarios used in this report has been expanded, the differences with AR5 RCPs explained and the emission-driven runs addressed in revise section TS.1.3.1
50551	1	1	232	17	The use of "global warming levels" (eg. as in the Cross-Section Box 2 title) is encouraged through the TS and entre report, in preference to "temperature levels" which is also used in many places. The latter may lead to a misunderstanding that the levels refer to the absolute temperature of the Earth, rather than their intended meaning as levels of temperature change. Furthermore, the use of "global" helps to clarify that warming levels (eg. 1.5C, 2C) are used as indicators of global climate change for policy purposes and that these numbers are not of actual physical significance at regional scales, which can be another common misunderstanding. [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Comment taken into account. "Global warming levels" are now the predominant term in the TS (with >50 occurrences). "Temperature levels" appear 3 times to describe more generic situations.
4531	1	1			You are defining some pre-industrial climatic anomalies in Rable TS.4 but ignore these in the text completely. Readers need to be made aware that land temperatures during the Holocene Thermal Maximum in many countries of the world were 1-3°C warmer than today. Why are you not mentioning that temperatures in many parts of the world were similar or warmer during the Medieval Warm Period? Global averages are not yet robust, so you should refer to the large number of case studies that show this consistent pattern. [Sebastian Luening, Switzerland]	Taken into account. Response to three-part comment follows: (1) Table TS.4 is now omitted from FGD. (2) Regional Holocene and Medieval temperatures: Space limitations preclude the inclusion of paleo temperature reconstructions at regional scale. Estimates for the ocean and the Arctic are included in chapters 2 and 9. (3) Global temperatures: Although global-scale reconstructions may be less robust than regional estimates, GMST is a metric of considerable interest as an indicator of global warming levels. It is a focus of the assessment of large-scale indicators in Chapter 2 of the report.
93873	1	18	1	18	I born in Esquel, Chubut, Argentina, and have been proposed for the IPCC by the focal point of Argentina. Thus, with all the love for Brazil's neighbors, please correct my nationality/representativeness to Argentina. Thanks! [Lucas Ruiz, Argentina]	Corrected. Author's name now reads Lucas Ruiz (Argentina).

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112947	1		1		In reading over the TS, it's clear that paleo is playing a major and generally quite well-integrated role in the TS, but it does strike me that if folks want to understand how paleoclimate approaches have uniquely contributed to the report, there is no consolidated one-stop shopping to accomplish that goal. I think a box in the TS might be a good way to collate key messages that leverage paleo approaches. I'm not sure how that would best be organized, but I note that Darrell Kaufman has laid much of the groundwork here. [Kim Cobb, United States of America]	Agreed and taken into account. The new Box TS.2: Paleoclimate address this concern.
40661	1		232		Please spell out acronyms once -- the first time they appear. Thank you for the acronym table in Appendix II. [TSU WGI, France]	Agreed and taken into account. The final edit should ensure that all acronyms are defined the first time they occur. Additionally, the list of acronyms used in the WGI Report is in Annex VIII.
86525	1		232		As opposed to previous WG1 TS this draft TS indeed seems very "technical". In its current form it is neither sufficiently accessible nor particularly interesting for the interested layman. I am very aware that for the experts all of this is very exciting stuff. In my view the TS should be significantly shortened and restructured and start with the most policy relevant questions to have an appealing entry (e.g. start with TS3 - TS8 followed by TS1 & 2) . The draft TS could be significantly shortened if the more technical discussions are merely referenced rather than repeated from the chapters. It is understood that SPM and TS should be complementary. However the authors should keep in mind that in the approval plenary meeting important messages from the authors to the public could be deleted, deformed or watered down. Therefore there can be a strong case for a high degree of redundancy between SPM and TS. [Jochen Harnisch, Germany]	Comment taken into account. The TS has been substantially redrafted to be more synthetic; the text length has been reduced by nearly 10 pages and >20 figures were dropped or were made more synthetic.
19557	2	1	2	1	from 86 pages (AR5) to 232 pages for AR6: +170%... [philippe waldteufel, France]	Noted. Please note that pdf and final IPCC layout pages do not map one to one. The first TS draft with figures was 232 pdf page, the final one was 150 pages, about a 35% reduction.
1931	2	1			Change "Content" to "Contents" [Alan Robock, United States of America]	Agreed and corrected.
38399	2	7	2	12	Key elements in SPM should be consistent with those in TS. For example, the text in lines 5-8 on page 4 in SPM addresses the progress in observation, theory and simulations, while theoretical development is little read in TS. Only titles for observation and simulations are listed under the entry '1.2 Development in climate science'. It is suggested to add the title 'Development in climate change theory' under this entry, and supplement and summarize main theoretical outcomes where appropriate. [Yaming LIU, China]	Agreed. The TS should underpin the SPM. A bulleted list is now presented in the TS with major update and or new results since the AR5. Some advances in climate theory (e.g. related to ECS) are described in TS.1.2.2 Climate Model Performance and in section TS.3 (Understanding the climate system response).

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130587	2	19	2	19	Global temperature definitions? I think it should be "global surface temperature definitions". [Panmao Zhai, China]	Agreed. "Global temperature definitions" is no longer used in the TS. "Global surface temperature" appears more than 150 times.
130585	3	13	3	19	Extremes here are too narrow? How about ocean heat wave, extreme sea level and many others? [Panmao Zhai, China]	Agreed. This is now addressed in Table TS.2 and TS.2.6 Land Climate, Including Biosphere and Extremes .
39957	6	1	6	1	As the TS will be posted on line as a stand-alone doc, perhaps add a descriptor for WG1 : "Working Group I, the scientific basis of the climate system and climate change," [TSU WGI, France]	Rejected. The full description of WGI will appear in the first page of the TS, under "This Technical Summary should be cited as" item, where WGI will be spelled out, as in the AR5 (In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change)
44485	6	1	6	27	This text should be part of the TS.1 section, which should have the title "Framing and structure". Currently section TS.1 only describes the structure of the TS. [Jana Sillmann, Norway]	The TS introduction was substantially rewritten and the framing and structure component was removed. The reviewer is invited to see Chapter 1 section "1.1 Report and chapter overview" for this information.
54761	6	3	6	5	This text states that the TS brings together different lines of evidence from different chapters to allow a synthesis of key assessments. We highly recommend adding an additional sentence here to state explicitly whether or not this synthesis of information from different chapters also introduces new assessment statements in the TS that are not already part of any underlying chapter. In our opinion, this would be legitimate and would support a line of sight to any such assessment statements in the SPM that are not traceable to individual chapters. [Nancy Hamzawi, Canada]	Indeed, all the information in the TS can be found in the WGI AR6 Chapters. This is clearly stated now "All the findings and figures here are supported by and traceable to the underlying chapters, with relevant chapter sections indicated in curly brackets." . The synthesis of the key findings is highlighted at the start of each section with the framed text.
19559	6	7	6	18	P6 L7-18: My view is that there is no need to duplicate information supplied by Box 1.1; keeping only the first sentence will be adequate, and save 10 lines. This comment is extended to footnotes 1 and 2. [philippe waldteufel, France]	Noted. TS needs to be stand-alone and thus some introductory material on the use of the uncertainty language is needed, with clear reference to the underlying Chapters, here Chapter 1, Box 1.1.

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39929	6	8	6	8	Again as the TS will be posted on line as a stand-alone doc, it might be good to spell out the roles of the other WGs: WGII assesses the impacts, adaptation and vulnerabilities related to climate change, and WGIII focuses on climate change mitigation, assessing methods for reducing greenhouse gas emissions, and removing greenhouse gases from the atmosphere. [TSU WGI, France]	Rejected. Since this is the TS for the WGI report, we do not see the need to introduce the other WGs upfront.
54763	6	14	6	14	Footnote 2: in the footnote, the likely and very likely ranges are said to represent the 17-83% and 5-95% probability ranges respectively. Is this always true throughout the WGI report or are there places where, for example, the 5-95% probability range is assessed as likely? If so, then the footnote needs clarifying in this regard. [Nancy Hamzawi, Canada]	Yes, this is true throughout the report; a brief description is given and explained more fully in Chapter 1, please see Box 1.1: Treatment of uncertainty and calibrated uncertainty language in AR6.
19561	6	20	6	21	Since chapter 1 to come next is named "Framing, context, methods", you cannot claim also that TS presents the overall framing and context of the whole report! We begin to experience here one among the report's frequent defects: repeating, duplicating too often. It is the purpose of drafts, among others, to offer opportunities to correct such defects. Please react. Certainly this section can be compacted, renamed, and harmonized with chapter 1. [philippe waldteufel, France]	Taken into account. Section TS.1 has been substantially revised and shortened, leaving out much of the "Framing, context, methods" comprehensively assessed in Chapter 1 of the underlying report.
111137	6	21	6	22	TS2 is claimed to synthesize information across all component of the climate system, but only three of five are named (atmosphere, ocean and hydrosphere) while lithosphere (land) and biosphere are missing with only carbon cycle covered. Biosphere is very important component in the climate system, needs more attention and should be better presented in TS [Volodymyr Osadchy, Ukraine]	Accepted. Biosphere is now specifically listed as a component of the climate system in TS.1. . This is now addressed in TS.2.6 Land Climate, Including Biosphere and Extremes .
19563	6	23	6	25	My comment on these lines is given when reading the appendix itself, P168 [philippe waldteufel, France]	Noted and addressed there.
97521	6	30	7	9	In this framing section, it should be pointed out, that some basics regarding biosphere, soils and land use are covered in the reports of WG 2 and 3 and not in this report and TS. The statement, that WG 1 assesses "studies of physical and biogeochemical climate processes" (line 39) implies, that these topics are fully covered in this report. [Nicole Wilke, Germany]	Noted. As this is the Technical Summary for WGI (i.e., the summary of results only from WGI), only WGI is referenced here. Aspects related to land climate are addressed in the revised TS in section TS 2.6 and in the box TS.5 on the carbon cycle.

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108573	6	37	6	37	What are 'reanalysis datasets', that's not a term I've come across before. It's not clear in this context. [Jason Donev, Canada]	Noted. We now only talk about "reanalysis". Reanalyses are explicitly introduced in revised TS.1.2.1, page TS-15, line 46, are also explicitly defined in the Annex VII, Glossary (see "Reanalysis").
100387	6	43	6	44	Should also refer to recent special reports (. SR1.5, the SROCC and SRCCCL) [Lincoln Alves, Brazil]	Agreed. References to special report have been added to the Introduction, including selected updates.
19565	6	43	7	9	Clearly all this is a matter for chapter 1 [philippe waldteufel, France]	Noted. The introduction has been modified and the contribution of WGI to the risk framework is introduced in box TS.1 (Core concepts central to this report)
40273	6	44	6	44	Footnote 2 (likely range etc) : Could this be simplified to stress that uncertainty is quantified using a likely range by default? [TSU WGI, France]	Accepted. Text/Footnote has been revised for clarity. Likely (and very likely) ranges now mentioned explicitly. The meaning of square brackets is also explained at first occurrence (page 8, footnote 8).
100389	7	19	7	20	Should also refer to recent special reports (. SR1.5, the SROCC and SRCCCL) [Lincoln Alves, Brazil]	Accepted. Introduction to the TS now explicitly mentions the AR6 Special Reports.
15457	7	22	7	25	It is suggested to put "rising atmospheric greenhouse gas concentrations" at the beginning rather than the end of the long list of observed physical changes because the increase in greenhouse gas concentrations is the primary driver of other changes in the list (probably except SLCFs). [SAI MING LEE, China]	Not applicable. Text substantially revised for FGD
78903	7	22	8	28	could include increasing ocean CO2 and associated changing carbonate chemistry [Pedro Monteiro, South Africa]	Taken into account, partly: Text substantially revised, but now include ocean acidification in the TS.1.1 Headline Statement
111139	7	25	7	26	There is nothing about SLCF in Figure TS.1 [Volodymyr Osadchy, Ukraine]	Not applicable. Figure dropped for FGD
111143	7	27	7	28	It is not clear what means "unusual nature" there, and how it can be seen from Fig.TS.9 (should be TS.2?) [Volodymyr Osadchy, Ukraine]	Taken into account. Wrong Figure reference. Text revised accordingly. Reference to Figure 1 in FGD

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84513	7	28	7	28	TS.9 should be TS.2? [Annalisa Cherchi, Italy]	Taken into account. Wrong Figure reference. Text revised accordingly. Reference to Figure 1 in FGD
40511	7	28	7	28	many numbering issues in the TS1 section: Figure TS-9 (SSP-RCP scenarios) does not seem to be well referenced in the context of the sentence. TS-2 instead? [TSU WGI, France]	Taken into account. Wrong Figure reference. Text revised accordingly. Reference to Figure 1 in FGD
18881	7	28	7	28	Figure TS.9 does not cover multi-millennial period. Figure TS. 2 does. [Govindasamy Bala, India]	Taken into account. Wrong Figure reference. Text revised accordingly. Reference to Figure 1 in FGD
97523	7	28			Reference "Figure TS.9" doesn't fit to the text, because Figure TS.9 is about the SSPs/RCPs and not about global changes in the context of a multi-millennial period. Figure TS.2., TS.11 or TS.12 would fit better. [Nicole Wilke, Germany]	Taken into account. Wrong Figure reference. Text revised accordingly. Reference to Figure 1 in FGD
32507	7	33			Figure TS.1: From a scientific and communication point of view, we consider that a local variable, such as the Kyoto cherry blossom date and the grapes harvest date in Beaune, should not be considered in the same figure as other representative key climate variables. Indeed, the underlying Chapter does not discuss the representativeness of these variables, for example as regards to the potential attribution of the trend to the Kyoto area progressive urbanization. Furthermore, there are probably more representative indicators of the general behaviour of the biosphere in a changing climate, such as the trend in the seasonal characteristics of the NDVI in extratropical regions during the last decades. [Eric Brun, France]	Not applicable. Figure dropped for FGD
113723	7	54	7	54	Figure TS.2 is placed on page 7 but no reference is given to this until page 23. [Jan Fuglestedt, Norway]	Taken into account. Wrong Figure reference. Text revised accordingly. Reference to Figure 1 in FGD
40257	7		7		Figure TS-2: it is not clear what are the shaded areas in the observed columns is (if "reference periods", could be labelled as such in the figure, in between 1850-1900 and 1995-2014). [TSU WGI, France]	Not applicable. Figure has been substantially revised for FGD.

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32509	8	15	8	15	We suggest to insert here "natural" before "changes" since human activities impact biogeochemical cycles [Eric Brun, France]	Rejected. The list refers to "principal natural drivers". We have removed the brackets and now write "including" to make this even clearer.
1935	8	15			Change "volcanoes" to "volcanic eruptions" Volcanoes do not cause climate change on their own, unless they erupt. [Alan Robock, United States of America]	Not applicable. Text substantially revised for FGD, but we now use "volcanic eruptions" where applicable throughout the TS.
84515	8	20	8	24	Fig.TS.3 in "observations" milestones for measurements in the atmosphere are absent; in "natural human drivers" Milankovich is repeated twice [Annalisa Cherchi, Italy]	Not applicable. Figure dropped for FGD
111147	8	22	8	22	Figure TS.3 should be better named since "event" in this report can be misunderstood with weather and climate event [Volodymyr Osadchy, Ukraine]	Not applicable. Figure dropped for FGD
19567	8	22	8	22	Figure TS.3: there are many problems with this figure. Every time you assign a name to a milestone you run into trouble. Some of my friends say that, although Maury played a major role, the main creator of operational meteorology was Urbain LeVerrier. Also why does Milankovitch's work appear twice? Concerning the satellites, you are apparently not aware that the first estimation of the Earth's radiative balance (the very kernel of climate!) was carried out by the first US spacecraft Explorer, conceived by Vernor Suomi and launched in 1959. And so on. [philippe waldteufel, France]	Not applicable. Figure dropped for FGD
19569	8	27	9	21	According to the WG1 outline, as adopted by the Panel at the 46th Session of the IPCC, the title of chapters were decided, as well as the issues to be addressed by each of them. While a technical summary was included, no detail was given on its content. For a reviewer, then the only explicit requirement for a technical summary is that it should be technical, that is deal with technical issues. I can only nevertheless stress that the matters in these paragraphs (entitled "international climate policy") are not of technical nature. In other words, this text does not comply with the decision of the Panel. [philippe waldteufel, France]	Accepted. Sections have been dropped

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
109711	8	27	9	21	As per the previous comment, broad-based community and democratic involvement seem to be noticeably absent here; the passage focuses instead on the existing technocratic, top-down philosophy of climate change policy formation and governance that has undoubtedly contributed in part to some of the public distrust we've unfortunately seen in several countries around climate change mitigation efforts. Is it possible to modify this passage just a little to suggest a somewhat more egalitarian and democratic tone to climate change policy formation going forward? [Sean Fleming, United States of America]	Not applicable. Section dropped for FGD
40809	8	29	8	29	Somewhere in this section, it would be good to list the SRs (including the greenhouse gas inventories) and give their full names. That way the scene is set and does not need to be repeated. Also, SRCL is never mentioned in support of assessment finding. [TSU WGI, France]	Taken into account. SRs now in TS.0, i.e., in the TS Introduction
97525	8	29	8	30	The international efforts regarding climate change began with the establishment of the IPCC in 1988, not the UNFCCC. Please modify. [Nicole Wilke, Germany]	Not applicable. Section dropped for FGD
34767	8	29	8	39	Detailed Comments by SOD Chapter – TS: The fact that UNFCCC mandate is to address “dangerous anthropogenic interference with the climate system” has regrettably totally biased its climate research away from any natural causes. Please see general comment #13 above. [Jim O'Brien, Ireland]	Rejected. Assessments considers natural and anthropogenic causes. See the comprehensive assessment provided in, e.g., Chapter 3. The TS covers natural variability explicitly in TS.1.2.3 and TS.2 and TS.4
26259	8	31	8	31	whose objective "is" to prevent -> whose objective "was" to prevent ? [María Santolaria-Otín, France]	Not applicable. Section dropped for FGD
40339	8	32	8	32	goals -> targets. IT would be good to change this throughout with respect to the Paris agreement. SDG goals is ok. [TSU WGI, France]	Not applicable. Section dropped for FGD

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
11141	8	36	8	36	The meaning of first appearance of SR1.5 should be explained here in parentheses. But it is explained in a latter place TS-9 L13. [Wen Wang, China]	Taken into account. SRs now in TS.0, i.e., in the TS Introduction
97527	8	41	8	43	Please cite Art. 2 of the PA correctly and do not omit Art. 2.1.c regarding finance flows. [Nicole Wilke, Germany]	Not applicable. Section dropped for FGD
87039	8	44	8	45	The text distinguishes between long-lived and short-lived climate forcers. "Immediate" climate forcers such as albedo should be singled out in addition. Short-lived forcers have shorter or longer lag between the cause and the effect. Immediate forcers only have an immediate effect, and the effect is only sustained if the cause is sustained. [Oyvind Christophersen, Norway]	Not applicable. Section dropped for FGD
113725	8	46	8	47	OK to say that WGI report is "complementary" SRs and WGII and WGIII, but I would not say complementary to SyR since it is a basis for SyR. Rewording is needed. [Jan Fuglestedt, Norway]	Not applicable. Section dropped for FGD
86167	8	48	8	48	"could potentially help inform the global stocktake" is very tentative. What about "finding that should help" Or "that hold value for" ? [Debra Roberts and the Durban WGI TSU, South Africa]	Not applicable. Section dropped for FGD
87041	8	49	8	49	It seems to be Cross-Chapter Box 1.1, not CC-Box 1.2, that has the table witch lists WGI findings and their relevance for the global stocktake. Please correct in both the sentence and in the line of sight reference. In the line of sight, the reference to chapter 1.2.2 is correct. [Oyvind Christophersen, Norway]	Not applicable. Section dropped for FGD

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97529	8	54	8	57	Please indicate the complete reference of the IPBES report, because this is a direct quotation. Based on our check, we assume that you are quoting IPBES, 2019, page 13: Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. [Nicole Wilke, Germany]	Not applicable. Section dropped for FGD
97531	8	54	8	57	We appreciate the fact that the TS includes this strong statement emerging from the IPBES Global Assessment Report (2019), which is also included in chapter 1, section 1.2.1.2, p. 14, lines 35-36, and which shows the strong evidence underpinning the interlinkages between climate change and biodiversity. Sufficient evidence is provided in the underlying chapters to underpin this statement. Therefore, we encourage the authors to consider transferring the message on the interlinkages between climate change and biodiversity from the Technical Summary (TS) in to the high-level Summary for Policymakers (SPM), possibly under section c: "Climate change is a direct driver that is increasingly exacerbating the impact of other drivers on nature and human well-being", a strong message emerging from the IPBES Global Assessment (2019:13). [Nicole Wilke, Germany]	Not applicable. Section dropped for FGD
40259	8		8		Figure TS-3: to mirror the text, it would be good to add the centuries on top of the timeline, in the figure. Also, to help navigate the content some keyword could be set in bold. [TSU WGI, France]	Not applicable. Figure dropped for FGD
55441	9	2			Given the Paris agreement also introduces Loss & Damage as a third pillar next to adaptation and mitigation it would be important to mention this here as well. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. Section dropped for FGD
113727	9	3	9	18	What is written about SLCF is OK, but highlighting this here seems a bit unbalanced vs other topics. With a separate chapter on SLCF as a new element in AR6 I can see some attention here is justified, but I still suggest shortening. [Jan Fuglestad, Norway]	Not applicable. Section dropped for FGD. But SLCF do receive a lot of attention in the revised FGD TS, see e.g., Box TS.7
86169	9	8	9	11	This sentence is quite convoluted and not easy to understand. [Debra Roberts and the Durban WGII TSU, South Africa]	Not applicable. Section dropped for FGD

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
54765	9	13	9	13	We are concerned this paragraph (cross-referencing SR1.5 conclusions) is not clear enough about how reduction in SLCFs will help (or hinder) achievement of the Paris Agreement global temperature goal because the fact that SLCFs include both warming and cooling agents is not explained. Given their many common sources, mitigation will result in reductions in emissions of both, with different effects on climate. The SR1.5 SPM referred to the need for deep reductions in BC and methane to meet 1.5C and noted that such emission pathways also lead to reductions in cooling aerosols that could offset mitigation efforts for 2 to 3 decades. [Nancy Hamzawi, Canada]	Not applicable. Section dropped for FGD
97533	9	13	9	18	These statements are policy prescriptive, please modify or delete. 1) The SR1.5 did not make statements on "requirements" but on characteristics of model pathways. 2) The last sentence of the paragraph on a specific requirement of policies must please be deleted. [Nicole Wilke, Germany]	Not applicable. Section dropped for FGD
97535	9	21			Why "renewed"? There has been no break. Please delete this adjective. [Nicole Wilke, Germany]	Not applicable. Section dropped for FGD

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
26097	9	26	9	28	We suggest to add 'and planetary boundaries' after '...of climate-related risks' [Don Alfonso Pino Maeso, Spain]	Not applicable. Paragraph substantially revised to only introduce Section TS.1. Sentence deleted from FGD. We note that risk is now introduced in the Core Concept Box TS.1
84517	9	27	9	28	it is not only about "larger ensembles" or "higher resolution". For models there is a lot of work on improvements in models' parameterizations and understanding of processes. Plus inclusion/coupling of the different components of the climate system (including new ones) [Annalisa Cherchi, Italy]	Not applicable. Paragraph substantially revised to only introduce Section TS.1. Sentence deleted from FGD.
84519	9	30	9	30	"changes in extreme events" only? [Annalisa Cherchi, Italy]	Not applicable. Paragraph substantially revised to only introduce Section TS.1. Sentence deleted from FGD.
34769	9	32	8	36	The SOD claims that projections published since the 1980s are in close agreement with previous models. Please see rebuttal comments #2 and #3 above. [Jim O'Brien, Ireland]	Rejected. Assessment in Ch1 provides the details for the summary statement repeated in TS.1: "Past projections of global surface temperature and the pattern of warming are broadly consistent with subsequent observations, especially when accounting for the difference in radiative forcing scenarios used for making projections and the radiative forcings that actually occurred. "
26261	9	32	9	32	FAR 'First Assessment Report should be defined here first, before Figure TS.4 [María Santolaria-Otín, France]	Not applicable. Paragraph substantially revised to only introduce Section TS.1. Sentence deleted from FGD.
18885	9	32	9	32	"FAR" is used first and only once. Maybe expanded as First Assessment Report? [Govindasamy Bala, India]	Not applicable. Paragraph substantially revised to only introduce Section TS.1. Sentence deleted from FGD.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
41057	9	38	9	39	There is not such information in the TS-3 figure. Are you referring to TS-4? [TSU WGI, France]	Not applicable. Figure dropped for FGD
84521	9	39	9	39	TS.3 should be TS.4? [Annalisa Cherchi, Italy]	Not applicable. Figure dropped for FGD
61235	9	39	9	39	Wrong figure reference. Reader should be pointed to TS.4 [APECS, MRI, PAGES ECN, PYRN and YESS ECS group review, Canada]	Not applicable. Figure dropped for FGD
23525	9	39	9	39	"Figure TS.3" should be corrected as "TS.4". [Masaki Satoh, Japan]	Not applicable. Figure dropped for FGD
17617	9	44	9	44	Sentence "this evidence is now even stronger" is not justified. Since AR5 many more publications have indicated the uncertainties associated with the observations and the fundamental limitations of the climate models due to tuning and parameterisations. There is no fundamental improvement of CMIP6 (projections are running too hot) compared to CMIP5. It is a fact that the parameterisation for clouds, aerosols and ocean energy distribution of the climate models does not follow a unified logic. In reality, different modeller groups use different parameterisations to describe the same physical climate process, as described in the literature: Hourdin "The Art and Science of climate model tuning" in BAMS 2017 and Voosen "Climate scientists open up their black boxes to scrutiny" in Science 2016. A match with historical climate data is only obtained after a complicated tuning process of the different (in sign and magnitude) parameters which are different for each model. [ferdinand meeus, Belgium]	Rejected. The comprehensive and robust assessment in the underlying Chapters, in particular Ch3, provides the basis for the statement. The progress in model performance is being discussed in TS.1.2.2.
111151	9	57	10	3	It worth to mention here radio-soundings as very important source of meteorological data [Volodymyr Osadchy, Ukraine]	Taken into account. "Balloon-based networks" are now explicitly mentioned in Section TS.1.2.2 "Observation-based products and their assessments"
40261	9		9		Figure TS-4: is Ar6 section be filled in for the final draft? Also, The dots should be on the curve and not next to it (it is confusing otherwise). Shouldn't the dataset be referenced in the caption? [TSU WGI, France]	Not applicable. Figure dropped for FGD

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
78905	10	5	10	11	ocean observing systems - major advances in observations and coordination (SROCC/CH05/CH09) [Pedro Monteiro, South Africa]	Taken into account: "Improvements are particularly evident in ocean observing networks and remote sensing systems" are now explicitly mentioned in Section TS.1.2.2 "Observation-based products and their assessments"
82597	10	13	10	18	This doesn't reflect the existence of other remote sensing with longer periods of record. Suggest adding "complementing longer-term satellite records which extend back to the late 1970s", or words to that effect, somewhere. [Blair Trewin, Australia]	Rejected. While certainly correct, we wanted to keep the focus on the most recent developments. For this reason and for reasons of brevity, the suggested text was not added.
108575	10	18	10	18	Please put radiosonde in the glossary [Jason Donev, Canada]	Reject. There is one Glossary only for all three IPCC WGs in AR6, thus only expressions/terms that are used a lot across one WG or across WGs are included. Note that the term "radiosonde" is part of the entry ozonesonde: "The radiosonde is usually carried on a weather balloon and transmits measured quantities by radio to a ground-based receiver."
6385	10	18	10	18	The statement regarding an emerging loss of radiosonde launches is at odds with the status report on the global observing system published by GCOS in 2015, which wrote that radiosonde "coverage has improved slightly [since 2002], at least in terms of the evenness of the distribution of observations". The amount of data from radiosonde observation has subsequently increased in quantity due to reporting with higher vertical resolution, and the data are now being provided with more accurate positions and timings. Where there has been a decline in reporting, over Europe for example, this is in part due to introduction of alternative profile data being provided by commercial aircraft on ascent from and descent to airports. Indeed, some European meteorological services have increased the frequency of radiosonde ascents in recent weeks to compensate for a much reduced flow of data from aircraft due to the Covid-19 pandemic. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Text revised accordingly: For surface and balloon-based networks, apparent regional data reductions result from a combination of data policy issues, data curation/provision challenges, and real cessation of observations, and are to an extent counter-balanced by improvements elsewhere."

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
34771	10	20	10	28	The SOD states that reanalysis of temperature datasets is providing internal consistencies. Please see rebuttal comment #1 above. [Jim O'Brien, Ireland]	Noted. References to alternative comments by the reviewer is unhelpful as it is difficult to find out what the reviewers comment #1 was. We have revised the statement following the underlying Chapter assessment: Reanalyses combine observations and models (e.g., a numerical weather prediction model) using data assimilation techniques to provide a spatially complete, dynamically consistent estimate of multiple variables describing the evolving climate state."
52797	10	33	10	33	"High confidence" is too strong for "EDW in most mountain ranges". The following half-sentence already hints to a major source of uncertainty. Recent work (presentation at EGU 2020) by Arnone et al. found considerable variability in elevation-dependent trends between data sets and mountain ranges. Be aware that the statement is repeated on p 89. Note that TS p 143 l 29 says "medium confidence"! [Petra Seibert, Austria]	Not applicable. Text has been removed for FGD.
19571	10	34	10	36	Which lines of evidence support this conclusion? In order to deserve the "virtually certain" label, there ought to be plenty of them. This is not to contest that scarcity and decline of observations will increase the uncertainty of projections; although of course possible compensations by new observations ought to be included in the picture. In weather forecasting, it is common practice to test the sensitivity to observations by switching off successively parts of the observing system. This is a way to move from "virtually certain" to "certain".. [philippe waldteufel, France]	Not applicable. Text has been removed for FGD.
82599	10	35	10	35	Suggest adding "available" before observations. In some cases this will be because the observations have indeed ceased, in some cases it will be that the observations are made but are not incorporated into available data sets, e.g. because of communications issues or data policy reasons (a particular problem for Indian data). Chapter 10 discusses these issues at some length. Also affects P89 L46. [Blair Trewin, Australia]	Not applicable. Text has been removed for FGD.
100391	10	35	10	36	Amazonia is also a good example to be added [Lincoln Alves, Brazil]	Not applicable. Text has been removed for FGD.
111155	11	9	11	9	"surface climate" sounds confusing [Volodymyr Osadchy, Ukraine]	Taken into account. Text has been revised and the term "surface climate" removed for FGD.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
111157	11	11	11	13	The last statement that "the multi-model mean captures most aspects of observed climate change well" sounds not as a proper assessment, as like as prior "significant differences" is not clear at what level of significance [Volodymyr Osadchy, Ukraine]	Taken into account. The text has been revised: "Developments in the latest generation CMIP6 climate and Earth system models, including new and better representation of physical, chemical and biological processes, as well as higher resolution, have improved the simulation of the recent mean climate of most large-scale indicators of climate change (high confidence, Figure TS.2) and many other aspects across the Earth system." and "For most large-scale indicators of climate change, the simulated recent mean climate from CMIP6 models underpinning this assessment have improved compared to the CMIP5 models used in AR5 (high confidence)."
111159	11	15	11	15	What is SSS? [Volodymyr Osadchy, Ukraine]	Taken into account. Sea surface salinity is no longer discussed since it seemed less relevant for the TS audience.
82603	11	15	11	15	SSS (sea surface salinity?) is not in the list of acronyms in Appendix B. [Blair Trewin, Australia]	Taken into account. Abbreviations removed from text.
18887	11	15	11	15	"SST" and "SSS" are used first time in the report here. Maybe expanded? [Govindasamy Bala, India]	Taken into account. Abbreviations removed from text.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97537	11	15	11	18	The reduced biases are mentioned for SST and SSS, but concretized only for SST. Please describe the reduced biases also for SSS. [Nicole Wilke, Germany]	Taken into account. Sea surface salinity is no longer discussed since it seemed less relevant for the TS audience.
108577	11	15	11	18	Please define SST and SSS in the text the first time it's use. [Jason Donev, Canada]	Taken into account. Abbreviations removed from text.
84523	11	15	11	18	is there something similar assessed for near surface temperature or precipitation? [Annalisa Cherchi, Italy]	Taken into account. A paragraph on precipitation has been included in the FGD.
131915	11	15	11	18	Spell out acronyms here and elsewhere [Hans Poertner and WGII TSU, Germany]	Taken into account. Abbreviations removed from text.
97539	11	15			Please write out "SST" and "SSS". These abbreviations are used here for the first time in the TS. Please define SSS in the table TS.B.1. [Nicole Wilke, Germany]	Taken into account. Abbreviations removed from text.
11525	11	21	11	34	Maybe you could consider plotting r2 on the vertical axis in Figure TS.5 - progress in simulating surface temperature might become a bit more visible [Gerhard Krinner, France]	Noted. Figure is same as the corresponding Figure in Chapter 1.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
108579	11	23	11	23	The two vertical axes here is confusing, can this be done some other way? [Jason Donev, Canada]	Taken into account. The new Figure TS.2 now has 3 panels, separating model resolution (a), model complexity (b) and pattern correlation with observational references (c).
26263	11	23	11	32	Figure TS.5: Different vertical order of CMIP phases in the two figures, choose one for both if possible. [María Santolaria-Otín, France]	Taken into account. The new Figure TS.2 now has 3 panels, separating model resolution (a), model complexity (b) and pattern correlation with observational references (c).
23527	11	37	11	39	It is better to add definition of "Convective permitting models". In this context, simulations at kilometre-scale resolution are done be convective permitting models. [Masaki Satoh, Japan]	Not applicable. Text has been removed for FGD.
18889	11	40	11	43	Why only "water cycle changes? This statement is valid for projections other components of the climate system as well. Sentence should be revised. [Govindasamy Bala, India]	Rejected. The paragraph is about the water cycle, thus the statement refers to this topic specifically.
97541	11	41			Please write out "GCMs" and "RCMs". These abbreviations are used here for the first time in the TS. [Nicole Wilke, Germany]	Taken into account. Abbreviations removed from text.
78907	11	45	11	50	should include the limitations due to inadequate sub-grid scale dynamics in the ocean component of ESMs [Pedro Monteiro, South Africa]	Not applicable. Text discussing the reasons for the limitations has been largely reduced for space reasons. The reader is referred to the comprehensive assessment in the underlying Chapters (see the line of sight provided in curly brackets).
84525	11	56	11	56	sentence seems incomplete: how many points follow from that statement? [Annalisa Cherchi, Italy]	Not applicable. Text has been removed for FGD.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
39083	11	56	11	56	Is a list of physical processes missing after this line? [Federico Serva, Italy]	Not applicable. Text has been removed for FGD.
23529	11	56	11	56	The sentence ends without giving examples of other processes. [Masaki Satoh, Japan]	Not applicable. Text has been removed for FGD.
11023	11	58	11	58	I believe this should be "ice-sheet mass loss" [Robert Kopp, United States of America]	Not applicable. Text has been removed for FGD.
1939	11	58	11	58	Specify ' future mass loss' of what (ice sheet , glaciers?) . [Hugues Goosse, Belgium]	Not applicable. Text has been removed for FGD.
39085	11	58	11	58	It is unclear to me what 'mass' refers to here. [Federico Serva, Italy]	Not applicable. Text has been removed for FGD.
26099	11	58	11	58	...mass loss...' (?) Please explain [Don Alfonso Pino Maeso, Spain]	Not applicable. Text has been removed for FGD.
106027	11	58	12	2	It is not clear what this sentence is about, though the chapter references suggest ice loss. Clarification needed. [William Gutowski, United States of America]	Not applicable. Text has been removed for FGD.
19573	11	58	12	2	Mentioning that this paragraph (and mass loss) refers to ice sheets and glaciers might help the confused reader. [philippe waldteufel, France]	Not applicable. Text has been removed for FGD.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97543	11	58			Quote: "The magnitude and timing of future mass loss (...)" . Which mass will be lost? Please specify. (Add ice/glacier/...) [Nicole Wilke, Germany]	Not applicable. Text has been removed for FGD.
40263	11				Figure TS-5: a) ESM atm and ocn might not be clear for everyone. A line separating resolution section from the processes would help understand faster which data goes with which axis. Same color for Y axis and CIMP5 and YY axis and CMIP6, is there a reason for that? b) the labels on the right are very helpful to get the message. // "a." "b." are missing in the figure [TSU WGI, France]	Taken into account. Partly. The new Figure TS.2 now has 3 panels, separating model resolution (a), model complexity (b) and pattern correlation with observational references (c). The abbreviations have not been replaced in the new Figure TS.2. It would further add to the complexity of the figure ore lengthen the caption without much benefit. The abbreviations are largely self-explanatory together with the text in the caption. E.g., (a) Evolution of model horizontal resolution and vertical levels.
11025	12	4	12	4	I believe this should be "sea ice area" [Robert Kopp, United States of America]	Accepted. Changed accordingly.
111161	12	4	12	4	"Ice area" - is it sea-ice? [Volodymyr Osadchy, Ukraine]	Accepted. Changed accordingly.
11523	12	4	12	7	This paragraph is perhaps a bit at odds with the rest of the seccion in terms of (geographic) detail. [Gerhard Krinner, France]	Taken into account. Revised paragraph covers Arctic and Antarctic sea ice, ice shelves and ice sheets.
84527	12	12	12	12	fig. TS.4 should be TS.5? [Annalisa Cherchi, Italy]	Accepted. Reference now to new Figure TS.2 in the FGD

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97545	12	12			Reference to Figure TS.4 seems to be wrong, possibly a reference to Figure TS.5 would fit better. [Nicole Wilke, Germany]	Accepted. Reference now to new Figure TS.2 in the FGD
19575	12	17	13	4	All this is nicely described in CC Box1.3; was it necessary to repeat it here? [philippe waldteufel, France]	REJECTED: The TS synthesizes Executive Summary statements from the underlying chapter, thus overlap or repetition cannot be avoided.
115195	12	19	12	31	The first paragraph TS.1.2.3. Risk framing in the AR6. Needs to be linked to NDCs and Mitigation & Adaptation plans beyond climate policies [Alex Godoy, Chile]	REJECTED: The TS only synthesizes Executive Summary statements from the underlying chapters, where the topic is elaborated in more detail and these aspects are covered.
111163	12	21	12	26	Is this quotation of risk definition from the Glossary? If yes, should it be placed as a footnote and proper referenced? [Volodymyr Osadchy, Ukraine]	ACCEPTED: Reference to underlying cross-chapter box and the Glossary is made.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
109713	12	21	12	26	In most disciplines, "risk" combines the concepts of how bad a potential thing is and how likely it is that bad thing will happen. Terminology and details vary, but these two concepts are always present. In the definition of risk suggested in this passage of the technical summary, the likelihood or exposure to bad things does not seem to be clearly included, in spite of the fact that the report does provide a measure of it in its calibrated language ("high confidence", "medium confidence", etc). Just a heads-up that lot of people may see a problem here. [Sean Fleming, United States of America]	REJECTED: The concept of risk in the IPCC is discussed and explained in more detail in the Guidance document and the underlying chapters.
84529	12	26	12	29	form of the sentence to be adjusted: awkward to read [Annalisa Cherchi, Italy]	NOT APPLICABLE: This section has been removed.
131917	12	31	12	31	reference glossary as well for the definition of risk [Hans Poertner and WGII TSU, Germany]	ACCEPTED: Reference to underlying cross-chapter box and the Glossary is made.
131919	12	41	12	47	The risk framework assess the potential for detrimental impacts, however a risk to one sector/species may be a positive to another. Using the term climate impact driver anticipates that the change is climate will have an impact - this is in the realm of WGII to assess and should not be assumed or implied. Why not use climate metric or factor or even just climate - maybe the comms specialists can help here [Hans Poertner and WGII TSU, Germany]	TAKEN INTO ACCOUNT: This section has been removed and text on the link between CIDs and risk have been included in TS1.4.
111153	12	49	12	55	Is is not clear sectors of what are affected by climatic impact drivers? [Volodymyr Osadchy, Ukraine]	NOT APPLICABLE: This section has been removed.
41785	13	1	13	1	In the water section, drought should be in dark red in all the case. E.g. droughts strongly affects groundwater. [Sergio Vicente-Serrano, Spain]	NOT APPLICABLE: Table 1 has been removed.
113729	13	3	13	3	The connection between the text and Figure TS.6 is not very strong. More about what the figure is showing should be given in the text. [Jan Fuglestedt, Norway]	TAKEN INTO ACCOUNT: Figure TS.6 has been substantially revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
131921	13	7			It is not clear, looking at chp 12, how the information was assessed and by whom. How were the relevance levels determined and for what time period as relevance may change as climate change progresses? How were the set of 'climate impact drivers' selected? Is this not presuming the assessment in the WGII report? [Hans Poertner and WGII TSU, Germany]	NOT APPLICABLE: Table 1 has been removed.
131923	13	7			why is lake acidity included under ocean? [Hans Poertner and WGII TSU, Germany]	NOT APPLICABLE: Table 1 has been removed.
78911	13	9	13	9	On Table: Acidity is an incorrect term - the ocean is not acid - rather use acidification - also lake acidification should not be together with ocean acidification - completely different drivers [Pedro Monteiro, South Africa]	NOT APPLICABLE: Table 1 has been removed.
78909	13	9	13	15	should the changes in ocean carbonate chemsistry be included? [Pedro Monteiro, South Africa]	NOT APPLICABLE: Table 1 has been removed.
97547	13	9	13	19	While the information provided in this table might be interesting we cannot find a robust scientific assessment in Ch12. It is unclear what "impacts and risk relevance" is, does it refer to the past or to the future, is the level of relevance determined by the probability of occurrence or by the consequences of an event - which might rather be in the remit of WG II? We urge the authors to severely improve this table or to delete it to avoid jeopardizing the integrity of the IPCC. We do not consider it suitable for the TS. [Nicole Wilke, Germany]	NOT APPLICABLE: Table 1 has been removed.
88421	13	9			Table TS.1 - Unclear why permafrost is not linked to cryosphere reservoir as it represents storage of ground water as ice so does influence aquifers and groundwater. Also landslides/mass movements are important in Polar regions and they are identified as an issue in the Polar table in Ch 12 (see also comments on ch 12) [Sharon Smith, Canada]	NOT APPLICABLE: Table 1 has been removed.
111169	13	10	13	10	Some of sectoral assets sounds strange (polar, morbidity, mortality, etc.) [Volodymyr Osadchy, Ukraine]	NOT APPLICABLE: Table 1 has been removed.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
111171	13	14	13	14	"Hazards" should be changed to climatic impact driver, as pointed in the Table TS.1 [Volodymyr Osadchy, Ukraine]	NOT APPLICABLE: Table 1 has been removed.
34773	13	22	13	27	It is stated that AR6 is based on the three recent Reports SR1.5, SROCC and SRCL. It must be acknowledged that SR1.5 has been shown to have significant deficiencies, see paper by Bates at: https://notalotofpeopleknowthat.wordpress.com/2018/12/20/ipccs-special-report-slammed-by-eminant-climate-scientist/), and that SROCC was primarily based on a erroneous paper by Resplandy et al, that was subsequently withdrawn, see: https://www.nature.com/articles/s41586-019-1585-5 . [Jim O'Brien, Ireland]	NOT APPLICABLE: This section has been removed.
113733	13	28	14	4	GSAT is referred to in the context of RfC. In the SRs, the RfC figures have used GMST. Needs clarification and consistent use from now. Coordination with Ch12 and WGII is needed. And figure TS.6 gives GMST in figure caption. [Jan Fuglestedt, Norway]	TAKEN INTO ACCOUNT: This section has been removed and text on GSAT and RfC has been updated in TS1.4.
44487	13	30	14	2	check the use of the word "hazard", should it be removed or replaced by "climatic impact driver" in this context? [Jana Sillmann, Norway]	TAKEN INTO ACCOUNT: Text revised were relevant in new section TS1.4.
55455	13	30			This is the first time GSAT is mentioned, needs to be linked to box TS.1 [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	NOT APPLICABLE: This section has been removed.
84135	13	31	13	31	delete „)" after hazards) [Manfred Treber, Germany]	NOT APPLICABLE: This section has been removed.
44489	14	11	14	11	should read "the greatest risk do not need to occur at the highest..." [Jana Sillmann, Norway]	NOT APPLICABLE: Text has been removed.
104831	14	11	14	13	I recommend to recall that the risk you mention here has also elements of exposure and vulnerability. Hence, from a physical climate storyline perspective I agree with this statement but less if you consider the interactions of the physical parts with vulnerability and exposure. My recommendation is not to use the term "greatest risk" but rather "severe effect" or "greatest impacts" [Veruska Muccione, Switzerland]	NOT APPLICABLE: Text has been removed.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97549	14	11			Please replace "decades" by "centuries to millennia", since WG1 looks back into paleo-climate and forwards beyond 2300. [Nicole Wilke, Germany]	NOT APPLICABLE: This section has been removed.
106029	14	15	14	15	Although TCR is defined in Table TS.B.1, it has not been defined previously in the text up to this point, like ECS was on p.7, line 6. I suggest doing similar for consistency. [William Gutowski, United States of America]	NOT APPLICABLE: This section has been removed.
108581	14	15	14	17	This idea needs to be explored in the text, not just in the figure caption for TS.6. [Jason Donev, Canada]	TAKEN INTO ACCOUNT: Revised Figure TS.6 is referred to in the text of TS1.4.
11027	14	15	14	18	consider adding an example of high-impact, low-probability SLR [Robert Kopp, United States of America]	NOT APPLICABLE: This section has been removed.
104833	14	15	14	18	If you talk about risk then you need to say something about socio-economic pathways which might not completely follow the high hazard space. I find this paragraph mixing the physical components of risk with the overall definition of risk which is misleading. Maybe you could elaborate more that the interactions with the other two determinants of risk is also essential to define the risk trajectory. [Veruska Muccione, Switzerland]	NOT APPLICABLE: This section has been removed.
31671	14	24	14	25	It seems that "likely" and "very likely" have been reversed. [Petra Seibert, Austria]	TAKEN INTO ACCOUNT: Figure TS.6 has been substantially revised.
113735	14	30	14	30	Here GMST is mentioned. Need to be consistent with text. [Jan Fuglestedt, Norway]	TAKEN INTO ACCOUNT: Figure TS.6 has been substantially revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
26101	14	38	14	38	Why don't we use the adjective 'unequal', since global warming is a global phenomenon but unequal. [Don Alfonso Pino Maeso, Spain]	NOT APPLICABLE: This section has been removed.
131925	14	41	14	41	WG not WGI [Hans Poertner and WGII TSU, Germany]	ACCEPTED: Text has been revised in new section TS1.4.
84531	14	47	14	50	form of the sentence needs to be adjusted, a bit awkward to read [Annalisa Cherchi, Italy]	NOT APPLICABLE: Text has been removed.
100393	14	52	14	53	This paragraphs should refer to {Atlas.2} section [Lincoln Alves, Brazil]	ACCEPTED: Reference to Atlas.2 has been made in revised text in section TS1.4.
26103	14	53	14	53	We suggest to use here the term 'geographical regions' instead of 'regions' (twice). [Don Alfonso Pino Maeso, Spain]	ACCEPTED: Text has been revised in new section TS1.4.
40265	14				Figure TS-6 might be a bit too complex for the TS audience [TSU WGI, France]	TAKEN INTO ACCOUNT: Figure TS.6 has been substantially revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
55445	15	6	15	7	This is very vague. How does climate information benefit from attribution? E.g. it increases or lowers the confidence in the projection if we can or cannot attribute the projected change already. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	NOT APPLICABLE: Text has been removed.
55447	15	22	15	25	This process (minus the user) applies to coming up with assessment statements in IPCC as well, so it might be worth to not only describe it as regional message crafting. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	ACCEPTED: Text has been revised in new section TS1.4.
113737	15	25	15	25	A reference is given to figure TS.6 but I assume this is meant to be figure TS.7 [Jan Fuglestad, Norway]	NOT APPLICABLE: Text has been removed.
44491	15	38	15	42	This paragraph is redundant to section TS1.2.3. Either delete or at least make reference to section T1.2.3 [Jana Sillmann, Norway]	TAKEN INTO ACCOUNT: Repetition has been removed in new section TS1.4.
106031	15	41	15	42	It would be good to point out that these storylines have strong physical basis. So, I suggest additional wording here: "which can explicitly address physically plausible, though low-likelihood, high-impact events". [William Gutowski, United States of America]	ACCEPTED: Text has been revised in new section TS1.4.
84533	15	47	15	49	"climate" is repeated many times. Form of the sentence could be adjusted [Annalisa Cherchi, Italy]	Taken into account. Text has been substantially revised in new Section 1.2.4
113739	15	49	15	52	Attribution in WGIII is not well reflected here; please add according to box in ch1. (And "driver" has different meaning in WGI and WGIII) [Jan Fuglestad, Norway]	Not applicable. Paragraph substantially revised. The Text in FGD Section 1.2.4 now focuses on the WGI aspects of attribution only.
97551	15	51	15	52	The sentence "If anthropogenic forcing is found to be a major driver of such an observed change, then it can be used to illustrate a narrative of the near future." is unclear. What is a "narrative of the near future"? [Nicole Wilke, Germany]	Not applicable. Paragraph substantially revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
44493	15	52	15	54	This sentence is strange in a WG1 context as it refers to assessments that belong in WG2, i.e. impact attribution. [Jana Sillmann, Norway]	Not applicable. Paragraph substantially revised.
40267	15		15		Figure TS-7: it seems more intuitive to have a horizontal flow (left-right) than vertical one. This would also allow a better readability of the vertical text without the need to tilt the head by 90 deg. // "users" and "producers" as stated in the main text could be more explicitly mentioned in the flowchart. // the overall design could be improved. For support please contact the TSU [TSU WGI, France]	not applicable.: Figures has been removed.
34775	16	5	16	21	It beggars belief that an unusual single day temperature could be attributed to climate change. [Jim O'Brien, Ireland]	Not applicable. Paragraph on event attribution deleted from FGD.
82601	16	14	16	14	The first "likely" here isn't being used in the sense of IPCC likelihood language, so should it be in italics or not? [Blair Trewin, Australia]	Not applicable. Paragraph on event attribution deleted from FGD.
40085	16	24	21	4	Dimensions of Integration: Thinking ahead to the SYR, it may be useful to mention land use, and in particular updates from SRCCL. [TSU WGI, France]	Noted. We maintain the focus on the three dimensions: scenarios, GWLs, cumulative CO2 emissions. Other integration dimensions are possible, but not specifically addressed here in the TS.
130347	16	24	22	38	Some discussion of Extended Concentration Pathways (ECPs) would be helpful here, providing insights beyond 2100. Figure TS.2 provides graphical information about ECPs to 2300, but additional text would help readers understand long-term implications of emissions and concentration pathways. In particular, when must CO2 emissions be reduced to zero to stay within a concentration or temperature limit? [Trigg Talley, United States of America]	Noted. Extensions of the SSPs beyond 2100 are briefly addressed in the text and in figures. However, given the space constraints, we can not go into any detail. The most important aspect, we think, is that the extensions are fundamentally different from the socio-economic pathways for the 21st century.
130589	16	29	16	29	carbon emissions should be CO2 emissions. [Panmao Zhai, China]	Accepted. Text revised accordingly
100395	16	32	16	35	This paragraphs should refer to {Atlas.2.1} section [Lincoln Alves, Brazil]	Accepted. Text revised accordingly

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
84535	16	34	16	34	Table TS1.3 should be table TS.3? [Annalisa Cherchi, Italy]	Accepted. Text revised accordingly
113741	16	40	16	42	Since there is some confusions related to use of concepts, I suggest mentioning/explaining (or pointing to) here the concept "remaining carbon budgets". (Or perhaps better to do this in section TS.1.3.3) And revise according to coordinated effort between WGI and WGIII [Jan Fuglestedt, Norway]	TBD -- to be covered in Core Concept Box and in TS.3
39565	16	45	16	53	Following Myrhe, G., et al 1998. Geophys. Res. Lett. 25, 2715, it is generally admitted that the radiative forcing, hence temperature, is logarithmic with CO2 concentration. Why here is it linear? [François Gervais, France]	Not applicable. Figure dropped for FGD
113743	16	47	16	51	The figure is very useful. Still I wonder if the dimension "scenarios" could be made more visible. It is not immediately clear to the user how the scenarios play in here, except for increasing cumulative CO2. [Jan Fuglestedt, Norway]	Not applicable. Figure dropped for FGD
19577	16	56	16	56	Is there a way to extract from the WG1 report simple, factual information about the illustrative SSP and their content? It seems logical to look for such information in the technical summary! [philippe waldteufel, France]	Taken into account. Text has been revised and hopefully clarified. SSPs are covered.
97553	17	1	17	30	A clear description of the scenarios and how they are used in the AR6 will be very helpful. Understanding the difference between SSP, RCP and their influence on the projections will greatly help the reception of the information from the AR6. However, the current description is too technical. We therefore strongly recommend that the authors complement the technical jargon with explanations in everyday language. [Nicole Wilke, Germany]	Taken into account. Text has been revised and hopefully clarified. SSPs and RCPs are covered and compared. Though we note that given the space constraints, this comparison has to be very limited. More details are given in the underlying chapters.
23531	17	1	17	70	In Fig. TS.9, "SSP1-8.5" should be corrected as "SSP5-8.5". [Masaki Satoh, Japan]	Not applicable. Figure dropped for FGD

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
84537	17	8	17	9	it is not only Earth system models [Annalisa Cherchi, Italy]	Accepted. Text revised accordingly
50543	17	16	17	16	It is stated here that the SSPs are "emissions or concentration scenarios". These are not the same thing - which are they here? [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. This has been clarified. The revised TS Section 1.3 now describes what the SSPs include in terms of emissions, land-use change etc. In a separate paragraph we then explain that climate and Earth system models can be run differently using the SSPs, i.e., driven by anthropogenic CO2 emission ('emissions-driven' runs), in which case atmospheric CO2 concentration is a projected variable; or by prescribed time-varying atmospheric concentrations ('concentration-driven' runs).
44495	17	16	17	20	In this paragraph it is important to mention that the SSPs feature multiple baseline worlds in which socio-economic factors (e.g. population, technological, and economic growth) could lead to very different future emissions and warming outcomes, even without climate policy. In contrast to the previous SRES scenarios, each SSP describes future developments in the absence of new climate policies (beyond those already in place today) and can be combined with various emission mitigation targets. (see also https://www.carbonbrief.org/explainer-how-shared-socioeconomic-pathways-explore-future-climate-change or related peer-reviewed literature). [Jana Sillmann, Norway]	Rejected. The TS section on Scenarios focuses on the use of climate change scenarios in IPCC WGI AR6. The basic assumptions underlying the SSPs are discussed in detail in Ch1 and then the WGIII report.
104835	17	16	17	30	This could complicate the assessments in WGII. For example, the borad literature on impacts and adaptation is still largely based on the CMIP5 and RCP2.6, 4.5 and 8.5 sometime combined with selected SSPs. I wonder how comparable are the results between WGI and WGII if the scenarios combinstion are not the same, e.g. WGI now uses SSPX-Y. I wonder also how this translates into levels of global warming across the two working groups. [Veruska Muccione, Switzerland]	Noted. Cross-WG collaboration are aiming to make for a smooth transition between the assessments. However, all three WG assessment reports need to be based on the underlying literature. If the different communities use different scenarios as the basis, this will definitely complicate comparison. But we do what we can to ease this comparison.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
54767	17	16	17	30	Missing from this paragraph about the new SSPs is an explanation that the five SSPs represent alternative plausible socio-economic futures with varying challenges for mitigation and adaptation. It would be helpful to first identify the 5 storylines and be clear that emission paths for each have been developed in the literature and then to explain the application of policy assumptions to arrive at the illustrative scenarios (SSP#-RFX.X) used by CMIP6. Similarly, it might be worth considering adding to Figure TS.9 a new panel (a) to show the scenario space covered by the 5 SSPs. [Nancy Hamzawi, Canada]	Rejected. The TS section on Scenarios focuses on the use of climate change scenarios in IPCC WGI AR6. The basic assumptions underlying the SSPs are discussed in detail in Ch1 and then the WGIII report. Figure TS.9 was dropped for FGD
50545	17	22	17	22	It is stated here that the SSPs are used to derive "emissions and concentrations". This is incorrect - emissions can be derived from the socioeconomic projections, but translation from emissions into concentrations involves climate system processes not socioeconomic processes. Please clarify that the SSPs provide emissions scenarios, and concentration pathways are derived from emissions using a carbon cycle model. [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Text revised substantially.
131927	17	24	17	24	is the correct figure referenced? [Hans Poertner and WGII TSU, Germany]	Not applicable. Figure dropped for FGD
23535	17	24	17	24	"Figure Box TS.1 Figure 1": It this an appropriate figure? "Figure TS.9" is more appropriate. Please check it. [Masaki Satoh, Japan]	Not applicable. Figure dropped for FGD
97555	17	24			Reference "(See Figure Box TS.1, Figure 1)" makes no sense. But a reference to Figure TS.9 would fit here perfectly. [Nicole Wilke, Germany]	Not applicable. Figure dropped for FGD
113749	17	33	17	39	Typo in fig in upper right corner: SSP1-8.5 --> SSP5-8.5 [Jan Fuglestedt, Norway]	Not applicable. Figure dropped for FGD
113751	17	33	17	39	The concepts "Marker scenarios" and "illustrative pathways" need to be explained in text - or removed. [Jan Fuglestedt, Norway]	Not applicable. Figure dropped for FGD

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
84539	17	35	17	37	in fig TS.9 the name of the most extreme scenario is misspelled SSP1-8.5 instead of SSP5-8.5 [Annalisa Cherchi, Italy]	Not applicable. Figure dropped for FGD
113745	17	42	17	42	Re "used consistently across this report": Yes, that is the intention - and we need to follow up and support that. [Jan Fuglestedt, Norway]	Taken into account. Text now reads "In this report, a core set of five scenarios is used to explore climate change over the 21st century and beyond." to reflect the flexibility in scenarios used across projections chapters.
108583	17	42	17	45	This doesn't seem consistent with the idea of temperature overshoot as discussed in the SR15 report from a couple of years ago. [Jason Donev, Canada]	TBD -- para does not discuss overshoot---
11031	17	42	17	50	Important to recognize that SSP5-8.5 is substantially above most projections of 'business-as-usual' - it should be clear to the reader that 'current trends' would probably be close to, if slightly below, SSP3-7 [Robert Kopp, United States of America]	Accepted. This is now explicitly stated in the revised FGD Section 1.3.1: "No likelihood is attached to the scenarios assessed in this report, and the feasibility of specific scenarios in relation to current trends is best informed by the WGIII contribution to AR6. In the scenario literature the plausibility of the high emissions levels underlying scenarios such as RCP8.5 or SSP5-8.5 has been debated in light of recent developments in the energy sector."
104837	17	42	17	57	The SSP1-1.9 is virtually non existent in the impacts and adaptation literature that we are assessing in WGII and I doubt there can be anything much by the cut-off date. the same goes for SSP3-7.0. is SSP1-2.6 equivalent to a RCP2.6 combined with the SSP1? This is what we usually find in the impact and adaptation literature. [Veruska Muccione, Switzerland]	Noted. Cross-WG collaboration are aiming to make for a smooth transition between the assessments. However, all three WG assessment reports need to be based on the underlying literature. If the different communities use different scenarios as the basis, this will definitely complicate comparison. But we do what we can to ease this comparison.
15299	17	43	17	45	"the lowest, SSP1-1.9, represents a low greenhouse gas emission, high mitigation future which may limit warming to less than 1.5°C above pre-industrial levels". Need to make it clear on what timescale warming may be limited to under 1.5 degrees. Is this by 2050, or 2100, or for ever? [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Timescales added where applicable.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
50547	17	43	17	47	Please clarify that concentrations resulting in radiative forcing of 2.6 and 8.5 Wm ⁻² by 2100 could arise from alternative emissions futures. Eg. Concentrations giving a forcing of 8.5 Wm ⁻² could result from a lower emissions scenario than SSP5 if climate-carbon cycle feedbacks are strong. [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Text in 1.3.1 now explicitly makes this point about the carbon cycle - climate feedbacks for SSP5-8.5 and RCP8.5: "However, climate projections from these scenarios can still be valuable because the concentrations of RCP8.5 or SSP5-8.5 and resulting simulated climate futures could also be reached by emission trajectories lower than RCP8.5 or SSP5-8.5. That is because of uncertainty in carbon-cycle feedbacks which can result in projected concentrations for specific emissions that are higher than the central estimates typically used to drive model projections"
11029	17	45	17	45	SSP5-8.5 represents not only no climate policy, but also rapid, fossil-fuel-driven economic growth. [Robert Kopp, United States of America]	Noted. Text revised and shortened substantially. SSP5-8.5 is now introduced only in terms of emissions: "SSP5-8.5 represents the very high end of future emissions pathways from the literature."
87043	17	52	18	4	Please consider to include a figure in the TS displaying the global trends in SLCF emissions from the different scenarios, the leftmost column of panels from Figure 6.4 on page 154 in Chapter 6 could be a nice starting point for such a figure. [Oyvind Christophersen, Norway]	Taken into account, partly. Figure TS.4 includes emission trajectories for CO ₂ , CH ₄ , SO ₂ , NO _x .
16629	18	4	18	5	Even in SSP3-7.0 the SLCFs (apart from methane) start to decrease by the end of the century, maybe could say "...over most of the 21st century". [William Collins, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. We want to highlight the overall strong increase over the 21st century.
55449	18	6	18	9	This seems to imply most of AR6 is based on CMIP6, but a lot of it is based on assessing the literature since 2014 a lot of which uses models with RCP forcings. Somewhere in this section this needs to be made more clear. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Text now reads: "Modelling studies utilizing the RCPs complement the assessment based on SSP scenarios, for example, at the regional scale (Section TS.4)."

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
104839	18	6	18	12	I would recommend a more extensive guidance in the TS on the use of scenarios and warming levels across the two working groups in a way that is fully consistent. It could be good that you provide a couple of in text examples or a cross working group case study/box on the equivalence of the scenarios across working groups and how to work with them. The TS of could be a good place to have this case study. [Veruska Muccione, Switzerland]	Noted. The WGI TS needs to focus on the underlying WGI assessment report and literature. Cross-WG collaborations are aiming to make for a smooth transition between the assessments.
84543	18	8	18	8	Table TS1.3 should be table TS.3? [Annalisa Cherchi, Italy]	Accepted. Text revised accordingly
113759	18	8	18	8	Typo in reference to table TS.3. TS1.3 --> TS.3 [Jan Fuglestedt, Norway]	Accepted. Text revised accordingly
113753	18	15	18	25	Figure TS.10: We need to decide about labelling as used here "Very high" to "very low" and coordinate this with WGII and WGIII. [Jan Fuglestedt, Norway]	Not applicable. Figure dropped for FGD
113755	18	15	18	25	Figure TS.10: from an aesthetic point of view, I wonder if the part up to 2015 could be shrunked to approx. the same size of the futures. The the branching and alternative ways would then be given more relative visual weight. [Jan Fuglestedt, Norway]	Not applicable. Figure dropped for FGD
84541	18	21	18	21	ESM is used here because it refers to models with active biogeochemical cycles only? [Annalisa Cherchi, Italy]	Not applicable. Figure dropped for FGD
97557	18	40	18	46	We would hope that the choice of scenarios was not only guided by academic reasons but also by their policy relevance, i.e. referring to the levels of max. global warming defined by the Paris Agreement and by the warming level that is estimated for the current NDC. Please add this information. [Nicole Wilke, Germany]	Not applicable. Paragraph deleted for FGD. Yes, the selection of the core set of scenarios did take policy relevance into account, at high priority, as can be seen from the inclusion of a wide range of scenarios.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
54769	18	41	18	41	it would be helpful to add the explanation for why SSP-1.9 was not included in the CMIP6 Tier 1 experiments. [Nancy Hamzawi, Canada]	Not applicable. Paragraph deleted for FGD. This is a CMIP decision, not an IPCC decision.
97559	18	43			How do the scenarios compare to those used in the recent Special Reports? E.g. the SR1.5 also addressed the LED scenarios, please provide this information in the TS. [Nicole Wilke, Germany]	Rejected. The LED scenario(s) are not explicitly considered in the WGI AR6 assessment and thus can not be included in the TS, which needs to be fully based on the underlying Chapter assessment. WGI AR6 is largely based on the SSP and RCP scenarios and comparison with the SRs of AR6 and with previous WGI Assessment Reports is made where possible and useful. See Section 1.6 for an introduction to the scenarios used across the WGI AR6 Assessment Report.
97561	18	45			Please revise the expression "forcings of interest" as this is probably not referring to the authors' personal interests. [Nicole Wilke, Germany]	Not applicable. Paragraph deleted for FGD.
113757	18	48	18	50	This is a bit ambiguous.Can you say to what extent the selected core-set is used? (It is given nicely in the table). And on page 17. line 42 it says "used consistently". [Jan Fuglestedt, Norway]	Not applicable. Paragraph and Table deleted for FGD.
84545	18	49	18	49	Table TS.1 should be table TS.2? [Annalisa Cherchi, Italy]	Not applicable. Table removed from FGD.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
111175	18	49	18	49	Should be Table TS.2 instead of Table TS.1 [Volodymyr Osadchy, Ukraine]	Not applicable. Table removed from FGD.
131929	18	49	18	49	should this be table TS.2? [Hans Poertner and WGII TSU, Germany]	Not applicable. Table removed from FGD.
23537	18	49	18	49	"Table TS.1" should be corrected as "TS.2". [Masaki Satoh, Japan]	Not applicable. Table removed from FGD.
19579	18	53	20	2	the table TS.2 confirms that nowhere in the report can one find quantitative information about the scenarios. Specifically: what are the time series describing the anthropogenic drivers? [philippe waldteufel, France]	Not applicable. Table removed from FGD.
11033	18	55	20	1	What about missing chapters (e..g, ch 9)? [Robert Kopp, United States of America]	Not applicable. Table removed from FGD.
113747	18	55	20	2	This is a very useful table. (For Ch5 you can mention that scenarios are used for assessing future warming for non-CO2) [Jan Fuglestedt, Norway]	Not applicable. Table removed from FGD.
97563	19	0			Ch4 is not limited to RCP2.6, RCP4.5, and RCP8.5. Please modify and add more scenarios including LED and 1.9. [Nicole Wilke, Germany]	Not applicable. Table removed from FGD.
15301	19	1	19	1	For the Chapter 7 section, "Focusing on metrics (TCR, ECS) and feedbacks uses idealized experiments". "uses" should be "using" ? [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. Table removed from FGD.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
19581	20	5	21	2	This table TS.3 presents some qualitative information and characterises the illustrative SSP with respect to former IPCC concepts (RCP and SRES); at the same time, no quantitative information about the SSP is given to the reader [philippe waldteufel, France]	Not applicable. Table removed from FGD.
112905	20	7	20	10	I would welcome it if for the low-end scenarios we could be explicit in this Table about the amount of CDR they include. [Johannes Quaas, Germany]	Not applicable. Table removed from FGD.
97565	20	7	21	2	Providing a table linking scenario information across reports is highly appreciated. Please mention also the LED-scenario which is very relevant in the SR1.5. Furthermore, it would be useful to also provide approximate peak warmings and levels by 2100 for each of the scenarios, not only for SSP1-1.9, since this is most relevant scenario characteristics for policy makers. [Nicole Wilke, Germany]	Not applicable. Table removed from FGD.
104841	20	7	21	2	This table is really useful as in part solves the problem that I mentioned above. However, it also shows that some scenarios have no equivalent and this can be problematic for comparability across working groups, This is why I think a case study or more explicit examples could really be helpful as to provide a guidance on how to proceed for example in WGII in the assessment of risks per level of global warming under different scenario assumptions. [Veruska Muccione, Switzerland]	Not applicable. Table removed from FGD.
131931	20	7			suggest to reference Table TS.5 so the reader can find the temperature levels associated with the SSPs [Hans Poertner and WGII TSU, Germany]	Not applicable. Table removed from FGD.
32511	20	7			Table TS.3: There is no reference to SRES B2 in the Table. Is it because no SSP scenarios are similar to B2 or is it missing in the Table [Eric Brun, France]	Not applicable. Table removed from FGD.
111177	20	11	21	2	The last column on SRES does not present SRES A1B. Why? [Volodymyr Osadchy, Ukraine]	Not applicable. Table removed from FGD.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
54771	21		21		Table TS.3: Column 1 for scenario SSP3-7.0. In the SPM, this scenario is described as an "unmitigated baseline scenario" (i.e. no climate policy scenario albeit lower than SSP5-8.5). Consistency in describing the scenarios across the SPM and TS and underlying chapters is important and in particular, it is important to be clear about whether the SSP3-7.0 scenario is to be considered a no climate policy scenario or not. [Nancy Hamzawi, Canada]	Not applicable. Table removed from FGD. Comment about consistent descriptions of scenarios has been taken into account.
111179	22	1	22	1	"Warming levels" should be "Global warming levels" [Volodymyr Osadchy, Ukraine]	Accepted. Text revised accordingly
113763	22	1	22	27	I suggest acknowledging the dependence of how the WL are reached; i.e. path and rate [Jan Fuglestedt, Norway]	Accepted. Text revised accordingly, path and rate now discussed
55453	22	4			Delete the term "risk" this is not assessed in WG1 hazards are but also not only. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Text revised accordingly. "Risk" is now only mentioned in the context of WGII and the RFC framework.
84547	22	6	22	7	not clear why "But" at the beginning of the sentence, and not clear what this sentence is intended for [Annalisa Cherchi, Italy]	Noted. Text revised and hopefully clarified.
130591	22	12		13	linearly related to climate impact (1.6.2) should be climate change [Panmao Zhai, China]	Accepted. Text revised accordingly
113761	22	17	22	18	Change "Working Group I" --> "WGI" (?) [Jan Fuglestedt, Norway]	Accepted. Text revised accordingly.
113765	22	30	22	38	Since there is some confusions related to use of concepts, I suggest mentioning/explaining (or poiting to) here the concept "remaining carbon budgets". And revise according to coordinated effort between WGI and WGIII [Jan Fuglestedt, Norway]	Taken into account. The term "remaining carbon budget" is introduced as part of the revised Core Concept Box TS.1. The detailed assessment is summarized in Section TS.3.4. The Glossary entry has been closely coordinated between the three WGs.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
113767	22	33	22	33	You may insert " (GSAT) " in the end of the first sentence. [Jan Fuglested, Norway]	Rejected. Across the TS "global surface temperature" is used. GSAT and GMST are used only where the distinction matters and in Box TS.2
4533	22	41	23	27	The conclusions of this paragraph are wrong, and the opposite is true. Using the 1850-1900 period as an approximation for pre-industrial global temperature, this choice results in a significant OVERESTIMATION of the total anthropogenic change in global mean surface temperature. In most case studies and many regional and global temperature reconstructions, the year 1750 marks the coldest phase of the Little Ice Age (LIA). The period 1850-1900 lies at the end of the LIA and is already slightly warmer. A meaningful approximation for „pre-industrial global temperatures“ has to represent an average temperature over a longer (late) Holocene time span, e.g. the last 2000 or 10,000 years (until 1850). The choice 1850-1900 does clearly not fulfil this criterion. See Lüning & Vahrenholt 2017 (doi: 10.3389/feart.2017.00104) for details. Furthermore it is dangerous to claim that even the pe-industrial warming 1750-1900 is associated with greenhouse gases. This is the idea of a minority of scientists, some of who happen to be part of the author group of this chapter. It is not ok to present personal beliefs as “consensus view” in an IPCC report. The majority of scientists view pre-industrial climate change to be fully driven by natural climate factors. A significant part of climate scientists also see “up to half” of the observed warming of the industrial era caused by natural climate drivers. [Sebastian Luening, Switzerland]	Rejected / Taken into account (partly). A baseline is needed against which to quantify temperature and other changes. 1850-1900 was selected prior to AR6 as an "approximation" of pre-industrial climate. Cross-section box TS.1 includes a statement about the 18th century being the coldest globally of the Holocene. The amount of warming to attribute to humans since that time is a different issue, which is addressed by multiple lines of evidence in this report.
18899	22	43	22	44	I see that many are unaware of the reasons for using anomalies rather than absolute values in climate change literature. The reasons may be very briefly discussed here. [Govindasamy Bala, India]	Noted. This topic is discussed in Section 1.4.1 but is not included here in the TS.
97567	22	45	22	46	We do not understand the sentence "The term ‘baseline’ implies a period against which anomalies are calculated, whereas a ‘reference period’ could include a transient state.", please reformulate. See also our comments on 1.4.1 and Cross-Chapter Box 1.2. [Nicole Wilke, Germany]	Noted. Text has been reformulated here and in Section 1.4.1.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
100397	22	48	22	49	This paragraphs should refer to {Atlas.2.1} section [Lincoln Alves, Brazil]	Taken into account. This section has been deleted. Baselines are however introduced in a footnote and in the new Core Concepts Box TS.1. The reference to the Atlas has been added
26265	22	51	22	53	Table TS.4 is cited twice, maybe it is a bit redundant. [María Santolaria-Otín, France]	Not applicable. Section has been deleted.
97569	23	1	23	4	"Mean global temperature during the 1850-1900 period has often been used as a pragmatic approximation for pre-industrial global temperature, but it is more likely than not that this choice results in a slight underestimation of the total anthropogenic change in global mean surface temperature (GMST)." This statement is of high political significance and needs to be contextualized: What does this mean for information from climate models for specific warming levels, is this information considered in risk assessment, and what does it mean for climate policy targets? [Nicole Wilke, Germany]	Noted. This topic is discussed in Cross-Chapter Boxes 1.2 and 2.3, and the text has been reworded here.
113769	23	1	23	6	It may be confusing to the reader that we speak about the two temperature metrics here. I wonder if we should include a few lines a bit earlier saying there are two metrics used, what they are, and then refer to the box. We need to consider carefully how to communicate this. [Jan Fuglestedt, Norway]	Noted. Topic is discussed in TS Cross-section box 1.
84549	23	8	23	27	not clear why all these details about pre-industrial raditive forcing in this section dedicated to the introduction/definition of baselines and reference periods [Annalisa Cherchi, Italy]	Noted. Text has been moved.
29561	23	13	23	14	This statement "there was a cooling influence from increased anthropogenic aerosol emissions" is not necessarily true because of uncertainty in aerosol forcing, (for example, as demonstrated in Smith and Bond 2014, Figure 4. doi:10.5194/acp-14-537-2014). After about 1920 it is very likely that there was aerosol cooling, but this is not the case before 1900. Note that the uncertainty in this era is even larger than illustrated in Smith and Bond 2014 since uncertainty in emissions levels was not considered. This is very high for BC/OC emissions, which can be a dominant aerosol forcing in this time period (depending on the relative forcing per unit emissions). [Steven Smith, United States of America]	Noted. The assessment of aerosol forcing over this period is given in Chapter 7 and Cross-Chapter Box1.2 and shows a cooling.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
29563	23	21	23	22	This "This warming influence was at least partially offset by a cooling influence from anthropogenic aerosol emissions." therefore also needs to be qualified. We cannot say with much certainty that this is true. (e.g., the words "was at least partially offset" imply more certainty than exists.) [Steven Smith, United States of America]	Noted. The assessment of aerosol forcing over this period is given in Chapter 7 and Cross-Chapter Box 1.2 and shows a cooling.
111183	23	22	23	23	"The net increase of GMST ... is likely -0.1 to 0.2", so, it is not only increase, but rather estimated change of GMST [Volodymyr Osadchy, Ukraine]	Noted. Wording has been changed.
40613	23	27			one could specify which section of the figure does correspond to GMST: "...is shown in Figure TS.2, panel b" [TSU WGI, France]	Noted. Figure has been replaced with new Figure TS.1. Number of panels have been reduced.
113771	23	30	24	40	Update the box according to revisions in Cross chapter Box 2.3 and include links to WGII and WGIII for implications and consistency. (Include here infographics that is being developed?) [Jan Fuglestedt, Norway]	Not applicable. Box TS.1, Table 1 was deleted from the Final Government Distribution Draft. The entire Box TS.1 on the Global Temperature Definitions does no longer appear in the revised FGD. We refer to "TS Cross-Section Box TS.1: Global Surface Temperature Change" and "Chapter 2, Cross-Chapter Box 2.3: New estimates of global warming to date and key implications" for an in-depth assessment.
100001	23	31			Comments related to this area was given in the SPM. The AR5 has assessed historic warming between the 1850-1900 and the 2003-2012 period to be 0.78°C. Now historic warming until 1995-2014 is assessed to be 0.91°C. A better explanation is required on the need for the change and how it affects the previous agreements made based on AR5 and country's are expected to continue their tracking process. This may cause confusion with different metric being used based on preferences, therefore a clear link needs to be made with the new metric and the previous metric highlighted in AR5. [Caroline Eugene, Saint Lucia]	Taken into account. Text in "TS Cross-Section Box TS.1: Global Surface Temperature Change" revised to better explain the changes and the reasoning behind. See "Chapter 2, Cross-Chapter Box 2.3: New estimates of global warming to date and key implications" for an in-depth assessment.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
84143	23	31			A line of sight is required to show the differences in how global mean temperature is treated. What is presented here is different to how historic warming was assessed in AR5. Information that will be used to inform the Paris Agreement needs to be provided in the same metric to what was assessed in AR5. This would allow better tracking progress. [Jeffers Cheryl , Saint Kitts and Nevis]	Taken into account. Assessment has been updated in the FGD. Changes in GMST and GSAT over time differ by at most 10% in either direction (high confidence), but conflicting lines of evidence from models and direct observations, combined with limitations in theoretical understanding, lead to low confidence in the sign of any difference in long-term trend. Therefore, long-term changes in GMST/GSAT are presently assessed to be identical, with expanded uncertainty in GSAT estimates. See "TS Cross-Section Box TS.1: Global Surface Temperature Change" and "Chapter 2, Cross-Chapter Box 2.3: New estimates of global warming to date and key implications" for an in-depth assessment.
39985	23	32	24	38	Box TS.1 There are no braces ({} showing lines of sight for this box, despite having calibrated language. [TSU WGI, France]	Taken into account. Lines of sight added in new "TS Cross-Section Box TS.1: Global Surface Temperature Change". Former Box TS.1 on the Global Temperature Definitions and related Box Table 1 do no longer appear in the revised FGD.
106033	23	32	24	38	There are several confidence statements in Box TS.1 that do not identify the basis for the confidence statements. They should at least state that the confidence is based on expert judgment, if that is the case, or identify the basis for confidence. Earlier statements referred to specific chapters and sections in the WG1 report for the confidence statements, but that does not occur here. [William Gutowski, United States of America]	Taken into account. Lines of sight added to new "TS Cross-Section Box TS.1: Global Surface Temperature Change". We refer to "Chapter 2, Cross-Chapter Box 2.3: New estimates of global warming to date and key implications" for an in-depth assessment.
19583	23	32	24	40	The situation is that we have both here this Box TS.1 "global temperature definitions", and in chapter 2 the CBox 2.3 "Surface temperature metrics - Global Mean Surface Temperature or Global Surface Air Temperature?" addressing the same issue with a lot of duplication, without any mutual reference. This must be corrected. A single box is certainly adequate, and will avoid to confuse the reader. [philippe waldteufel, France]	Taken into account. Text in "TS Cross-Section Box TS.1: Global Surface Temperature Change" refers now to "Chapter 2, Cross-Chapter Box 2.3: New estimates of global warming to date and key implications" for an in-depth assessment.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
89449	23	32			The GSAT vs. GMST issue is not the key problem here. It is the change in the GMST metrics since the AR5, as an attempt to resolving the blended-masking issue. Therefore, there is not traceability to the AR5 and thus the PA. I commented on this in great detail on Box SPM2. But this box might be a good place to discuss it further. [Carl-Friedrich Schleussner, Germany]	Taken into account. The distinction between GMST and GSAT has been reassessed as part of the revisions for the FGD in Chapter 2, Cross-Chapter Box 2.3: New estimates of global warming to date and key implications. This is summarized in the new TS Cross-Section Box TS.1: Global Surface Temperature Change. The impacts of new and revised estimates of GMST change and their impact is more clearly articulated across 2.3.1.1 and Cross-Chapter Box2.3 and necessary details elevated to the Cross-section box in the revised TS.
6387	23	34	23	34	"Observed" should not be used here, as the global surface temperature as defined is not something that is observed. It is something that is estimated from observations of SST and screen-level temperature over land. The sentence should be rewritten to reflect this. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Text in new TS Cross-Section Box TS.1: Global Surface Temperature Change revised accordingly.
15303	23	34	23	36	This is probably addressed in the underlying chapter, but what is the contribution to GMST for regions where seaice is present? The text here implies that SST (i.e. approx -1.8 degrees under seaice) would be used, but I don't think that this is the usual definition of GMST. For regions of seaice, I would expect seaice-surface temperature or near-surface air temperature to be used. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. The revised Cross-Chapter Box2.3 text includes a discussion and assessment of this issue in making the new assessment of GMST / GSAT differences
131933	23	34	23	39	The glossary definition is more nuanced 'near-surface air temperatures over land and sea-ice and SST over ice-free ocean regions' [Hans Poertner and WGII TSU, Germany]	Taken into account. Text in "TS Cross-Section Box TS.1: Global Surface Temperature Change" revised accordingly.
131935	23	35	23	35	Specify at what height is SST taken? [Hans Poertner and WGII TSU, Germany]	Taken into account. Text in "TS Cross-Section Box TS.1: Global Surface Temperature Change" revised accordingly.
131937	23	36	23	36	ESM - spell out acronym [Hans Poertner and WGII TSU, Germany]	Taken into account. Text in "TS Cross-Section Box TS.1: Global Surface Temperature Change" revised accordingly. ESM not used in the new box.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97571	23	38	23	39	Please explain why the implicit assumption of equivalence of GSAT and GMST was justified in earlier reports until 2019 but is no longer now in 2020, and why the difference changes over time. We strongly urge the authors to provide such of high policy relevance information in the SPM as well. In addition, 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. The distinction between GMST and GSAT has been reassessed as part of the revisions for the FGD in Chapter 2, Cross-Chapter Box 2.3: New estimates of global warming to date and key implications. This is summarized in the new TS Cross-Section Box TS.1: Global Surface Temperature Change.
6389	23	43	23	43	The statement "there is none for GSAT" is incorrect. Reanalyses are observational datasets that provide GSAT. The observations that are used to form reanalysis datasets are more numerous than used to produce a GMST dataset such as HadCRUT5, and much more complex (though physically based) models are used to spread information into unobserved regions. Formally, however, both reanalyses and the HadCRUT5 type of dataset are analyses (or syntheses) of observations. The reference to reanalyses later in the paragraph implies that they are not observational datasets, whereas datasets of the HadCRUT5 type are observational. See also comment 8 on the entire report. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. The distinction between GMST and GSAT has been reassessed as part of the revisions for the FGD in Chapter 2, Cross-Chapter Box 2.3: New estimates of global warming to date and key implications. This is summarized in the new TS Cross-Section Box TS.1: Global Surface Temperature Change.
10903	23	43	23	53	The evidence of there being a significant effect to be accounted for between the definitions of "GMST" and "GSAT" is almost entirely based on the Cowtan (2015) study, or from studies that use data/analysis/code produced by that study. I have tried to look at this issue, and believe nuances in modelling and observational datasets can be overlooked and lead to over-confident statements about the differences between "GMST" and "GSAT" (Jones, 'Apples and oranges': on comparing near surface temperatures from climate models with observations, submitted Q.J.R. Meteorol. Soc., 2019). More studies, that have independently looked at this issue, are needed for a robust assessment to be made. Given the lack of critical assessment, the high amount of confidence given to the "4%" factor to be applied to "GMST" to get to "GSAT" is misplaced. [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. The distinction between GMST and GSAT has been reassessed as part of the revisions for the FGD in Chapter 2, Cross-Chapter Box 2.3: New estimates of global warming to date and key implications. This is summarized in the new TS Cross-Section Box TS.1: Global Surface Temperature Change.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
34777	23	43	24	36	It is extraordinary that the SOD has adopted the artificially-derived Global Mean Air Temperature (GSAT), for which no dataset exists. Please see comment #1 above. [Jim O'Brien, Ireland]	Noted. No change suggested.
18901	23	46	23	47	The reason for GSAT increasing faster than GMST? This may be briefly discussed as this is scientifically interesting. [Govindasamy Bala, India]	Taken into account. Assessment has been updated in the FGD. Changes in GMST and GSAT over time differ by at most 10% in either direction (high confidence), but conflicting lines of evidence from models and direct observations, combined with limitations in theoretical understanding, lead to low confidence in the sign of any difference in long-term trend. Therefore, long-term changes in GMST/GSAT are presently assessed to be identical, with expanded uncertainty in GSAT estimates. See "TS Cross-Section Box TS.1: Global Surface Temperature Change" and "Chapter 2, Cross-Chapter Box 2.3: New estimates of global warming to date and key implications" for an in-depth assessment.
10905	23	56	24	2	There is at least one study that deduces that the 'effect' is not that important for historical temperature analysis, especially when compared to all the other observational, modelling and analysis uncertainties (Jones, 'Apples and oranges': on comparing near surface temperatures from climate models with observations, submitted Q.J.R.Meteorol. Soc., 2019). [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. The distinction between GMST and GSAT has been reassessed as part of the revisions for the FGD in Chapter 2, Cross-Chapter Box 2.3: New estimates of global warming to date and key implications. This is summarized in the new TS Cross-Section Box TS.1: Global Surface Temperature Change.
87287	23	56	24	2	The assessed increase in surface air temperature is higher than in previous reports (even if comparing the same periods). Only a fraction of the difference can be explained by the new concept GSAT instead of GMST (about 0.04C). The largest difference of about 0.1C is due to dataset innovations and new products referring to Ch.2 (p.36 l.27 - p.36 l.31). This is a very policy relevant statement, as it brings us in fact closer to 1.5C of global warming. The explanation should be summerized in the TS and Chapter 2 (summary) as well (now missing). It is by far not clear whether the reassessment or innovations of global surface air temperatures are in ocean temperatures or in land temperatures (or both). [Marcel Berk, Netherlands]	Taken into account. The distinction between GMST and GSAT has been reassessed as part of the revisions for the FGD in Chapter 2, Cross-Chapter Box 2.3: New estimates of global warming to date and key implications. This is summarized in the new TS Cross-Section Box TS.1: Global Surface Temperature Change. The contribution of new and updated knowledge about GMST historical changes is now more clearly highlighted in both places.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97573	24	1	24	2	We appreciate the progress of scientific knowledge that allows for a more robust assessment of historical warming. However, this re-assessment needs to be carefully communicated to non-experts and the reasons need to be well explained to avoid a loss of confidence in other fundamental statements of the IPCC. We strongly encourage the authors to include such information in the SPM. Furthermore, the TS lacks such information. Currently, it mentions the additional 0.1°C one subordinate clause in TS-24-1 noting succinctly that it results from "combined effect of dataset innovations and new products since the AR5". Please add an entire section with a detailed explanation of this shift in historical warming and provide information on the implications of the change for information from climate models for specific warming levels, for risk assessments, and for climate policy targets. This information will be needed and it cannot be provided by non-experts including policy makers. Please identify a temperature "AR5-temperature" that is consistent with the one provided in AR5 and thus in the context of the Paris Agreement. [Nicole Wilke, Germany]	Taken into account. The distinction between GMST and GSAT has been reassessed as part of the revisions for the FGD in Chapter 2, Cross-Chapter Box 2.3: New estimates of global warming to date and key implications. This is summarized in the new TS Cross-Section Box TS.1: Global Surface Temperature Change.
131939	24	1	24	7	Could you rewrite to clarify what the definition gap is and the hybrid approach shown in Figure Box TS.1 Figure 1 [Hans Poertner and WGII TSU, Germany]	Not applicable. Box TS.1, Figure 1 was deleted from the Final Government Distribution Draft. The entire Box TS.1 on the Global Temperature Definitions does no longer appear in the revised FGD. We refer to "TS Cross-Section Box TS.1: Global Surface Temperature Change" and "Chapter 2, Cross-Chapter Box 2.3: New estimates of global warming to date and key implications" for an in-depth assessment.
97575	24	4			Please explain what is meant with "switchover". [Nicole Wilke, Germany]	Taken into account. Term deleted from new "TS Cross-Section Box TS.1: Global Surface Temperature Change". Former Box TS.1 on the Global Temperature Definitions does no longer appear in the revised FGD.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
55457	24	4			Not clear what is meant with "switchover". [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Term deleted from new "TS Cross-Section Box TS.1: Global Surface Temperature Change". Former Box TS.1 on the Global Temperature Definitions does no longer appear in the revised FGD.
97577	24	13			There is no table in Box TS.2. Is it rather Box TS.1 Table 1? But this table does not highlight key aspects. Please clarify. [Nicole Wilke, Germany]	Not applicable. Box TS.1 on the Global Temperature Definitions does no longer appear in the revised FGD.
10907	24	29	24	40	It should be noted that the uncertainties on GSAT overlap with the estimates of GMST. Significant difference? [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. The distinction between GMST and GSAT has been reassessed as part of the revisions for the FGD in Chapter 2, Cross-Chapter Box 2.3: New estimates of global warming to date and key implications. This is summarized in the new TS Cross-Section Box TS.1: Global Surface Temperature Change. Former Box TS.1 on the Global Temperature Definitions and related Box Table 1 do no longer appear in the revised FGD.
10909	24	29	24	40	Are the uncertainties on the "multi-model means" or are they the ensemble uncertainties? That should be made clear. [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. Former Box TS.1 on the Global Temperature Definitions and related Box Table 1 do no longer appear in the revised FGD.
10911	24	29	24	40	There is something odd about the "Multi-model mean" numbers. The GSAT uncertainty ranges are symmetric around the mean, but the GMST are not. [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. Former Box TS.1 on the Global Temperature Definitions and related Box Table 1 do no longer appear in the revised FGD.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
131941	24	31	24	38	Box TS.1 Table 1 - could you add the examples of the policy relevant GMST 1.5 and 2C - their levels for GSAT and also point the reader to Table TS.5 [Hans Poertner and WGII TSU, Germany]	Not applicable. Box TS.1, Table 1 was deleted from the Final Government Distribution Draft. The entire Box TS.1 on the Global Temperature Definitions does no longer appear in the revised FGD. We refer to "TS Cross-Section Box TS.1: Global Surface Temperature Change" and "Chapter 2, Cross-Chapter Box 2.3: New estimates of global warming to date and key implications" for an in-depth assessment.
40531	24	36	24	36	missing °C in first line :1.06°C (0.95 – 1.17°C) [TSU WGI, France]	Taken into account. Editorial change made in new "TS Cross-Section Box TS.1: Global Surface Temperature Change". Former Box TS.1 on the Global Temperature Definitions and related Box Table 1 do no longer appear in the revised FGD.
6391	24	36	24	36	"Observed warming" could be replaced by "Estimated warming". The numbers presented are estimates made using observations. GMST and GSAT are not observables. Also, the choice of three GMST datasets used here can be questioned. One of them is in essence an update of another of them. The Cowtan and Way dataset is a spatially extended version of HadCRUT4; HadCRUT5 is an updated version of HadCRUT4 that incorporates spatial extension. Moreover, the third dataset, Berkeley Earth, is based on the same SST dataset as Cowtan and Way. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Text in new "TS Cross-Section Box TS.1: Global Surface Temperature Change" revised accordingly.
11035	25	1	25	7	elevated CO2 forcing is also very important for EECO [Robert Kopp, United States of America]	Taken into account. Table has been removed. CO2 concentration during EECO is now listed in Box TS.2.
11037	25	1	25	7	2081-2100 and post-2100 are also relevant for adaptation -- infrastructure can last for a century or more [Robert Kopp, United States of America]	Taken into account. Table has been removed. Climate beyond 2100 considered in other sections of TS
19585	25	1	25	8	It is recommended to add in table TS.4 the period named "historical period", as well as near-, mid- and long-term; see SPM P2, footnote 3. Possibly, this note should then refer preferentially to the table under discussion and perhaps to nothing else... [philippe waldteufel, France]	Noted. But Table has been removed.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
10913	25	1	25	8	I strongly discourage the use of "Medieval Warm Period" and "Little Ice Age". They are inaccurate terms, and puts in the readers mind that it was warm/cool uniformly over some ill defined periods (Neukom et al., "No evidence for globally coherent warm and cold periods over the preindustrial Common Era", Nature 2019). At the very least ditch "MWP" that was gotten rid of in the last assessment report. [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. As explained in Cross-Chapter Box2.1, Table 1 footnote, these terms have been deprecated in the WG1 report in favour of specific ages. These terms are, however, widely used in the literature and are an appropriate characterization for some times in some regions.
10915	25	1	25	8	I recommend checking with chapter 3 (3.3.1.1) to see what "Characteristic climate forcings" are actually associated with the inaccurate terms "MWP" and "LIA". Solar is more or less excluded now, and GHGs play a bigger role than previously thought (Schurer et al (2014). [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Table has been removed.
10917	25	1	25	8	"Pre-industrial" has "Characteristic climate forcings" of "None" but 1750 is in the middle of 1450-1850, which apparently has "Volcanic and Solar" "Characteristic climate forcings". Uhm? [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Table has been removed.
131943	25	1			Table TS.4 please add an explanation of acronyms to the table caption: Ma, ka, CE [Hans Poertner and WGII TSU, Germany]	Taken into account. Table has been removed. Ma, ka are avoided. CE is defined in the Glossary
131945	25	1			Table TS.4 the near-term will overlap with present when the reports are approved in 2021-2022 [Hans Poertner and WGII TSU, Germany]	Noted. But these periods were agreed when WGI submission was going to be in 2020.
83573	25	5	25	5	The footnote from Chapter 2 explaining the meeting of ka and Ma should be included in the table header, especially since the TS is aimed for a broad readership. [Antje H. L. Voelker, Portugal]	Taken into account. Table has been removed. Ma, ka are avoided. CE is defined in the Glossary
100551	25	6	25	6	Add to Table TS.4 "16.9-14.7 Ma; Carbon cycle: Major transfer of C from atmosphere to lithosphere; Paleogeography: Different continental margins and ocean gateways" [Matthew Kohn, United States of America]	Taken into account. Table has been removed. The Miocene Climatic Optimum is now included as a paleoclimate reference period in Cross-Chapter Box2.1, Table 1.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
15305	25	6	25	6	I don't think it's correct that the EECO was warm due to "Paleogeography: Different continental margins and ocean gateways". My understanding is that the EECO was warm (whether relative to the pre/post EECO, or relative to present-day) primarily due to elevated CO2 concentrations. Similar to the PETM, but on longer timescales. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Table has been removed. Brief discussion of forcings during EECO and PETM are included in Cross-Chapter Box2.1.
15307	25	6	25	6	"Carbon cycle and paleogeography: Minor difference relative to now". This is not clear. "now" is not clear. Maybe use "the period 2010-2020" or something to make this clearer. Also, maybe add "CO2 concentrations elevated relative to preindustrial". I would suggest: "CO2 concentrations elevated relative to preindustrial but similar to period 2010-2020. Paleogeography very similar to today." [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Table has been removed. Brief discussion of forcings during paleoclimate reference periods are included in Cross-Chapter Box2.1.
15309	25	6	25	6	"Orbital: Enhanced high-latitude summer insolation". Need to add "Northern Hemisphere" somewhere. Also for time periods below this in the table. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Table has been removed. Brief discussion of forcings during paleoclimate reference periods are included in Cross-Chapter Box2.1.
15311	25	6	25	6	LGM: The orbit is very similar to today. The key climate forcing is the low CO2 and larger ice sheets. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Table has been removed. Brief discussion of forcings during paleoclimate reference periods are included in Cross-Chapter Box2.1.
15313	25	6	25	6	MPWP and LIA: land-use change are also potentially important forcings. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Table has been removed. Brief discussion of forcings during paleoclimate reference periods are included in Cross-Chapter Box2.1.
15315	25	6	25	6	For the paleo time periods, for the final column it needs to be made clear what the forcings are referenced to. e.g. preindustrial, or today, or the period just before the event? [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Table has been removed. Brief discussion of forcings during paleoclimate reference periods are included in Cross-Chapter Box2.1.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
40665	25	6	25	6	Question on the orbital forcing (it should be astronomical forcing, correct?) and could you please explain what is the reference used to describe NH summer insolation changes (present day?). Note : the minimum of NH summer insolation is not at 19-21 ka but around 25 ka. I suggest to refer to NH summer insolation as one example of astronomical forcing as other aspects matter too (e.g. obliquity...). [TSU WGI, France]	Taken into account. Table has been removed. Brief discussion of forcings during paleoclimate reference periods are included in Cross-Chapter Box2.1.
6393	25	6	25	6	What does the asterix in the column heading "Age/year" signify? Is a footnote missing? [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Table has been removed.
97579	25	6	25	7	Table TS.4: The period post-2100 is also highly relevant for mitigation decisions since it provides information on long term, irreversible change and tipping points. Please replace the current box in the lower right of the table by "To inform mitigation decisions and some risk management strategies" [Nicole Wilke, Germany]	Noted. Table has been removed.
557	25	6	25	7	I am embarrassed with the wording used 4 lines before the end of the table : Why Chosen? For the period 2021-2040. I think it would be better to write "to inform short term adaptation and mitigation decision". During that period, the decisions dealing with mitigation are of utmost importance! [Michel SIMON, France]	Noted. Table has been removed.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97581	25	6	25	7	Table TS.4: We suggest to revise the explanations in the column "Why chosen" for the future time periods. As pointed out in recent IPCC reports, e.g. SR1.5, SROCC and SRCCL, the near-term future is of great importance both for adaptation AND mitigation. We disagree that the near-term future is only relevant to "inform short term adaptation decisions", since it could be perceived as if mitigation is not important in the near-term. Vice-versa, the same is true for the explanation regarding the long-term future, because the changes in the long-term are also relevant for adaptation decisions of today. Instead these explanations why certain time periods are chosen we recommend to provide linkages to time frames commonly used by policymakers in national and international contexts including the UNFCCC, e.g. near-term refers to 2030 in many policies, long-term goals are made for 2050 or beyond. Please see also our general comment on naming time periods on the Entire report. [Nicole Wilke, Germany]	Noted, but Table has been removed.
130349	25	6	25	7	Continuing to characterize 2081 -2100 as the long-term future and using this period to inform mitigation decisions, but not adaptation strategies, has its shortcomings. 2081 is only 60 years in the future. Built infrastructure will often remain in place for over 60 years so upfront strategies for adaptation if there is a high potential for climate change impacts should likely be considered for the period between 2020-2120. [Trigg Talley, United States of America]	Noted. Table has been removed.
54773	25		25		Table TS.4: Support inclusion of this table as it is a useful reference of the various reference periods used in the TS. However, the decision to state that mitigation decisions alone are the reason for considering the late century time period (2081-2100) is puzzling. Strongly recommend also including here that this period is chosen to inform risk management strategies. [Nancy Hamzawi, Canada]	Noted. Table has been removed.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
87045	26	1	48	46	Chapters TS2 is named "Large scale climate change", and is divided into various large-scale components of the climate system; oceans, cryosphere, water cycle and carbon cycle. We miss separate mention of the land-component or "living world"-component in addition, which was successfully analysed in the SRCL. The "living world"-component resists simple labels such as "drivers of climate change" or components of the climate system, in contrast to oceans and carbon cycle. Rather it is both a driver of climate change, it is impacted by climate change and an area for adaptation and mitigation option. Further, the (actual and potential) role of the living world component does not fit with the the "large scale climate change"-approach in chapter TS2, but must be understood less aggregated from the small scale. Crucially, this is not a single compartment that can be distinguished from others, such as the ocean, rather the land and living world component is characterized by interconnections (of water cycles, carbon cycles, biogeophysical forcings/feedbacks and every other basis for our existence). We therefore think the "large scale" approach in TS2 should be supplemented with perspectives on the land- and living world component, in a less aggregated perspective, and where the interconnections are also introduced. Such perspectives of the "living world domain" should include perspectives on, inter alia, land use, vegetation greening, vegetation browning, the state of world's soils. [Oyvind Christophersen, Norway]	Taken into account. We restructured TS2, and in particular added a land section that contains a substantial amount of findings from this report, and draws on SRCL where necessary. The ocean section (now TS2.4) symmetrically summarizes findings about the ocean biosphere.
40469	26	1		22	It seems that the biosphere is missing as a driver; it could be mentioned together with carbon cycle. [TSU WGI, France]	Taken into account. Land use change as driver is now treated in a separate paragraph in TS2.2 (Drivers).
113773	26	3	26	3	Not sure if "summarizes knowledge" is the right formulation of what TS does. Sounds more like a review and TS does more than that. "Summarizes and integrates the outcome of the assessment" or something like that may be better. [Jan Fuglestedt, Norway]	Rejected. In the interest of saving space, and because Technical Summary indicates that this is a summary, we would like to keep this formulation.
55459	26	3	26	10	Only the first sentence mentions attribution although it is assessed alongside observations and projections throughout the section. This should be made clear in every sentence that mentions observations and projections. This is a major new development of AR6 that these three lines of evidence are assessed together so this should be highlighted not hidden. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Attribution is mentioned more prominently in this revised first paragraph.
15321	26	13	27	53	I am surprised that (albedo and surface properties due to) land-use change is not listed here as one of the key drivers of climate change. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Land use change as driver is now treated in a separate paragraph in TS2.2 (Drivers).

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
39685	26	13	27	54	TS2.1 : no mention of land use as a driver? [TSU WGI, France]	Taken into account. Land use change as driver is now treated in a separate paragraph in TS2.2 (Drivers).
130593	26	13			P.26,line 13, TS.2.1: "changes in drivers of global change" should be "changes in drivers of global climate change". [Panmao Zhai, China]	Taken into account. The revised title is "Changes in the Drivers of the Climate System"
78913	26	15	26	22	Are the drivers not the emissions of GHG rather than the concentrations of GHGs which are the net effect of the emissions - the feedbacks? [Pedro Monteiro, South Africa]	Rejected. In the TS we follow Chapter 2, which considers the physical drivers of the climate system. Emissions as drivers follow the socio-economic aspects
39921	26	15	26	22	A schematic could be added to illustrate the processes described here. This might help a technical but non-expert reader understand better what comes next in the chapter [TSU WGI, France]	Rejected. For reasons of page-length we have not added such a figure; however the new Figure 2.9 shows ERF of the physical drivers
19587	26	21	26	22	What is written does not correspond to section 2.5; possibly to section 2.6 [philippe waldteufel, France]	Rejected. The references to other section was removed.
34779	26	24	26	34	The SOD claims that the rate of increase in CO2 in the Industrial Era is 10 times higher than at any other time in the last 66m years. Is this a relevant fact as the paleoclimate saw CO2 levels multiples of those now prevailing? [Jim O'Brien, Ireland]	Taken into account. Atmospheric concentrations of CO2 during the past are featured in several places, including Figure TS.1 and Box TS.2.
97583	26	25	26	27	The statement on the concentration increase since the preindustrial (absolute and relative numbers) with very high confidence is very helpful for policymakers. We suggest to rise this statement into SPM. [Nicole Wilke, Germany]	Accepted. Statement on pre-industrial concentrations of GHG is included in FGD of SPM (HS.2)

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
15459	26	25	26	28	According to the WMO Greenhouse Gas Bulletin 2019 (https://library.wmo.int/doc_num.php?explnum_id=10100), the atmospheric carbon dioxide concentration in 2018 was 407.8 ppm. There is a slight discrepancy if rounded figure is considered. Also, according to the Bulletin, the atmospheric methane concentration in 2018 was 1869 ppb. Please check and consider revision of the text as appropriate. [SAI MING LEE, China]	Rejected. The values of CO ₂ , N ₂ O, and CH ₄ were taken from the assessment in Chapter 2, which is based on multiple data sources including the WMO Greenhouse gas bulletin. Therefore small differences maybe possible.
83575	26	25	26	49	Even if ka and Ma are used in the Table on p. 25, I recommend to write 800 000 years instead of 800 ka and 3.5 million years instead of 3.5 Ma, because it will be easier to read and understand for a broad readership (like stakeholders). Writing out ka/Ma as years was done in several AR6 chapters, especially in Chapter 1. [Antje H. L. Voelker, Portugal]	Accepted. While the text generally has spelled out thousands and millions, figures for conciseness have used the ka, ma notation
559	26	31	26	32	"There have been times in Earth's history when CO ₂ concentrations were much higher than at present,..." OK with that, but it could be mentioned that this occurred at a time where humans did not exist on the earth, and so there was no consequences for the mankind. [Michel SIMON, France]	Rejected. Focus here is on quantifying levels of GHG. Influence for past GHG and climate changes on humans and biosphere is taken up by WGII.
97585	26	31	26	34	"There have been times in Earth's history when CO ₂ concentrations were much higher than at present, but multiple lines of evidence show with medium confidence that the rate at which CO ₂ increased in the atmosphere during the Industrial Era has been at least 10 times higher than at any other time during the last 66 million years." Why is the level of confidence only medium? Is it because of the long time period or because of the multiplier? Please consider a revised formulation with higher confidence or provide confidence levels for both the time period and the multiplier. [Nicole Wilke, Germany]	Taken into account. FGD states that CO ₂ concentrations are unprecedented in at least 2 million years (high confidence). Uncertainty in quantifying rate of change back to 66 million years is considered in Section 2.2.3.
55461	26	32			define "much" [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Specific reference to levels of 2 million years ago has been made
26267	26	37	26	38	"ppb yr-1", yr-1 is in a different font [María Santolaria-Otín, France]	Accepted.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
84551	26	47	26	55	Fig TS.11 has very small figures and lot of text. Maybe it could be simplified with more text in the caption and larger plots [Annalisa Cherchi, Italy]	Accepted. The amount of figures has been reduced, and text has been added to the figure
26269	26	47	26	55	Figure TS.11: in b) Text: include space between +- and 0.5Wm-2. [María Santolaria-Otín, France]	Accepted. The text has been modified and doesn't include this number
130351	26	48	26	55	In figure TS.11 caption, some 'changes' are capitalized and some are not. [Trigg Talley, United States of America]	Accepted. Figure caption has been modified.
81045	26		26		Large Scale Climate Changes. The section would benefit from having an additional section on the Biosphere addressing some of the biospheric indicators in Ch2 and perhaps additional from other chapters, understanding that there is already quite a bit in the section of water cycle and carbon cycle. I think it would be best to have an independent section, and no mix with the C cycle which would make the justification of the mix bag of information harder. [canadell pep, Australia]	Taken into account. We introduced a land section.
97587	27	3	27	7	"Definition gap" should be explained. What does that gap mean? [Nicole Wilke, Germany]	Taken into account. The revised text does not use this expression.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97589	27	3			Please write out "CFCs, HCFCs, HFCs". These abbreviations are used here for the first time in the TS. [Nicole Wilke, Germany]	Rejected. For severe page restrictions we refer to section 2.2.4 and 6.2.2 for full names of these abbreviations.
84553	27	4	27	4	produced since "industrial revolution" but estimates of increase given only for 2011-2018 [Annalisa Cherchi, Italy]	Acknowledged. For page limitations, we have focused on the change since the AR5 assessment.
84557	27	9	27	16	if aerosols are considered in TS.3 maybe details here are useless. Better to reduce as much as possible repetitions [Annalisa Cherchi, Italy]	Rejected. The inclusion of ERF from aerosol warrant the discussion of aerosol
84555	27	13	27	14	"these trends are more pronounced yet in fine-mode AOD": what does it mean? [Annalisa Cherchi, Italy]	Acknowledged. Fine mode aerosol is found below 1 micrometre, a size range which is interacting strongly with UV/VIS radiation. We have changed this into sub-micrometre aerosol
55463	27	14			fine-mode AOD is very jargony [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Acknowledged. Changed to sub-micrometre aerosol
113777	27	15	27	50	Why use "2010-2019" on line 49 but "2009-2018" on line 15? Make even more clear that this is the human induced part. [Jan Fuglestad, Norway]	Taken into account. We use consistently 2010-2019 in the revised text.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
55465	27	26	27	33	This doesn't seem to belong here (at least it doesn't follow logically) but seems to belong to the last paragraph on the page (41-53) [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Reject. The logics is that O3 and OH are intimately coupled through photochemistry, and changes in O3 are also affecting OH.
112907	27	41	27	53	Is this paragraph not rather redundant with the preceding ones? [Johannes Quaas, Germany]	Accepted. Elements of this paragraph have been integrated with previous text
78915	27	41	27	53	Perhaps the most unusual aspect of this period are the rates of change rather than the concentrations - Chapter 5 [Pedro Monteiro, South Africa]	Acknowledged. Rates of change are highlighted in the text.
113775	27	41	27	53	This para contains repeated messages from paragraphs in same section. [Jan Fuglestedt, Norway]	Accepted. Elements of this paragraph have been integrated with previous text
23539	27	41	27	53	Not only the unprecedented values of greenhouse gases, the unprecedented faster rate of the changes in these gases should be described. [Masaki Satoh, Japan]	Acknowledged. Rates of change are highlighted in the text.
39961	27	42	66	24	As TS2 is about "climate change", would suggest changing "Earth System" to "Climate System". [TSU WGI, France]	Accepted. Changed into climate system
97591	28	8	31	33	Section TS.2.2.1 provides information about GMST and GSAT, but is silent about the significance of the difference of this information when compared to the AR5 and the SR1.5. It is however essential for policy makers to receive this information. Please modify. [Nicole Wilke, Germany]	Taken into account. Cross-Section Box TS.1 addresses these points.
34781	28	10	28	22	Similarly is it of any consequence to claim that the last 4 decades have been the warmest since 1850 in view of past warmer times in the Minoan, Roman and Mediaeval Warming Periods, ignored in the SOD? Please see also general comments #1, #2 and #3 above. [Jim O'Brien, Ireland]	Noted. 1850 is the reference period for reporting temperature changes. Warming levels are reported for periods further back in time. Global temperatures over the past millennium are considered in Box TS.2.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
130595	28	17	28	19	"Temperatures have increased faster over land than over the ocean since 1850-1900, with warming to 2009-2018 of 1.44 °C (1.32 – 1.60 °C) versus 0.89 °C" this statement seems inconsistent with IPCC SRCCL. [Panmao Zhai, China]	Noted. The SRCCL assessment used a single dataset (which is the dataset which shows the strongest land warming). The difference with SRCCL is smaller in the final AR6 assessment (1.59).
104687	28	19	28	19	Add: "During the Miocene Climatic Optimum (16.9 to 14.7 Ma) GMST was 8.7±2.3 °C warmer;" [Matthew Kohn, United States of America]	Rejected. Length limitations preclude the inclusion of all paleo reference periods in the TS. MCO is included in more complete list of reference periods (Cross-Chapter Box 2.1)
55467	28	20			warmer should be higer [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. This text is no longer in the TS.
111191	28	27	28	28	There is anomalies of GMST at the panel (a) [Volodymyr Osadchy, Ukraine]	Accepted. Y-axis now labelled as "relative to 1850-1900"
84561	28	27	28	44	Fig TS.12 contains panel D about spatial differences in the warming that has not been referenced/considered in the text of section TS2.2.1 [Annalisa Cherchi, Italy]	Taken into account. This figure has been reframed to focus on Arctic amplification, which is discussed in TS4.
108587	28	27	28	45	This is for all figure captions. I like the 'purpose', but it's not clear if that's going to be in the final copy. I think with a slight rephrasing (or even without) it could and should be included. I also think it should be at the beginning. [Jason Donev, Canada]	Noted. Purpose of the "intent" information was to help the reviewer. It is not replicated in the final version, although it could indeed be useful.
55469	28	49	28	51	The first sentence here doesn't make sense. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. The corresponding text has been reworded.
131947	28	50	28	50	This is getting confusing, the range of 0.97-1.25 refers to GSAT? See line 15 above which gives time period of 2009-2018 [Hans Poertner and WGII TSU, Germany]	Taken into account. The corresponding text has been reworded.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
40371	28	51	28	51	I don't think drivers of emissions were used in AR5. Maybe a footnote could clarify this? Also, it would be helpful to think carefully about the term "driver" term in the WGI AR6 context, as well as how it will be used in WGII and III. This could be particularly important as we look forward to the SyR. [TSU WGI, France]	Noted. "Driver" and "Main driver" is quite clearly defined in Chapter 3, so it is difficult here to change the definition in the WGI context.
97593	28	51			Why is attribution of warming similar to the AR5 given that fact that there is so much more evidence? Please consider strengthening the statement [Nicole Wilke, Germany]	Noted. The assessment follows that of the underlying chapters.
55471	28	54			This reads as if the remaining uncertainty in the internal climate variability contribution is unchanged since AR5 which is in contrast to the findings in ch3 where it is stated that the uncertainty is reduced. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. The revised text in Cross-Section Box 1 does not give rise to this ambiguity.
97595	29	1			This consistency would be expected if ERF, ECS and TCRE would be obtained - at least partly - from GSAT as in past reports. It seems that in AR6 this is no longer the case and GSAT and ERF, ECS and TCRE are independent? Para starting from TS-29-50 seems to say the opposite. Please add a section to the TS where the reader can learn more about this. [Nicole Wilke, Germany]	Taken into account. The sentence has been revised for clarity in Cross-Section Box 1. For the sources of the assessment of ERF, ECS and TCRE, the reader is referred to TS3, in particular TS3.2.1. Very detailed information, however, can only be found in the full report (in particular Chapter 7) because of space constraints.
82605	29	4	29	4	Unclear whether this range is -0.7 to +0.2 or -0.7 to -0.2. [Blair Trewin, Australia]	Taken into account. Text clarified and numbers recalculated. The revised text (in Cross-Section Box TS.1) says: "...while aerosols and other anthropogenic forcings likely cooled global surface temperature by 0.0°C to 0.8°C. "

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
108585	29	10	24	29	This is for all figure captions. I like the 'purpose', but it's not clear if that's going to be in the final copy. I think with a slight rephrasing (or even without) it could and should be included. I also think it should be at the beginning. For example: The purpose of this figure is to summarize the natural and anthropogenic global climate forcings since... Then go on to say 'Attribution of GSAT evolution (left) and ... I think giving the purpose will help the reader understand why they're looking at what they're looking at, framing the figures more effectively for the entire report. Sadly many people really only look at the figures and figure captions. This framing would make this technical summary more effective for the actual readers. [Jason Donev, Canada]	Noted. Purpose of the "intent" information was to help the reviewer. It is not replicated in the final version, although it could indeed be useful.
113779	29	10	29	24	Figure TS.13 looks potentially very useful - but difficult to read due to low resolution. I suggest you develop this further by making it more clear visually that two different approaches are used. [Jan Fuglestedt, Norway]	Not applicable. This figure is no longer being used.
97597	29	11			Please define what an "emulator" is. [Nicole Wilke, Germany]	Taken into account. Emulators are defined in TS.1.2.2
54775	29	29	29	31	This short paragraph (comparing CMIP6 to CMIP5 for paleoclimate simulations) seems out of place and unconnected to the rest of the discussion on this page. Unclear what the core message being conveyed is. [Nancy Hamzawi, Canada]	Taken into account. Paleoclimate modelling is now mentioned in the Paleoclimate Box TS.2.
39959	29	30	29	30	As this is the first time the term MH is used in the main body text, it would be good to define -- mid-Holocene. [TSU WGI, France]	Not applicable. These abbreviations are no longer used in the text.
111193	29	30	29	30	Abbreviation MH and LGM are not clear [Volodymyr Osadchy, Ukraine]	Not applicable. These abbreviations are no longer used in the text.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
26271	29	30	29	30	Suggestion of write the whole name of the period, Mid-Holocen (MH) and Last Glacial Maximum (LGM) (even if they are describe in Table TS.4, it can make the reading easier) [María Santolaria-Otín, France]	Not applicable. These abbreviations are no longer used in the text.
113781	29	33	29	42	Observed GMST is compared with model results - which give GSAT. But nothing is mentioned about different metrics used. [Jan Fuglestedt, Norway]	Taken into account. A discussion of GMST and GSAT is now included in box TS1
84559	29	35	29	37	why sentence on ocean heat content here in this section? [Annalisa Cherchi, Italy]	Not applicable. This text is no longer being used in the TS.
55475	29	35			delete "tendency" [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. This text is no longer being used in the TS.
10923	29	37	29	38	It is not possible to do a true "like-for-like" comparison of simulated and observed GMST ('All models are wrong but some are useful' Box,1978). The phrase should not be used, as it gives the false impression that the way model and observations are compared are currently absolutely correct with no room for improvement, and that models can perfectly emulate the way the observations were measured. [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. The text still reports that the observational data sets lie within the 5-95% range of CMIP5 models (which is a statement of fact) but the additional sentence about consistency of models and observations is no longer in the text.
6395	29	38	29	38	Change "observed estimates" to "observational estimates". The estimates are not observed, they are values derived from observations. I would prefer the paragraph to start "The slower GMST increase inferred from observations" as GMST is not itself an observable, but this might be considered to be a bit cumbersome. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. "Observed" here is understood as a quantity derived from observations.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97599	29	38			"like-for-like comparison"? [Nicole Wilke, Germany]	Noted. This refers to the data sets being considered in equivalent ways, e.g. masking to match spatial coverage between the two.
15461	29	41	29	41	It has been confirmed by WMO that 2015-2019 is the hottest five-year period on record (Ref.: https://public.wmo.int/en/media/press-release/wmo-confirms-2019-second-hottest-year-record). Please consider revision. [SAI MING LEE, China]	Accepted. This text has been updated to reflect that 2016-2020 now holds the record.
17615	29	41	29	41	Not a fair balanced technical summary, because warming in this "hottest" 5 year period 2014-2018 is strongly influenced by El Nino and less by CO2. Not mentioning El Nino "natural variability" as key driver for this hottest warming period is giving the wrong "AGW-climate" message. It is a good example of strong AGW groupthink and tunnel vision when preparing the technical summary. Chapter 3-P86 Line 12 states "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 to explain the 5 hottest years 2014-2018 is unacceptable. [ferdinand meeus, Belgium]	Rejected. The reference to the warmest period (now 2016-2020) is a statement of fact and no attribution is made of this either to AGW or to other modes of variability.
113783	29	44	29	48	A figure showing when global mean temp reaches 1.5 (incl uncertainty range) would be useful. Would be an update or follow up of the figure in SR1.5. [Jan Fuglestedt, Norway]	Taken into account. This is covered by a table in Box TS1.
39893	29	46	29	48	**This is where an explanation of difference / SR15 would be relevant (what explains the difference with 2030 here and 2040 in SR15).** This comment relates to my other ones for p.65 lines 41-44. [TSU WGI, France]	Taken into account. This is now discussed in Box TS1.
55477	29	47			neglecting is not the right term to express the assumption that no major volcanic eruption is happening [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. This text is no longer being used in the TS.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97601	29	50	29	53	The sentence is really long and hard to understand, in particular for non-native speaker. Possible improvement: "The assessment of future GSAT changes (see Table TS.5, Figure TS.14 and Cross-Section Box 2) is based on multiple lines of evidence. It combines new projections for the SSP scenarios with observational constraints, which are based on past simulated warming as well as the AR6-updated assessment of equilibrium climate sensitivity and transient climate response." [Nicole Wilke, Germany]	Not applicable. This text is no longer being used in the TS.
113785	30	3	30	34	Very useful set of figures. I wonder if b) should be more highlighted since it contains very important results - and is also important for explaining the approach taken. [Jan Fuglestedt, Norway]	Noted. The figures have been significantly restructured and this material now appears in a different form in Box TS1.
6397	30	9	30	9	HadCRUT5 is not "observations". It is a dataset derived using observations and a number of assumptions, and includes estimated values for grid boxes that contain no usable observations. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. "Observed" here is understood as a quantity derived from observations.
113787	30	16	30	34	We may need to reconsider the choice of 2.6 and 8.5 as low and high scenarios to show on maps. Or as discussed in various settings, be sure to give the rationale for what we show. [Jan Fuglestedt, Norway]	Noted. The corresponding figure in Box TS1 now uses 7.0 only.
113789	30	38	31	2	Very useful table. The timing of crossing 1.5 and 2 could also be shown in a figure (as a follow up to a figure in SR1.5 SPM). [Jan Fuglestedt, Norway]	Noted. The data remains in a table without a corresponding figure.
131949	30	38			Table TS.5 - how do the years to 1.5 compare to SR15 key messages and GMST which the Paris Agreement is based on? Is this the same 1.5C? [Hans Poertner and WGII TSU, Germany]	Taken into account. Cross-Section Box 1 explains in details the difference between GMST and GSAT, and why the crossing time assessment has evolved since SR15.
131951	30	38			Table TS.5 - it is difficult for the reader to translate back to GMST - for a start the table uses two references periods (1995-2014 and 1850-1900), the reader also can't refer to TS.1 Table 1 due to different reference period [Hans Poertner and WGII TSU, Germany]	Accepted. The corresponding table now uses a 1850-1900 baseline throughout.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
6399	30	40	30	40	The estimates of 2030 for crossing the 1.5°C level given in Table TS.5 are questionable, for reasons set out in earlier comments 2 to 5, and expanded upon in chapter-specific comments. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Noted. As this is not a very specific comment, it is difficult to respond to it here. The comments the review refers to are addressed separately.
100399	30	40	31	1	Check the consistency of the values with the Interactive Atlas. [Lincoln Alves, Brazil]	Taken into account. Care was applied across the entire report to ensure consistency.
32513	30	40			Table TS.5: We express a strong preference for choosing 1850-1900 as the reference period. This would be more consistent with the Paris Agreement temperature goal and easier to compare for a large community of readers. [Eric Brun, France]	Accepted. The corresponding table now uses a 1850-1900 baseline throughout.
89451	30	40			see comment Box SPM2. [Carl-Friedrich Schleussner, Germany]	Noted. As this is not a very specific comment, it is difficult to respond to it here. The SPM comment the reviewer refers to is addressed there.
97603	30	58	31	1	Table TS.5: please provide the warming for the three future periods in the first three rows also with respect to preindustrial level. [Nicole Wilke, Germany]	Accepted. The corresponding table now uses a 1850-1900 baseline throughout.
113791	31	5	31	8	The info on 20% higher is important, but more explanation would be useful (updated models vs changes in emissions). It is also not clear if this is for raw CMIP6 results or assessed ranges using constraints from ch7. [Jan Fuglested, Norway]	Taken into account. This is indeed very important. It is treated in some detail in section TS.1.2.2. However, this is also the object of ongoing active research.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
34783	31	5	31	8	Even the SOD casts doubt as to whether the 20% higher sensitivity of the CMIP6 models versus the CMIP5 models can be correct. Please see general comment #2. [Jim O'Brien, Ireland]	Noted. This report (underlying chapters and TS) goes into great detail in assessing ECS based on multiple lines of evidence, and clearly and transparently shows that at least some CMIP6 models have climate sensitivities beyond the likely range - however, these models remain useful for multiple reasons, as an abundant scientific literature shows.
97605	31	6	31	8	CMIP5 < CMIP6: Since the higher ECS is one of the most important findings in this report, it would be very helpful to add some reasons as to why ECS of CMIP6 is higher compared to CMIP5. [Nicole Wilke, Germany]	Taken into account. This is indeed very important. It is treated in some detail in section TS.1.2.2. However, this is also the object of ongoing active research.
6401	31	26	31	26	I believe this is yet another poor use of the word "observations". My understanding is that the text refers not to updated satellite observations, but instead to updated estimates of temperature made from pre-existing satellite measurements of radiance. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. This text is not in the revised TS.
15325	31	33	32	52	This section has some very nicely structured paragraphs that tell a "story" from observed change, to attribution, to future projection, to model biases. However, some paragraphs miss some elements of this nice structure, for example the paragraph on Hadley+Walker circulation has nothing on future changes. It would be nice if all paragraphs had the same structure. In fact it would be nice if this structure were used throughout TS2.x. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The lack of commentary on projections of the Hadley and Walker circulation reflects the underlying chapter.
23541	31	35	31	36	There are various definitions of the intensity of the Hadley/monsoon circulations, such as stream function, precipitation, or vertical velocities. It is not clear from this sentence on what aspect of the Hadley circulation intensities is changed. To be consistent with p.44 L38-30 in TS for the monsoon circulation. [Masaki Satoh, Japan]	This level of detail is included in the linked chapters.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
84563	31	35	32	5	the sentence about global monsoon intensity is out of context here [Annalisa Cherchi, Italy]	No reference to monsoon here -we believe this comment is mis-assigned and cannot identify what it refers to.
1941	32	9	32	11	medium confidence' for the storm track changes during the Medieval Warm Period seems too optimistic to me. I would use 'low confidence' as for the mid-Holocene (see Chapter 2). [Hugues Goosse, Belgium]	This text is not in the revised TS.
10921	32	10			Don't use "medieval warm period", use actual dates. The term is inaccurate and the associated period is not even consistently defined in studies. The term gives the inaccurate impression that climate was uniformly warm over a certain period. [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	This text is not in the revised TS.
81653	32	18	32	19	The SPM notes the movement in southern hemisphere storm tracks is 'likely', and the message should be consistent between SPM and TS (also Chapter 8, where it is listed as 'hgh confidence') [Michael Grose, Australia]	This statement has been revised for consistency with chapter 8.
19589	32	27	32	52	It is surprizing that TS authors find necessary to include summaries within the technical summary. Does that mean that eventually the subsection 2.2 appears too long? Then it is recommended to shorten it, rather than adding a shortened version and leaving in place a text which stand little chance of being ever read. [philippe waldteufel, France]	This text is not in the revised TS.
84565	32	32	32	34	not exactly focused on what described in the paragraphs just before. Monsoons just mentioned remain a bit out of context [Annalisa Cherchi, Italy]	This text is not in the revised TS.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
111197	32	32	32	34	It is not clear what kind of models are speaking about. [Volodymyr Osadchy, Ukraine]	This text is not in the revised TS.
23543	32	32	32	34	If this paragraph describes the general model behaviors, Chapters 8 and 10 should be referred to on the model biases of monsoon and blocking events. [Masaki Satoh, Japan]	This text is not in the revised TS.
39945	32	33	32	33	Are they "errors" or "anomalies"? [TSU WGI, France]	This text is not in the revised TS.
100829	32	33	32	33	I would suggest to replace North Atlantic with Euro-Atlantic sector, since the underestimation is particularly evident in the central Europe region [Corti Susanna, Italy]	This text is not in the revised TS.
78917	32	39	32	52	... it also depends significantly on the rates of ocean uptake - good link to next section [Pedro Monteiro, South Africa]	This text is not in the revised TS.
113793	32	41	32	41	Insert " (GSAT) " after "temperature" [Jan Fuglested, Norway]	This text is not in this part of the revised TS.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97607	32	55	34	6	<p>Box TS.2:</p> <p>1) We are highly concerned about the term "storyline" to classify models that simulate a seemingly too high warming due to issues with cloud parameterisations. We are also strongly concerned about the classification "low-probability, high-warming" as this term links high-warming with low-probability, although there is also high-warming with high probability (depending on what readers refer to with the term "high warming"). To avoid fundamental misunderstandings and to add clarity we strongly suggest replacing "low-probability, high-warming storylines" by "very-high-warming projections" throughout the report.</p> <p>2) To add clarity and transparency, some more information on these high-warming models would be useful in Box TS.2. Unrealistically high warming should have implications on the entire model physics, but there is no analysis of these implications. This information should please be added to maintain the scientific integrity of the IPCC.</p> <p>3) We also suggest to include a figure comparing the ECS and TCRP of all models that would help readers understand, what models were chosen to be low-probability, high-warming models. Are there different models included to obtain the different statements: i.e. high ECS and the corresponding likelihood of high impact events or high warming rates corresponding to large wide-spread temperature and precipitation changes? Or are there only certain models included in all high-warming storylines?</p> <p>5) Box TS.2 Figure 1 does not help, please see our comment on this figure. [Nicole Wilke, Germany]</p>	<p>Noted. It is deemed clear from the context what is meant by the terms used. It is not the purpose of this box to provide a detailed analysis of the models that warm the most, for this information the reader must see the report itself.</p>
19591	32	55	34	6	<p>Chapter 11, in section 11.2.4, addresses the cases of low probability, high impact extremes. Why is here the issue restricted to warming extremes? [philippe waldteufel, France]</p>	<p>Taken into account. The updated text now discusses extremes more generally.</p>
11039	32	57	34	3	<p>Consider adding an example of high-impact, low-probability SLR [Robert Kopp, United States of America]</p>	<p>Taken into account. We have added an example regarding SLR.</p>
15327	33	20	33	21	<p>"The upper end of the projected warming range increases...". Increases relative to what? AR5? [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]</p>	<p>Taken into account. The corresponding text was revised.</p>

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97609	33	22	33	22	Please clarify the description "assessed range of GSAT in comparison to the raw output of unconstrained projections" [Nicole Wilke, Germany]	Taken into account. The corresponding text was revised, see also #97611.
84567	33	22	33	23	not clear what "high warming storyline" exactly means. Where do these values are taken from? [Annalisa Cherchi, Italy]	Noted. We believe this is clear from the updated text. Quantitative values are taken from the assessed very likely ranges.
18903	33	23	33	23	"for a level of warming" could be misleading. This may be changed to "for a specific time period in a scenario" [Govindasamy Bala, India]	Noted. It was decided that throughout the report to discuss warming levels rather than time periods.
97611	33	31	33	32	Please quantify more clearly and in a quantitative manner: what means "strongly exceed the multi-model mean"? [Nicole Wilke, Germany]	Taken into account. The sentence was revised in such a way that it specifies the selection of models to be outside or close to the upper bound of the very likely range.
131953	33	32	33	32	Avoid using Eurasia - the TS has not presented any regionalisation so far so it is unknown what you mean by Eurasia [Hans Poertner and WGII TSU, Germany]	We broadly refer to Eurasia as the entire continental land mass including Europe and Asia. Because the statement is broadly consistent to the entire land masses and not only to specifically confined region we think the use of the term is not critical here.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
26273	33	33	33	33	Espace between "Figure" and "2" [María Santolaria-Otín, France]	Noted. The corresponding text was removed.
113795	33	48	34	4	I am not sure how well this works as support for the purpose. I suggest you explore other ways of making the point and difference stand out more clearly. [Jan Fuglestedt, Norway]	Taken into account. The figure was revised.
111199	34	11	34	13	It is not clear how recent are changes exceptional? [Volodymyr Osadchy, Ukraine]	Accepted. Text clarified
34785	34	11	34	25	How can paleo records possibly indicate that current ocean temperatures are exceptional, in view of the many significantly warmer periods in the past? Similarly how can it be proven that the rate of ocean warming is now faster than any time since the last deglaciation? Please see general comment #5. [Jim O'Brien, Ireland]	Taken into account. Text clarified related to "exceptional". Regarding rate of warming, all reference of the assessment can be found in the linked chapter. In that particular case Chapter 2
113797	34	12	34	12	"Many highlight the role" sounds strange. What is "many" referring to? (I think IPCC can say that it has an important role, without referring to someone else's view on this, if this is what you mean?) [Jan Fuglestedt, Norway]	Accepted. Text revised
84569	34	12	34	13	"many" what?not clear purpose of the second half of the sentence [Annalisa Cherchi, Italy]	Accepted. Text revised
389	34	21	34	22	suggestion for changing the sentence to: "Major changes to ocean circulation have not yet been observed, but may be anticipated for some current systems, such as the Atlantic Meridional Overturning Circulation, in coming centuries under strong forcing scenarios (Box TS.3)." [Leticia Cotrim da Cunha, Brazil]	Not applicable. Text removed
33263	34	21	34	22	Maybe we should find a more subtle wording here indicating that lack of sustain in situ observation network have impede monitoring ocean current reliably, rather than saying change have not been observed which is ambiguous [Jean-Baptiste SALLEE, France]	Accepted. Text revised
78919	34	21	34	23	apparent contradiction with text below that sys that changes to the AMOC / MOC have been observed [Pedro Monteiro, South Africa]	Accepted. Text revised

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97613	34	22			"may be anticipated" is not IPCC-language - please revise. [Nicole Wilke, Germany]	Accepted. Text revised
78921	34	23	34	25	perhaps make the link to WG2 by connecting these variables to multi stressor ecosystem impacts [Pedro Monteiro, South Africa]	taken into account - exchange with WG II established, and text revised in collaboration
391	34	24	34	24	The correct term is de-oxygenation [Leticia Cotrim da Cunha, Brazil]	Accepted. Text revised
78923	34	25	34	25	the ocean is not acid so while acidification is correct acidity is not [Pedro Monteiro, South Africa]	Accepted. Text revised
84571	34	27	34	28	quite general sentence: is that really needed/useful here? [Annalisa Cherchi, Italy]	Accepted. Sentence removed
393	34	27	34	28	The sentence "In the open and deep ocean, changes are projected for sea surface temperature, heat extremes, waves, sea ice extent, oxygen and acidity. {12.4.8}" is not very clear - a) the time scale of these changes; b) sea surface temperature, heat extremes, sea ice extent, waves are surface ocean issues, and may happen also in the coastal ocean; c) it would be more correct to say "decrease in oxygen content" and [Leticia Cotrim da Cunha, Brazil]	Not applicable. Text removed
131955	34	33	34	33	recognisable? This is a strange term to apply - why not key indicators? [Hans Poertner and WGII TSU, Germany]	Accepted. Figure/caption revised

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
131957	34	33	34	36	meaningful indicators? Meaningful to who? I agree the O2 should be included, and SST should be included [Hans Poertner and WGII TSU, Germany]	Accepted. Figure/caption revised
113801	34	33	34	36	Here you have chosen SSP2-4.5. This choice could be coordinated with other scenario choices, and rationale given [Jan Fuglestedt, Norway]	Noted
32869	34	33			fig TS.15-1 understand why sea ice would be included in this figure but that is then confusing since sea ice appears in TS2.4 [Helene Hewitt, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Figure revised
97615	34	41	55		Please quantify the heat uptake in the ocean. [Nicole Wilke, Germany]	Accepted. We note quantify that about 90% of the excess heat associated with climate change since 1970s is stored in the ocean
395	34	43	34	43	Seems that there is a bit of text missing: "The global ocean has warmed since at least 1971 when globally representative measures are available." [Leticia Cotrim da Cunha, Brazil]	Accepted. Text revised
33265	34	44	34	45	except during a According to chapter 2: "except during short period of rapid warming at the end of the Younger Dryas (medium confidence)." Can that be eluded altogether from TS? (note that the "short" period is much longer than the modern period we observe warming) [Jean-Baptiste SALLEE, France]	Not applicable. Chap 2 ES has been revised

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
39547	34	47	34	50	Please cite and discuss Wunsch, C., Heimbach, P., 2014, Bidecadal thermal changes in the abyssal ocean. J. Phys. Oceanogr. 44, 2013, who estimate the heat content down to abyssal depths and who question this claim since the heat content is found of approximately 4E22 J in 19 years, for a net heating of 0.2 W/m2, smaller than some published values. Figure 10 of Laloyaux et al (2018) doi: 10.1029/2018MS001273, shows that the ocean heat content seems to follow a 60-70 year cycle, possibly related to Atlantic Multidecadal Oscillation further discussed in other comments. All this make questionable this sentence. [François Gervais, France]	The underlying assessment can be found in Chapter 9 that evaluates the literature on this aspect.
97617	34	48	34	48	Please add a hint that increase in OHC represents more than 90% of the observed total Earth system warming from GHG (as described in SPM-12, line 3 and 12; chapter 9, 9-20, line 28) [Nicole Wilke, Germany]	Accepted. Text revised
97619	34	50	34	52	Warming rate per what? °C per year? Please revise. [Nicole Wilke, Germany]	Not applicable. Text removed

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97621	34	50			"it is certain" is not IPCC-language - please revise. [Nicole Wilke, Germany]	Accepted. Text revised
18905	34	51	34	51	Units are incorrect. "per decade" is missing [Govindasamy Bala, India]	Not applicable. Text removed
111201	34	51	34	52	The rate should be per decade or year at least [Volodymyr Osadchy, Ukraine]	Not applicable. Text removed
111203	34	57	34	57	Confidence statement is not in Italic [Volodymyr Osadchy, Ukraine]	Accepted
97623	35	2	35	3	"The current ocean state is unprecedented for centuries to millennia for some indicators (high confidence)." This statement is empty if the indicators are not specified. Please revise. [Nicole Wilke, Germany]	Accepted. Text revised

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
111205	35	3	35	3	"Some indicators" is not consistent with high confidence. Please, provide more details [Volodymyr Osadchy, Ukraine]	Accepted. Text revised
97625	35	3	35	4	Exactly the same sentence as on page 34, line 43-45. Please modify to avoid duplications and streamline the text. [Nicole Wilke, Germany]	Accepted. Text revised
84573	35	3	35	4	this sentence is a repetition here, also at page 34 lines 44-45 [Annalisa Cherchi, Italy]	Accepted. Text revised
97627	35	22	35	23	"It is extremely likely that human influence has contributed to this surface ocean change as well as change in the subsurface ocean. "This statement is empty if the contribution is not quantified or at qualified. Please revise. [Nicole Wilke, Germany]	Accepted. Text revised
78925	35	38	35	39	Contradicts the text in 2.3 [Pedro Monteiro, South Africa]	Accepted. Consistency between section has been discussed

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
84575	35	40	35	40	what is a "large method uncertainty"? [Annalisa Cherchi, Italy]	Accepted. Text clarified
97629	35	43	35	44	"Projected AMOC decline by 2100 is only weakly dependent on emission scenario ranging from 40% in SSP1-1.9 to 50% in SSP5-8.5 (medium confidence)." Please specify what this means for the European climate, even if it has no implications. [Nicole Wilke, Germany]	Taken into account. The paragraph on AMOC has considerably changed, and cross-section interaction ensures to also provide regional scale information when available in the AR6 assessment.
32863	35	48	35	55	Southern Ocean upper ocean will enhance...what does this refer to? Presumably currents. [Helene Hewitt, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Text clarified
97631	35	51	35	51	Please insert: Southern Ocean upper ocean overturning will.....(9-33, line 4) [Nicole Wilke, Germany]	Accepted. Text clarified

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
111207	35	51	35	51	"Southern Ocean upper ocean will enhance..." is not clear [Volodymyr Osadchy, Ukraine]	Accepted. Text clarified
1943	35	51	35	51	I guess something is missing in the sentence ' Southern Ocean upper ocean will enhance as a result of intensifying winds'. [Hugues Goosse, Belgium]	Accepted. Text clarified
82607	35	51	35	51	Needs to be stated that these rates are per decade. These numbers will need to be made consistent between Chapter 2, Chapter 9 and the TS (at present Chapter 2 and Chapter 9 use different data sets and different trend periods, although Chapter 9 has explicitly noted that these will need to be reconciled). [Blair Trewin, Australia]	Noted. This is indeed now reconciled
39663	35	51	35	54	Is it possible that there is a missing word (e.g., southern ocean upwelling, or circulation or will be enhanced)? [TSU WGI, France]	Accepted. Yes. Text revised
61237	35	51	39	51	It is unclear to which oceanic circulation/current this sentence refers to. I suspect the Southern Ocean upwelling or overturning. [APECS, MRI, PAGES ECN, PYRN and YESS ECS group review, Canada]	Accepted. Text clarified
78995	35	53	35	54	what is the boundary of the poleward and equatorward - maybe temperate and sub-tropical? [Pedro Monteiro, South Africa]	Accepted. Text clarified
32865	36	1	36	13	TS2.3.4 might be better before TS2.3.3 since it refers to changes in temperature and salinity and follows on better from TS2.3.1 and TS2.3.2 [Helene Hewitt, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. Text removed
108589	36	4	36	4	Space between number and unit [Jason Donev, Canada]	Accepted

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97633	36	8	36	10	What are the reasons for this his new assessment about surface ocean stratification, and what does it mean? [Nicole Wilke, Germany]	Taken into account, and implications added.
97635	36	11			"prediction" is not a scientific method. Please revise. [Nicole Wilke, Germany]	Accepted. Text revised
78997	36	16	36	16	I would like to suggest that the integrated assessment of the CO2 - Heat nexus in the ocean is a significant gap in WG1 and an area of knowledge that is emerging rapidly even since SROCC which provides a significant part of the basis for TCRE. This could be considered by Chs 5, 7, and 9 [Pedro Monteiro, South Africa]	Accepted. Though this is done as part of the Box on Carbon cycle
80179	36	18	36	28	Although the ocean carbon sink is elaborated in TS.2.6, it would be worth mentioning here that ~30% of atmospheric CO2 is absorbed by the oceans and leading to acidification and as a positive effect it lessens the atmospheric warming. Also, the solubility of the gases is temperature dependent. If the oceans continue to warm, they are no longer able to absorb the increased atmospheric CO2 concentration, which will further strengthen atmospheric warming. Maybe it should be mentioned here too (though this appears on Page 76 Lines 49-50). [Lilian Fejes, Hungary]	Taken into account, and cross-checked with carbon box, but repetitions avoided due to space limitations. The link to the carbon box is now given at the top of the ocean section

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
34787	36	18	36	28	What real evidence is available to assert that ocean pH is lower than at any time in the last 2m years? Please see general comment #6. [Jim O'Brien, Ireland]	Noted. Evidence assessment is provided in the main assessment, and is based on proxy data. A figure is also provided in chapter 2.
36407	36	19	36	21	This statement is incorrect. It is a reduction in calcium carbonate mineral saturation state, not calcium carbonate minerals. [Adrienne Sutton, United States of America]	Accepted and changed accordingly.
30593	36	19	36	21	This statement is incorrect. It is a reduction in calcium carbonate mineral saturation state, not calcium carbonate minerals. [nina bednarsek, United States of America]	Accepted and changed accordingly.
78999	36	20	36	20	please delete minerals and add dissolved calcium carbonate - minerals are what the biology makes by taking up dissolved CO ₃ [Pedro Monteiro, South Africa]	Accepted and changed accordingly.
97637	36	25	36	28	Please explain why CO ₂ concentration would increase parallel to an increase in ocean temperature, in particular while the ocean carbon sink weakens with warming as stated in the second part of the statement. [Nicole Wilke, Germany]	Taken into account, and text has been revised, however limited due to cross-interaction with carbon box to avoid repetition.
54777	36	25	36	28	It could be helpful to explain why an increase in CO ₂ concentration in parts of the ocean is a response that "corresponds to the expected weakening of the ocean carbon sink with warming" as this is not intuitive to understand. (A weakening sink would be expected to lead to less CO ₂ uptake and lower ocean CO ₂ .) [Nancy Hamzawi, Canada]	Taken into account, and text has been revised, however limited due to cross-interaction with carbon box to avoid repetition.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97639	36	31	36	32	Why is there only medium confidence that deoxygenation in the surface ocean is due in part to anthropogenic forcing - in part is vague anyway, and what else would be the reason? Please reconsider the attribution statement and compare to AR5/SROCC. [Nicole Wilke, Germany]	Noted. The AR6 assessment on human influence on ocean deoxygenation is in agreement with SROCC.
397	36	32	36	33	"Future ocean warming will assist the development of hypoxic or minimal oxygen zones" - would be useful to apply na assessment of confidence to this statement. [Leticia Cotrim da Cunha, Brazil]	Not applicable. Text has been removed.
84577	36	37	36	37	earth system models in the sense of models with necessarily active biogeochemical cycles [Annalisa Cherchi, Italy]	Noted.
97641	36	39			Please translate aragonite for non-experts (crystal forms of calcium carbonate). [Nicole Wilke, Germany]	Not applicable. Text has been removed.
113803	36	45	36	53	It would be very relevant to show development out to 2300. [Jan Fuglestedt, Norway]	Noted. development out to 2150 is provided in the sea-level figure
19593	36	56	36	56	See comment on page 32 lines 37-52: more summaries of a summary [philippe waldteufel, France]	Accepted. Summary removed

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
399	37	4	37	4	Ocean circulation instead of "circulations" [Leticia Cotrim da Cunha, Brazil]	Not applicable. Text removed
32867	37	9	37	10	As deeper waters become increasingly affected by changes circulating downward from the surface, slow changes to ocean circulation and sea level (Box TS.3) will continue for centuries after surface anthropogenic forcing ceases. This sentence is correct but I think that I would consider rewording it to more clearly reflect that temperature (and salinity) in the ocean will change both due to changes in the surface properties and to changes in the large-scale circulation. [Helene Hewitt, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. Text removed
401	37	11	37	11	Ocean circulation instead of "circulations" [Leticia Cotrim da Cunha, Brazil]	Not applicable. Text removed
41185	37	11	37	15	While the substance of this sentence is important, I find the current formulation a bit hard to understand. In particular, what is meant by the plural used here : "ocean circulations"? "systems"? Could it be reformulated? Also, I could not find the supporting lines of evidence in Box TS.4. [TSU WGI, France]	Not applicable. Text removed
32871	37	23			Note the value for the AIS sea level contribution needs to be revised in line with the IMBIE number [Helene Hewitt, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. This is now harmonized.
40047	37	25	37	27	Could this important framing material come earlier? Perhaps TS1. Also missing all framing reference to SRCLL. [TSU WGI, France]	Taken into account. SROCC is now mentioned right at the start, and SRCLL is mentioned at the beginning of the new land section.
130353	37	30	37	54	What is meant by no significant trend in overall Antarctic sea ice is detected from 1970 to 2018. What variable is used to represent overall Antarctic sea ice trends? Additionally, what is the significance of becoming effectively ice-free in September, why is this emphasized versus other months? The text should make it clear that September is when sea ice reaches its annual minimum. [Trigg Talley, United States of America]	Taken into account. This is about sea-ice area, as explicitly written in the revised TS.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
84579	37	32	37	34	sentence partially incomplete or to rephrase [Annalisa Cherchi, Italy]	Taken into account. Sentence reformulated.
84581	37	32	37	36	harmonize the paragraph, first all what is related to the Arctic and then all what is related to the Antarctic [Annalisa Cherchi, Italy]	Taken into account. Two separate paragraphs now, one on the Arctic, then one on the Antarctic.
88423	37	32	37	36	Unclear why confidence statements only given for SROCC assessment and not for conclusions from Ch 2 and Ch 9 [Sharon Smith, Canada]	Taken into account. The revised paragraphs on sea-ice changes contain more systematic confidence statements.
54779	37	32	37	36	In keeping with the way results are presented for changes in snow cover and permafrost, could a sentence be added here reporting projected changes in arctic (summer?) sea ice per °C global warming? [Nancy Hamzawi, Canada]	Noted. Severe space limitations imply difficult choices. We were able to mention the linear relationship between Arctic sea-ice area in September and GSAT, but need to refer the reader to the underlying chapter for details.
34789	37	32	37	54	The SOD claims an unprecedented loss in Arctic sea ice over the last 1000 years. Please see rebuttal comment #7 [Jim O'Brien, Ireland]	Noted. The revised text is more precise - September sea-ice changes in the Arctic are likely unprecedented for the last 1000 years, based on the assessments presented in section 2.3.2 (and 9.3.1) of the main report. Unclear what is "rebuttal comment #7, unfortunately not traceable.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97643	37	42	37	44	How do these shortcomings and the fact that they are not understood relate to the many statements of the increased model quality since the AR5? And how do they affect the confidence in model projections in general? Please contextualize this statement in order to avoid misunderstandings. [Nicole Wilke, Germany]	Noted. Given tight space constraints, we are unfortunately not able to go into very much detail here and have to refer the reader to the underlying section 9.3.2 of the main report. What we can say here is that the low confidence in model simulations of past and future Antarctic sea-ice evolution is due to deficiencies of process representation, in particular at the regional level, in the context of due to regionally opposing anthropogenic and natural forcings, and the large interannual variability.
111209	37	44	37	46	Ice area should be sea-ice [Volodymyr Osadchy, Ukraine]	Noted. The paragraph has been substantially shortened and the sentence this comment refers to has been cut. We do systematically indicate whether the subject is sea-ice area or extent.
93875	37	50	37	54	Although not a contradiction. In the form it is formulated, this statement could look like as a misunderstanding between the SPM and TS, which is worth taking into account. This statement assesses with high confidence that the Arctic ocean will become "effectively" ice-free in September average over the 2081-2100 period. Meanwhile, the C 2.3 statement of the SPM assesses that the Arctic Ocean is likely to become ice-free for the "first time" in September before 2050. Thus, here in the TS, where there is more space for clarifications, we need to include also the statement made in the SPM. Explaining that although by 2081-2100, the Arctic Ocean will be effectively free of ice in September, it is also expected that, for the first time, this occurs early (although not continuously in time). [Lucas Ruiz, Argentina]	Noted. The TS has been aligned with the latest version of the ES of Chapter 9, and now contains the missing information.
54781	37	50	37	54	An additional message worth including in this para about the likelihood of future ice free conditions in summer in the Arctic is the extent to which low emissions scenarios avoid this outcome and/or are projected to stabilize arctic summer sea ice extent. [Nancy Hamzawi, Canada]	Noted. Unfortunately, space constraints do not allow to include this information, which is, in addition, not present in the ES of Chapter 9.
32515	37	53	37	53	The starting date for deriving the cumulative CO2 emissions must be specified [Eric Brun, France]	Noted. The revised statement does not contain explicit cumulative emissions numbers, so there is nothing to do here.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97645	37	53	37	53	It is the first time, that the CO2 emissions in GtCO2 are used to describe certain climatic threshold. Please provide instead the CO2 concentration in ppm, as it was also provided to discuss projections throughout TS.2. [Nicole Wilke, Germany]	Noted. The revised statement does not contain explicit cumulative emissions numbers.
39567	38	1	38	15	It is important to realise that in Fig. TS.17(b), the observations show an increase of sea ice extent whereas models show a decrease. This discrepancy by itself is sufficient to invalidate climate models retained in AR6 and, therefore, the alarmist projections of the entire report which are based on these models. [François Gervais, France]	Rejected. The reasons for this misfit are understood and observations show a substantial circumpolar heat increase in the subsurface Southern Ocean and strong mass loss of the Antarctic Ice sheet. The overall picture is therefore correctly represented by the climate models in spite of localized misfits at the thin ocean-atmosphere interface characterized by high regional and spatial variability. Moreover, the observations do not show an increase, as there is no significant trend over the satellite period.
26277	38	3	38	13	Caption Figure TS.17: Northern Hemisphere (both in capitals) [María Santolaria-Otín, France]	Noted. The figure is merged with the ocean figure.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
71137	38	7			Here, but also in other sections of the report the authors talk about permafrost volume in the top 3 meters and how it will change. This may be a misleading statement for several reasons. First, it is not clear what is meant by volume when referring to a depth (3 m). Then, it is also not clear if the authors refer to the ground ice loss in the permafrost, which starts below the top of the permafrost, i.e. under 0.5 - 4 m below ground surface (active layer). Finally, it can also be confusing because ground settles in response to permafrost degradation, which means that the loss in ground ice and permafrost may not be accurately represented when simply looking at the "3 m below surface" because the surface also settles and a lowering of the permafrost table in absolute elevation terms is not actually represented by this statement of permafrost degradation in the top 3 m. If the authors want to make reference to the current conditions, then this must clearly be stated, otherwise the statement is misleading and may lead to confusion when the permafrost table today is compared with future permafrost tables. [Lukas Arenson, Canada]	Taken into account. We now refer to perennially frozen volume in the top 3 below the ground (instead of permafrost) and clearly indicate that this is the model surface, necessarily simplified.
26275	38	20	38	26	Northern Hemisphere (both in capitals) [María Santolaria-Otín, France]	Noted. The figure is merged with the ocean figure.
88425	38	23	38	24	Repetition of statement given earlier in paragraph. [Sharon Smith, Canada]	Taken into account. The statement has been streamlined, and the repetition has been eliminated.
26283	38	26	38	26	km2 is in a different font [María Santolaria-Otín, France]	Editorial. The corresponding statement has been deleted in subsequent versions of the TS.
108591	38	26	38	27	What is the temperature that this number is for? Arctic changes or global changes? It's not clear if this is a global or a local phenomenon, since it is a local effect from a global cause that's more intense in the Arctic. [Jason Donev, Canada]	Noted. Word count constraints led us to shorten this statement, leaving out numbers.
108593	38	32	38	32	What is the temperature that this number is for? Arctic changes or global changes? It's not clear if this is a global or a local phenomenon, since it is a local effect from a global cause that's more intense in the Arctic. [Jason Donev, Canada]	Noted. Word count constraints led us to shorten this statement, leaving out numbers (see comment #108591)
26279	38	32	38	32	km2 is in a different font [María Santolaria-Otín, France]	Editorial. The corresponding statement has been deleted in subsequent versions of the TS (see comment #26283).

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
88427	38	35	38	36	Be clear about decade, 2007-16 -- not really the last decade. You could also consider saying something about the longer term trends first to provide context and show this decadal change is part of a longer term trend. Reference could be made to Ch 2 for observed trends [Sharon Smith, Canada]	Taken into account. The corresponding statement has been deleted to save space.
66447	38	35	38	39	I made a corresponding comment to the Ch. 2 Exec Summary, but this would be strengthened if observed changes to active layer thickness was also included here. [Charles Koven, United States of America]	Noted. The latest version of the ES of Chapter 2 does not contain a specific statement on active layer thickness changes because of strong spatial variability. Therefore, such a statement is not included in the revised TS either.
97647	38	35	38	46	We miss a clear statement of the amount of carbon which is contained in permafrost (c.f. SROCC SPM A1.3), which could be compared to the anthropogenic emissions until now, and a range of carbon that could be released (c.f. SROCC SPM B1.4). Thereby, the significance of the permafrost in the long-term would be made more obvious. Please check the underlying chapters of this report, including Chapter 5 (05-7-51, 05-08-52, 05-57-34, 5.4.8.2, 5.4.9, 5.5.2.2.4), FAQ 5.2 and Ch02 (2.3.2.5.) [Nicole Wilke, Germany]	Noted. To avoid duplication under tight word count constraints, this section does not treat permafrost carbon. Permafrost carbon feedbacks are more specifically treated in Section 3 of the Technical Summary (TS3).
26281	38	37	38	37	Northern Hemisphere (both in capitals) [María Santolaria-Otín, France]	Taken into account. Editorial.
108595	38	40	38	40	What is the temperature that this number is for? Arctic changes or global changes? It's not clear if this is a global or a local phenomenon, since it is a local effect from a global cause that's more intense in the Arctic. [Jason Donev, Canada]	Noted. Word count constraints led us to shorten this statement, leaving out numbers (see comment #108591)

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97649	38	41	38	41	Please insert: ...will lead to near surface permafrost volume loss. (9-6, line 48) [Nicole Wilke, Germany]	Taken into account. The revised statement clearly only refers to frozen soil in the top 3 meters, preventing possible misunderstandings.
88429	38	41	38	46	There should also be a comment that permafrost will continue to thaw below 3 m --- the focus on upper 3 m could imply that this will not be an ongoing phenomena once the upper 3 m is thawed. Also "degradation" is probably a better term to use than "decay" when referring to thawing permafrost. [Sharon Smith, Canada]	Noted. This is true. Because of tight space constraints, and because the climatically most relevant processes occur close to the surface, we have to refrain from including such a statement.
39683	38	43			this figure (Cross-section Box 2, Figure 2) does not seem to clearly display information about permafrost, as indicated in the text. [TSU WGI, France]	Taken into account. Editorial. The figure is not referred to any more.
71139	38	45			What do the authors mean by "decay"? The report uses permafrost thawing, thawing permafrost, decay, permafrost degradation, permafrost warming and even melting permafrost (which must not be used as stated in a comment below). It would be good if the report would be consistent in the use of the terminology and specifically decay doesn't mean much. [Lukas Arenson, Canada]	Noted. The word "decay" is not used in the revised version.
108597	38	50	38	50	Reporting this in metres seems really weird, could it be done in cm? [Jason Donev, Canada]	Taken into account. The revised version provides projected glacier volume losses in percent, and sea-level contributions are listed consistently in the sea-level box.
84583	38	50	38	50	sentence seems incomplete [Annalisa Cherchi, Italy]	Noted. The sentence was cut.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
111211	38	50	38	50	"...sea level rise between 1971 and." [Volodymyr Osadchy, Ukraine]	Noted. The sentence was cut.
97651	38	50	38	50	Please insert: ...between 1971 and 2016. (9-6, line 34) [Nicole Wilke, Germany]	Noted. The sentence was cut.
26285	38	50	38	50	sea level rise between 1971 and "some year". [María Santolaria-Otín, France]	Noted. The sentence was cut.
97653	38	56			"The magnitude and timing of future global glacier mass loss remains uncertain due to scenario uncertainty, low-resolution GCM forcing, model oversimplification, and limited observations for calibration." Is this information consistent with the SROCC? [Nicole Wilke, Germany]	Taken into account. The revised statement provides glacier loss for RCP2.6 and 8.5 in percent over the 21st century from GlacierMIP and is much more precise (and new compared to SROCC).
108599	39	1	39	1	Reporting this in metres seems really weird, could it be done in cm? mm? [Jason Donev, Canada]	Taken into account. The revised version provides projected glacier volume losses in percent, and sea-level contributions are listed consistently in the sea-level box (see comment #108597)

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97655	39	7	39	19	Please add information on changes in the rate and potential disappearance of the Greenland Ice Sheet. . [Nicole Wilke, Germany]	Noted. We refer to Box TS5 (Sea level) for GrIS mass loss rates and to Box TS10 (Irreversibility) for an assessment of potential disappearance of the ice sheet.
34791	39	7	39	19	The SOD claims that the Greenland ice sheet state is unprecedented over centuries. Please see rebuttal comment #8. [Jim O'Brien, Ireland]	Noted. The revised version does not use the word "unprecedented" in this context.
108605	39	11	39	11	mass losses have been consistently negative', is that what you mean to say? Could this be rephrased without a double negative? [Jason Donev, Canada]	Taken into account. The timing of retreat and advance phases has been clarified, and the use of double negatives ("negative losses") has been consistently avoided in the revised chapter and TS drafts.
106657	39	11	39	11	annual mass losses have been consistently negative: I would avoid talking about negative mass losses. The use of the adjective negative to qualify mass losses is a bit misleading. Simply state that the Greenland has consistently lost mass each year. [Kevin Bulthuis, United States of America]	Taken into account. The timing of retreat and advance phases has been clarified, and the use of double negatives ("negative losses") has been consistently avoided in the revised chapter and TS drafts.
108601	39	12	39	12	Reporting this in metres seems really weird, could it be done in cm? mm? [Jason Donev, Canada]	Taken into account. Changed to cm, as in the Antarctic paragraph.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
106659	39	13	39	13	and/or: Why simply not use and? [Kevin Bulthuis, United States of America]	Taken into account. Editorial. Sentence clarified and reformulated without "and/or".
106661	39	13	39	13	Greenland ice mass loss -> The Greenland ice-mass loss [Kevin Bulthuis, United States of America]	Taken into account. Reformulated as suggested.
106663	39	14	39	15	For future warming levels between 2°C and 3°C: it would be interested to give a reference data or period to which the temperature increase is considered (I assume this is considered to present or 2000) [Kevin Bulthuis, United States of America]	Noted. The assessment of Greenland ice-sheet loss is now in Box TS.10. In Chapter 9, the assessment has evolved with respect to the SOD and more prominence is given to a threshold in terms of ice sheet mass (for irreversible loss) than in terms of climate (for a negative mass balance).
106665	39	15	39	15	Greenland Ice Sheet -> The Greenland ice sheet (for consistency) [Kevin Bulthuis, United States of America]	Noted. Editorial.
52799	39	15	39	16	Concerning "there is medium confidence that the Greenland Ice Sheet will pass a threshold where long-term mass loss becomes irreversible over centennial timescales.": 1) It is not clear whether this refers to a total loss of the GrIS or to irreversibility of a loss of whatever magnitude, e.g. by lowering the sfc elevation. 2) I can't locate a corresponding statement in Ch. 9.4.1. Note that the sentence is repeated in Cross-Section Box 2. [Petra Seibert, Austria]	Taken into account. Potential (near-complete) loss of the Greenland ice sheet is now only assessed in Box TS10 on irreversibility, based on the final version of Chapter section 9.4.1.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
32873	39	15	39	16	The threshold for the Greenland ice sheet appears a number of times. This assessment should be revisited following Gregory et al. (submitted) [Helene Hewitt, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. The statement does not appear here and has been updated in chapter 9 and accordingly in Box TS10 (irreversibility).
32517	39	17	39	17	The starting date should be specified [Eric Brun, France]	Taken into account. We now refer to the sea-level box TS5 for this, where these numbers are clearly given for specific periods in a table in the box.
106667	39	17	39	17	0.03 to 0.12 -> 0.03-0.12 (for consistency) [Kevin Bulthuis, United States of America]	Taken into account. We now refer to the sea-level box TS5 for this, where these numbers are clearly given for specific periods in a table in the box.
106669	39	17	39	17	0.07 (0.03 to 0.12) and 0.13 (0.09-0.19): It would be interesting to specify what the values 0.07 and 0.13 represent (mean or median values) and what the uncertainty ranges (0.03 to 0.12 and 0.09-0.19) are (likely range, very likely range, 33%-66% probability interval,...) [Kevin Bulthuis, United States of America]	Taken into account. We now refer to the sea-level box TS5 for this, where these numbers are clearly given for specific periods in a table in the box.
15329	39	21	39	35	It would be nice if this Antarctic paragraph started with some paleo context (e.g. Pliocene), as is done for Greenland in the previous paragraph. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Due to space constraints and to more uncertain reconstructions of recent changes, we unfortunately cannot add this information here.
40627	39	23	39	23	Perhaps use mm or cm instead of m? Policy maker appreciated this in the SPM of SROCC. [TSU WGI, France]	Noted. Done.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
106675	39	23	39	23	0.069+-0.0014 m: What does 0.060 represent (mean or median value) and what does the uncertainty range represent? [Kevin Bulthuis, United States of America]	Noted. This is the mean estimate and the likely range.
106679	39	27	39	27	Is it really entirely true to state that ice-shelf basal melting dominates current dynamical losses? I would argue that so far there is also a not negligible impact of calving (mass losses due to calving are approximately equal to mass losses due to ice-shelf basal melting). But I agree that in the future, ice-shelf basal melting will (certainly) dominate mass losses in West Antarctica. This sentence would benefit from further clarifications. [Kevin Bulthuis, United States of America]	Taken into account. We now write "mainly induced by ice shelf basal melt" - increased calving is mostly a consequence of an increase drainage flux, itself induced by reduced buttressing, which is in many (but not all) cases ultimately caused by initial basal melt.
108603	39	29	39	29	What is the temperature that this number is for? Arctic changes or global changes? It's not clear if this is a global or a local phenomenon, since it is a local effect from a global cause that's more intense in the Arctic. [Jason Donev, Canada]	Noted. No numbers are given on this topic in the revised version.
52801	39	32	38	32	"but there is deep uncertainty regarding the Antarctic contribution beyond 2100 linked to potential destabilization of the West Antarctic Ice Sheet" - this is insufficient to reflect the discussion in Ch. 9.4.2. It should be stated what the time frames to reach equilibrium and potential sea-level rise contributions would be. [Petra Seibert, Austria]	Taken into account. We now specify the involved processes very briefly within the tight word count constraints.
19595	39	38	39	50	summary of a summary; see comment on page 32. Moreover, you give references to the full text rather than to the summarizing subsections above. What becomes then the role of these subsections 2.4.1 to 2.4.3? [philippe waldeufel, France]	Taken into account. This paragraph has been cut in response to this comment and because of tight word count constraints.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97657	39	42			We are surprised that the attribution statement is not stronger. What else could be the reasons? [Nicole Wilke, Germany]	Noted. This paragraph was cut, but the attribution statements in this section refer to Chapter 3, where the attribution of observed changes is assessed. However, we do think a "very likely main cause" is the appropriate attribution statement in the light of high temporal variability and sometimes sparse observational networks.
106685	39	46	39	46	Greenland Ice Sheet -> Greenland ice sheet (for consistency) [Kevin Bulthuis, United States of America]	Noted. Editorial. The paragraph has been cut.
106687	39	47	39	48	Antarctic Ice Sheet -> Antarctic ice sheet (for consistency) [Kevin Bulthuis, United States of America]	Noted. Editorial. The paragraph has been cut.
82613	39	50	39	50	A word is missing after "1971 and" [Blair Trewin, Australia]	Noted. The sentence was cut.
11041	39	57	39	57	Global *mean* sea-level change [Robert Kopp, United States of America]	Accepted. GMSL is now used wherever appropriate.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
84585	40	6	40	8	in the sense of SSP rather than RCP? Better to specify more clearly [Annalisa Cherchi, Italy]	Taken into account. The methods, models and scenarios used for sea level projections in the AR6 are updated from those employed by the SROCC, with contributions from the latest model projections described in the ocean and cryosphere sections.
54783	40	6	40	8	It would be helpful to include here a statement stating any major differences between AR6 WGI projections of SLR relative to conclusions of the IPCC SROCC (recognizing that the results are not directly comparable due to updated models and scenarios). [Nancy Hamzawi, Canada]	Taken into account. Despite these differences, the sea level projections are broadly consistent with those of the SROCC
106689	40	10	40	11	On multi-decadal-to-centennial timescales there is deep uncertainty: I would say that on (multi-)decadal timescales, the use of phrase deep uncertainty may be a little bit strong. In the next decades (until 2050), there are uncertainty in the projections but I would not quality this uncertainty as deep (most models are basically in agreement). [Kevin Bulthuis, United States of America]	Taken into account. Deep uncertainty is now discussed in the context of processes that could give rise to substantially large global mean sea level by 2100 and beyond.
106035	40	12	40	14	The confidence and probability statements here do not identify the basis for these statements. Chapter and section number(s) are needed. [William Gutowski, United States of America]	Accepted. Chapter and section numbers added.
54785	40	16	40	17	This para starts with a paleo perspective on sea levels going back 55 million years then jumps immediately to changes in sea level since 1900. It is unclear what the message is from the paleoperspective. Suggest a message be made more explicit and consider whether sea level changes during the last interglacial might be relevant information here. [Nancy Hamzawi, Canada]	Taken into account. Added more paleo context.
40039	40	16	40	23	Could anything be stated about the rate of change in this paragraph. I realize that this is addressed in the next paragraph, but it may be useful to consider doing so here. [TSU WGI, France]	Accepted. Added rate of change to this paragraph.
34793	40	16	40	43	As regards Global Mean Sea Level (GMSL) projections, please see general comment #6. [Jim O'Brien, Ireland]	Noted.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97659	40	16			GMSL was used before. Acronym is already introduced. [Nicole Wilke, Germany]	Accepted. Now use GMSL consistently
97661	40	17			GMSL was used before. Acronym is already introduced. [Nicole Wilke, Germany]	Accepted. Now use GMSL consistently
93879	40	18	40	20	Wordiness sentence. Split it in two to improves readability. [Lucas Ruiz, Argentina]	Taken into account. This box has been substantially rewritten.
113799	40	25	40	25	"The rate of GMSL rise is accelerating" is imprecise. You may consider "GMSL is rising at an accelerating rate" [Jan Fuglestedt, Norway]	Not applicable. Acceleration no longer quoted in the box. Instead, the changing rates over time are presented.
11043	40	25	40	27	Consider adding confidence to acceleration [Robert Kopp, United States of America]	Not applicable. Acceleration no longer quoted in the box. Instead, the changing rates over time are presented.
561	40	48	41	1	Apparently, there is a misfit between Total value and the sum of contributions. For example, if you add the minimum value of the different contributions for SSP1 2.6, you find 0.23 for a total of 0.33. Same discrepancies on most of the lines of the table. If the values were to be confirmed, there is a need for additional explanation. [Michel SIMON, France]	Not applicable. No longer discussed in this box.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
32875	40	50			Table 1 needs values added [Helene Hewitt, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. Table has been deleted.
11045	41	5	41	5	You do not need the SSP qualification for the extremely unlikely statement -- it is also true for higher emissions scenarios. Perhaps more straightforward to say that "GMSL is extremely likely to increase by more than 0.2 m by 2100 under all emissions scenarios. To keep GMSL rise through 2100 below 0.3 m would require not only strong mitigation, but also strong stabilizing feedbacks, such as..." [Robert Kopp, United States of America]	Not applicable. No longer discussed in this box.
39549	41	5	41	5	Parker, A., Ollier, C.D., 2015. Analysis of sea level time series. Phys. Science Int. J. 6, 119-130 report that sea level gauges show an average sea level rise of 1 mm per year. This would give 0.08 m in 2100 contrary to the statement. [François Gervais, France]	Noted. Individual papers are not cited in the TS. The TS is based on the careful assessments provided in the individual chapters. Tide level gauges were assessed in Chapter 9.
106691	41	6	41	6	feedbacks would need to take place: I find this sentence a bit awkward. Normally these feedbacks should take place in the future. The issue is more related to the importance/magnitude of these feedbacks in playing a mitigation role. [Kevin Bulthuis, United States of America]	Taken into account. Higher amounts of GMSL rise could be caused by earlier-than-projected disintegration of marine ice shelves and onset of Marine Ice Sheet Instability around Antarctica, the onset of Marine Ice Cliff Instability (MICI) around Antarctica, and faster-than-projected changes in the surface mass balance and dynamical ice loss from Greenland
97663	41	13	41	15	Please explain the method "probabilistic projections incorporating expert judgment". In addition, the formulation "is likely only if" is unusual for the IPCC. What is the likelihood of these conditions (contributions from the ice sheets in excess of the thresholds)? [Nicole Wilke, Germany]	Taken into account. Has been substantially restructured.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97665	41	13	41	23	This paragraph on the highly important issue of ice sheet contributions to GMSL needs serious revisions please, taking into account the reception by a non-expert audience. The information provided should be self-contained, e.g. referring to secondary thresholds or model ensembles or unexplained expressions like "deep uncertainty" should be avoided. [Nicole Wilke, Germany]	Taken into account. Has been substantially restructured.
106693	41	14	41	15	46 cm and 42 cm -> 0.46 m and 0.42 m for consistency [Kevin Bulthuis, United States of America]	Accepted.
97667	41	18			The information "exceeding those simulated by the ISMIP6 ensemble" is not helpful, since the reader is not provided with information on this ensemble. Please revise. [Nicole Wilke, Germany]	Accepted. Has been substantially restructured.
11047	41	25	41	30	Consider adding language on sea-level commitment [Robert Kopp, United States of America]	Accepted. Added 2000-year commitments.
130355	42	1	42	5	It is stated that a 1% extreme water level is to become an annual event at about 20% of tide gauge stations by 2050. This seems like an extreme shift in the next 30 years, particularly because in general they are only projected to occur between 11-14 time more frequently dependent on selected emission scenario. Please clarify this statement. [Trigg Talley, United States of America]	Not applicable. Global summary statements about changes in extreme sea levels are no longer presented in the TS.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
66913	42	31	42	43	TS.2.5.1 Observed changes. This sub-section appears to be missing several key pieces of observed change in the water cycle (changes in variability, intensity of extremes, snow and glacier melt and associated discharge). [Mathew Barlow, United States of America]	Taken into account. The water cycle is now synthesized in Box TS.6 (FGD version of TS) and largely re-drafted. Changes in many aspects of observed water cycle changes (as listed by the reviewer) are now included in the revised text
55481	42	31			The subheadings in this section are really helpful would be good to include in all sections in TS.2 [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Noted. However text has been completely re-drafted for FGD and water cycle section is now Box TS.6 with a different layout structure
108607	42	35	42	36	Explain relative and absolute humidity here, not all readers will know. Also explain water column. Put it here and in the glossary. [Jason Donev, Canada]	Taken into account: these terms are defined in the glossary
39915	42	40	42	41	A bit jargon-y. Please consider : "There is also low confidence in pre-instrumental variability, due to... [TSU WGI, France]	Not applicable. Text completely re-drafted for FGD
54787	42	41	42	43	Here, it is stated that "the global water cycle has strengthened since 1980 meaning that global precipitation has increased but at a lesser rate than the atmospheric water content (medium confidence)". This explanation for what "strengthening of the global water cycle" means is not consistent with explanations elsewhere in the report (in Ch. 8) (where the emphasis is on increased precipitation intensity and increased number of dry days). A clear explanation of what this oft-used phrase means would be helpful here. [Nancy Hamzawi, Canada]	Taken into account. The text has been re-drafted and now the assessment about intensification of the water cycle from ch 2 and ch8 are harmonized
41083	42	41	42	43	This comment relates to finding support for a particular SPM headline statement in the TS: It seems that there is high confidence in the SPM statement concerning the water cycle, while medium confidence in the TS. SPM B.2 (p.9 line 40): " There is high confidence that since pre-industrial times human activities have strengthened the global water cycle. " TS: "Yet, there is medium confidence that the global water cycle has strengthened since at least 1980, meaning that global precipitation has increased but at a lesser rate than the atmospheric water content (medium confidence). {2.3.1}" NB: TS2.5.2 "There is growing evidence and high confidence that human activities have affected the global water cycle since pre-industrial times." [TSU WGI, France]	Noted. However text has been completely re-drafted for FGD and water cycle section is now Box TS.6. The key assessments to be elevated to the SPM are now framed in a salmon box at the beginning of the text

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
84589	42	46	43	17	reference to fig TS.18 is missing in the paragraphs of sect TS2.5.2 [Annalisa Cherchi, Italy]	Not applicable. Fig TS.18 is not in the FGD.
130357	42	48	42	49	[CONFIDENCE] Use of the term 'since pre-industrial times' in the sentence ""There is growing evidence and high confidence that human activities have affected the global water cycle since pre-industrial times"" is ambiguous if not problematic, and could confuse the information being provided to policymakers, especially given the first statement (page 41-42) and second statement (page 45, lines 47-51) listed below from TS.2.5: 1) There is also low confidence in the paleo context given limitations in proxy-based reconstructions at continental and global scales. 2) The effect of anthropogenic forcings on the observed water cycle is generally less clear than on temperature, given the larger observational uncertainties and the larger relative magnitude of internal variability. It is however likely that human influence has contributed to observed large-scale precipitation changes since 1950. There is no evidence provided in Chapters 2, 3, or 8 that reveals a high degree of confidence that human activities impacted the global water cycle starting in pre-industrial times (1750 to 1850-1900 [SPM-2]). It is likely human activities impacted regional to local components of the water cycle starting in pre-industrial times. It is likely human activities have impacted the global water cycle starting in the mid-20th century. Suggest sentence be revised to ""There is growing evidence and high confidence that human activities have affected the global water cycle since the end of the 19th century."" Or even better ""There is growing evidence and high confidence that human activities have affected the global water cycle since the beginning of the 20th century."" [Trigg Talley, United States of America]	Not applicable. The text has been completely re-drafted
66905	42				Overall organization of section TS.2.5 Water cycle. Please consider having the same subsections as the organization of chapter 8's executive summary (physical basis, causes, future changes, and abrupt change) - it would be easier for tracability and make better use of the chapter to mirror that here. [Mathew Barlow, United States of America]	Noted. The water cycle is treated now in separated box of the TS. All the relevant outputs are taken from the respective chapters (CH 8 in primis)

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
66907	42				Overall comment on section TS.2.5 Water cycle. This section did not have as many traces back to chapter 8 as I expected - I suggest looking at chapter 8's executive summary to make sure all key points are included. Additionally, there are flood and drought parts of chapter 12 that are relevant to the water cycle and so should have at least some mention here. Possibly chapter 12 should be referenced as well. [Mathew Barlow, United States of America]	Noted. The water cycle treatment now is founded on ch 8 outcomes. Ch 12 is highly regional oriented and it is considered mostly in TS4 section
66909	42				Overall comment on section TS.2.5 Water cycle. The section does not appear to address abrupt change and the potential impacts of geoengineering on the water cycle - I think these should be included. [Mathew Barlow, United States of America]	Noted. Abrupt changes are now included in the text related to water cycle changes (now Box TS.6)
66911	42				Overall comment on section TS.2.5 Water cycle. Permafrost is also part of the water cycle and should at least be mentioned in this section (even if more fully considered elsewhere). [Mathew Barlow, United States of America]	Noted. Permafrost is treated in the section dedicated to cryosphere. Water cycle is re-drafted in a box with words limitations
97669	43	0			What could be the reason of the soil moisture limitation? Please explain this finding. [Nicole Wilke, Germany]	Noted. The text has been re-drafted
84587	43	3	43	4	"last 6-7 decades" could be better specified by including years' intervals [Annalisa Cherchi, Italy]	Not applicable. The text has been completely re-drafted
108611	43	8	43	9	The 'fresher get fresher and the saltier get saltier statement' is unclear in this context. Is this just ocean water? What about lakes? Brackish rivers? A little more explanation on this statement would help. [Jason Donev, Canada]	Noted. The text has been re-drafted and that statement removed

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
41085	43	8	43	9	This comment relates to finding support for a particular SPM headline statement in the TS: NB the difference in the TS vs the SPM and Chapter. TS: "It is extremely likely that human influence has contributed to observed near-surface and subsurface oceanic salinity changes since the mid-20th century, with a clear "fresh-get-fresher, salty-get-saltier" pattern." vs. SPM" It is virtually certain that large-scale changes in near-surface and subsurface salinity patterns (fresh get fresher, saltier get saltier) have occurred since at least 1950, adding to the observational evidence for an intensification of the water cycle." [SPM B.3 p.12-line 9] Chapter 2: (2-5) It is virtually certain that large-scale changes in near-surface salinity patterns (fresh get fresher, saltier get saltier). Perhaps change TS to "virtually certain". [TSU WGI, France]	Noted. However text has been completely re-drafted for FGD and water cycle section is now Box TS.6. The key assessments to be elevated to the SPM are now framed in a salmon box at the beginning of the text
130359	43	11	43	12	The sentence: "Anthropogenic emissions of greenhouse gases have contributed to regional changes in runoff and river discharge (medium confidence)" should be expanded upon. This is a pretty vague statement that does not provide any context to where these regional changes are occurring or provide insight into the trends as far as attributing to anthropogenic emissions. [Trigg Talley, United States of America]	Noted. The text has been re-drafted and that statement removed
97671	43	22	43	23	Is P-E equal to moisture availability? [Nicole Wilke, Germany]	Not applicable. Precipitation and evaporation are plotted in separated maps
108609	43	40	43	41	Does this statement imply that places with greater temperature change will have greater precipitation change? That seems a bit odd. It could be true, but this needs to be made a bit more clear. [Jason Donev, Canada]	Noted. The sentence has been re-written and maps on variables in GWL give better ideas on how these changes work
87047	43	41	43	45	The statement seems contradictory for SSP5-8.5. The sentence reads "increase in moisture availability (...) is larger for SSP5-8.5, thereby indicating a soil moisture limitation (...) in low-mitigation scenarios." The latter part, indicating a moisture limitation in "low mitigation scenarios" seems reasonable, while it doesn't fit with the "larger increase in moisture availability for SSP5-8.5. [Oyvind Christophersen, Norway]	Not applicable. Sentences have been re-written and re-distributed within the water cycle section (Box TS.6)

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
130361	43	45	43	45	Define what is meant by global continental runoff. Can this be broken any further? [Trigg Talley, United States of America]	Not applicable. Sentence has been re-written and runoff is represented as global maps (changes in scenarios)
93881	43	47	43	47	the confidence statement must be in italics [Lucas Ruiz, Argentina]	Accepted. Checked and modified in the whole text
2973	43	52	43	58	Please add the numbers of CMIP6. All figures and tables of TS should give the numbers of CMIP6. [Zong Ci Zhao, China]	Accepted. Number of CMIP6 is included in each table and in each figures when shown
88433	43	60			Table TS.10 - Snow cover section - unclear why time period given in 1st (indicator) and 2nd (assessment) column is different --time periods are not given for all other indicators. Isn't the indicator just a reduction of snow cover over time? [Sharon Smith, Canada]	Not applicable. Table TS.10 is not in the FGD anymore with that content. Snow cover information are now provided in TS2.6 (land section)
97673	44	4	22	5	We do not understand the meaning of "the percentage of simulations for which such exceedances are true". Please specify in the left column in all the boxes, if the values are for land, ocean, or global, since this is unclear in the current version. [Nicole Wilke, Germany]	Not applicable. Table TS.6 of the SOD is not in the FGD
84591	44	14	44	14	"over the Mediterranean" could be removed here and left only at the end of the paragraph where also other regions are specified [Annalisa Cherchi, Italy]	Not applicable. The text has been completely re-drafted

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
26105	44	14	44	14	It is more precise to say 'Mediterranean region' than 'Mediterranean', because the projected precipitation decrease will affect not only the Mediterranean sea but also its land basin. [Don Alfonso Pino Maeso, Spain]	Accepted.
97675	44	16	44	19	Since the pronounced drying of so many regions in almost all continents (with medium to high confidence) is useful information for policy makers, we request the authors to rise the second part of the sentence to the SPM. We think C4.4 would be very suitable as it already contains the first part of the sentence. [Nicole Wilke, Germany]	Noted. Statement about changes in regions prone to drought in the salmon box, to be elevated to SPM
26287	44	40	45	11	In this paragraph the level of probability confidence is not in italics (Page 44-Line 40; Page 45-Lines:3,8,9,11) [Maria Santolaria-Otin, France]	Noted. All confidence statements checked and changed into italic
130363	45	1			"regional disparities" is not the best term since it implies undo burden such as economic , health , racial , or ethnicity disparities. Suggest replacing with "large regional differences". [Trigg Talley, United States of America]	Not applicable. Sentence removed
84593	45	7	45	7	Maritime Continent [Annalisa Cherchi, Italy]	Noted the editorial. Anyway the term is not anymore in the text

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97677	45	7			The expression "Maritime Continent" is unknown outside research, please use another term. [Nicole Wilke, Germany]	Noted. It refers to a geographical place. Anyway it is not anymore specified in the text
130365	45	8	45	8	What is meant by "the seasonality of precipitation, runoff, streamflow, and water availability will increase"? Increase in terms of variation between seasons? Start/end dates will progress forwards? [Trigg Talley, United States of America]	Not applicable. That part of the text has been removed
23545	45	12	45	14	The message of this sentence is not clear. To be more clarified such as "The trend of precipitation in the tropics is obscured." [Masaki Satoh, Japan]	Not applicable: the author is in fact referring to lines 54-57 of page 42 which has now been removed.
84595	45	19	45	30	fig TS.20 is not well and completely referenced within the section [Annalisa Cherchi, Italy]	Noted. Figure has been re-drafted and referenced where needed
109717	45	19	45	30	As per previous comment, need to define here what is meant by "runoff", as this is commonly understood to be river runoff but these global climate models are incapable of modeling that process. Physically plausible projections of future river runoff is only possible by downscaling climate model data to the watershed scale and using this information to drive river hydrology models - which has been widely done. At best, the runoff fields generated by climate models are a loose indicator of some general directions that future river runoff could take. [Sean Fleming, United States of America]	Noted. The term "runoff" is included in the glossary

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
111217	45	21	45	21	P-E usually refers as "soil moisture deficit" [Volodymyr Osadchy, Ukraine]	Taken into account. Water cycle variables and their meaning is better organized in the water cycle box
66915	45	45	45	55	TS.2.5.4 Summary of water cycle changes. The summary should mention changes to the intensity of heavy precipitation. [Mathew Barlow, United States of America]	Not applicable. The summary section is removed from FGD but we kept few key statements (without specific details) that we wanted elevated in the SPM at the beginning of the water cycle section (Box TS.6 in the FGD)
66917	45	45	45	55	TS.2.5.4 Summary of water cycle changes. Changes to melt and discharge seem important and robust enough to merit mention in the summary. [Mathew Barlow, United States of America]	Not applicable. The summary section is removed from FGD but we kept few key statements (without specific details) that we wanted elevated in the SPM at the beginning of the water cycle section (Box TS.6 in the FGD)
66919	45	45	45	55	TS.2.5.4 Summary of water cycle changes. Suggest comparing with the SPM summary (SPM C.4), which has more detail. I like the detail in the SPM but I think the TS should have more detail than the SPM, not less (unless I misunderstanding the structure). [Mathew Barlow, United States of America]	Not applicable. The summary section is removed from FGD but we kept few key statements (without specific details) that we wanted elevated in the SPM at the beginning of the water cycle section (Box TS.6 in the FGD)
19597	45	45	45	55	This summary of a summary is particularly vague. Paradoxically, while some positive information about precipitation is supplied in previous subsections (expansion of arid areas towards higher latitudes), this information has disappeared in this summary's summary, which boils down to increased global mean precipitation, and increased variability at all space and time scales. For users looking for some help and hope to be some day able to project precipitations a little better than now, the best chance is to bypass the summary and read the main text. [philippe waldteufel, France]	Not applicable. The summary section is removed from FGD but we kept few key statements (without specific details) that we wanted elevated in the SPM at the beginning of the water cycle section (Box TS.6 in the FGD)
41087	45	47	45	48	This comment relates to finding support for a particular SPM headline statement in the TS: Where is the support in the TS for this SPM headline statement A.2 (p6, line 5): "Human-induced climate trends are superimposed on natural decadal or multi-decadal climate variability, whose effects are more pronounced at regional scales than at the global scale, and relatively larger for most water-cycle variables, including precipitation, than for temperature."? NB that the TS states "The effect of anthropogenic forcings on the observed water cycle is generally less clear than on temperature, given the larger observational uncertainties and the larger relative magnitude of internal variability." [TSU WGI, France]	Noted. Section on water cycle has been completely re-drafted (Box TS.6 in the FGD). The text to be elevated/linked to the SPM is now in a short frame (salmon box) at the beginning

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
79001	45	47	45	53	what about decrease in evapo-transp due to the impact of increasing atm CO2? [Pedro Monteiro, South Africa]	Not applicable. The summary section is removed from FGD but we kept few key statements (without specific details) that we wanted elevated in the SPM at the beginning of the water cycle section (Box TS.6 in the FGD)
100233	46	1	46	1	This section is very well-written and easy to read. I have a few suggestions for word choices and reading ease. [Carlye Peterson, United States of America]	Noted. Thank you.
87049	46	1	48	46	Quantification of emissions and reservoir changes resulting from land use should be expressed not only in net amounts (that is aggregated at the global scale), but also with some examples given of gross amounts from different situations, for instance resulting from particular instances of deforestation, afforestation, soil degradation or soil regeneration. Gross amounts are often more interesting for policy/mitigation as any mitigation effort can mostly address the gross amount, and any contribution to carbon sequestration is valuable even if gross losses arise elsewhere. (See also chapter 2.4.1 in the Special report on climate change and land: "gross fluxes are more informative for assessing the potential for mitigation than estimates of net fluxes, because the gross fluxes indicate the extent of individual activities." [Oyvind Christophersen, Norway])	Noted. The scope of the (revised) carbon cycle box is the behaviour of natural sinks and sources. Land use and resulting emissions are treated in the revised section TS2.2 (drivers)
97679	46	1	48	46	This section TS.2.6. on the Carbon Cycle does not provide information on overshoot scenarios. This is a major shortcoming since such scenarios play a major role in the context of the Paris Agreement. Please provide information about how C-cycle react to temperature overshoot. [Nicole Wilke, Germany]	Taken into account. Information about the carbon cycle source and sinks under net negative emissions is provided in the revised version.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97681	46	3			GHG was used before. Acronym is already introduced. [Nicole Wilke, Germany]	Taken into account. Not redefined in the revised text.
100235	46	4	46	5	Re-write: Since 1950, the human induced increase in these atmospheric GHGs has been the primary cause of observed climate change. --OR-- Since 1950, the human induced increase in these atmospheric GHGs has been the primary cause of the observed climate changes. [Carlye Peterson, United States of America]	Noted. The sentence has been cut (not directly a carbon cycle question)
108613	46	11	46	11	Mention that 1 Pg = 1 Gt, since those are both used. If you're using Pg for carbon and Gt for CO2, that needs to be stated explicitly. I think that's your convention, but I'm not confident with the different writers. Pg is an 'odd' enough unit that it should briefly be explained in the terms that many people are talking about. [Jason Donev, Canada]	Taken into account. This is now explained in the Introduction of the TS.
40365	46	11	46	11	I believe that in the SR of the AR6 cycle, GtCO2 was given. Perhaps provide this number or its equivalent, or add a footnote? [TSU WGI, France]	Taken into account. This is now explained in the Introduction of the TS.
100237	46	14	46	16	Suggested re-write: This section also assesses changes in ocean and land carbon cycle processes that are relevant as drivers, indicators, and feedback elements of global climate change and their attribution to human and natural influences. {5.1.2} [Carlye Peterson, United States of America]	Noted. The entire paragraph has been rewritten and shortened. This comment, though valuable, is therefore not applicable.
111219	46	21	46	23	First statement very badly formulated, including "the atmospheric growth in GHGs" instead of "the growth of atmospheric GHGs". And there are no confidence levels in the paragraph [Volodymyr Osadchy, Ukraine]	Taken into account. Text revised accordingly. The statement is now the leading statement of the carbon cycle box.
563	46	27	46	29	44+23+29 = 96% with a high confidence level. Were are the other 4%? [Michel SIMON, France]	Noted. The given uncertainties in the absolute land and ocean sinks correspond to much more than the missing 4%.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
108615	46	27	46	34	The numbers in TS. 2.6 'the carbon cycle' aren't consistent with section 5.2.2 or figure 5.3. [Jason Donev, Canada]	Taken into account. Numbers were carefully checked against the underlying chapters in the revision process.
97683	46	30	46	31	"The sum of these quantities has an imbalance of 0.4 PgC suggesting an underestimation of the sinks, or an overestimation of the emissions, or combination of both." Please explain the reasons for this imbalance and relate the information to the SRCLL. [Nicole Wilke, Germany]	Noted. This statement has been deleted because of tight space constraints.
97685	46	31	46	34	As commented on the entire report, it would be helpful if the units used to quantify carbon emissions would be aligned. Here, we do not see why PgC per year is used instead of GtCO2 although it is just about CO2 emissions in this sentence. In particular this may confuse the reader, since this PgC figure does not include other carbon emissions such as CH4. Please revise. Furthermore, we would like to request the authors to use units found in the SRCLL (Mt CH4 and Mt N2O) and to provide the figures of GtCO2 equivalent to make numbers comparable. [Nicole Wilke, Germany]	Noted. This TS also has to be consistent with the underlying chapters, which provide these numbers in PgC. Methane and N2O are not treated in the revised version of this subsection (carbon cycle box).
108617	46	34	46	34	Section 5.2.3 isn't actually relevant to this paragraph. [Jason Donev, Canada]	Noted. Indeed 5.2.3 is not directly relevant but we want to refer the reader to underlying chapter sections where more greenhouse gases (not just CO2) are treated.
108619	46	34	46	34	I think you mean 'figure 5.3' rather than 5.4. [Jason Donev, Canada]	Taken into account. The line of sight has been corrected.
108621	46	34	46	34	I'd encourage you to mention table 5.1 here as well as the other references to chapter 5 [Jason Donev, Canada]	Taken into account. The lines of sight were updated. However, we prefer not to specifically mention the table but only the relevant section to avoid duplication.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
6403	46	36	46	37	The sentence needs rewriting as it is structurally incorrect in its present form. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The sentence was cut.
97687	46	36	46	37	Please provide a confidence level. [Nicole Wilke, Germany]	Not applicable. The sentence was cut.
97689	46	39	46	41	Please quantify the CH4 trend from live stock and fossil fuels. [Nicole Wilke, Germany]	Noted. The scope of the (revised) carbon cycle box is the behaviour of natural CO2 sinks and sources. CH4 emissions are assessed in the revised section TS2.2 (drivers).
130597	46	44	46	46	"Agricultural N2O emissions have increased by about 80% since the early 1900s, and by 30% since the 1980s. There is high confidence that increased use of nitrogen fertiliser and manure contributed to about 70% of the increase during the 1980–2016 period" duplicate with TS-26. [Panmao Zhai, China]	Noted. The revised text focuses of CO2 sources and sinks.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97691	46	48	47	15	The first paragraph (TS.2.6.1 TS-46:48-54) states that there is high confidence that the combined RATES of CO2 removals by ocean and land have declined per unit of excess anthropogenic CO2 in the atmosphere. The following paragraph (TS.2.6.2 TS-47:3-15) concludes that the STRENGTH of global net land CO2 sink increased. This sounds contradicting. We request the authors to distinguish in TS.2.6.1 between relative land and ocean sink and explain whether also the removals by land per unit of excess anthropogenic CO2 are declining and how this relates to the absolute global net land CO2 sink. [Nicole Wilke, Germany]	Taken into account. In rewriting the subsection (box), we aimed at clarifying this distinction.
108623	46	49	46	51	This statement about what remains in the atmosphere being constant over time is inconsistent throughout the document. See FAQ 5.1 and SPM lines 35-37 page 8 [Jason Donev, Canada]	Taken into account. Great care was taken to align the SPM and the TS with the underlying chapters in the FGD.
97693	47	10	47	13	It would be also appreciated if authors could provide more information on the "increasing strength of global net land CO2 sink". We request the authors to reflect other findings (extent and variability of the "increasing strength" of the sink) more clearly. 1) We suggest to this increase into context and compare it with other relevant figures, e.g. the emission increase during this time period: As stated in chapter 5.2.1.4.1 (TS-25:47-53), this sink increased from 0.3+/- 0.5 PgC per year in the 1960s to 2.1 +/- 0.7 PgC per year in 2008-2017. Compared to the increase in the emission during this time (about 8 PgC Figure 5.6), this increase is quite small. 2) There is strong variability of the net land CO2 sink as found in Figure 5.10 Panel a. We feel that just to refer to an "increasing strength" does not reflect this variability which is of the same magnitude as the total flux. Also, there are differences between models and satellite data, which should be mentioned here as well. [Nicole Wilke, Germany]	taken into account – regarding the strength, this is covered earlier in the carbon cycle section, where the strength of the land sink is given as a percentage of the emissions (31%). Regarding the large variability this is now explicitly described here.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97695	47	10	47	15	We kindly request the authors to provide quantifications of the impacts of these two effects (fertilisation, nitrogen deposition) and how they evolved over time. [Nicole Wilke, Germany]	Rejected. Due to tight space constraints, we were unable to include these details here and need to refer to the underlying chapter.
97697	47	15	47	15	Figure 5.9 in the line of sight is about sea-air flux, most likely it should be referred to Figure 5.10. Please revise. [Nicole Wilke, Germany]	Taken into account. The line of sight was corrected.
97699	47	17	47	18	Please add a confidence level. [Nicole Wilke, Germany]	Taken into account. The statement has been reformulated and combined with an assessment of changes on land, leading to overall medium confidence about the observed changes.
108625	47	22	47	22	pCO ₂ , I know what it is, but I think it needs to be defined somewhere, here, glossary, somewhere. [Jason Donev, Canada]	Noted. pCO ₂ is not used in the revised version.
108627	47	25	47	25	The units of microatm are unclear, is this a partial pressure of CO ₂ ? Please re-word this. [Jason Donev, Canada]	Not applicable. The statement was deleted.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
39551	47	30	47	52	Haverd, V., et al, 2020. Global Change Biology 26, 2390-2402. doi.org/10.1111/gcb.14950 question the data. Please cite and discuss [François Gervais, France]	Rejected. Scientific papers are not cited in the TS, which summarizes the chapter content. We note that the first author of this paper is a contributing author to the relevant chapter.
97701	47	30	48	19	Here the influence of human behaviour on the potential of land as a sink under the different SSPs can be mentioned to clarify differences between estimations. [Nicole Wilke, Germany]	Noted. Indeed this could be mentioned in more detail, but the main uncertainty still arises from the emissions scenario (which is of course due to human behaviour). We feel that insisting on other human influences would blur this message.
16631	47	30	48	30	Section TS.2.6.3: Since CH4 and N2O were discussed in section TS.2.6.1 maybe a couple of sentences on future changes in methane and N2O cycles could be added in this section. [William Collins, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. N2O and CH4 are not mentioned in the revised version of this section.
41113	47	30	48	46	TS 2.6.3: Future changes to the ocean and terrestrial carbon cycles: I would like to know what is accounted for in projections reported previously (e.g. global Temperature change) and what is not accounted for (carbon cycle feedbacks, which processes missing in models). [TSU WGI, France]	Rejected. Unfortunately, the tight space constraints really leave no place for such a discussion which the reader will need to look for in the underlying chapter.
97703	47	32	47	45	If we understand correctly, the information on C-fluxes has been obtained from concentration-driven models? If yes, please indicate that the fluxes shown are model responses to the concentrations prescribed by the two assessed scenarios. [Nicole Wilke, Germany]	Accepted. The paragraph was reformulated such that this fact is conveyed more clearly.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97705	47	33	47	33	Please explain "emerging feedbacks" more clearly and if possible provide some examples. Is it just due to ocean carbonate chemistry or higher temperature, or is it the case that also extremes such as droughts are important? [Nicole Wilke, Germany]	Accepted. The sentences following the expression "emerging feedbacks" go into some detail on these feedbacks (with limited available space)
26289	47	44	47	45	High confidence should be in italic [María Santolaria-Otín, France]	Accepted (editorial)
111221	47	50	47	51	Very likely and very unlikely are both not Italic [Volodymyr Osadchy, Ukraine]	Accepted (editorial)
66505	47	50	47	52	It seem slike the text should qualify this statement by saying "but it is very unlikely that the land will switch from being a sink to a source by 2100" (since figure 5.29 shows that this switch could easily happen after 2100 under high emissions). [Charles Koven, United States of America]	Accepted. We added " but it is very unlikely that it will switch from being a sink to a source before 2100."
108629	47	51	47	51	Italics are missing [Jason Donev, Canada]	Accepted (editorial)
97707	47	56	47	57	Does the confidence level refer to the feedback in general, or to the timing? How about the situation beyond 2100? [Nicole Wilke, Germany]	Taken into account. In rewriting, we tried to clarify this. We added a specific paragraph on feedbacks until 2300.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97709	48	9	48	11	Stopping warming stabilizes biological drivers of ocean carbon uptake. But what if warming is stopped while CO2 concentration are still rising leading to higher ocean acidification? As stated in 5.4.4 (5-59:55 - 5-60:4) this will reduce primary production and in turn decreases the ability of the ocean to take up carbon. We request the authors to state this contrary effect of ocean acidification also in the TS and SPM to provide helpful information, i.e. to assess whether SRM is able to increase the global ocean sinks as done in the SPM D.3.1 where the effects of increasing ocean acidification are not mentioned. [Nicole Wilke, Germany]	This comment on the impact of increasing CO2 on the role of the ocean biological drivers of the ocean carbon sink is based on the assessment of the paleo record over long periods (TS2.6.3_SOD). The mechanisms that explain the response of the biological carbon pump to climate and carbon are complex (5.4.4.2_FGD). For this reason while there is high confidence that the biological carbon pump can indeed influence the carbon sink in a long term there is low confidence in the magnitude and the sign of that influence in the modern period (5.4.4.2_FGD 49:53). In the specific instance of SRM, TS_FGD (Box TS.8 70-38:40) assesses with medium confidence a strengthening of ocean sinks due to cooling and high confidence that OA would continue to increase under growing anthropogenic emissions. However, the resulting effect of the BCP on the carbon sink is assessed as low confidence. The effect of OA on ecosystems is assessed in WG II.
88431	48	14	48	14	"landscape change associated with thawing permafrost" would be better than "frozen landscape collapse" as it better describes the process. [Sharon Smith, Canada]	Not applicable. The text was shortened and landscape changes due to permafrost thaw are not mentioned in the revised version.
113805	48	22	48	30	It would be useful if one or two intermediate scenarios could be included in some way; e.g. by vertical bars along the right y-axis indicating ranges for 2100. [Jan Fuglestedt, Norway]	Taken into account. The revised figures shows intermediate scenarios.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
54789	48	35	48	46	1. One important conclusion from section 2.6.2 is not captured in this summary paragraph: the fact that the airborne fraction of CO2 has remained approx. constant over the last 6 decades (could be added easily to the sentence ending on line 38). 2. The high confidence sentence on lines 42 to 44 about potential abrupt irreversible impacts (on regional scale carbon cycles) is not found in the preceding subsections of Section 2.6.2 and should be, to be included in this summary paragraph. What kinds of abrupt changes are being referred to here? [Nancy Hamzawi, Canada]	Taken into account. The summary paragraph now appears at the beginning of the box. The mention of abrupt changes is removed as you suggest. Regarding the constant airborne fraction, while this is true, we prefer to highlight the fact that this will not remain the case, and future airborne fraction depends crucially on the scenario of emissions.
26291	48	37	48	37	atmosphereS in singular [María Santolaria-Otín, France]	Accepted (editorial)
108631	48	37	48	41	This statement about what remains in the atmosphere being constant over time is inconsistent throughout the document. See FAQ 5.1 and SPM lines 35-37 page 8 [Jason Donev, Canada]	Noted. In this FGD, much care was taken to provide a consistent treatment of this issue. In particular, the SPM was written starting from the TS summary paragraphs.
111227	48	42	48	43	Little evidence and high confidence are supposed to be in Italic [Volodymyr Osadchy, Ukraine]	Accepted (editorial)
113807	48	42	48	43	"high confidence" should be in italics [Jan Fuglestvedt, Norway]	Accepted (editorial)
19599	48	49	48	49	Why is box TS.2 not included in this section? [philippe waldteufel, France]	Taken into account. Box TS2 is included in section TS.2 in the FGD (as Box TS.3)
87051	48	49	58	57	There seems to be new information in at least chapter 12 regarding lightning and climate change. Please consider to include more information in the SPM on lightning. This is very relevant for wildfires and for the security of the electricity grids and telecommunication. [Oyvind Christophersen, Norway]	Rejected. Unfortunately, the tight space constraints this TS is subject to do not allow to include this information.
87053	49	19	49	25	It should be added that moisture deficits are compound effects of not only precipitation deficits or surplus evaporative demand, but also of the land use and state of soil and vegetation. Impoverished soils have less capacity to handle/retain water, accelerating moisture deficits. Moisture deficits again have repercussions for heat extremes as there is less water available for (near surface) evaporative cooling. [Oyvind Christophersen, Norway]	Taken into account. Effects of vegetation changes on runoff rates are explicitly mentioned in the water cycle box and compound events are treated in the new summary section TS2.1 and its table, as well as in the new land section.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
84597	49	30	49	30	is seems that 1.5C is a threshold: if global temperature stay below 1.5C the extremes will not change or increase? [Annalisa Cherchi, Italy]	Taken into account. The text was revised such that this impression of a strict 1.5°C limit should not arise.
44497	49	32	49	32	make sure the spelling of "heatwaves" is consitent throughout the section (and the TS). Here it is written as two words, elsewhere as one word. [Jana Sillmann, Norway]	Taken into account. Now consistently using "heatwave"
109719	49	36	50	11	Given that this section specifically includes implications not just to heavy precipitation but to floods, just a few extra words are required to provide the correct context - very briefly mention that flood risks are increasing from the combination of increased precipitation extremes, growing human populations in flood-prone areas, and increases in the flood response for a given storm due to urbanization of landscapes, that is, population growth and urbanization are exacerbating climate change impacts on flood events. This summary will be read by a very large and very diverse group of people, so this basic context needs to be explicitly but very briefly spelled out. [Sean Fleming, United States of America]	Taken into account. These aspects are mentioned in the revised last paragraph of the water cycle box.
41787	49	38	49	38	Remove Europa. In the chapter 11, only medium confidence is stated for Europe (P55, line 35) [Sergio Vicente-Serrano, Spain]	Accepted. The text was corrected (no regions explicitly mentioned), and the line of sight refers to the relevant chapter sections.
108633	49	46	49	48	Unclear, could these lines be re-worked. I had trouble understanding what was being said. [Jason Donev, Canada]	Taken into account. We reformulated the relevant sentences and aimed at consistent treatment of this aspect across this section.
84599	49	47	49	47	"trends in peak streamflow" in what direction? Pos/neg? increase/dcrease? [Annalisa Cherchi, Italy]	Taken into account. This is now clarified in the water cycle box (streamflow seasonality)
111231	49	47	49	47	"The significant trends in peak streamflow" is not clear at what level of significance and direction of the trends [Volodymyr Osadchy, Ukraine]	Taken into account. This is now clarified in the water cycle box (streamflow seasonality)

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
130367	49	47	49	48	It is stated that "There is high confidence that significant trends in peak streamflow have been observed in some regions." Many people will assume this means an increase in peak streamflows; however, there are regions with significant decreases and ones with significant increases (and many regions with no consistent signal). It should be stated here that the significant trends in some regions have shown both increases and decreases. [Trigg Talley, United States of America]	Accepted. This is now treated in the water cycle box and the sentence was clarified: "In response to cryosphere changes (TS.2.5), there have been changes in streamflow seasonality, including an earlier occurrence of peak streamflow in high-latitude and mountain catchments (high confidence)"
97711	49	48	49	48	Please insert: ...regions over the past decades. (11-7, line 44-46) [Nicole Wilke, Germany]	Noted. The streamflow statements has been substantially revised. In particular, it is clarified that these changes are in response to cryospheric changes (in particular snow), which occurred mainly since 1950; therefore, the relevant period should be clear.
84601	49	53	49	53	how is "record-breaking one-day precipitation" defined? [Annalisa Cherchi, Italy]	Taken into account. The statement has been revised and this unclear formulation has been deleted.
97713	49	55	49	55	Please insert:is emerging, e.g. in North America. (11-7, line 31) [Nicole Wilke, Germany]	Noted. The paragraph was reformulated, and the proposed addition would not be appropriate in the revised version.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
55483	50	1	50	6	It would be important to highlight that there are highly impact relevant exceptions to this rule (e.g. rainfall associated with TCs as discussed below) [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Projected precipitation rate increases associated with tropical cyclones are specified in the revised Table TS.2.
54791	50	2	50	4	This sentence is confusing and the meaning not quite clear. Also, is the 50-year event important here? Does the scaling change with the rarity of the event? [Nancy Hamzawi, Canada]	Taken into account. The associated uncertainties are shown in revised Figure TS12b, which clearly shows the linearity of the projected changes.
84603	50	2	50	4	better to simplify the long sentence into shorter ones as it contains too many information [Annalisa Cherchi, Italy]	Taken into account. Formulations were simplified throughout.
84605	50	9	50	9	an estimate of what can be considered a "high global warming level" should be given: more than 2C? Or just the largest 3C and 4C? [Annalisa Cherchi, Italy]	Taken into account. This is now consistently treated in the water cycle box, and the specific statement was revised and does not refer to warming levels.
97715	50	10	50	10	Please insert:river floods (e.g. western Amazon, the Andes and Northern Eurasia) (11-8, line 2-3) [Nicole Wilke, Germany]	Rejected. Regional detail is provided in the section TS4, while this section concentrates on global-scale changes as much as possible.
41789	50	15	50	27	Trends strongly depend on the drought metric used, which should be detailed here. [Sergio Vicente-Serrano, Spain]	Taken into account. The drought metrics were defined more clearly in the revised version.
41791	50	17	50	18	On which metric is this based? AED? [Sergio Vicente-Serrano, Spain]	Taken into account. In the revised text, we refer to Figure TS.12. The legend of that figure gives the definition (based on normalized soil moisture)

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
130369	50	19	50	21	[CONFIDENCE] AED is not a complete measure of drivers of ET. CO2 fertilization is another driver that works in the opposite direction. So, while one might have high confidence in a trend in AED, such a statement is arguably irrelevant and should not be highlighted by the assessment. It is more relevant to consider the sum of the AED and CO2 effects. It has been shown (doi:10.1111/1752-1688.12538, doi:10.1038/nclimate3046) that ACC-driven increases in climate-model ET from non-water-stressed areas are greatly overestimated by both AED (i.e, Penman equation) and by constant-stomatal-resistance estimates of potential evapotranspiration (reference-crop PET). It has also been shown that the ACC-induced changes in non-water-stressed ET are, to first order, predicted well by changes in surface net radiation, calling into question the importance of increases in AED and suggesting that they are largely countered by the effect of stomatal closure (even in an earth-system model that permits LAI increases). All of this is for non-water-stressed conditions. Under water-stressed conditions, ET is controlled more by the supply of water, so increases in PET, however they are defined, become of secondary importance. It should also be kept in mind that suppression of ET by CO2 fertilization in the non-water-stressed season leads to soil-water conservation, which will delay the seasonal transition to water-limited conditions. [Trigg Talley, United States of America]	Taken into account. We took great care in clarifying drought types (agricultural/ecological) in the revised text. The combined effects of CO2 increase and AED are also addressed in the revised text. However, detailed assessments cannot be expected in the TS because of tight space constraints.
97717	50	19			What is "atmospheric evaporative demand"? [Nicole Wilke, Germany]	Noted. We think that the revised statement provides a sufficiently clear context that allows us to not define this explicitly, for the sake of saving space.
130371	50	21	50	23	The relevance of this statement to the issue of drought is questionable, because potential evaporation (as defined in Chapter 11) is different from potential evapotranspiration. The latter is the more appropriate measure when considering how supply and demand interact in the water balance. However, it seem likely that PE could be replaced by PET in this statement, especially with the qualifier "some regions and seasons" if Chapter 11 supports that. [Trigg Talley, United States of America]	Accepted. The revised equivalent statement refers to an overall increase in evapotranspiration.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
111233	50	21	50	25	A few times term "trend" is used with neither direction nor estimates [Volodymyr Osadchy, Ukraine]	Accepted. We clarified this by replacing "trend" by "increase" or "decrease" where this seemed necessary and appropriate.
130373	50	23	50	25	[CONFIDENCE] These models (esp. offline land and hydrologic) might not merit this level of confidence. Generally, they are capable of capturing ups and downs of soil moisture and streamflow in response to variations of precipitation, but their ability to reproduce the very slow, long-term changes associated with drivers such as AED, CO2, radiation, and temperature have not been well established. [Trigg Talley, United States of America]	Accepted. This statement is not kept in the FGD.
111237	50	32	50	45	"Some regions" in the paragraph are very non-informative, especially when high confidence reported. Please, at least provide some examples [Volodymyr Osadchy, Ukraine]	Accepted. Regions were specified where possible and necessary, keeping in mind that this section focuses on global-scale changes.
112909	50	33	50	33	Is it possible at all to characterize these "some regions" rather than this very vague statement? [Johannes Quaas, Germany]	Accepted. Regions were specified where possible and necessary, keeping in mind that this section focuses on global-scale changes.
44931	50	33	50	45	"some regions" should be more explicitly listed. (L33, L35, L43) [Masaki Satoh, Japan]	Accepted. Regions were specified where possible and necessary, keeping in mind that this section focuses on global-scale changes.
41793	50	34	50	36	I would remove the reference to the CO2 fertilizing issues. This mechanisms is still very uncertain, only based on model outputs and also with strong ecological implications. See e.g. Brodrribb, T. J., Powers, J., Cochard, H., & Choat, B. (2020). Hanging by a thread? Forests and drought. <i>Science</i> , 368(6488), 261–266. https://doi.org/10.1126/science.aat7631 , Vicente-Serrano, S. M., McVicar, T. R., Miralles, D. G., Yang, Y., & Tomas-Burguera, M. (2020). Unraveling the influence of atmospheric evaporative demand on drought and its response to climate change. <i>Wiley Interdisciplinary Reviews: Climate Change</i> , 11(2). https://doi.org/10.1002/wcc.632 , Allen, C. D., Breshears, D. D., & McDowell, N. G. (2015). On underestimation of global vulnerability to tree mortality and forest die-off from hotter drought in the Anthropocene. <i>Ecosphere</i> , 6(8). https://doi.org/10.1890/ES15-00203.1 [Sergio Vicente-Serrano, Spain]	Accepted. This statement is much more precise in the FGD and refers specifically to the role of fertilization in alleviating specific types of drought (and specifies low confidence).

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
112911	50	35	50	37	I don't understand the message of that sentence. Agreement or uncertainties/problems? [Johannes Quaas, Germany]	Not applicable. This statement was deleted.
130375	50	39	50	41	Need to specify what depth range of soil moisture this refers to. The patterns vary considerably depending on vertical domain used. [Trigg Talley, United States of America]	Not applicable. This statement was deleted.
84607	50	39	50	41	sentence to rephrase, meaning not clear at all [Annalisa Cherchi, Italy]	Not applicable. This statement was deleted.
111239	50	39	50	41	This sentence is very unclear formulated [Volodymyr Osadchy, Ukraine]	Not applicable. This statement was deleted.
84609	50	41	50	43	sentence not well posed: is there a high warming level over which a 0.5C makes a difference? Or it makes a difference in any case? [Annalisa Cherchi, Italy]	Accepted. The revised text does not mention warming levels in the corresponding statement.
130377	50	43	50	44	Not clear what variable(s) "drier" refers to here. [Trigg Talley, United States of America]	Not applicable. The statement was cut.
97719	50	43			This is judgmental language: Please do not qualify a global warming of half a degree as "small" in the statement "even for changes as small as 0.5°C in global warming". This is not appropriate given the significance of such warming in terms of additional energy in the Earth system and associated risks, see SR1.5 [Nicole Wilke, Germany]	Taken into account. The relevant statement was cut, and we took care not to qualify a 0.5°C global temperature change as "small" anywhere.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
84611	50	48	50	48	section TS2.7 is not only about TC. In the projections paragraph the extratropical cyclones are mentioned but they are missing in the observations/attribution paragraph [Annalisa Cherchi, Italy]	Taken into account. We took care to equilibrate the treatment of tropical vs. extratropical cyclones across the section.
130379	50	48	51	21	This section needs revision to be aligned/consistent with Chapter 11. The confidence levels are too high. [Trigg Talley, United States of America]	Accepted. The entire section was reduced to essentially one paragraph which was carefully checked for consistency with Chapter 11
112913	50	50	50	51	The confidence statement and the “detectably” seem to contradict each other. If something is detected, it should be certain. Same two sentences later. [Johannes Quaas, Germany]	Not applicable. This section has been deleted.
69457	50	51	50	52	Comparing to descriptions in Chapter 11 (page 94, line 35-38) and referred paper Kossin et al., 2016a that say that the poleward migration can influence TC hazard exposure and risk, a word “substantially increasing” sounds too strong. Considering that TC hazard exposure is not only of substance but also sensitive for the region, qualitative assessment here should be faithful to and consistency with description in Chapter 11 and referred paper. [Kaoru Magosaki, Japan]	Noted. This section has been deleted here (in part taken up in section TS2.3) and the relevant statement has been cut.
111241	50	53	50	54	It is difficult to understand the last statement in the sentence as it is formulated in negative, but not positive words like "it can be explained..." [Volodymyr Osadchy, Ukraine]	Noted. This section has been deleted here (in part taken up in section TS2.3) and the relevant statement has been cut.
39087	50	55	50	55	Maybe 'over the North Atlantic' rather than 'over the US' (e.g., Kossin, Nature, 2018)? [Federico Serva, Italy]	Noted. This section has been deleted here (in part taken up in section TS2.3) and the relevant statement has been cut.
111243	51	7	51	8	"...tropics expand with warming" sounds incorrect since tropics depend on astronomical characteristics namely the planet axis tilt and cannot expand [Volodymyr Osadchy, Ukraine]	Noted. This section has been deleted here (in part taken up in section TS2.3) and the relevant statement has been cut.
111251	51	9	51	11	It is not clear statement on wind speeds with increases/decreases? [Volodymyr Osadchy, Ukraine]	Taken into account. In the revised version (in section TS2.3), this is clarified.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
82615	51	11	51	12	The results from Chapter 11 on severe convective storms are specific to the United States, not global as implied here. Also affects Table TS.8 on p54. [Blair Trewin, Australia]	Taken into account. The statement has been deleted.
84613	51	14	51	21	reference to section in ch8 about atmospheric rivers is missing [Annalisa Cherchi, Italy]	Accepted. This is not treated in the water cycle box and the appropriate line of sight is added.
11049	51	24	51	24	where they are a climate impact driver, extreme sea levels are really coastal extremes, not marine extremes. Suggest titling the section "marine and coastal extremes" accordingly [Robert Kopp, United States of America]	Not applicable. The section has been deleted. Extreme sea level are treated more specifically in TS4, as coastal extremes.
97721	51	26	51	26	Please insert: ...(high confidence) and persistent (medium confidence) with ...(9-7, line 42) [Nicole Wilke, Germany]	Taken into account. The revised statement (in section TS2.4) is now: "Marine heatwaves have become more frequent over the 20th century (high confidence), approximately doubling in frequency (high confidence) and becoming more intense and longer since the 1980s (medium confidence)."
44499	51	26	51	26	Why exactly 1982? Is it "high confidence" that marine heatwaves have become more frequent from that particular year? How many studies have identified that year as the starting year of changes in marine heatwaves? [Jana Sillmann, Norway]	Taken into account. The revised statement (in section TS2.4) is now: "Marine heatwaves have become more frequent over the 20th century (high confidence), approximately doubling in frequency (high confidence) and becoming more intense and longer since the 1980s (medium confidence)."
6405	51	33	51	33	This is another structurally incorrect sentence. Either remove the two occurrences of "are" on this line, or otherwise rewrite. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Editorial. Statement rewritten.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
84615	51	36	51	36	what does " extreme still water levels" mean? [Annalisa Cherchi, Italy]	Not applicable. The statement has been cut.
11051	51	36	51	37	In the chapter, this is 'median 165% increase in high-tide flooding' -- i.e., across tide gauges, the median increase in high-tide flooding is 165%. "median high-tide flooding increasing by 165%" is more ambiguous, and couple be read as suggesting that there is a type of flooding associated with the 'median high-tide' ' [Robert Kopp, United States of America]	Not applicable. The statement has been cut.
82619	51	37	51	37	It needs to be clarified what period the 165% increase is over: Figure 9.33 implies that it is the difference between 1995-2014 and 1961-1990, but the text here (and in the Chapter 9 ES) suggests it is over the 20th century. Also affects P42 L2 in the TS. [Blair Trewin, Australia]	Not applicable. The statement has been cut.
97723	51	37	51	37	Please insert: high-tide flooding frequency increasing....(9-7, line 45) [Nicole Wilke, Germany]	Not applicable. The statement has been cut.
11053	51	41	51	41	again, this amplification factors are median values across the set of tide gauges [Robert Kopp, United States of America]	Not applicable. The statement has been cut.
131959	51	49	51	49	the term breadbasket may not be recognisable to many - suggest major grain producing regions (or similar) [Hans Poertner and WGII TSU, Germany]	Taken into account. The statement has been cut.
82621	51	49	51	49	"breadbaskets" is a somewhat colloquial term and may be misunderstood by non-native speakers of English: "major cropping areas" may be better. [Blair Trewin, Australia]	Taken into account. The statement has been cut.
44933	51	52	51	54	"some locations" or "some regions" should be more explicitly listed. [Masaki Satoh, Japan]	Rejected. To avoid providing an incomplete list we decided to leave this statement open. The reader is referred to Chapter 11 for more details.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
111253	51	52	51	54	Please, give some examples for some locations and some regions [Volodymyr Osadchy, Ukraine]	Rejected. To avoid providing an incomplete list we decided to leave this statement open. The reader is referred to Chapter 11 for more details.
54793	51	53	51	54	As for the other types of compound events mentioned, please include, if possible, a result for future wildfire risk (and not just for observed risk). [Nancy Hamzawi, Canada]	Accepted. Future changes in fire weather are now discussed in a single paragraph in Section TS.2.6.
108635	51	53	51	54	This is only medium confidence? Really? It seems that the wildfire risk has increased in *some* regions (Australia, West coast of North America) is virtually certain. [Jason Donev, Canada]	Not applicable. Wildfires are not mentioned in TS2 in the FGD. The remaining statement (in TS4) explicitly refers to weather conditions that favour wildfires.
130381	51	53			Table TS.7 needs revision to be aligned/consistent with Chapter 11 and the recommended SPM changes for Tropical Cyclones confidence levels. The confidence levels are too high in the SPM and Chapter 11, and the same issues appear here in the Technical Summary. [Trigg Talley, United States of America]	Taken into account. Table TS.7 was thoroughly revised and shortened, and aligned with Ch 11.
84617	51	55	51	55	what "higher level of global warming"? Over what threshold? [Annalisa Cherchi, Italy]	Taken into account. To clarify, we simply write "higher global warming"
26293	52	3	52	6	Figure TS.22: typo at y-label 'changes' [María Santolaria-Otín, France]	Noted. Figure TS.22 was replaced by TS12, which is very different. The suggestion is not applicable.
69461	52	11	53	2	Though almost same information is covered, classification of "Phenomenon and detection of trend" of this table differs from the corresponding table in SPM, Table SPM.1. The same classification would facilitate mutual reference of SPM and TS. Furthermore, information covered in this table seemed less structured than Table SPM.1. For instance, a description "Low confidence for detectable global change in TC translation speed" is found in "Increase in precipitation associated with tropical cyclones" but this should be related to tropical cyclone track changes. [Kaoru Magosaki, Japan]	Taken into account. The table was very substantially revised and shortened (now Table TS.2), so the comment is not applicable.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
111255	52	11	53	2	The heading of the first column is "Phenomenon and direction of trend", but "severe convective storms" doesn't have direction [Volodymyr Osadchy, Ukraine]	Taken into account. The table was very substantially revised and shortened (now Table TS.2), so the comment is not applicable.
64743	52	13	55	2	Table TS.7 and Table TS.8 : One statement concerning extratropical cyclones consistent with section 11.7.2 should be added. [Serge PLANTON, France]	Taken into account. The table was very substantially revised and shortened (now Table TS.2), so the comment is not applicable.
54795	52	17			In Table TS.7 for Flooding, does "little evidence" mean that few studies have been conducted or that there are generally null results? [Nancy Hamzawi, Canada]	Taken into account. The table was very substantially revised and shortened (now Table TS.2), so the comment is not applicable.
54797	52	17			Table TS.7 compound events: Suggest using "wildfire risk" or "wildfire potential" instead of "wildfire occurrence" in the human contribution column. Related to climate, most studies of wildfires assess a likelihood or maybe a burned area metric. Humans starting fires is a separate issue, but anthropogenic forcing has been shown to have increased the likelihood of conditions conducive to wildfire ignition and spread. [Nancy Hamzawi, Canada]	Taken into account. The table was very substantially revised and shortened (now Table TS.2), so the comment is not applicable.
40063	52	37			Cross-section Box 2, Figure 1c - there is not panel c in this figure [TSU WGI, France]	Taken into account (refers to page 37, line 52) - the corresponding figure panel is now TS8.c, referenced in the text.
41795	52		52		Flood assessment. It should be Western Amazon to be consistent with Ch. 11 [Sergio Vicente-Serrano, Spain]	Noted. Figure TS.22 was replaced by TS12, which is very different. The suggestion is not applicable.
82623	53	1	53	4	The table should refer to wildfire risk (as in the text on p51), to separate the climatic drivers of risk from non-climatic factors such as land use change, land management etc. [Blair Trewin, Australia]	Taken into account. The table was very substantially revised and shortened (now Table TS.2), so the comment is not applicable.
108637	53	4	53	6	The table states that increase in tropical cycle intensity has 'low confidence' this is inconsistent with the text. I think the text is the more accurate. [Jason Donev, Canada]	Taken into account. The table was very substantially revised and shortened (now Table TS.2), and consistency with the revised Ch 11 assessment was carefully checked.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
111257	53	12	54		For the first row of the Table TS.8 on hot days and nights should be not for all continents since these indices are not relevant for Antarctica [Volodymyr Osadchy, Ukraine]	Taken into account. The revised table specifies "over most land areas", and we think that it is obvious that this excludes Antarctica.
111259	53	12	55		In "increase in mean tropical cyclone..." the estimate of 3.75% seems to be very low to have medium-to-high confidence [Volodymyr Osadchy, Ukraine]	Taken into account. The table was very substantially revised and shortened (now Table TS.2). The corresponding table entry was cut, so the comment is not applicable.
111261	53	12	55		"Severe convective storms" doesn't have direction of trend [Volodymyr Osadchy, Ukraine]	Taken into account. The table was very substantially revised and shortened (now Table TS.2). The corresponding table entry was cut, so the comment is not applicable.
55485	55	7	57		It is really good to have a box like his, but as it stands it is not very well written. Aspects of the "concept" section are repeated below, the subheadings are not very informative or relate to the text under them. It would be good to restructure this with a clearer narrative and message. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. The box has been considerably streamlined and made less technical.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
28265	55	7	58	30	<p>I believe that box TS4 could still be improved in terms of structure, content and clarity of language. For example:</p> <ul style="list-style-type: none"> - The term tipping point is introduced as an abrupt /disruptive change. Then extinctions are used as an example, but it is not clear why that implies any abrupt shift (in fact, it does not; I think that extinctions are a good example of irreversibility, but not of abruptness or catastrophic “tipping”). It is only noted in passing that the actual definition here is the increased sensitivity to the forcing. More convincing and clearer definitions are provided in the paragraph starting on p. 56, line 24. It might be helpful to move this paragraph to the beginning, and shorten the information that currently comes before it. I suggest to drop the notion “changes faster than the forcing” (system and forcing have non-comparable units!) in favor of the notion of an increased sensitivity to the forcing at a certain state / point in time. - The language is confusing at some places, e.g. “earth system components can have tipping points ruled out observationally”. - It is not obvious how the Figure matches to the text. What about a world map with potential abrupt shifts / tipping elements like presented in Lenton et al 2008 (https://doi.org/10.1073/pnas.0705414105), or Drijfhout et al. 2015 (https://doi.org/10.1073/pnas.1511451112), or a sketch illustrating the definitions? - Some statements could benefit from precise examples, e.g. “monitoring systems are being put into place to observe if mechanisms associated with tipping in models are occurring” (what monitoring systems? observing the AMOC? observing glacier mass loss?), or “Tipping points occur in narrow regions of parameter space”. 	Accepted. This box has been considerably shortened and streamlined, incorporating many of the suggestions made.
97725	55	7	58	32	<p>Box TS.4 is essential to explain the many new concepts and the new approaches of the AR6 WG I. However, the current version is written in a very technical style and the structure is not obvious. In addition, it mixes explanations of definitions and methods with statements of content regarding specific tipping points. These are not exhaustive, e.g. MICI is not mentioned. On the other hand, please make sure there are no duplications or inconsistencies for those some tipping points that are addressed elsewhere in the report. [Nicole Wilke, Germany]</p>	Accepted. The box has been considerably streamlined and made less technical. Examples of tipping points selected draw mostly on chapter emphasis.
11057	55	11	55	11	<p>not sure how this parenthetical is supposed to modify 'anthropogenic forcing' - the anthropogenic CO2 forcing is proportional to the log of pCO2, not cumulative emissions [Robert Kopp, United States of America]</p>	Accepted. Text removed.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
11055	55	11	55	18	As Kopp et al, (2016) observe, this discussion is set up to confuse less technical readers, for whom an 'abrupt change' is naturally read as occurring quickly, whereas some of these 'tipping points' exhibit abrupt commitment to change but not rapid realization of change. (Kopp et al 2016 argue against the usage of the term 'tipping points' for these critical thresholds with long lags between commitment and realization.) [Robert Kopp, United States of America]	Noted. The discussion has been restructured to emphasize commitment and irreversibility, rather than abrupt change.
97727	55	11			Please do not use judgmental languages such as "modest anthropogenic forcing". Instead, please quantify the ranges you are referring to. [Nicole Wilke, Germany]	Accepted. Text removed.
97729	55	20	56	2	We do not understand the relation of population shrinks / species extinction and the scope of the WG I report. This also holds for the statement on the relation of physical phenomena such as ice sheets or the oceans to higher sensitivity - or what? [Nicole Wilke, Germany]	Accepted. Text removed.
84619	56	6	56	7	"already" is repeated twice, better to rephrase [Annalisa Cherchi, Italy]	Accepted. Text removed.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
84621	56	20	56	20	here 2C is sort of "low warming levels" while in some text before (out of the box) it was.a threshold of high warming level. These definitions should be harmonized over the whole document [Annalisa Cherchi, Italy]	Accepted. Text removed.
54799	56	22	56	22	Considering the risk that this sentence could be used out of context "fuelling concerns that anthropogenic GHGs could tip the climate into a permanent hot-house state" it would help to explain what is meant by a hot-house state. Since this sentence is linked to the paleoclimate record, can we put a number on how much warmer previous 'hot house earths' were? Some caution may be appropriate to include here in making parallels to distant hot house Earths. [Nancy Hamzawi, Canada]	Accepted. Text removed.
84623	56	35	56	36	earth system models considering only models that have active biogeochemical cycles? [Annalisa Cherchi, Italy]	Accepted. Text removed.
35859	56	36	56	36	Add a link here to the tipping points discussion in 4.7.3 [Baylor Fox-Kemper, United States of America]	Accepted. Link added.
54801	56	42	56	49	This para is rather unclear as it seems to emphasize the potential reversibility of climate changes rather than their irreversibility. 1. Should "reversibility" in sentence 1 not be "irreversibility" since an important conclusion of the AR5 WGI assessment was about the irreversibility of global warming and sea level rise even after emissions were zeroed. 2. in sentence 3, again talking about reversibility, under what conditions and time frames would recovery of SST occur. [Nancy Hamzawi, Canada]	Noted. The discussion has been restructured to emphasize commitment and irreversibility, rather than reversibility.
26295	56	43	56	45	Earth System Models (capitals) [María Santolaria-Otín, France]	Not applicable, text removed.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97731	57	15	57	20	There is a lot of relevant information on forest diebacks in subchapter 8.6.2 using the example of the Amazon. In particular it would be beneficial to concretize factors that push the system across a threshold such as "decline in precipitation (20%) in combination with simultaneous deforestation (30%)". Hence not only climate change is a main driver of abrupt changes of tropical forest areas but also deforestation. We suggest to add this very relevant information here in the paragraph on changes on land. [Nicole Wilke, Germany]	Not applicable, text removed.
84625	57	16	57	16	earth system models considering only models that have active biogeochemical cycles? [Annalisa Cherchi, Italy]	Not applicable, text removed.
26297	57	16	57	16	Earth System Model (capitals) [María Santolaria-Otín, France]	Not applicable, text removed.
26299	57	26	57	27	"dust, and " and "rainfall, and" -> No commas before "and" here [María Santolaria-Otín, France]	Not applicable, text removed.
26301	57	35	57	36	Rephrase sentence [María Santolaria-Otín, France]	Not applicable, text removed.
112915	57	39	57	39	I have trouble understanding the "acidification" and "rainfall" in this one sentence. How could (ocean?) acidity change abruptly at all? [Johannes Quaas, Germany]	Not applicable, text removed.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97733	57	45	57	46	We kindly ask the authors to provide further information about the changes in the water cycle and the potential climatic impacts and risk. Please include the main hazards due to a AMOC collapse as found in 8-101:5-41 and 9-31:36-52. [Nicole Wilke, Germany]	Accepted. The box has been considerably streamlined and made less technical. Examples of tipping points selected draw mostly on chapter emphasis. AMOC and water cycle changes are mentioned and links to chapter discussions are included.
26303	57	48	57	48	Just AMOC, it has already been defined in line 40. [María Santolaria-Otín, France]	Not applicable, text removed.
32877	57	48	58	4	This section (and underlying text in chapter 9) would benefit from assessment of the tipping point literature eg, Steffen et al, 2018, PNAS; review by Wang and Hausfather in ESDD, under review and references within [Helene Hewitt, United Kingdom (of Great Britain and Northern Ireland)]	Noted, but these references were not added.
32889	57	50	57	50	The statement that the AMOC weakened between 2007 and 2011 is not consistent with observations at 26°N. Smeed et al. (2014) observed a decline 2004-2012, and with a longer time series Smeed at al. (2018) concluded that that it was in a reduced state 2008-2017 as compared to the earlier observations 2004-2008. Note that there is considerable inconsistency about observed AMOC weakening throughout the AR6 draft (see further comments). [Meric Srokosz, United Kingdom (of Great Britain and Northern Ireland)]	Noted, text removed.
26305	57	51	57	51	reanalyses (in plural) [María Santolaria-Otín, France]	Not applicable, text removed.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97735	57	53	57	55	Please include more information about the long-term perspective beyond 2100. E.g. include the information that there is a slight change in confidence due to new evidence suggesting that AMOC was too stable in CMIP5 simulations that were used for AR5 and SROCC and that a collapse of the system is possible although highly uncertain (8-101:32-41). [Nicole Wilke, Germany]	Accepted. Longer term assessments of ice sheet changes and AMOC are now included.
26307	57	57	57	57	circulation (high confidence) . -> check punctuation [Maria Santolaria-Otin, France]	Not applicable, text removed.
54803	58	3	58	4	These two lines are the only information in this summary section (and assessment of irreversibility, abrupt change and tipping points) in Box TS.4 section that deal with ice sheet changes and there is no mention of the Antarctic Ice Sheet. Recommend including here text about potential instabilities in the WAIS from Ch. 9 or SROCC. [Nancy Hamzawi, Canada]	Accepted. More aspects of ice sheet changes is here and in Section TS.2, although overall length is reduced.
97737	58	3	58	4	Please include information on these questions in this statement. There is already some discussion in the underlying chapter 8.6.1 and 9.2.3.1, which could be brought together here in the box on tipping points. 1) What are the implications for the long-term SLR of this long-term mass loss? 2) Does this also mean that the AMOC could collapse after this threshold? As discussed in Ch9-30:49 - 9-31:13 accounting for the melting of the Greenland Ice sheet, which is not yet accounted for in the vast majority of scenario runs, could result in a further AMOC weakening. [Nicole Wilke, Germany]	Accepted. Further assessments of ice sheet changes and AMOC are now included. Linkages to discussion of the sea level rise implications occur in the sea level box, chapter 9, and elsewhere in links provided.
84627	58	8	58	11	why this sentence about extremes here? [Annalisa Cherchi, Italy]	Accepted, text removed.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
112917	58	9	58	9	Does hail matter a lot in the context of irreversibility, abrupt changes and tipping points? Are not other things more relevant such as the lack of reliable convection in models? [Johannes Quaas, Germany]	Accepted, text removed.
84629	58	14	58	16	is this strictly related to abrupt changes or tipping points? [Annalisa Cherchi, Italy]	Accepted, text removed.
111263	58	39	58	42	There are many high confidence statements that can be grouped. Otherwise, it is not clear - is "on the global scale" related only to droughts? [Volodymyr Osadchy, Ukraine]	Taken into account. The section was rewritten. In rewriting, we took care to group confidence statements where appropriate and where this did not induce confusion. The statement containing "aggregated on the global scale" was dropped.
44935	58	53	58	54	"rarer events": These are too generic and this sentence does not hold in general. Need more specifications. [Masaki Satoh, Japan]	Taken into account. The statement was reformulated for clarification: "With increasing global warming, some very rare extremes and some compound events (multivariate or concurrent extremes) with low likelihood in past and current climate will become more frequent, and there is a higher chance that events unprecedented in the observational record occur (high confidence)."
84631	58	54	58	54	do we need a threshold for "higher"? [Annalisa Cherchi, Italy]	Noted. The statement was reformulated for clarification: "With increasing global warming, some very rare extremes and some compound events (multivariate or concurrent extremes) with low likelihood in past and current climate will become more frequent, and there is a higher chance that events unprecedented in the observational record occur (high confidence)."

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
15463	58	54	58	56	The statement "There is high confidence that the highest category tropical cyclones will be associated with increased maximum wind speed and precipitation with increasing warming levels.)" may not correctly summarize the relevant conclusions in 11.7.1.5. There is high confidence that average peak wind speeds and precipitation rate of tropical cyclones will increase globally, not just associated with the highest category tropical cyclones only. Also, there is high confidence that the proportion of Cat 4-5 tropical cyclones will increase globally. Please consider revision. [SAI MING LEE, China]	Taken into account. The revised statement "There is high confidence that average peak TC wind speeds and the proportion of Category 4–5 TCs will increase with warming and that peak winds of the most intense TCs will increase" is in agreement with the FGD version of Chapter 11.
55487	59	3			This heading doesn't prepare you for what is coming which are the key indicators of change. Change the heading to reflect better the content. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. TS2 has been re-structured with material formerly in TS2.8 now sitting in TS2.1 "Changes Across the Global Climate System" and TS2.6 "Land Climate, Including Biosphere and Extremes".
132137	59	5	59	6	This sentence totally ignores "Land" as an Earth System realm. This is the result the choice of the chapter 2 authors not to include "Land" as one of their considered Earth System realms, with which I am deeply concerned. I had also commented on this point in the FOD, but this does not seem to have been taken into account. Note that this is inconsistent with text in chapter 1 (pages 10-11, and Section 1.5.1.1) as well as with the publication of a full IPCC report on "Climate Change and Land". [Sonia Seneviratne, Switzerland]	Accepted. The re-structured TS2 now includes section TS2.6 "Land Climate, Including Biosphere and Extremes"
97739	59	10	59	32	This is a useful table, but we have two important requests: Please add information 1) on the "1.9" scenario that is consistent with 1.5°C warming and 2) on the near-term, mid-term and long-term future periods as defined in Table TS.4. [Nicole Wilke, Germany]	Taken into account. Table now simplified as Box TS.2, Figure 1. Future warming is no longer included. Global warming levels are the focus of TS.1.3.2 and Cross-Section Box TS.1
113809	59	11	59	32	Table TS.9 can be very useful if developed further wrt clarity. "Future1" and "Future 2" are a bit confusing. Better to skip these labels and give just the years? [Jan Fuglestad, Norway]	Taken into account. Table now simplified as Box TS.2, Figure 1. Future warming is no longer included. Global warming levels are the focus of TS.1.3.2 and Cross-Section Box TS.1

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
54805	59	13	59	13	Table TS.9: A few comments: 1. The numbers (for global mean temp rise and sea level rise) under the selected scenarios (2.6, 4.5, 8.5 (full scenario names are needed)) in the row for Future 1 (2081-2100) cannot be reconciled with those for the same time period in Cross-section Box 1 Table 1. 2. Re footnote 2 - what does it mean to say GSAT in the table for Future 2 is given as \pm one half of model range? Should this be Median/Mean \pm one half of model range? If the first value is median, then what is provided is simply the total model range, which is not necessarily a robust measure, and non standard in terms of IPCC. 3. It is unclear what the reference period(s) is/are for the values in the table. [Nancy Hamzawi, Canada]	Taken into account. Table now simplified as Box TS.2, Figure 1. Future warming is no longer included. Global warming levels are the focus of TS.1.3.2. and Cross-Section Box TS.1. Cross-Chapter Box 2.1 is called out for information on reference periods. Uncertainty for GMSL is explained in Figure 2.34, the source of this summarized version.
15331	59	13	59	21	Table TS.9. I like this Table, but I think the layout and presentation needs some thinking. The "2.6, 4.5, 8.5" heading are not immediately understandable, and the labels "Future 1" and "Future 2" are not self-explanatory (maybe use short-term Future and long-term Future for example). maybe have the paleo examples at the top and the future at the bottom? [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Table now simplified as Box TS.2, Figure 1. Future warming is no longer included. Global warming levels are the focus of TS.1.3.2 and Cross-Section Box TS.1
15333	59	13	59	21	Table TS.9.. The uncertainty of " \pm 3" for early Eocene sea level is much too small, in my opinion (tectonic changes to paleobathymetry mean that the sea level component is not just due to ice sheets). [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Section 2.3.3 states that uncertainty relates to ice volume component.
100555	59	22	59	22	Add to Table TS.9 "Miocene Climatic Optimum; 16,000,000 7.6 \pm 2.3/4.0 to 5.9; 400-600 ppm; 50 to 65" [Matthew Kohn, United States of America]	Rejected. Because of length constraints, not all reference periods are included in the TS. MCO is included in the more extended list of reference periods in Cross-Chapter Box 2.1.
113811	60	1	60	24	I got a bit confused here and I wonder if this material should be here. If this section is meant to be about human influence I think the start of the section TS2.8 should make that more clear. [Jan Fuglestedt, Norway]	Taken into account. The attribution content has been consolidated in the revised TS2 in section TS2.1 "Changes Across the Global Climate System".
84633	60	8	60	19	most of this text was also at the beginning of the document. Better to reduce here or there and to minimize repetitions [Annalisa Cherchi, Italy]	Taken into account. The attribution content has been consolidated in the revised TS2 in section TS2.1 "Changes Across the Global Climate System".
26427	60	14	60	14	"it is" is in a different font [María Santolaria-Otín, France]	Typo has been fixed.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
26309	60	14	60	14	Here, maybe it is better to write the whole definition: effective radiative forcing (ERF) [María Santolaria-Otín, France]	Taken into account. Effective radiative forcing is now introduced in Box TS.1 "Core Concepts Central to This Report", which appears at the start of the Technical Summary.
54807	60	14	60	15	Ch. 3 ExSumm concludes that it is virtually certain that human influence has warmed the global climate system. Here it says that it is "unequivocal that human activities have warmed the climate system". Slightly different conclusions, whereas they should be consistent, we assume. [Nancy Hamzawi, Canada]	Taken into account. The revised Chapter 3 states "It is unequivocal that human influence has warmed the global climate system since pre-industrial times". Section TS2 builds upon this, drawing on assessments across the report to state "human influence on the climate system as a whole is assessed as unequivocal for the first time ...".
10919	60	41	62	2	The "cessation of the Little Ice Age" should not be used in this table, use actual dates. The term is inaccurate and the associated period is not even consistently defined in studies. The term gives the inaccurate impression that climate was uniformly cool over a certain period. [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. Text has been removed. The revised Table is now called Table TS.1.
93877	60	41	62	2	All lines of evidence regarding the retreat of glaciers are citations of chapter 2 and 3 without a mention to chapter 9. Please include section 9.5.1 for observation assessment of glacier retreat. [Lucas Ruiz, Argentina]	Accepted. Reference to 9.5.1 has been added - see Table TS.1.
97741	60	41	62	2	Table TS.10: We appreciate this table. However it would be very helpful to harmonize the classification used in this table especially in the third column. Of course some more quantification would be appreciated, although we understand that the authors are not able to add quantifier. Nevertheless, we suggest to add some more steps onto the scale (not only contribute or main driver): 1) Sometime you call it human influence, sometime it is anthropogenic forcing or influence. Are they interchangeable? 2) Sometimes the effect is dominating, sometimes it is the main driver, sometimes substantial contribution. We wonder, if they are interchangeable and mean that the influence of this effect is higher than 50%. Are there influences that are significantly higher than 50% (let say 90%). If so, we request the authors to name them. 3) Also please quantify the "contributing" influence. Does this mean only 5% or 40%? This is a huge difference and it would be very helpful if such differences come across. [Nicole Wilke, Germany]	Taken into account. We have simplified and harmonized the text in the revised Table TS.1. Human influence is categorized as either a driver or main driver. More quantitative information is available in the underlying chapter sections, which are referenced in table.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97743	60	43	62	1	The attribution statements contain two assessments which are interdependent: the likelihood and the quantified degree of the anthropogenic contribution. This this renders the statements ambiguous and prevents comparison. [Nicole Wilke, Germany]	Taken into account. The table shows attribution assessments from the underlying report, which are based on the assessed literature. The reviewer is correct that the likelihood level, and the quantified degree of anthropogenic contribution are complementary aspects of the assessment statements, and because the degree of anthropogenic contribution differs between variables, statements are sometimes hard to compare directly. The revised Table TS.1 has been simplified and better separates the likelihood statement with degree of anthropogenic contribution.
97745	60	43	62	1	Why do you not mention the well-known concept of "detection and attribution" in the table header and title of its second column? Please provide the legend with colours, not only in words. [Nicole Wilke, Germany]	Taken into account. The information provided in the table is not exclusively based on formal detection & attribution, so we do not highlight this in the table header / titles. The legend with colours has been provided in the revised Table TS.1.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
39553	60	43	62	27	The assessments are qualitative, not quantitative. They are, therefore, of little interest if they do not quantify more rigorously the human influence. Some assessments are questionable. When the assessment claims: it is virtually certain that the stratosphere has cooled, this is contrary to UAH MSU measurements at 17 km which do not show cooling since 1993. Among the 1°C of average temperature increase since the pre-industrial period, it is seen that about 0.6°C has been achieved between 1910 and 1945 (Fig. SPM4.B) in a period when the emissions were only 11 ppm with respect to 129 ppm since 1750. As a result, Ring, M.J., Lindner, D., Cross, E.F., Schlesinger, M.E., 2012 (Causes of the global warming observed since the 19th century. Atmos. Clim. Sci. 2, 401–415) consider that this increase was mainly natural. This was confirmed in IPCC FAR. Only a part of +0.4°C since 1945 might be anthropogenic. The anthropogenic forcing of ocean heat content is not demonstrated since Figure 10 of Lalouaux et al (2018) doi: 10.1029/2018MS001273, shows that the ocean heat content seems to follow a 60-70 year cycle, possibly related to Atlantic Multidecadal Oscillation. Retreat of certain glaciers, not all, Arctic sea ice are in balance with the average INCREASE of Antarctic sea ice by 11,300 km ² per year since 41 years (www.pnas.org/cgi/doi/10.1073/pnas.1906556116). The conclusions, therefore, should be toned down. [François Gervais, France]	Taken into account. The purpose of the table is to summarise the huge wealth of assessment undertaken in the balance of Section 2 of the TS which, in turn, summarises a huge body of assessment performed in the underlying assessments. The table colour coding relates to the confidence / likelihood assessments reached in the underlying assessment. It is not possible or practical to provide more quantitative information than is given without significantly complicating the table. The table should be interpreted in the context of the balance of TS2 and the underlying assessments performed in the chapters. To address the particular issues raised: i) The reviewer is correct that the rate of lower stratospheric cooling has been less since the mid-1990s, and this topic is now assessed in 3.3.1.2, where it is related to the stabilization of stratospheric ozone over this period. ii) The influences of internal variability on historical temperature evolution are assessed in Section 3.3.1.1. Variations in forcings through the historical period, including rates of CO2 increase are
108639	61	12	61	12	Strange 'f' in the middle of the 'salinity changes since mid 20th century box on probability [Jason Donev, Canada]	Not applicable - text has been removed. See revised Table TS.1.
39885	62	1	62	1	"virtually certain that human influence has warmed the global climate system {3.8.1}" It would be helpful to have this statement consistent with others in the TS, such as p.23 lines 20-22. [TSU WGI, France]	Taken into account. Text revised.
54809	62	7	62	10	AR5 concluded that human influence on the climate system is clear - a statement of fact. Here the text concludes there is 'irrefutable evidence of the impact of human activities on the global climate system (very high confidence). The AR6 statement seems weaker even though the evidence base for this conclusion is stronger since the AR5 made a statement of fact and the AR6 assesses the same result with very high confidence. [Nancy Hamzawi, Canada]	Taken into account. The temperature assessment has been moved to Cross-section box 1 and the text revised. We now assesses that it is unequivocal that human influence has warmed the climate system (Table TS.1 and Section 3.8.1). This can more clearly be related to the AR5 statement, and more clearly reflects the strengthened evidence.
26311	62	8	62	8	Earth system "is" changing [María Santolaria-Otín, France]	Not applicable. Text has been removed.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97747	62	8	62	26	We appreciate this conclusion here very much and suggest the authors to consider raising all of the statements in these lines to the SPM. [Nicole Wilke, Germany]	Taken into account. This conclusion is highlighted in the revised section TS2.1 and in headline statements HS1 and HS2 in the Summary for Policy Makers.
54811	62	18	62	21	Missing from the concluding paragraph for section TS2 about large scale changes in climate is any mention of extremes. These lines 18-21 refer to the benefits of emission reductions in line with SSP1-1.9 and SSP1-2.6, and reference Cross-section box 1 and box 2. Box 2 presents global-warming based future changes with a focus on extremes. Recommend information on benefits of achieving low global warming levels be included here, including avoidance of changes in extremes. [Nancy Hamzawi, Canada]	Noted. Section TS2 has been restructured for clarity, with the former TS2.8 now as an introduction subsection TS2.1. So there is no final concluding paragraph any more in this section.
44501	62	24	62	24	replace "risk" with "likelihood" to be conform with the use of the term "risk" as defined in section TS1.2.3 [Jana Sillmann, Norway]	Taken into account. We have eliminated "risk" in the revised text. The box on irreversibility is now Box TS.9 and sits in section TS3 "Understanding the Climate System Response ...".

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
39555	62	30	65	1	Scenario-based future climate change are highly questionable because they exaggerate the observed increase of atmospheric CO2 which is only 2 ppm per year since two decades, without observed impact of the covid-19-related lockdown, and are based on climate sensitivities which even do not agree between themselves and ignore values of climate sensitivity of 1°C or lower published in peer-reviewed papers, see list in notrickszone.com/50-papers-low-sensitivity . [François Gervais, France]	Rejected. Information in the TS needs to be based on the comprehensive assessment provided in the underlying assessment. Blog entries can not be used. Please see Chapters 4 and 7 for the assessment of climate model projections and climate sensitivity. Section TS.3 summarizes the assessment of ES in detail (see e.g., Figure TS.16. The AR6 assessment of future change in global surface temperature is, for the first time in an IPCC report, explicitly constructed by combining new projections for the SSP scenarios with observational constraints based on past simulated warming as well as the AR6-updated assessment of equilibrium climate sensitivity and transient climate response. Please note that former Cross-Section Box.1 has been dropped from the FGD and its content been distributed between TS.1.3 and TS.2. The temperature projections are being introduced in new Cross-Section Box TS.1, which synthesizes the outcomes of the assessment of past, current and future global surface temperature.
97749	62	30	68	10	Cross-Section Box 1 provides useful information, but is required much earlier in the TS. Please duplication with the text outside box. [Nicole Wilke, Germany]	Taken into account. Cross-Section Box.1 has been dropped from the FGD and its content been distributed between TS.1.3 and TS.2.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
84635	62	32	62	32	cross-section box 1: it contains most information already repeated in the text, it does not seem a real summary or specific explanation [Annalisa Cherchi, Italy]	Not applicable. Cross-Section Box.1 has been dropped from the FGD and its content been distributed between TS.1.3 and TS.2.
87055	62	32	68	10	The sentence could distinguish between long-lived and short-lived greenhouse gases. For long-lived gases the whole time-series of "emissions still to be emitted" must be taken into account, while for short-lived gases, the effect is decided by the emission rate at the given point of time. Please consider to insert such level of detail in the technical summary. [Oyvind Christophersen, Norway]	Not applicable. Cross-Section Box.1 has been dropped from the FGD and its content been distributed between TS.1.3 and TS.2.
97751	62	43			The term "scenario uncertainty" is not introduced in TS1.3.1 but used in several places in the TS. Please introduce this term before first using it or provide a suitable reference. [Nicole Wilke, Germany]	Not applicable. Cross-Section Box.1 has been dropped from the FGD and its content been distributed between TS.1.3 and TS.2. Scenario uncertainty is now introduced in Section 1.3.
113813	63	3	63	25	Cross-Section Box 1, Figure 2 can be developed further; e.g. making the time periods more visible. A secondary y-axis giving warming relative to 1850-1900 can also be added to the right part of the figure. [Jan Fuglestad, Norway]	Not applicable. Cross-Section Box.1 has been dropped from the FGD and its content been distributed between TS.1.3 and TS.2. The figure has been removed.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97753	63	28	63	37	The explanation on "changes in global surface air temperature (GSAT)" is insufficient. Please describe the new approach of the AR6 and how it differs from the AR5. It is not enough to state that there has been "substantial research progress", the reader needs to know in which way. The readers have been told in previous reports, that the models are able describe future warming. Now the IPCC tells them, that models are not sufficient anymore, and also that the ECS is fixed in some models. This needs to be extremely carefully explained to those who are not familiar with the fact that 1) revisions of previous statements are entirely normal in research and 2) to explain that the new methodological approach does not put previous assessments in question. [Nicole Wilke, Germany]	Taken into account. Cross-Section Box.1 has been dropped from the FGD and its content been distributed between TS.1.3 and TS.2. The GMST-GSAT temperature issue is being introduced in new Cross-Section Box TS.1. The AR6 assessment of future change in global surface temperature is, for the first time in an IPCC report, explicitly constructed by combining new projections for the SSP scenarios with observational constraints based on past simulated warming as well as the AR6-updated assessment of equilibrium climate sensitivity and transient climate response. Please note that former Cross-Section Box.1 has been dropped from the FGD and its content been distributed between TS.1.3 and TS.2. The temperature projections are being introduced in new Cross-Section Box TS.1, which synthesizes the outcomes of the assessment of past, current and future global surface temperature. The Box starts with introducing the AR6 assessment approach. For all further details the reader is referred to the comprehensive assessment provided in the underlying
97755	63	28	64	3	It is essential to provide the projected warming levels also in relation to the pre-industrial period. It is not helpful to ask the readers to find out the off-set to be added to the recent past to obtain policy relevant information. We strongly urge the authors to make up their minds and consider the needs of the readers of IPCC reports, also linking the information to the AR5-temperature scale that is relevant for the Paris Agreement. [Nicole Wilke, Germany]	Taken into account. Assessment results for 20-year averaged change in global surface temperature are now given in Cross-Section Box TS, relative to the 1850-1900 period, an approximation for the preindustrial period. We note that the warming levels Cross-Section Box.1 has been dropped from the FGD and its content been distributed between TS.1.3 and TS.2. The temperature projections are being introduced in new Cross-Section Box TS.1, which synthesizes the outcomes of the assessment of past, current and future global surface temperature.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
34795	63	39	63	50	The SOD estimates GSAT to reach 1.6°C by 2040 (while elsewhere indicating 1.5°C by 2030); how can such estimates be justified in the context of models that even the SOD admits to be over-sensitive? Please see general comments #1, #2 and #3 above. [Jim O'Brien, Ireland]	Taken into account. The text has been revised. The AR6 assessment of future change in global surface temperature is, for the first time in an IPCC report, explicitly constructed by combining new projections for the SSP scenarios with observational constraints based on past simulated warming as well as the AR6-updated assessment of equilibrium climate sensitivity and transient climate response. Please note that former Cross-Section Box.1 has been dropped from the FGD and its content been distributed between TS.1.3 and TS.2. The temperature projections are being introduced in new Cross-Section Box TS.1, which synthesizes the outcomes of the assessment of past, current and future global surface temperature.
11527	63	49	63	49	This sounds a bit like you imagine a scenario consisting of an increased frequency of volcanic eruptions (because you use the plural and talk about likelihoods and frequencies). Isn't one big eruption, with several cold years, and possibly a negative decadal trend over the following 10 years, the more likely scenario (or call it a storyline if you want)? That would be consistent with how this is written in the precipitation change part of the box. [Gerhard Krinner, France]	Taken into account. Sentence has been dropped from the FGD. Note that Cross-Section Box.1 has been dropped from the FGD and its content been distributed between TS.1.3 and TS.2. The temperature projections are being introduced in new Cross-Section Box TS.1, which synthesizes the outcomes of the assessment of past, current and future global surface temperature.
97757	64	5	64	8	The statement of the much larger warming due to larger ECS in CMIP6 needs a detailed explanation please. The way it is stated now is unhelpful because it leaves the reader basically without an explanation, since warming and ECS are not independent. [Nicole Wilke, Germany]	Taken into account. This is now taken up in Section TS.1.2.2 on model developments and TS.1.3 Assessing Future Climate Change. Note that the former Cross-Section Box.1 has been dropped from the FGD and its content been distributed between TS.1.3 and TS.2. The temperature projections are being introduced in new Cross-Section Box TS.1, which synthesizes the outcomes of the assessment of past, current and future global surface temperature.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
111265	64	11	64	34	This Cross-Section Box 1, Table 1 is identical to the Table TS.5 [Volodymyr Osadchy, Ukraine]	Not applicable. Cross-Section Box.1 has been dropped from the FGD and its content been distributed between TS.1.3 and TS.2.
6407	64	13	64	13	Comment 37 on table TS.5 applies also to Table 1, Cross-Section Box 1. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. Cross-Section Box.1 has been dropped from the FGD and its content been distributed between TS.1.3 and TS.2.
97759	64	13			We would have wished that the TS structure would have provided in a more mature state and free of duplication and placeholders. E.g. CROSS-SECTION BOX 1, TABLE 1 and Table TS.5 TS-31 are identical. [Nicole Wilke, Germany]	Not applicable. Cross-Section Box.1 has been dropped from the FGD and its content been distributed between TS.1.3 and TS.2.
39651	64	33	64	33	CS Box 1., Table TS.1: for which duration is global warming calculated / reaching a certain threshold here? Is this for an average over 20 years? 30 years as in SR1.5? Clarity would be appreciated particularly important for those who just glance at the table. [TSU WGI, France]	Taken into account. This is now clarified in the new Table 1 of new Cross-Section Box.1. The caption reads: Assessment results for 20-year averaged change in global surface temperature based on multiple lines of evidence. The change is displayed in °C relative to the 1850–1900 reference period for selected time periods, and as the first 20-year period during which the average global surface temperature change exceeds the specified level relative to the period 1850–1900. The entries give both the central estimate and, in parentheses, the very likely (5–95%) range. An entry n.c. means that the global warming level is not crossed during the period 2021–2100.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
111267	65	33	66	2	This Cross-Section Box 1, Table 2 is identical to the Table TS.6 [Volodymyr Osadchy, Ukraine]	Not applicable. Cross-Section Box.1 has been dropped from the FGD and its content been distributed between TS.1.3 and TS.2.
40345	65	41	65	44	Here, the time of GSAT exceedance is determined as the first year at which 11-year running averages of GSAT exceed the given threshold. => is the level of warming calculated over a period of 11 years? Then it is very different / approach in SR15. [TSU WGI, France]	Not applicable. Table 2 of former Cross-Section Box.1 has been dropped from the FGD. The content of the Box has been distributed between TS.1.3 and TS.2.
11529	66	9	66	10	"emissions. (high confidence)." -> "emissions (high confidence)" [Gerhard Krinner, France]	Not applicable. Cross-Section Box.1 has been dropped from the FGD and its content been distributed between TS.1.3 and TS.2.
403	66	11	66	11	Zetta Joules -> are we going to show this amount in scientific notation i.e. *10E21 ? [Leticia Cotrim da Cunha, Brazil]	Not applicable. Cross-Section Box.1 has been dropped from the FGD and its content been distributed between TS.1.3 and TS.2.
108641	66	21	66	21	Space between number and unit [Jason Donev, Canada]	Not applicable. Cross-Section Box.1 has been dropped from the FGD and its content been distributed between TS.1.3 and TS.2.
39557	66	23	67	8	The fact that in Table 3, the projections are THE SAME for 2040 or for 2050 (within a factor 2 of uncertainty) although based on scenarios with different CO2 emissions and different radiative forcings strongly selfcontradicts the alarmism of the entire AR6 report. [François Gervais, France]	Rejected. Please read the comprehensive assessment in Chapters 2 and 9, summarized in Box TS.4. Sea level responds to GHG emissions more slowly than global surface temperature, leading to weaker scenario dependence over the 21st century than for global surface temperature (high confidence) . This slow response also leads to long-term committed sea level rise, associated with ongoing ocean heat uptake and the slow adjustment of the ice sheets, that will continue over the centuries and millennia following cessation of emissions (high confidence). Note that former Cross-Section Box.1 has been dropped from the FGD and its content been distributed between TS.1.3 and TS.2. Sea level projections are now discussed in Box TS.4

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
11059	66	24	66	28	Unlike previous sections, numeric results are not provided in the text here. [Robert Kopp, United States of America]	Taken into account. This has been revised to make it consistent in the FGD in new Box TS.4. Note that former Cross-Section Box.1 has been dropped from the FGD and its content been distributed between TS.1.3 and TS.2. Sea level projections are now discussed in Box TS.4.
97761	66	38	66	43	Why is the 66-percentile used for the GMSL while for temperature it is the 90-percentile? Please use only one percentile for the ranges in order not to confuse your reader and to provide clear messages to policy makers. What is meant by "upper plausible limit"? Why is RCP4.5 used and not RCP2.6, i.e. the lowest with the highest scenario? [Nicole Wilke, Germany]	Taken into account (partly). The TS needs to rely on the assessment provided in the underlying chapters, also in terms of the uncertainty ranges for projections. Sea level projections are taken from Ch9, which generally assessed the likely range throughout. This has been clarified in the text now and the range considered is explicitly mentioned in the text. The term "upper plausible limit" has been deleted as it was not in line with the Chapter assessment. Note that former Cross-Section Box.1 has been dropped from the FGD and its content been distributed between TS.1.3 and TS.2. Sea level projections are now discussed in Box TS.4.
39645	66	39	66	40	"the range defined by the lowest 17th and highest 83rd percentile projection" : perhaps this could be a footnote, but it is the definition of a likely range and would not need to be repeated. [TSU WGI, France]	Taken into account. This has been clarified in the text now and the range considered is explicitly mentioned in the text. Note that Cross-Section Box.1 has been dropped from the FGD and its content been distributed between TS.1.3 and TS.2. Sea level projections are now discussed in Box TS.4.
11061	66	39	66	43	not sure where this 99% chance came from -- this is NOT the assessment statement, which stated that it is extremely likely that GMSL will be less than these levels. Moreover, not sure where 'upper plausible limit' for 4.7 m came from -- this is a change from the assessment statement, which said that it was extremely likely to be below 4.7 m. [Robert Kopp, United States of America]	Taken into account. TS made consistent with the underlying Chapter assessment for the FGD. Note that Cross-Section Box.1 has been dropped from the FGD and its content been distributed between TS.1.3 and TS.2. Sea level projections are now discussed in Box TS.4.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
32879	67	1	67	6	Values need to be added to the table [Helene Hewitt, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. Table 3 has been deleted. Cross-Section Box.1 has been dropped from the FGD and its content been distributed between TS.1.3 and TS.2.
97763	67	11	67	25	Please consider including the recent publications by R. Goyal et al. (ERL, 2019) and L.M. Polvani et al. (nature, 2020) regarding the role of CFCs in the Arctic Amplification. [Nicole Wilke, Germany]	Rejected. TS only refers to the underlying Chapters, not original literature. Cross-Section Box.1 has been dropped from the FGD and its content been distributed between TS.1.3 and TS.2.
15335	67	19	67	21	This sentence is repetition from page 59, line 37. Maybe this is not a problem because here it is in a box and there it is in the main text. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. Cross-Section Box.1 has been dropped from the FGD and its content been distributed between TS.1.3 and TS.2.
113819	68	13	72	53	Would be useful if role of path up to WL and rate for change is mentioned. [Jan Fuglestedt, Norway]	Not applicable. Cross-Section Box.2 has been dropped from the FGD and its content been distributed between TS.1 and TS.2. The issues raised here have been addressed as part of this revision.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97765	68	13	72	53	<p>We have serious concerns with Cross-Section Box 2:</p> <p>1) This box is essential to present the new approaches and serious revisions compared to previous reports. However, the current version lacks explanations on the most important issues, including the reassessment of the historical temperature record and the reasons for and consequences of the new approach to assess future warming not purely based on model projections anymore. Please explain in this box how the warming levels presented in the AR6 relate to the temperature scale of the AR5 that is relevant for the Paris Agreement and provide policy makers with a method to convert from one scale to the other.</p> <p>2) Much of the language referring to the Paris Agreement is inappropriate and policy prescriptive. Please do not interpret the Paris Agreement in relation to warming levels. Issues like the consequences of different levels of peak warming, long term stability, and overshoot including aspects of timing for the climate system should be assessed by the IPCC WG I. However, their interpretation in the context of the Paris Agreement must be left to policy makers. Please delete such text.</p> <p>3) In addition, the text is written in a very technical style. Please revise, possibly with the help of the science communication expert. [Nicole Wilke, Germany]</p>	Not applicable. Cross-Section Box.2 has been dropped from the FGD and its content been distributed between TS.1 and TS.2. The issues raised here have been addressed as part of this revision.
54813	68	15	68	15	"Global warming levels" is not an apt title for this Box. Something in line with the title of Cross-section Box 1 would be better (e.g. Global warming level-based future climate system changes). [Nancy Hamzawi, Canada]	Not applicable. Cross-Section Box.2 has been dropped from the FGD and its content been distributed between TS.1 and TS.2. The issues raised here have been addressed as part of this revision.
11531	68	15	68	31	It could probably be said very clearly from the beginning that many variables of the climate system respond slowly to warming (for example sea level, ice sheet geometry), and that the warming level concept therefore needs to be used cautiously for these slow variables. [Gerhard Krinner, France]	Not applicable. Cross-Section Box.2 has been dropped from the FGD and its content been distributed between TS.1 and TS.2. The issues raised here have been addressed as part of this revision.
97767	68	15	69	9	This purpose and narrative of this text is unclear. There is a mixture of information on methodologies - albeit incomplete and difficult to understand - and some information on changes in meteorological quantities, but is it unclear why these are highlighted in this box. It would be extremely useful, if a box could be provided instead to explain the AR6's approach to historical and projected temperatures in comparison to previous reports and the implications of the new approach for policy relevant information, e.g. pre-industrial temperature, current warming, timings of 1.5C and 2C as well as the budget. [Nicole Wilke, Germany]	Not applicable. Cross-Section Box.2 has been dropped from the FGD and its content been distributed between TS.1 and TS.2. The issues raised here have been addressed as part of this revision.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
113825	68	15	72	53	There is some repetition between cross section box 1 and 2 on dates for reaching temp levels. This is relevant in both boxes, but please consider what is needed and possibilities for tighter coordination. [Jan Fuglestedt, Norway]	Not applicable. Cross-Section Box.2 has been dropped from the FGD and its content been distributed between TS.1 and TS.2. The issues raised here have been addressed as part of this revision.
113815	68	26	68	26	Re "literature-based assessments": This is in my view a bit vague. Can you say more? [Jan Fuglestedt, Norway]	Accepted. Note that Cross-Section Box.2 has been dropped from the FGD and its content been distributed between TS.1 and TS.2. The issues raised here have been addressed as part of this revision.
97769	68	26			What does "literature based assessments" mean? The full AR6 should be a "literature based assessments". Please explain. [Nicole Wilke, Germany]	Accepted. Note that Cross-Section Box.2 has been dropped from the FGD and its content been distributed between TS.1 and TS.2. The issues raised here have been addressed as part of this revision.
113817	68	29	68	29	Not sure if we can say "seamless". Can you try to reformulate? [Jan Fuglestedt, Norway]	Not applicable. Cross-Section Box.2 has been dropped from the FGD and its content been distributed between TS.1 and TS.2. The issues raised here have been addressed as part of this revision.
54815	68	35	68	35	Need to be clear here that events assessed to be attributed to 1C warming in fact refers to events that have been attributed at observed levels of warming. [Nancy Hamzawi, Canada]	Accepted. Note that Cross-Section Box.2 has been dropped from the FGD and its content been distributed between TS.1 and TS.2. The issues raised here have been addressed as part of this revision.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97771	69	20	69	21	Since the statement on the disappearance of the Greenland and Antarctica ice sheets at warming of 3°C to 5°C is with medium confidence, we do not understand that the statement about the GMSL is only with low confidence. Is there low confidence about whether there will be about 16 meter rise or is there low confidence only about the timing (after two millennia)? Please revise and include a statement of long-term GMSL at 4°C peak warming with a confidence that reflects the medium confidence of the causes for the sea level rise. [Nicole Wilke, Germany]	Not applicable. Cross-Section Box.2 has been dropped from the FGD and its content been distributed between TS.1 and TS.2. The issues raised here have been addressed as part of this revision.
32519	69	29			Cross-section Box 2, Figure 2: France has a major concern with the current division of Europe into geographic domains, especially for the Central Europe domain. Indeed, the current "Central Europe" covers a domain with completely different climates. We strongly recommend to choose a new division which makes it possible to separate the Western part of Europe, which has a maritime climate, from the Eastern part which has a continental climate. If it is not the case, all Tables and messages in the vol1 SPM, TS and Chapters referring to the current "Central Europe" would be completely meaningless and useless for France. We recommend to adopt for the Atlas the division mentioned in the first paragraph of 12.4.5 [Eric Brun, France]	Not applicable. Cross-Section Box.2 has been dropped from the FGD and its content been distributed between TS.1 and TS.2. The issues raised here have been addressed as part of this revision.
6409	69	41	69	43	The central estimate of the temperature increase from 1850-1900 to 1995-2014 quoted here is the same as quoted in SR1.5 for the period 1850-1900 to 2006-2015. The period used in SR1.5 is in effect 6 years longer, and at the current observed rate of warming the six-year difference implies a shift of a little over 0.1°C in the pre-industrial level. This moves the goalposts of the Paris Agreement, even though the risks associated with climate change over the years following the Paris Agreement are unchanged by altering the pre-industrial level. Please see comments 2 and 3 on the entire report, which argue that the pre-operational level should be fixed at the level it was estimated to be at the time the Paris Agreement was made, or at least as it was estimated in SR1.5. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. The reasoning behind this difference is explained in Chapter 2, CC-Box 2.3, and in TS.1.
54817	69	41	69	43	It is unclear why GMST is used here to report the observed warming from 1850-1900 to 1995-2014 rather than GSAT. The observed increase in GSAT is higher (~0.91C vs 0.87C) and therefore closer to this "warming of 1C" scenario. [Nancy Hamzawi, Canada]	Rejected. The reasoning behind this difference is explained in Chapter 2, CC-Box 2.3, and in TS.1.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
40343	69	51	70	17	Here is what I understand from this section: the updated estimate for reaching net zero CO ₂ / 1.5°C is now in 20 years (so 2040 and not 2050 as in SR15) and /2°C with 50% chance in 2075 (but SR15 had 2070 for 2°C, 2/3 chance). Do I understand correctly that this also results from the updated observational record as for when 1.5°C is reached in projections? Could this be explained more clearly? This would help facilitate the compression of one of the key findings of this report. [TSU WGI, France]	Not applicable. Cross-Section Box.2 has been dropped from the FGD and its content been distributed between TS.1 and TS.2. The issues raised here have been addressed as part of this revision.
113821	69	52	69	52	Check consistency in use of "target" in context of PA. [Jan Fuglestedt, Norway]	Not applicable. Cross-Section Box.2 has been dropped from the FGD and its content been distributed between TS.1 and TS.2. The issues raised here have been addressed as part of this revision.
97773	69	52			What does "approximately in line with the PA"? Please specify, what this means. [Nicole Wilke, Germany]	Not applicable. Cross-Section Box.2 has been dropped from the FGD and its content been distributed between TS.1 and TS.2. The issues raised here have been addressed as part of this revision.
132021	69				cross-section Box 2, Figure 2: the regions will have to be updated to match Box TS.5 Figure 2 [TSU WGI, France]	Accepted. Note that Cross-Section Box.2 has been dropped from the FGD and its content been distributed between TS.1 and TS.2. The issues raised here have been addressed as part of this revision.
97775	70	6	70	12	Please see our comments on the re-assessment of the timing of 1.5 °C. [Nicole Wilke, Germany]	Not applicable. Cross-Section Box.2 has been dropped from the FGD and its content been distributed between TS.1 and TS.2. The issues raised here have been addressed as part of this revision.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
113823	70	7	70	12	Check for updates and consistency with ch2 and ch4 on this. [Jan Fuglestedt, Norway]	Not applicable. Cross-Section Box.2 has been dropped from the FGD and its content been distributed between TS.1 and TS.2. The issues raised here have been addressed as part of this revision.
6411	70	10	70	12	Comment 42 applies to this sentence also. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. Cross-Section Box.2 has been dropped from the FGD and its content been distributed between TS.1 and TS.2. The issues raised here have been addressed as part of this revision.
40091	70	10	70	12	Does this explain the 10 year best estimate difference? [TSU WGI, France]	Not applicable. Cross-Section Box.2 has been dropped from the FGD and its content been distributed between TS.1 and TS.2. The issues raised here have been addressed as part of this revision.
39955	70	15	70	17	As the Paris Agreement does not say *when* the 2°C warming level should be met, perhaps the part this be formulated with more subtlety? Particularly when considering a potential 2°C overshoot and then return. [TSU WGI, France]	Not applicable. Cross-Section Box.2 has been dropped from the FGD and its content been distributed between TS.1 and TS.2. The issues raised here have been addressed as part of this revision.
108643	70	24	70	24	I think you mean 10 ⁶ not 106. [Jason Donev, Canada]	Not applicable. Cross-Section Box.2 has been dropped from the FGD and its content been distributed between TS.1 and TS.2. The issues raised here have been addressed as part of this revision.
26315	70	24	70	24	6 is a power [María Santolaria-Otín, France]	Not applicable. Cross-Section Box.2 has been dropped from the FGD and its content been distributed between TS.1 and TS.2. The issues raised here have been addressed as part of this revision.
52803	70	24	70	25	Loss of small glaciers: “low latitudes” to be replaced by “low and mid-latitudes” [Petra Seibert, Austria]	Accepted. Note that Cross-Section Box.2 has been dropped from the FGD and its content been distributed between TS.1 and TS.2. The issues raised here have been addressed as part of this revision.
112919	70	27	70	27	Can we also say a number, by how much they will decline? [Johannes Quaas, Germany]	Not applicable. Cross-Section Box.2 has been dropped from the FGD and its content been distributed between TS.1 and TS.2. The issues raised here have been addressed as part of this revision.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
11541	70	30	74	31	Does the wording "expressed relative to Earth's surface area" really make sense? Why not write "global mean" imbalance [Gerhard Krinner, France]	Taken into account. Wording changed: "The global energy inventory change for the period 1971–2018 corresponds to an Earth energy imbalance (Box TS.1) of 0.57 [0.43 to 0.72] W m ⁻² , increasing to 0.79 [0.52 to 1.06] W m ⁻² for the period 2006–2018"
26313	70	43	70	43	Maybe extent definition of NCD (Nationally Determined Contribution) [María Santolaria-Otín, France]	Not applicable. Cross-Section Box.2 has been dropped from the FGD and its content been distributed between TS.1 and TS.2. The issues raised here have been addressed as part of this revision.
40361	71	2	71	3	I am not sure what is meant here. Perhaps drop the second part of the sentence? [TSU WGI, France]	Not applicable. Cross-Section Box.2 has been dropped from the FGD and its content been distributed between TS.1 and TS.2. The issues raised here have been addressed as part of this revision.
97777	71	2			Please do not refer to "reference scenarios" in this report as this expression is policy prescriptive and might confuse readers. [Nicole Wilke, Germany]	Not applicable. Cross-Section Box.2 has been dropped from the FGD and its content been distributed between TS.1 and TS.2. The issues raised here have been addressed as part of this revision.
11533	71	7	71	8	"Permafrost warming is very likely a pan-Arctic phenomenon. Active layer thickness increase is a pan-Arctic phenomenon, subject to interannual variations." Why are these two sentences here? They do not belong here. [Gerhard Krinner, France]	Not applicable. Cross-Section Box.2 has been dropped from the FGD and its content been distributed between TS.1 and TS.2. The issues raised here have been addressed as part of this revision.
111195	71	17	71	17	Twice in the line instead of 10 ⁶ km ² written 106 [Volodymyr Osadchy, Ukraine]	Not applicable. Cross-Section Box.2 has been dropped from the FGD and its content been distributed between TS.1 and TS.2. The issues raised here have been addressed as part of this revision.
26317	71	17	71	18	6 is a power and km is in different font [María Santolaria-Otín, France]	Not applicable. Cross-Section Box.2 has been dropped from the FGD and its content been distributed between TS.1 and TS.2. The issues raised here have been addressed as part of this revision.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97779	71	18	71	18	To make the reader able to assess the relevance of the permafrost thawing at high temperature levels of warming, please provide more context about the projected decrease in permafrost thawing. Please add information on the following questions: What is the absolute figure of the volume of permafrost decrease in the top 3 meters? How much carbon is stored in this volume? And what could be the potential carbon emission of this thawing? There are figures provided in Ch5-57:38 of 1300 PgC of carbon stored in high latitude soils. Providing such a number here and the linked potential carbon emission would be very helpful to evaluate the potential effect of permafrost thawing. [Nicole Wilke, Germany]	Not applicable. Cross-Section Box.2 has been dropped from the FGD and its content been distributed between TS.1 and TS.2. The issues raised here have been addressed as part of this revision.
113827	71	28	72	2	"Risk ratio" used in Cross section Box 2, table 1. Although the reader can see what it means from that table it could be useful with a sentence in the text or table caption. [Jan Fuglestedt, Norway]	Not applicable. Cross-Section Box.2 has been dropped from the FGD and its content been distributed between TS.1 and TS.2. The issues raised here have been addressed as part of this revision.
97781	71	28	72	2	Cross-Section Box 2, Table 1: Please add the confidence levels and likelihood ranges of the figures presented in this table. [Nicole Wilke, Germany]	Not applicable. Cross-Section Box.2 has been dropped from the FGD and its content been distributed between TS.1 and TS.2. The issues raised here have been addressed as part of this revision.
97783	71	34			Last row, second column of the table: 28 instead of 41? [Nicole Wilke, Germany]	Not applicable. Cross-Section Box.2 has been dropped from the FGD and its content been distributed between TS.1 and TS.2. The issues raised here have been addressed as part of this revision.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
15337	72	5	72	27	This section on non-linearities could also reference Chapter 7, Section 7.4.3 (Dependence of feedbacks on climate mean state). [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Note that Cross-Section Box.2 has been dropped from the FGD and its content been distributed between TS.1 and TS.2. The issues raised here have been addressed as part of this revision.
97785	72	13	72	19	GMST/GSAT: Here in the paragraph both GSAT and GMST are referred to. We request the authors to revise and only use GSAT to prevent confusion. Please see our overarching comment on temperature. [Nicole Wilke, Germany]	Accepted. Note that Cross-Section Box.2 has been dropped from the FGD and its content been distributed between TS.1 and TS.2. The issues raised here have been addressed as part of this revision.
113829	72	17	72	17	I guess this should be GSAT not GMST. [Jan Fuglestedt, Norway]	Accepted. Note that Cross-Section Box.2 has been dropped from the FGD and its content been distributed between TS.1 and TS.2. The issues raised here have been addressed as part of this revision.
97787	72	21	72	27	Please lift information about peak warming and the committed sea level rise after on a millennial time scale to the SPM, e.g. using this statement for peak warming of 4°C. Please move the statement on P71 L 20 to this paragraph. [Nicole Wilke, Germany]	Accepted. Note that Cross-Section Box.2 has been dropped from the FGD and its content been distributed between TS.1 and TS.2. The issues raised here have been addressed as part of this revision.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
11547	72	26	77	48	The Planck response is (sometimes?) not considered as a feedback, but as the initial response that is modified by other feedbacks. Maybe it could be visually distinguished from other feedbacks in Figure TS.26? [Gerhard Krinner, France]	Noted. Chapter 7 does indeed introduce a distinction by referring to the Planck response, instead of feedback. But they also note that it is often called Planck feedback. For the Figure that is now TS.17, it was felt that distinguishing between negative (blue bars) and positive (red bars) feedbacks was more important than this subtle distinction.
113831	73	6	73	7	When I read TS I feel I have heard this statement many times. It is important but let's avoid repeating this too many times. [Jan Fuglestedt, Norway]	Accepted. We have removed this general statement because it is largely redundant with the more specific statements that come later.
97789	73	12			Please explain these "new approaches". [Nicole Wilke, Germany]	Not applicable. Text has been revised to be concise. Details on the new approaches applied for the quantification of feedbacks is described in section TS3.2.2
97791	73	12			Please specify which new approaches to the quantification and treatment of feedbacks the AR6 adopts. [Nicole Wilke, Germany]	see response to #97789
23723	73	17	73	18	'Metrics, such as the Transient Climate Response to Emissions (TCRE)' should be 'Metrics, such as the transient climate response to cumulative carbon smissions (TCRE)' [Masahiro Watanabe, Japan]	Not applicable. Text has been revised to be concise.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
84637	73	22	73	29	not clear what concepts have to be conceived from this paragraph [Annalisa Cherchi, Italy]	Noted. The paragraph has been rewritten.
113833	73	22	73	29	Is this para needed? Again, I feel that this has been said already. And the sentence on SRM does not fit very well in here in my view. [Jan Fuglestedt, Norway]	Noted. The paragraph has been rewritten.
16633	73	26	73	26	Since this just refers to aerosols and ozone precursors I think it is clearer just to leave it as "aerosols and ozone precursors" rather than saying SLCFs apart from methane (and HCFCs and HFCs). Then there is no need for the footnote 5 which I don't think helps here. Re the footnote: it is not strictly true that methane has a "much shorter" lifetime than all LLGHGs. For instance if HCFC-22 is a LLGHG (it's not clear where your cut-off is) its lifetime is only a few years longer than methane. [William Collins, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Text has been changed accordingly.
11535	73	26	73	29	Could you please refer to the relevant sections in the main report that support these two sentences? [Gerhard Krinner, France]	Not applicable. Text has been revised to be concise. Other sections have been cross-referenced where applicable
97793	73	27	73	29	Only to state the compensation of warming "is identified to be IMPERFECT on regional and seasonal scales" in this short introduction of TS.3 does not provide the most relevant issues of SRM. What about the risks associated with SRM? And what about the existence of "large uncertainties in important climate processes associated with SRM options and the interaction among these processes (high confidence)" as stated in the underlying subsection on SRM TS.3.6 (TS-88:16-17). We request the authors to include here some words on the risks. Key side effects can be found here: Table 4.7 in 4-81 and 4-82) and the knowledge gaps. Otherwise the sentence could be perceived as if SRM is well understood and only features some regional variety. [Nicole Wilke, Germany]	Rejected. This is only the introduction paragraph to the TS section, with specifics and references to the full report coming in the following subsections and boxes. That being said, we now also state that variables other than temperature are also imperfectly compensated for.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97795	73	32			The introduction of the ERF praises its value and the innovations since AR5 twice on P32 (L 7-11, L 36-38), but does not define what it actually is, nor does it identify the new approaches. Please amend. The following paragraphs of section TS3.1 provide a lot of detail which is not comprehensible for non-experts. It mentions significant quantitative changes from the figures provided in AR5 but does not explain the reasons for these changes, e.g. forcing efficiencies of GHG, new assessment of aerosol ERF, shortwave forcing from CH4. We urge the authors to please provide this information or delete the information altogether in the TS since it is not useful the way it is presented. [Nicole Wilke, Germany]	Noted. The paragraph in question has been removed, and we have attempted to make the text on ERF assessments more accessible.
11537	73	40	73	40	What is "heat energy"? I think the correct physical term would be "thermal energy". You could also simply use "heat", but heat is more properly applied to energy in transfer. [Gerhard Krinner, France]	Accepted. We now consistently use "Earth System heating", consistent with Ch. 7 terminology.
84639	73	40	73	44	definition of "total earth system warming" is repeated twice in 4 lines [Annalisa Cherchi, Italy]	Accepted. Redundancy has been addressed.
108645	73	40	73	49	These numbers should be broken out graphically. The energy, both absolute and the percents, need to be clearly displayed. [Jason Donev, Canada]	Noted. This is already done in Fig. TS.24, but percentages have been added to the figure.
108647	73	40	73	49	These numbers should be in the FAQ, and aren't. Create a new FAQ: How much energy is there and where is it going? I know it was in previous reports, but it needs to be in this one since it's still a frequently asked question. You can even recycle and update the numbers from a previous FAQ. [Jason Donev, Canada]	Noted. The TS does not have FAQs. In the report itself, there is a cross-chapter box on this topic, so it is highly visible and Chapter 7 now includes an FAQ on the earth energy budget.
108649	73	40	73	49	These numbers should be in the SPM, and aren't. [Jason Donev, Canada]	Noted. This has been passed on to the SPM authors and included in the SPM

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97797	73	43	73	46	The information on the accumulated energy is much as interesting as the energy imbalance relative to the Earth surface and we suggest to also lift the first to the SPM. [Nicole Wilke, Germany]	Noted. This has been passed on to the SPM authors.
40037	73	45	73	45	Could a footnote be added to explain Zetta Joules? I believe this was done in SROCC and helped with compression. [TSU WGI, France]	Accepted. Information added.
11539	74	2	74	2	1 ZJ = 1021 J... [Gerhard Krinner, France]	Accepted. Typo has been fixed.
26319	74	29	74	47	Check font of W m ⁻² [María Santolaria-Otín, France]	Accepted.
108651	74	29	74	55	The difference between the different energy imbalances is unclear. What's the 0.54 vs the 0.81? How are those different from the ERF of 3.63? [Jason Donev, Canada]	Rejected. As explicitly states, the energy imbalances of 0.54 and 0.81 Wm ⁻² are for two different time periods. ERF is the imbalance we would have without any warming change since pre-industrial times.
97799	74	33	74	35	Please clarify, why heat accumulation will continue even under strong mitigation of GHG emissions. Make clear, that under less strong mitigation the consequences are worse. [Nicole Wilke, Germany]	Accepted. Brief explanation added.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
84641	74	38	74	42	and what are the "true" numbers? [Annalisa Cherchi, Italy]	Accepted. Numbers are now changed from percentages to actual numbers.
39559	74	46	74	47	To give a result with 3 digits within an uncertainty of 30 % is physically meaningless. http://dx.doi.org/10.1155/2013/503727 concludes to a radiative forcing of 2.6 W/m ² at DOUBLED CO ₂ concentration based on infrared spectra of the atmosphere which are missing in the entire report. This observational evidence contradicts the 2.15 W/m ² claimed whereas doubling is far from being achieved. [François Gervais, France]	Rejected. Giving three digits is deemed reasonable given the uncertainties. Further, the reviewer is confusing ERF and instantaneous radiative forcing.
97801	74	47	74	48	We kindly request the authors to specify the increase in estimated shortwave forcing from methane. Is there an increase compared to the AR5? Is it due to higher concentrations/emissions or lower sinks of methane, or is it due to methodological updates in assessing forcing from methane? [Nicole Wilke, Germany]	Not applicable. Text has been revised for conciseness.
54819	74	47	74	48	In the technical summary, it would be useful to add information to explain the significance of the statement that "the estimated shortwave forcing from methane has been increased", such as what the overall impact of this was on methane's ERF. [Nancy Hamzawi, Canada]	Not applicable. Text has been revised for conciseness.
16635	74	47	74	48	Better to say "The shortwave forcing from methane is now included which also increases its ERF" - it was completely missing in AR5 and earlier. [William Collins, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. Text has been revised for conciseness.
113835	75	1	75	54	Sometimes 1750 is given as reference for RF numbers, while fig TS.25 says 1850. Need to be clear about this. [Jan Fuglestad, Norway]	Accepted. All RF numbers are relative to 1750 now.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
16639	75	8	75	8	This sentence on emission driven scenarios is a bit out of place in a discussion of TCR and ECS (in which by definition carbon cycle feedbacks are excluded). I suggest leaving it out, or if keeping it, being more explicit that carbon cycle feedbacks are important for future transient and equilibrium warming but are excluded from the TCR/ECS formalism. [William Collins, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. There is no statement about emission driven scenarios in relation to Fig. TS.25
6413	75	31	75	31	"in situ records" should be "in situ data records" or something similar. "in situ" qualifies the data, not the records. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Accepted.
11543	75	31	75	32	"Due to discrepancies in satellite and in situ records, there is low confidence in stratospheric water vapour change" OK, but this says nothing about what we know or what the low confidence really refers to. The low confidence should refer to some value or some finding. Do we know the sign of the changes? Do we know the order of magnitude of the trend, but have only low confidence in the published values? [Gerhard Krinner, France]	Taken into account. Text has been revised for conciseness.
84643	75	45	75	49	and what are these numbers? [Annalisa Cherchi, Italy]	Accepted. Numbers have been added.
97803	75	48	75	54	We suggest that this summarizing paragraph should be merged with other summarizing paragraphs in the subsections TS.3.X and moved to the beginning of TS.3. To provide a summary of a section that is only about 1 page long seems not reasonable. [Nicole Wilke, Germany]	Taken into account. Summary is now provided in text within the salmon box.
40373	75	48	75	54	I found it hard to compare changes in ERF (rates) and changes in heat uptake rates. Are the numbers being compared for similar time intervals? [TSU WGI, France]	Accepted. The paragraph has been rewritten and the forcing and heat uptake numbers are not given side-by-side. Fig. TS.24 provides consistent comparison of forcing and heat uptake.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97805	75	57	76	24	The statements on the assessment of the net cloud feedback in this section are inconsistent. On the one hand P76 L 16-25 are enthusiastic about "major advances in the understanding of cloud processes" but on the other hand, P77 L 51-53 claims that "cloud feedbacks are the dominant source of uncertainty in this century's transient global warming ... " and the too high ECS in CMIP6 are attributed to "changes in extra-tropical cloud feedbacks that have emerged from efforts to reduce biases in these clouds compared to satellite observations". Please clarify and provide consistent information. [Nicole Wilke, Germany]	Accepted. Text has been changed to provide consistent information
97807	75	57	80	26	This subsection contains a lot of valuable information about metrics and feedbacks. However, it is not straightforward to read. E.g. it starts with discussing feedbacks that are included/not included in the ECS, although a general definition of ECS is not given until two pages afterwards (from line TS-77:57 onwards). We suggest the authors to restructure and begin with a general ECS definition. Also, the subsection is quite long. We therefore recommend to divide it into three subsection: ECS/TCR, feedbacks, warming. We would not expect issues the carbon cycle, permafrost or SLCF in this section and we do not feel that they belong here: please reconsider the structure. [Nicole Wilke, Germany]	Accepted. This section has been restructured and text has been revised for conciseness
105947	75	57	80	26	This section is fairly long and it is difficult to find the key messages as ECS is introduced but then feedbacks are discussed without the reader expecting this before numbers for ECS are actually given. A bit more signposting would be helpful. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. This section has been restructured and text has been revised for conciseness
41193	75				Why is Figure TS.25b not being referred to in the main text? [TSU WGI, France]	Rejected. TS.25b was referred to in the text (page 75, line 44)
11545	76	2	76	2	"feedbacks, or self-reinforcing cycles in the climate system": although correct, this sounds a bit like focusing only on positive feedbacks [Gerhard Krinner, France]	Not applicable. This sentence is no longer in the revised text.
15339	76	2	76	2	"or self-reinforcing cycles" implies only positive feedbacks. I would remove "or self-reinforcing cycles". [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. This sentence is no longer in the revised text.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
15341	76	4	76	14	I really like this section and it explains very clearly how the definition of ECS has changed in AR6. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Thank you!
97809	76	8	76	14	How does this new definition of the ECS relate to its value and the fact that is larger in this report than in previous ones? How can the values from AR6 and previous reports be compared? We do not consider it helpful to change definitions without explaining their implications to the readers of the report. Please amend. [Nicole Wilke, Germany]	Noted. The definition of ECS remains the same but the methodology for quantifying it is different in AR6. We provide explicit comparisons with AR5 values
1945	76	9	76	10	I would maybe explain very briefly why biogeochemical feedbacks affecting the atmospheric concentration of CO2 are not included. This may appear obvious if you are used with the definition of ECS but may be considered strange for someone who is asking why those important feedbacks are not taken into account. [Hugues Goosse, Belgium]	Accepted. Text revised
108653	76	14	76	14	Why are the long term feedbacks associated with ice sheets not included? I don't disagree, but a bit of an explanation here as to why would strengthen what's being said. [Jason Donev, Canada]	Accepted. Explanation is added
23719	76	16	76	18	Please move the citation to figure '(Figure TS.26a)' to the end of the sentences at L.18 because the figure is not about AR5. [Masahiro Watanabe, Japan]	Done.
15343	76	28	76	31	I feel that the part of this paragraph starting "The sum of.." should appear later, on the next page, after line 21. This is a summing-up of all the feedbacks, and to me it makes sense for this to appear after each feedback has been introduced. Or, move it earlier, so that all feedbacks are discussed in more detail after this summing-up. At the moment it is in the middle. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Moved to the end of the section.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
31677	76	33	77	21	The discussion of feedbacks from CH4 and CO2 might be too optimistic, especially with respect to permafrost thawing. The wording concedes gaps in knowledge and low confidence, but there is a risk that relatively small numbers may outweigh the cautionary wording. Also, it is mentioned that the sensitivity refers to 2100, but it is not clear in which scenario. The sensitivity could be low because most of the near-surface permafrost could have disappeared already, with a considerable higher sensitivity earlier, when the rates of permafrost loss are higher. All in all, it appears that this topic needs to receive more attention and maybe modification.. [Petra Seibert, Austria]	Noted. The wide error bars in the quantified estimate are reflective of the degree of uncertainty, so the wording and estimate are consistent. The sensitivity is calculated from a set of different scenarios, including RCP4.5 and RCP8.5.
97811	76	42	76	52	Please explain more clearly how figure TS.26c relates to the text. E.g., is the effect of reduced efficiency included in the positive feedback? Are both feedbacks linear to the degree of warming as presented in figure TS.26c? The text in this paragraph and on page 47 about reduced efficiency/stop taking up more CO2 from a certain time onwards seems to contradict this linearity. Please revise. If there is a linear relation in a certain temperature range, please provide information on the range and the reasoning behind. [Nicole Wilke, Germany]	Taken into account. Points have been clarified.
97813	76	54	77	6	The SRCL reported a compensation of the release of GHG due to increased sink through enhanced carbon uptake from enhanced plant growth. Please comment on this interesting finding also in the AR6 WGI and its TS. [Nicole Wilke, Germany]	Noted. Increased plant growth with warming and CO2 is captured in the "standard" assessments of CO2- and climate-carbon interactions. The permafrost thaw is the additional C release due to the increase in the active layer.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97815	76	54	77	6	The text only provides numbers in PgC per °C. We kindly request the authors to provide the corresponding emissions in GtCO ₂ eq to make it easier to compare the numbers. Also, please provide the ERF of the permafrost feedback in combination with expected fire feedbacks, because these figures are provided in Figure TS.26c and add some explanation about the relation of ERF and CO ₂ release from permafrost. [Nicole Wilke, Germany]	Taken into account. Permafrost emissions per degC warming are now provided in GtCO ₂ eq as well.
68235	76	54	77	6	Add that N ₂ O also released from permafrost thaw. Wilkerson J., et al. (2019) Permafrost nitrous oxide emissions observed on a landscape scale using the airborne eddy-covariance method, ATMOS. CHEM. PHYS. 19:4257–4268. [Durwood Zaelke, United States of America]	Accepted. The text now includes mention of N ₂ O emissions from permafrost thaw.
66731	76	54	77	6	Add that N ₂ O also released from permafrost thaw. Wilkerson J., et al. (2019) Permafrost nitrous oxide emissions observed on a landscape scale using the airborne eddy-covariance method, ATMOS. CHEM. PHYS. 19:4257–4268. [Kristin Campbell, United States of America]	Accepted. The text now includes mention of N ₂ O emissions from permafrost thaw.
29235	77	20	77	20	It is understandable that the total non-CO ₂ biogeochemical feedback is assessed to have a zero mean value but the likely range (from -0.1 to 0.1 W m ⁻² degC ⁻¹) would be too narrow, in that the central estimate of -0.18 W m ⁻² degC ⁻¹ (Figure TS.26b) is even outside of the range. I would suggest a revised expert judge here, with my own as -0.2 to +0.2 W m ⁻² degC ⁻¹ . [Yugo Kanaya, Japan]	Taken into account. The assessed value is based on Ch6 and Ch7 estimates coming out to be -0.01 [-0.27 to + 0.25] Wm ⁻² C ⁻¹
16637	77	51	77	53	This sentence on the uncertainties is a bit confusing. I suggest to split into two - one on historical and one on net zero. [William Collins, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Revised for consistency with Chap 7 ES point.
15345	77	51	77	55	Again, this paragraph seems a bit out of place. For me, it would better appear next to discussion of the other "Charney" feedbacks (i.e. earlier). [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Revised and moved to end of ECS discussion.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
113837	77	53	77	53	Not sure why you say "scenarios reaching net zero...". Sufficient to say 1.5/2 deg scenarios? Just to indicate low warming scenarios? [Jan Fuglestedt, Norway]	Rejected. This terminology is used to consistent with text in the underlying chapters (1, 5, 6)
97817	78	7	78	8	Please explain the difference between concentration vs. emissions driven scenarios. Since the ECS is of high policy relevance, the readers must be enabled to understand the issue. Please amend avoiding scientific jargon, and provide a reference in the TS to Ch05, section 5.4.5. [Nicole Wilke, Germany]	Jargon has been reduced for this statement by removing reference to emissions-driven and concentration-driven. In either case, ECS and TCR help explain the variation in warming.
34797	78	12	78	22	The SOD admits that the current models are not used to estimate ECS and TCR; which inherently implies a lack of confidence in the CMIP6 models. Please see general comment #3 above. [Jim O'Brien, Ireland]	As discussed in Chapter 7, It is not so much a lack of confidence in CMIP6 models in particular, but a recognition that observation-based constraints are now sufficient to constrain the range of ECS and are considered more reliable than taking the raw ECS range from numerical models, for several reasons.
40467	78	12			it seems that Figure TS.27 would fit better in the next sentence, where IPCC reports are mentioned. [TSU WGI, France]	Moved.
15349	78	24	78	30	Maybe add something here about the dependence of feedbacks on background state, which is not mentioned here (i.e. Chapter 7, Section 7.4.3). [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Added.
16641	78	25	78	25	Perhaps "are expected to become" is better than "will become". [William Collins, United Kingdom (of Great Britain and Northern Ireland)]	Revised accordingly.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
15347	78	25	78	25	"Radiative feedbacks will become less negative (more amplifying)". The use of "less negative" here probably refers to feedback parameters, but given that feedback parameters are not introduced (as far as I can tell) in the TS, this language could be confusing. Maybe use "Radiative feedbacks will become overall more positive (more amplifying)". [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Revised accordingly.
108655	78	25	78	26	Radiative feedback has just come out of nowhere, it hasn't been defined before. Is this Planck feedback? [Jason Donev, Canada]	Changed to 'feedback processes'. The changes occur in the cloud and lapse-rate feedbacks predominantly, but that is too much detail here so the language is kept more general.
108657	78	25	78	26	How is the sign of radiative feedback become 'less negative'? [Jason Donev, Canada]	Revised to state this more simply.
66709	78	28	78	30	For clarity, could we rephrase this? I had to read it a couple of times to square it with the subsequent paragraph. How about "However, there is currently insufficient evidence to quantify a likely range of the magnitude of future changes to current climate feedbacks. {7.4.4, 7.5.2, 7.5.3, Figure 7.18, Figure 7.19, Figure 7.20}" It might be obvious to some that future feedback changes" means the same thing, but making it clear that we are talking about departures from the current patterns in feedbacks might help spell the point out for some. [Dave Frame, New Zealand]	Revised accordingly.
111269	78	29	78	29	Here "likely" should be not italic [Volodymyr Osadchy, Ukraine]	This is a likelihood statement so it should indeed be italicized.
39561	78	32	78	41	The values of climate sensitivity given here are the AVERAGE of many results which contradict each other and are, therefore, presumably all wrong but may be one. The average of wrong results is of poor utility. The average ignores results published in more than 120 peer reviewed papers which conclude to climate sensitivity of only 1°C or less (see list in notrickszone.com/50-papers-low-sensitivity). Please enlarge the uncertainty range to take account of them, as is the duty of IPCC to take account of all peer reviewed literature. [François Gervais, France]	Chapter 7's assessment of ECS, based on multiple lines of evidence in the full peer reviewed literature, finds the very likely range to be 2-5 C. Altogether, the lines of evidence suggest that it is virtually certain that ECS is greater than 1.5 C, with high confidence.
15355	78	32	78	51	It is difficult to interpret the subtly different meanings of "help rule out", "challenging to rule out", and "cannot be excluded". More consistent and clear language in this section would be helpful in this regard. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Revised to be consistent with Chap 7 ES points.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
15351	78	34	78	36	"and all lines help rule out ECS values below 1.5 °C. Emergent constraint evidence, process evidence, and paleoclimate evidence help rule out ECS values above 5 °C,". There is an inconsistency here because at the lower end "rule out" is being applied to a "virtually certain" statement (1.5 degrees), but at the top end "rule out" is being applied to a "very likely" statement (5 degrees). [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Revised to state this more precisely in agreement with Chapter 7 ES point.
16643	78	35	78	36	They can't "rule out" an ECS above 5 as the rest of the sentence says. Maybe better to say "reduce the likelihood" or some such. [William Collins, United Kingdom (of Great Britain and Northern Ireland)]	Revised to be consistent with Chap 7 ES points.
23727	78	40	78	40	The term TCR has been defined on p.77 L.57. [Masahiro Watanabe, Japan]	Revised accordingly.
15353	78	45	78	45	"the assessed ranges" should be "the very likely assessed ranges" [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Revised for consistency with Chap 7 ES point.
39569	78	54	79	7	The uncertainty range admitted by IPCC remains of 3°C since 1979. It has not decreased in 41 years. The uncertainty is actually much larger if, as this expert reviewer strongly recommends, one takes account of the more than 120 peer-reviewed papers listed in notrickszone.com/50-papers-low-sensitivity. [François Gervais, France]	Chapter 7's assessment of ECS, based on multiple lines of evidence in the full peer reviewed literature, finds the very likely range to be 2-5 C. Altogether, the lines of evidence suggest that it is virtually certain that ECS is greater than 1.5 C, with high confidence.
113839	78	54	79	7	Useful figure. [Jan Fuglestedt, Norway]	Thanks.
18801	78	56	78	56	change "range is ECS" to "range in ECS" [Govindasamy Bala, India]	Done.
113841	79	10	19	41	The two paras on emission metrics come a bit abruptly. Could need a sentence as transition or more intro. The first sentence could be modified to by inserting "emissions of" before "of greenhouse gases" to make it clear that this is not focusing on ERFs. [Jan Fuglestedt, Norway]	Taken into account: These sentences have been completely rewritten

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97819	79	10	79	26	The sentence "Some of these give a more faithful simulation of the temperature effects of a portfolio of gases, especially under mitigation scenarios, such as those implied by successful attainment of the temperature goals set out in Article 2 of the Paris Agreement." is inappropriate for the IPCC as it recommends using new metrics on the grounds that they perform better in terms of quantifying global warming. The underlying report however does not provide a new temperature metric but blends LLCF with SLCF in the GWP*, which is a forcing metric. Please remove any recommendations of metrics in the AR6 WG I report. [Nicole Wilke, Germany]	Rejected: "simulation of the temperature effects" is a physical statement and so can be assessed quantitatively.
85881	79	10	79	41	This section on emission metrics could be structured to improve the flow, for instance starting by introducing the issue. Much of the text comes from the underlying chapter, however the text chosen is not necessarily that which was intended to be the focus of that chapter. This is largely the fault of the chapter itself not being clear enough what the highlights are. I suggest two-way interaction with the chapter on refining the chapter text to make their key messages clear and then to ensure these are brought up into the TS [William Collins, United Kingdom (of Great Britain and Northern Ireland)]	Accepted: This section has been restructured

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
66701	79	10	79	41	<p>English Bill Collins and I have drafted a suggested alternative for these two paragraphs - CH7 thinks they need more of a narrative flow and a bit more context. The text I have (Bill may have a later version - but I think his should be the same)is: "Emissions metrics are useful for comparing the relative effects of different climate forcing agents, for example comparing the relative contributions of mitigation towards a climate policy target. There are different varieties of emissions metrics. Pulse emissions metrics compare the effects of an idealised pulse of 1kg of some climate forcing agent against a reference climate forcing agent, almost always CO2. The two most prominent pulse emissions metrics are the global warming potential GWP and global temperature potential GTP. GWPs for each agent are defined as the ratio of the time-integrated radiative forcing over a specified time horizon from the pulse emission relative to that from CO2, whereas global temperature-change potentials (GTPs) compare the ratios of global mean surface temperature at a specified time horizon. GTPs quantify an effect further down the impact chain (temperature), but the main difference in their values comes because GWPs are an integrated measure whereas GTPs quantify the impact at a specific point in the future. The GTPs for SLCFs therefore decrease with time horizon due to the decrease in SLCF concentrations following a single pulse of emissions {Table 7.15}.</p> <p>The methodology of accounting for carbon-cycle responses is placed on a more robust scientific footing compared to AR5 and their, inclusion treats CO2 and non-CO2 species consistently (high confidence). GWP and GTP values have changed since AR5 mainly</p>	Taken into account. The narrative flow has been improved.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
68237	79	10	79	41	Given the short lifetimes of SLCFs, a shorter timescale than 50 or 100 years—specifically using a metric of GWP20—would provide a better understanding of the near-term warming from SLCFs. This is important because many feedbacks and tipping points are anticipated within the next 10 to 20 years, as the 1.5C guardrail is approached and likely breached. Masson-Delmotte V., et al. (eds.) (2018) SUMMARY FOR POLICYMAKERS, in IPCC (2018) GLOBAL WARMING OF 1.5 °C; Lenton T. M., et al. (2019) Climate tipping points—too risky to bet against, NATURE, Comment, 575:592–595; Steffen W., et al. (2018) Trajectories of the Earth System in the Anthropocene, PROC. NAT'L. ACAD. SCI. 115(33):8252–8259, 8254; and Drijfhout S., et al. (2015) Catalogue of abrupt shifts in Intergovernmental Panel on Climate Change climate models, PROC. NAT'L. ACAD. SCI. 112(43):E5777–E5786, E5784. GWP* being used throughout the AR6 Report can be a useful metric, but does not completely negate the need and utility of a metric for a shorter timescale like GWP20. In the IPCC 1.5C Report, GWP* is noted for its ability to describe the impacts from SLCFs, even providing a Figure in Cross-Chapter Box 2 that shows the differences between GWP100, GTP100, and GWP*. This does not help for shorter timescale concerns. In the First Order Draft for WGIII for AR6, GWP* is explained in Chapter 2 as allowing the comparison of a sustained change in emissions for non-CO2 forcers in comparison with CO2, but the chapter also notes that there are limitations to using GWP* for policy applications, including those relevant for the Paris Agreement (see WGIII FOD 2-23–2-24). Further, Chapter 2 does suggest that GWP20 may be useful alongside metrics like GWP100 and GTP100 to compare changes in emissions (WGIII FOD 2-22). In	Noted: No suggestion made.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
66733	79	10	79	41	<p>Given the short lifetimes of SLCFs, a shorter timescale than 50 or 100 years—like using a metric like GWP20—would provide a better understanding of the near-term warming from SLCFs. GWP* being used throughout the AR6 Report can be a useful metric, but does not completely negate the need and utility of a metric for a shorter timescales like GWP20. In the IPCC 1.5C Report, GWP* is noted for its ability to describe the impacts from SLCFs, even providing a Figure in Cross-Chapter Box 2 that shows the differences between GWP100, GTP100, and GWP*. This does not help for shorter timescale concerns. In the First Order Draft for WGIII for AR6, GWP* is explained in Chapter 2 as allowing the comparison of a sustained change in emissions for non-CO2 forcers in comparison with CO2, but the chapter also notes that there are limitations to using GWP* for policy applications, including those relevant for the Paris Agreement (see WGIII FOD 2-23–2-24). Further, Chapter 2 does suggest that GWP20 may be useful alongside metrics like GWP100 and GTP100 to compare changes in emissions (WGIII FOD 2-22). In Chapter 6 of WGIII FOD, the authors note that a chosen climate metric and the time horizon for which it covers affect assessing the timing of achieving climate targets like net-zero emissions (WGIII FOD 6-100). In discussing the balance of CO2 and non-CO2 emissions from aviation, Chapter 10 of WGIII’s FOD suggests that time horizon is a subjective choice of the whomever is using the information, and that if longer time horizons are chosen, CO2 becomes more important (WGIII FOD 10-51: “Any GWP/GTP type emissions equivalency calculation always involves the user selection of a time horizon, over which the calculation is made, which is a subjective choice (Fuglestedt et al., 2010). In general, the longer</p>	Noted: No suggestion made.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
69855	79	10	79	41	Near term differences in mitigation pathways have significant effects on climate extremes (see Chapter 4). Given the short lifetimes of SLCFs, a shorter timescale than 50 or 100 years—specifically using a metric of GWP20—would provide a better understanding of the near-term warming from SLCFs. This is important because many feedbacks and tipping points are anticipated within the next 10 to 20 years, as the 1.5C guardrail is approached and likely breached. Masson-Delmotte V., et al. (eds.) (2018) SUMMARY FOR POLICYMAKERS, in IPCC (2018) GLOBAL WARMING OF 1.5 °C; Lenton T. M., et al. (2019) Climate tipping points—too risky to bet against, NATURE, Comment, 575:592–595; Steffen W., et al. (2018) Trajectories of the Earth System in the Anthropocene, PROC. NAT'L. ACAD. SCI. 115(33):8252–8259, 8254; and Drijfhout S., et al. (2015) Catalogue of abrupt shifts in Intergovernmental Panel on Climate Change climate models, PROC. NAT'L. ACAD. SCI. 112(43):E5777–E5786, E5784. GWP* being used throughout the AR6 Report can be a useful metric, but does not completely negate the need and utility of a metric for a shorter timescales like GWP20. In the IPCC 1.5C Report, GWP* is noted for its ability to describe the impacts from SLCFs, even providing a Figure in Cross-Chapter Box 2 that shows the differences between GWP100, GTP100, and GWP*. This does not help for shorter timescale concerns. In the First Order Draft for WGIII for AR6, GWP* is explained in Chapter 2 as allowing the comparison of a sustained change in emissions for non-CO2 forcings in comparison with CO2, but the chapter also notes that there are limitations to using GWP* for policy applications, including those relevant for the Paris Agreement (see WGIII FOD 2-23–2-24). Further, Chapter 2 does suggest that GWP20 may be	Noted: No suggestion made.
108659	79	14	79	14	This sentence misuses the word 'social license' in a dangerous way. This use of the term implies that political leaders have power that they don't have. Social license is granted by society. The lack of social license to do something about climate change has stymied any real progress for decades. Please talk with someone who actually understands social license or this one sentence could damage the entire report. Better yet, talk to more than one person because this heavily charged and emotional word is more tricky than the authors can probably imagine. [Jason Donev, Canada]	Accepted: The phrase has been removed.
11063	79	23	79	26	GWPs for periods as short as 20-years are used for some policy purposes, and it would be helpful for AR6 to update these. [Robert Kopp, United States of America]	Accepted: GWP20 has been updated in the Chapter 7 text.
113843	79	23	79	26	It is a user choice, but still I wonder if it is meaningful to provide GWPs for 500 years. What do these values tell us when GWP is based on an integral and not the response of the climate system? What is GWP500 for methane telling policymakers? (It gives a value determined by the denominator (CO2) and the integral of RF-CH4 in the very beginning of the 500 yrs period). See discussion in AR5 WGI Ch8. [Jan Fuglestedt, Norway]	Rejected: These issues are best discussed in the chapter text rather than the TS.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
111271	79	26	79	26	There is no Table 7.SM.2 [Volodymyr Osadchy, Ukraine]	Taken into account: References have been updated to reflect the final report structure.
26321	79	28	79	35	Replace this sentence " GWP* is a new metric which compares pulse emissions of long-lived climate 35 forcers (LLCFs) like CO2 and N2O against changes in emissions of SLCFs, such as CH4.' and place it before in this paragraph [María Santolaria-Otín, France]	Not applicable: The section has been completely rewritten
97821	79	28	79	41	The paragraph on the GHG metrics is policy prescriptive since it promotes GWP* as a new metric that is better suitable to quantify the surface warming. This statement (which is indeed repeated three times in this one paragraph) is not scientifically justified since it ignores the time dimension of the warming. GWP* only refers to the short term situation while the long term warming is dominated by LLCF. The choice of the temporal dimension is a political one and hence the recommendation is unjustified. In addition, Ch07 does not assess GWP* in detail and does not justify the emphasis the issue obtains in the TS. Please see also our comments on this issue in Ch07. [Nicole Wilke, Germany]	Rejected: Chapter 7 provides an assessment of GWP* at various timescales and shows it to more accurately reflect the temperature change than GWP20 and GWP100.
16645	79	30	79	31	GTPs don't use the GWP (which is integrated) rather they use the ERF from a pulse (called GFP in chapter 7) . [William Collins, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable: This section has been completely rewritten
113845	79	30	79	31	I would not relate GTP to GWP in this way. They both use ERF, but GWP integrates this over time, while GTP use this together with a response function for temperature to give dT at a chosen point in time. [Jan Fuglestedt, Norway]	Not applicable: This section has been completely rewritten
113847	79	34	79	35	Re GWP*: See explanation in ch7, and check consistency. [Jan Fuglestedt, Norway]	Accepted: The definitions have been made consistent with Ch 7.
18803	79	34	79	37	GWP* is not clearly defined. Also, CGTP is not defined at all. [Govindasamy Bala, India]	Taken into account: References to GWP* and CGTP in the chapter text are now provided.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
93631	79	34	79	41	It seems fair to put the message even clearer, namely that GWP* and CGTP are not just more accurate, but rather that traditional metrics such as GWP(100) have failed to represent the effects of a time-series of (relatively) short lived emissions such as methane. Newly developed metrics are not only more valid for methane, but also enables us to take black carbon and other SLCF into the account (which have hiherto been omitted due to shortcomings in the GWP(100) metrics. [Jon Magnar Haugen, Norway]	Rejected: this discussion is better addressed in the chapter text than the TS.
18805	79	35	79	35	"against changes" to "against sustained changes" ??? [Govindasamy Bala, India]	Not applicable: This section has been completely rewritten
129	79	35	79	35	"CGTP" not defined - just 'GTP'? [Harald Winkler, South Africa]	Not applicable: This section has been completely rewritten
97	79	35	79	41	The first sentence should specify spatial scale (global) and time scale (long term). In the second sentence, the policy question is unclear; to find that new metrics are "more accurate" may be the case for global temperature limits, but not for near-term mitigation targets - the conclusion is too general. The basis of high confidence seems at odds with the novelty of the metrics. Similarly confidence in possibilities ("can lead") seems not fully supported. See comments in detail on pages 115 to 115 in ch 7. [Harald Winkler, South Africa]	Not applicable: This section has been completely rewritten
18809	79	36	79	41	Are GWP and GTP not suitable metric because the lifetime of CO2 and other gases are vastly different? If so, this may be explicitly stated here. [Govindasamy Bala, India]	Not applicable: This section has been completely rewritten
113849	79	37	79	39	I don't see a need to refer to the use in scenarios here. Again, check with CH7 [Jan Fuglestvedt, Norway]	Not applicable: This section has been completely rewritten
23725	79	43	79	43	The term TCRE has been defined at the beginning of TS.3. [Masahiro Watanabe, Japan]	Not applicable: This section has been completely rewritten
66703	79	49	79	49	Might be tempted to rephrase this for simplicity - there is plenty of detail in chapter 5 (and in the literature). "The utility of this metric derives from the long lifetime of CO2. Because CO2 acts as a stock pollutant - i.e. its climate effects are proportional to cumulative emissions - warming is approximately linear in cumulative emissions. This gives rise to the near-constancy of TCRE. {5.5.1} " (Although this description misses key bit about the decline in CO2 concentrations offsetting the equilibrating warming in response to fixed concentrations, so maybe it's too simple...) [Dave Frame, New Zealand]	Not applicable: This section has been completely rewritten

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
15359	79	57	79	57	"additional Earth system feedbacks". Additional to what? The concept of "additional Earth system feedbacks" is not discussed in Chapter 7, as all feedbacks (apart from ice sheet feedbacks) are considered equally in AR6. Probably best to discuss with Piers and Trude. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable: This section has been completely rewritten
18807	80	7	80	7	A recent study indicates that the linearity holds for emissions of up to 5000 PgC. (Tokarska et al. Nature CC 2016) [Govindasamy Bala, India]	Not applicable: This section has been completely rewritten
111987	80	7			cumulative CO2 emissions until roughly 1500 PgC - to be consistent better in GtCO2 unit [Tomas Halenka, Czech Republic]	Not applicable: This section has been completely rewritten
97823	80	15	80	26	We suggest that this summarizing paragraph should be merged with other summarizing paragraphs in the subsections TS.3.X and moved to the beginning of TS.3. [Nicole Wilke, Germany]	Taken into account: This summary has been removed.
18811	80	19	80	24	Are GWP and GTP not suitable metric because the lifetime of CO2 and other gases are vastly different? If so, this may be explicitly stated here. [Govindasamy Bala, India]	Not applicable: This summary has been removed.
66705	80	20	80	20	insert "emissions" in front of metrics. [Dave Frame, New Zealand]	Not applicable: This summary has been removed.
113851	80	20	80	20	I suggest replacing "in emission scenarios" with "in policymaking and assessment of emissions time series" [Jan Fuglestedt, Norway]	Not applicable: This summary has been removed.
113853	80	20	80	20	I suggest insert "emission" before "metrics" [Jan Fuglestedt, Norway]	Not applicable: This summary has been removed.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
66707	80	22	80	22	insert "emissions" in front of metrics. I know it scans repetitively, but it's what we said we'd do. [Dave Frame, New Zealand]	Not applicable: This summary has been removed.
113855	80	24	80	24	I suggest changing "more" to "improved" before "equivalence" [Jan Fuglestedt, Norway]	Not applicable: This summary has been removed.
97825	80	24	80	26	What does "GWP and GTP are larger compared to AR5, due to the methodological change of accounting for carbon-cycle responses" mean? This is only mentioned in this last summary paragraph but not explained in the para on these metrics on P 79 L 28-41. Please explain in this paragraph. [Nicole Wilke, Germany]	Not applicable: This summary has been removed.
6415	80	32	80	33	This needs rewording. At least remove the words "near-surface". This is because near-surface relative humidity has decreased over land, and is projected to continue to do so as the land warms faster than the ocean. Over the past 40 or so years, the average near-surface specific humidity over land has increased at about the same rate as the average value over sea. The near-surface temperature increase over land has been larger than that over sea by some 70% or more, depending on dataset (Table 2.4). See also lines 9 and 10 on page TS-81. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Not Applicable: this section has been deleted and the water cycle is now discussed in Box TS.6. The decrease in near surface relative humidity is identified in BoxTS2.6.
26323	80	32	80	45	°C in different font [María Santolaria-Otín, France]	Not Applicable: this section has been deleted and the water cycle is now discussed in Box TS.6
18813	80	42	80	42	"reduced by fast atmospheric adjustments"? Fast adjustments could cause an increase depending on the forcing agent. Change to "altered by fast atmospheric adjustments" [Govindasamy Bala, India]	Taken into account: this section has been deleted and the water cycle is now discussed in Box TS.6 which now specified "fast atmospheric adjustments"
105949	80	43			The figure is not self-explanatory, but it's not explained in detail. Either this needs to be done or the figure needs to be simplified. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account: this section has been deleted and the water cycle is now discussed in Box TS.6 and the figure is removed with a simplified version used to discuss effective radiative forcing (TS.14)

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
108661	80	47	80	47	The eta-a looks weird. Should that be a subscript? It is elsewhere. [Jason Donev, Canada]	Not Applicable: this section has been deleted and the water cycle is now discussed in Box TS.6
18815	80	48	80	48	The sentence is not true for all forcing agents. It is true for GHGs. Hence, "radiative forcing agents" should be changed to GHGs. [Govindasamy Bala, India]	Not Applicable: this section has been deleted and the water cycle is now discussed in Box TS.6 without referring to stomata
97827	81	16	81	16	Please explain "stomata regulation". [Nicole Wilke, Germany]	Not Applicable: this section has been deleted and the water cycle is now discussed in Box TS.6 without referring to stomata
130383	81	18	81	18	In addition to land use change and irrigation change, changes in levels of subsurface drainage, changes in water demand, and land cover change also have the potential to drive water cycle changes. Were these considered? [Trigg Talley, United States of America]	Taken into account: this section has been deleted and the water cycle is now discussed in Box TS.6 with specific reference to land cover change
105951	81	22	81	28	The reader needs this information earlier on, before the figure is discussed. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Not Applicable: this section has been deleted and the water cycle is now discussed in Box TS.6
108663	81	26	81	27	What are shallow and what are deep clouds? Need to be defined. [Jason Donev, Canada]	Not Applicable: this section has been deleted and the water cycle is now discussed in Box TS.6
6417	81	30	81	30	Comment 45 applies here also, with "near-surface" replaced by "low level". [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Not Applicable: this section has been deleted and the water cycle is now discussed in Box TS.6

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
111273	81	40	81	42	Please, provide more information on "some regions" [Volodymyr Osadchy, Ukraine]	Not Applicable: this section has been deleted and the water cycle is now discussed in Box TS.6
11551	81	45	81	45	"Overall, there is more evidence..." - you mean, compared to AR5? Similar for the next sentence - unclear with respect to when there is improved understanding. [Gerhard Krinner, France]	Not Applicable: this section has been deleted and the water cycle is now discussed in Box TS.6
97829	81	45	82	2	We suggest that this summarizing paragraph should be merged with other summarizing paragraphs in the subsections TS.3.X and moved to the beginning of TS.3. To provide a summary of a section that is only about 1 page long seems not reasonable. [Nicole Wilke, Germany]	Not Applicable: this section has been deleted and the water cycle is now discussed in Box TS.6
113889	82	5	85	12	Please check formulations on net zero emissions with ongoing coordination effort with WGIII on the concepts net zero CO2, net zero GHG (So far you have not used carbon neutrality and GHG neutrality, which I think is fine, but if these are used later check glossary definitions carefully)) [Jan Fuglestedt, Norway]	Taken into account. "Net zero CO2 emissions" used throughout, except in 3.3.3 Relating Different Forcing Agents, where net zero GHG is used, as expected. The concept of neutrality is not used.
54821	82	7	82	13	A message that doesn't appear anywhere in this section on climate stabilization, net zero emissions and carbon budgets is the message that even when carbon emissions are zeroed, global temperature remains at close to peak levels for millennia (irrespective of the small increases/decreases in global temperature in the decades following, from the ZEC). This is an important message to continue to convey and could be included in this introductory paragraph on this topic. (It is not clearly stated either currently in Box TS.4 on irreversibility, tipping points etc.). [Nancy Hamzawi, Canada]	Accepted - The understanding that CO2-induced warming does not disappear with net zero CO2 emissions is added to the introductory paragraph.
113857	82	9	82	9	"Cumulative carbon budget": Check if adjustmet of wording is needed after coordination and clarification efforts. [Jan Fuglestedt, Norway]	Accepted - This has been double-checked for consistency.
113859	82	16	84	13	Consider whether changes in formulations, definitions etc are needed as a consequence of ongoing process for checking consistency across WGs. [Jan Fuglestedt, Norway]	Accepted - This has been double-checked for consistency.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97831	82	18	82	20	The statement "There is high confidence that mitigation requirements for limiting warming to specific levels can be quantified using a carbon budget that relates cumulative CO2 emissions to global mean temperature increase (Figure TS.29)." may be perceived as policy prescriptive. The choice of the suitability of a certain method to obtain policy relevant information should be left to policy makers. In this case, the carbon budget might be interesting for scientific purposes but for policy purposes the high uncertainty - that is about as large as the budgets for ambitious mitigation targets itself - might be problematic. Please consider revising this sentence: "There is high confidence that mitigation requirements for limiting warming to specific levels can be estimated using a carbon budget that relates cumulative CO2 emissions to global mean temperature increase (Figure TS.29)." [Nicole Wilke, Germany]	Accepted
105953	82	18	82	30	This is a really well written paragraph. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - And thanks!
39563	82	20	82	22	At the current average rate of increase of 2 ppm per year, or 15 GtCO2 per year, viz. 0.5 % of the CO2 in the atmosphere, the doubling is not for tomorrow and the connection with the supposed increases of temperature is exaggerated. [François Gervais, France]	Rejected - This statements speaks about cumulative historical CO2 emissions, not the atmospheric CO2 concentrations.
111989	82	20			and 1.25 as well - not sure if necessary both in GtCO2 and PgC [Tomas Halenka, Czech Republic]	Taken into account - The use of specific units was considered. Because the carbon cycle literature uses units of PgC, while the policy literature uses units of GtCO2. The decision has been made to cater to both user communities and thus include values for both units.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97833	82	25	82	28	Please provide the timing for these temperature limits also for a 66 % probability. [Nicole Wilke, Germany]	Accepted - These have been included.
97835	82	25	82	28	What is meant by "linear downward trajectory"? Ch05 does not explain how these years have been obtained, but the same sentence as in the TS can be found in the ES of Ch05. Please amend both the TS and Ch05 and explain which reduction rates are assumed. [Nicole Wilke, Germany]	Accepted - This has been clarified in the Chapter 5 text. Reduction rates are not assumed ex ante. The determining factor is that by the time the linear (straight) trajectory reaches net zero, the emitted cumulative CO2 emissions since 2020 are exactly equal to the assessed remaining carbon budget.
97837	82	28	82	29	The sentence "If a specific remaining carbon budget is exceeded, carbon dioxide removal will be required to return warming to a certain temperature level." is not appropriate for four reasons. 1) There is no sharp limit of exceedance that justifies the word "requires", 2) A high uncertainty is associated with the carbon budget, 3) in the long term, GHG mitigation would also lead to decreasing C-load in the atmosphere, albeit this would take time, 4) CDR is not the only option to limit global warming in the short term. Please revise or remove this sentence. [Nicole Wilke, Germany]	Taken into account - 1) accepted; 2) accepted; 3) rejected, GHG mitigation would not strongly affect the C-load in the atmosphere, only CO2 mitigation would do so. The reduction in C-load (or CO2 concentrations) in the atmosphere result in the resulting global warming being virtually constant on century timescales; 4) This sentence intended to reflect the long term. The sentence has been edited.
18817	82	57	83	4	Table TS. 11: I wonder whether an increment of 0.1 deg C is really necessary. Less is more. Communication could be better with just 3 rows, 1.5, 2 and 2.5 deg C warming above the pre-industrial level. [Govindasamy Bala, India]	Taken into account - In the TS a smaller number of rows was included, while the chapter keeps the full table.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
18819	82	57	83	4	Table TS. 11, Footnote 9: the text at the bottom of the table does not match with "recent emissions uncertainty" [Govindasamy Bala, India]	Accepted - Internal consistency has been double-checked.
41119	82	57	83	4	Unclear what is the assumption for non-CO2 RF for the remaining carbon budget calculations. Could not find an explanation in the text. [TSU WGI, France]	Accepted - This has been clarified in footnotes 5 and 6.
97839	82	57	83	5	Table TS.11: The SR1.5 provided carbon budgets of 1450 GtCO ₂ from 01.01.2018 onwards for an additional warming since 2006-2015 of 1°C. Here the carbon budget for 1°C additional warming since 2010-2019 is 1290 GtCO ₂ , so about 160 Gt smaller. We understood that some difference arises from the timeframe as for the SR1.5 there were 3 years between the reference period 2006-2015 and the time for which this carbon budget is valid. In the AR6, the reference period is 2010-2019 but it is not obvious from what point in time the carbon budget is valid. Please add this information and explain any remaining difference of these numbers between the SR1.5 budgets and the budgets provided in this report. [Nicole Wilke, Germany]	Accepted - The starting point for remaining carbon budgets has been added. A comparison with earlier estimates is available in Chapter 5, Box 5.1
32521	82	57			Table TS.11: The choice of the warming levels (1.3 to 2.5°C since 1850-1900 with a 0.1°C increment) is very surprising. So small increments do not provide a strong added-value. Instead, we recommend to choose warming levels from 1.5°C to 5°C with a 0.5°C increment. It would be much more informative for a large community of readers and more consistent with the projections associated with the different SSPs. [Eric Brun, France]	Rejected - The validity of the TCRE and remaining carbon budget concept has been assessed for a range of temperatures up to about 2.5°C. Providing remaining carbon budgets for warming up to 5°C cannot be based on the assessment available in the underlying report. We here provide remaining carbon budgets up to 2.5°C and therewith fully cover the international climate targets that are being pursued as part of the UN Paris Agreement.
97841	83	3	83	4	Please see our comment on Table SPM.3 on the undue accuracy of the information provided in this table. [Nicole Wilke, Germany]	Taken into account - Because of the uncertainties involved, the table has not been reproduced in the SPM. Here, values are rounded to the nearest

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
11065	83	3	83	4	suggest adding 'from 2020' to 'remaining carbon budget' column header [Robert Kopp, United States of America]	Accepted
16647	83	11	83	12	This is very brief on non-co2 forcing (half a sentence). Non-co2 effects can be significant and are not just an "uncertainty" as they are physically understood. [William Collins, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - This half sentence introduces the non-CO2 contribution. In the subsequent sentences it is highlighted that there is both a probabilistic forcing/response uncertainty and a scenario uncertainty related to non-CO2.
97843	83	20			Has the Zero Emissions Commitment been revised since the SR1.5 that stated in its SPM "Anthropogenic emissions (including greenhouse gases, aerosols and their precursors) up to the present are unlikely to cause further warming of more than 0.5°C over the next two to three decades (high confidence) or on a century time scale (medium confidence)." Please clarify. [Nicole Wilke, Germany]	Accepted - It has been reassessed based on new evidence that has become available since SR1.5. The Zero Emissions Commitment also speaks to the effect of zeroing CO2 emissions only, not of other greenhouse gases or aerosols.
16649	83	23	83	24	Since it is expected to be around zero, rather than saying there is low confidence in the sign, it would be more useful for the reader to be more certain about the upper limit on ZEC magnitude. E.g. "The sign is not known, but the magnitude of ZEC is likely less than 0.18 deg {4.7.2.2.1} with medium confidence.". [William Collins, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - The statement has been adjusted.
105955	83	23	84	3	It seems important that though we do not know the sign or magnitude we do have an upper and lower bound which tells us that it is a comparable small number. So when we reach net zero in a decent timeframe temperatures will be relatively stable. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - The statement has been adjusted.
40479	83	23		24	It would probably be good to restate the time horizon here, just in case this sentence was taken out of context. "There is therefore low confidence in the sign and magnitude of the Zero Emissions Commitment on the time scale of ~50 years." [TSU WGI, France]	Accepted - The statement has been adjusted.
11553	83	24	84	2	I'm not a native speaker, but I think that there are some grammatical errors in this sentence. Shouldn't the sentence be "if the commitment is positive, the remaining budget will be reduced, and vice versa if it is negative"? [Gerhard Krinner, France]	Accepted - The statement was edited.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
15357	84	4	84	4	"The combined effect of all additional Earth system feedbacks". Additional to what? The concept of "additional Earth system feedbacks" is not discussed in Chapter 7, as all feedbacks (apart from ice sheet feedbacks) are considered equally in AR6. Probably best to discuss with Piers and Trude. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - The "additional" feedbacks refer to feedbacks that are typically not already taken into account in estimates of TCRE. This has now been clarified.
68239	84	15	84	30	Avoided warming in near-term crucial for avoiding tipping points/feedbacks. Aggressive mitigation of SLCPs can cut the rate of warming in half, Arctic warming by two-thirds, and avoid up to 0.6C of warming by 2050. UNEP & WMO (2011) Integrated Assessment of Black Carbon and Tropospheric Ozone; Shindell D., et al. (2012) Simultaneously Mitigating Near-Term Climate Change and Improving Human Health and Food Security, Science 335(6065):183–189; Xu and Ramanathan (2017) Well below 2 °C: Mitigation strategies for avoiding dangerous to catastrophic climate changes, Proc. Natl. Acad. Sci. 114(39):10315–10323; Report of the Committee to Prevent Extreme Climate Change (Co-Chairs: Ramanathan V., Molina M. L., and Zaelke D.; Authors: Alex K., Auffhammer M., Bledsoe P., Borgford-Parnell N., Collins W., Croes B., Forman F., Gustafsson Ö., Haines A., Harnish R. Jacobson M. Z., King S., Lawrence M., Leloup D., Lenton T., Morehouse T., Munk W., Picolotti R., Prather K. Raga G. B., Rignot E., Shindell D., Singh A. K., Steiner A., Thiemens M., Titley D. W., Tucker M. E., Tripathi S., Victor D., & Xu Y.) (2017) Well Under 2 Degrees Celsius: Fast Action Policies to Protect People and the Planet from Extreme Climate Change. [Durwood Zaelke, United States of America]	Rejected - It is unclear which changes to the referenced paragraph the reviewer is suggesting.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
68241	84	15	84	30	<p>Warming and cooling SLCFs are emitted alongside CO₂, and as CO₂ is reduced through efficiency and clean energy, there will be warming in the near-term from reduction in sulfates (“global brightening”). Xu Y. & Ramanathan V. (2017) Well below 2 °C: Mitigation strategies for avoiding dangerous to catastrophic climate changes, PROC. NAT’L. ACAD. SCI. 114(39):10315–10323 (“Another complexity of the coemission issue is that a major part of the cooling aerosols (mostly sulfates and nitrates) is also coemitted by CO₂-dedicated measures. Hence, the CO₂ measures implemented in 2020 will unmask some of the aerosol cooling (red lines in SI Appendix, Fig. S5) and offset the warming reduction by CO₂ and SLCP mitigation. In the baseline scenarios of this study, the cooling aerosols are regulated gradually between 2020 and 2100 (SI Appendix, Fig. S6), whereas in the mitigation scenario examined here, CO₂ mitigation is implemented starting from 2020 and CO₂ emission is brought to net zero in about three decades (SI Appendix, Fig. S2B). As a result, the unmasking of coemitted aerosol cooling (a net warming effect) is more rapid in the decreasing CO₂ emissions beginning in 2020 (CN2020) mitigation scenario (SI Appendix, Fig. S5B vs. S7).”); Ramanathan V. & Feng Y. (2008) On avoiding dangerous anthropogenic interference with the climate system: Formidable challenges ahead, PROC. NAT’L. ACAD. SCI. 105(38):14245–14250, 14245 (“The observed increase in the concentration of greenhouse gases (GHGs) since the preindustrial era has most likely committed the world to a warming of 2.4°C (1.4°C to 4.3°C) above the preindustrial surface temperatures. ...The estimated warming of 2.4°C is the equilibrium warming above preindustrial temperatures that the world will observe even if GHG</p>	<p>Rejected - It is unclear which changes to the referenced paragraph the reviewer is suggesting.</p>

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
68243	84	15	84	30	<p>However, targeting SLCPs and reducing them quickly can result in near-term avoided warming, which is critical to slowing feedbacks and avoiding tipping points. There are strategies that specifically target SLCPs that will provide further benefits than what comes from SLCPs that are co-emitted with CO₂. See Shindell D., et al. (2012) Simultaneously Mitigating Near-Term Climate Change and Improving Human Health and Food Security, Science 335:183–189, 183–184 (“Tropospheric ozone and black carbon (BC) contribute to both degraded air quality and global warming. We considered ~400 emission control measures to reduce these pollutants by using current technology and experience. We identified 14 measures targeting methane and BC emissions that reduce projected global mean warming ~0.5°C by 2050. This strategy avoids 0.7 to 4.7 million annual premature deaths from outdoor air pollution and increases annual crop yields by 30 to 135 million metric tons due to ozone reductions in 2030 and beyond. Benefits of methane emissions reductions are valued at \$700 to \$5000 per metric ton, which is well above typical marginal abatement costs (less than \$250). The selected controls target different sources and influence climate on shorter time scales than those of carbon dioxide–reduction measures. Implementing both substantially reduces the risks of crossing the 2°C threshold. ...The short atmospheric lifetime of these species allows a rapid climate response to emissions reductions. In contrast, CO₂ has a very long atmospheric lifetime (hence, growing CO₂ emissions will affect climate for centuries), so that the CO₂ emissions reductions analyzed here hardly affect temperatures before 2040. The combination of CH₄ and BC measures along with substantial CO₂</p>	<p>Rejected - Despite providing a lot of information, it is unclear which changes to the text of the Technical Summary the reviewer would like to see based on the assessment in the underlying chapter.</p>

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
68245	84	15	84	30	<p>Given the short lifetimes of SLCFs, a shorter timescale than 50 or 100 years—specifically using a metric of GWP20—would provide a better understanding of the near-term warming from SLCFs. This is important because many feedbacks and tipping points are anticipated within the next 10 to 20 years, as the 1.5C guardrail is approached and likely breached. Masson-Delmotte V., et al. (eds.) (2018) SUMMARY FOR POLICYMAKERS, in IPCC (2018) GLOBAL WARMING OF 1.5 °C; Lenton T. M., et al. (2019) Climate tipping points—too risky to bet against, NATURE, Comment, 575:592–595; Steffen W., et al. (2018) Trajectories of the Earth System in the Anthropocene, PROC. NAT'L. ACAD. SCI. 115(33):8252–8259, 8254; and Drijfhout S., et al. (2015) Catalogue of abrupt shifts in Intergovernmental Panel on Climate Change climate models, PROC. NAT'L. ACAD. SCI. 112(43):E5777–E5786, E5784. GWP* being used throughout the AR6 Report can be a useful metric, but does not completely negate the need and utility of a metric for a shorter timescale like GWP20. In the IPCC 1.5C Report, GWP* is noted for its ability to describe the impacts from SLCFs, even providing a Figure in Cross-Chapter Box 2 that shows the differences between GWP100, GTP100, and GWP*. This does not help for shorter timescale concerns. In the First Order Draft for WGIII for AR6, GWP* is explained in Chapter 2 as allowing the comparison of a sustained change in emissions for non-CO2 forcers in comparison with CO2, but the chapter also notes that there are limitations to using GWP* for policy applications, including those relevant for the Paris Agreement (see WGIII FOD 2-23–2-24). Further, Chapter 2 does suggest that GWP20 may be useful alongside metrics like GWP100 and GTP100 to compare changes in emissions (WGIII FOD 2-22). In</p>	<p>Rejected - It is unclear which changes the reviewer would like to see. The referenced paragraph does not speak about any of the GHG metrics that are the subject of the reviewer's comment.</p>

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
66735	84	15	84	30	Given the short lifetimes of SLCFs, a shorter timescale than 50 or 100 years—like using a metric like GWP20—would provide a better understanding of the near-term warming from SLCFs. GWP* being used throughout the AR6 Report can be a useful metric, but does not completely negate the need and utility of a metric for a shorter timescales like GWP20. In the IPCC 1.5C Report, GWP* is noted for its ability to describe the impacts from SLCFs, even providing a Figure in Cross-Chapter Box 2 that shows the differences between GWP100, GTP100, and GWP*. This does not help for shorter timescale concerns. In the First Order Draft for WGIII for AR6, GWP* is explained in Chapter 2 as allowing the comparison of a sustained change in emissions for non-CO2 forcers in comparison with CO2, but the chapter also notes that there are limitations to using GWP* for policy applications, including those relevant for the Paris Agreement (see WGIII FOD 2-23–2-24). Further, Chapter 2 does suggest that GWP20 may be useful alongside metrics like GWP100 and GTP100 to compare changes in emissions (WGIII FOD 2-22). In Chapter 6 of WGIII FOD, the authors note that a chosen climate metric and the time horizon for which it covers affect assessing the timing of achieving climate targets like net-zero emissions (WGIII FOD 6-100). In discussing the balance of CO2 and non-CO2 emissions from aviation, Chapter 10 of WGIII's FOD suggests that time horizon is a subjective choice of the whomever is using the information, and that if longer time horizons are chosen, CO2 becomes more important (WGIII FOD 10-51: "Any GWP/GTP type emissions equivalency calculation always involves the user selection of a time horizon, over which the calculation is made, which is a subjective choice (Fuglestedt et al., 2010). In general, the longer	Rejected - It is unclear which changes the reviewer would like to see. The referenced paragraph does not speak about any of the GHG metrics that are the subject of the reviewer's comment.
66737	84	15	84	30	Avoided warming in near-term crucial for avoiding tipping points/feedbacks. See Xu and Ramanathan (2017) Well below 2 °C: Mitigation strategies for avoiding dangerous to catastrophic climate changes, Proc. Natl. Acad. Sci. 114(39):10315–10323; Ramanathan and Xu (2010) The Copenhagen Accord for limiting global warming: Criteria, constraints, and available avenues, Proc. Natl. Acad. Sci. 107(18):8055–8062; Ramanathan and Feng (2008) On avoiding dangerous anthropogenic interference with the climate system: Formidable challenges ahead, Proc. Natl. Acad. Sci. 105(38):14245–14250; Ramanathan, Molina, and Zaelke (2017) Well Under 2 Degrees Celsius: Fast Action Policies to Protect People and the Planet from Extreme Climate Change. [Kristin Campbell, United States of America]	Rejected - Despite providing a lot of information, it is unclear which changes to the text of the Technical Summary the reviewer would like to see based on the assessment in the underlying chapter.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
69857	84	15	84	30	<p>Avoided warming in near-term crucial for avoiding tipping points/feedbacks. Aggressive mitigation of SLCPs can cut the rate of warming in half, Arctic warming by two-thirds, and avoid up to 0.6C of warming by 2050. UNEP & WMO (2011) Integrated Assessment of Black Carbon and Tropospheric Ozone; Shindell D., et al. (2012) Simultaneously Mitigating Near-Term Climate Change and Improving Human Health and Food Security, Science 335(6065):183–189; Xu and Ramanathan (2017) Well below 2 °C: Mitigation strategies for avoiding dangerous to catastrophic climate changes, Proc. Natl. Acad. Sci. 114(39):10315–10323; Report of the Committee to Prevent Extreme Climate Change (Co-Chairs: Ramanathan V., Molina M. L., and Zaelke D.; Authors: Alex K., Auffhammer M., Bledsoe P., Borgford-Parnell N., Collins W., Croes B., Forman F., Gustafsson Ö., Haines A., Harnish R. Jacobson M. Z., King S., Lawrence M., Leloup D., Lenton T., Morehouse T., Munk W., Piccolotti R., Prather K. Raga G. B., Rignot E., Shindell D., Singh A. K., Steiner A., Thiemens M., Titley D. W., Tucker M. E., Tripathi S., Victor D., & Xu Y.) (2017) Well Under 2 Degrees Celsius: Fast Action Policies to Protect People and the Planet from Extreme Climate Change.</p> <p>Given the short lifetimes of SLCPs, a shorter timescale than 50 or 100 years—specifically using a metric of GWP20—would provide a better understanding of the near-term warming from SLCPs. This is important because many feedbacks and tipping points are anticipated within the next 10 to 20 years, as the 1.5C guardrail is approached and likely breached. Masson-Delmotte V., et al. (eds.) (2018) SUMMARY FOR POLICYMAKERS, in IPCC (2018) GLOBAL WARMING OF 1.5 °C; Lenton T. M., et al. (2019) Climate tipping</p>	<p>Rejected - It is unclear which changes the reviewer would like to see. The referenced paragraph does not speak about any of the GHG metrics that are the subject of the reviewer's comment.</p>
34799	84	15	84	30	<p>How can the SOD claim that CO2 is the planetary “control knob” when it can only claim that “more than half” of the temperature increase 1980-2018 is due to anthropogenic influence? How can there be any confidence in the “Global Carbon Budget” estimations under the Paris Agreement? Please see general comments #1, #2, #3 and #13 above. [Jim O'Brien, Ireland]</p>	<p>Rejected - Figure SPM.3 in the SOD shows, based on the evidence presented in the underlying assessment, that roughly 100% of current warming is the result of human activities and about 80% of that warming is attributable to CO2.</p>
113861	84	19	84	19	<p>I suggest changing "AR5 found" to AR5 WGI used emission metrics to illustrate sectoral contributions to warming and found..." or something like that. [Jan Fuglestedt, Norway]</p>	<p>Not applicable: statement was removed during revisions</p>
16651	84	19	84	20	<p>The statement about AR5 doesn't add anything here unless the point is that the importance of different sectors has changed since AR5. If that is the point, it needs to be stated explicitly. [William Collins, United Kingdom (of Great Britain and Northern Ireland)]</p>	<p>Accepted - this statement was removed</p>

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
108665	84	20	84	23	What is meant by 'energy sector'? What's included in that? The 'primary energy extraction' sector? Poorly defining this term is going to create serious blowback from people who disagree on what the energy sector is. As an energy expert I can tell you that many different people define this term differently. You can define it, just define it very precisely. [Jason Donev, Canada]	Not applicable: statement was removed during revisions
29565	84	25	84	27	Do these confidence intervals take into account uncertainty in aerosol forcing? If not, it would be useful to clarify in the text that these are based on central estimates of forcing per unit emissions for SLCFs. [Steven Smith, United States of America]	Noted. This statement takes into account the uncertainty in aerosol forcing
108667	84	46	84	48	I agree with this anonymous author, but the comment should be taken out. :) [Jason Donev, Canada]	Accepted
113863	84	56	85	12	A bit confusing that there is a part on SLCF here and than again in TS3.5. Combine? Coordination needed. [Jan Fuglestedt, Norway]	Taken into account. Section has been restructured. Revised TS3.3.3 covers different ways of relating forcing agents also including SLCFs
29567	84	57	84	57	Similar question. Does the "likely" range also take into account the full range of aerosol forcing uncertainty, or if this just the range in model results (which is probably too small to fully represent the full range of potential aerosol forcing uncertainty). [Steven Smith, United States of America]	Noted. This taken into account the full range of aerosol forcing uncertainty
97845	85	1	85	2	Please revise or remove this sentence since recommending a prioritization of CH4-mitigation is policy prescriptive. It is not up to the IPCC authors to make such choices. [Nicole Wilke, Germany]	Accepted. Text revised

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
130385	85	8	85	10	"The estimated reduction of global warming due to hydrofluorocarbons (HFCs) would be less than 0.07°C by 2050 and between 0.2-0.4°C by 2100, relative to scenarios without HFCs regulation. This results from both HFC substitution and CO2 reduction driven by energy efficiency improvements in refrigeration and air-conditioning equipment." The second sentence is simply not correct; these numbers don't include energy efficiency improvements. See WMO (2018), Chapter 2. Suggested re-write: "Provided that the Kigali Amendment and national regulations are implemented and efficiently enforced, HFC contributions to global warming would be 0.07°C in 2050 and 0.06°C in 2100, versus 0.1°C in 2050 and 0.3-0.5°C in 2100 absent regulation." From WMO (2018): "Improvements in energy efficiency in refrigeration and air-conditioner equipment during the transition to low-GWP alternative refrigerants can potentially double the climate benefits of the HFC phase-down of the Kigali Amendment." [Trigg Talley, United States of America]	Taken into account. Text has been revised to be consistent with findings in Chapter 6
68247	85	8	85	12	The avoided warming as stated here is that from the transition away from HFCs to low-GWP refrigerants. Further, the avoided warming does not consider HFC-23, which is primarily a by-product of producing HCFC-22, and not included in these calculations, although HFC-23 represents 17% of forcing from HFCs in 2016. Future emissions of HFC-23 are expected to be limited now that it is regulated by the Kigali Amendment. See World Meteorological Organization (WMO), United Nations Environment Programme (UNEP), National Oceanic and Atmospheric Administration (NOAA), National Aeronautics and Space Administration (NASA), and European Commission (2018). Scientific Assessment of Ozone Depletion: 2018, Global Ozone Research and Monitoring Project-Report No. 58. Geneva, Switzerland. ES.39 ("The 2016 Kigali Amendment to the Montreal Protocol, assuming global compliance, is expected to reduce future radiative forcing due to HFCs by about 50% in 2050 compared to the forcing from HFCs in the baseline scenario. Currently (in 2016), HFCs account for a forcing of 0.025 W m ⁻² not including 0.005 from HFC-23; forcing from these HFCs was projected to increase up to 0.25 W m ⁻² by 2050 (excluding a contribution from HFC-23) with projected increased use and emissions in the absence of controls. With the adoption of the Kigali Amendment, a phasedown schedule has been agreed for HFC production and consumption in developed and developing countries under the Montreal Protocol. With global adherence to this Amendment in combination with national and regional regulations that were already in place in, e.g., Europe, the USA, and Japan, along with additional recent controls in other countries, future radiative forcing from HFCs is projected to reach 0.13 W m ⁻² by 2050, which is about 50% of the forcing from HFCs in the baseline scenario. This is a significant reduction in radiative forcing, but it is not sufficient to meet the goal of limiting global warming to 1.5°C by 2100. The remaining radiative forcing from HFCs in 2050 is still a significant contributor to global warming, and it is important to continue to reduce HFC emissions as much as possible. The Kigali Amendment is a critical step in this direction, but it is not enough. We need to see stronger national and regional regulations to ensure that the Kigali Amendment is fully implemented and that HFC emissions are kept as low as possible. We also need to continue to improve energy efficiency in refrigeration and air-conditioning equipment to reduce the need for HFCs in the first place. This is a complex challenge, but it is one that we must address if we are to have any chance of meeting the goal of limiting global warming to 1.5°C by 2100. The Kigali Amendment is a critical step in this direction, but it is not enough. We need to see stronger national and regional regulations to ensure that the Kigali Amendment is fully implemented and that HFC emissions are kept as low as possible. We also need to continue to improve energy efficiency in refrigeration and air-conditioning equipment to reduce the need for HFCs in the first place. This is a complex challenge, but it is one that we must address if we are to have any chance of meeting the goal of limiting global warming to 1.5°C by 2100.	Noted. No revisions requested

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
66739	85	8	85	12	The avoided warming as stated here is that from the transition away from HFCs to low-GWP refrigerants. Energy efficiency improvements to cooling equipment, which could take places as part of this transition. Policies to improve efficiency of ACs and other cooling equipment can avoid significant emissions as demand for cooling grows. Shah, N., Wei, M., Letschert, V. and Phadke, A. (2019). Benefits of Energy Efficient and Low-Global Warming Potential Refrigerant Cooling Equipment. U.S.A: Lawrence Berkeley National Laboratory (“For best-available-technology (or “maximum” efficiency), total savings to 2050 are 373.0 and 257.6 GtCO ₂ e for baseline (or static) electricity emission factors and decreasing emission factors, respectively (Fig. 1). Table S1 in the SI shows the GHG emissions for the reference case (no efficiency improvement and baseline HFC refrigerants) vs. the policy case of best-available technology (BAT) energy efficiency and low GWP refrigerants for 2030, 2040, and 2050 with static emission factors for both cases Reference case cumulative GHG emissions are 587.1 Gt CO ₂ e while the policy case is 214.1 Gt for an overall cumulative savings of 373.0 Gt CO ₂ e.”); Dreyfus G., et al. (2020) ASSESSMENT OF CLIMATE AND DEVELOPMENT BENEFITS OF EFFICIENT AND CLIMATE-FRIENDLY COOLING, 1 (“However, robust policies that drive the use of best available technologies can cut cumulative emissions from the stationary air conditioning and refrigeration sectors by 38–60 GtCO ₂ e by 2030, by 130–260 GtCO ₂ e by 2050, and by 210–460 by 2060, depending on future rates of de- carbonization of electricity generation (Table 3.1). (For comparison, the global annual CO ₂ emissions from fossil fuel energy sources in 2018 totalled 33.1 GtCO ₂ .8) A quarter of the mitigation is from phasing down HFC	Noted. Assessment on the effects of HFC reductions are based on findings in Ch6

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
69859	85	8	85	12	Note that the energy efficiency considered here is only associated with the chemical transition. It does not consider emissions reductions associated with improved the efficiency of the equipment. Energy efficiency improvements to cooling equipment historically have been catalyzed by refrigerant transitions under the Montreal Protocol, and in the case of the Kigali Amendment, there are parallel decisions by the Parties promoting energy efficiency, as well as a fast-start fund. Transitioning the best currently available efficiency and refrigerant technologies for stationary air conditioning and refrigeration would cut cumulative emissions by 38–60 GtCO ₂ e by 2030, by 130–260 GtCO ₂ e by 2050, and by 210–460 by 2060, depending on future rates of decarbonization of electricity generation. Shah, N., Wei, M., Letschert, V. and Phadke, A. (2019). Benefits of Energy Efficient and Low-Global Warming Potential Refrigerant Cooling Equipment. U.S.A: Lawrence Berkeley National Laboratory (“For best-available-technology (or “maximum” efficiency), total savings to 2050 are 373.0 and 257.6 GtCO ₂ e for baseline (or static) electricity emission factors and decreasing emission factors, respectively (Fig. 1). Table S1 in the SI shows the GHG emissions for the reference case (no efficiency improvement and baseline HFC refrigerants) vs. the policy case of best-available technology (BAT) energy efficiency and low GWP refrigerants for 2030, 2040, and 2050 with static emission factors for both cases Reference case cumulative GHG emissions are 587.1 Gt CO ₂ e while the policy case is 214.1 Gt for an overall cumulative savings of 373.0 Gt CO ₂ e.”); Dreyfus G., et al. (2020) ASSESSMENT OF CLIMATE AND DEVELOPMENT BENEFITS OF EFFICIENT AND CLIMATE-FRIENDLY COOLING, 1 (“However, robust policies that drive the use of best	Noted. Assessment on the effects of HFC reductions are based on findings in Ch6
80181	85	15	86	36	Even though the CDR methods will be discussed in detail in the WG3 report, it would be also just mentioned the concrete available methods (e.g. blue carbon, carbon farming, DAC). [Lilian Fejes, Hungary]	Rejected. Available Methods are listed in Chapter 5. We refrain from listing them again here because of lack of space.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
104349	85	15	86	36	Technical Summary: throughout the TS.3.4.2 Carbon Dioxide Removal, it is stated several times, in a rather general manner, that 'CDR methods can have unintended biogeochemical and biophysical side-effects and other side-effects related to water, food and biodiversity, but the level of confidence in the direction and magnitude of multiple side effects of CDR methods varies from low confidence to medium confidence'. A more refined and differentiated assessment of the land-based and ocean-based CDR methods and the negative impacts is needed. The statement is too vague, especially if we consider the state of knowledge that we currently have of the negative impact on ocean ecosystems. And also, not all CDR methods are the same (land or ocean but also among all the CDR methods, some will be more damaging than others). And we already know that the negative impacts are there so, would advise on a stronger verb than 'can'. [Philippe Tulkens, Belgium]	Taken into account. The assessment of side effects of CDR is now more specific.
18789	85	17	85	18	The key terms "deliberate" and "large scale" are missing in the definition of CDR here. [Govindasamy Bala, India]	Taken into account. We included the term "deliberate" but avoided the term "large-scale" as not all CDR methods involve large-scale deployment (e.g. agricultural and forest-based methods).
50535	85	17	85	18	"Carbon dioxide removal (CDR) refers to anthropogenic activities that seek to remove CO2 from the atmosphere and durably store it in geological, terrestrial or ocean reservoirs, or in products." Suggest removal of 'or in products'. There is no reference to the products in the rest of the technical summary, and as this will not result in net negative emissions (e.g. if product is used for Enhanced Oil Recovery or in greenhouses) it will not have a significant effect on the physical climate system. It actually says this throughout e.g. ch5 p88 - is this always the definition? Please clarify. [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. Removing CO2 from the atmosphere and storing it in durable products does result in negative emissions. Storage of CO2 in products is part of the IPCC Glossary definition of CDR.
18791	85	39	85	46	A brief discussion of the Climate system response to CDR is missing. One key that is missing is "The climate system response is expected to lag behind the deployment of CDR (high confidence)." [Govindasamy Bala, India]	Taken into account. An assessment of the climate response to CDR has been included.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97847	85	45	85	46	The statement "The effects of terminating CDR are expected to be small for the deployment of CDR that is applied at scales as large as currently deemed possible." might apply to physical and biogeochemical effects but might not be true for socio-economic effect. Therefore, please specify the scope of this finding. [Nicole Wilke, Germany]	Taken into account. We specified that the statement applies to climate and biogeochemical effects.
97849	85	46	85	46	Please quantify these scales that are "currently deemed possible". [Nicole Wilke, Germany]	Rejected. The assumed scale of deployment varies with CDR method, and a detailed list is beyond the scope of the TS.
97851	85	51	85	55	Please consider lifting this important information about the sink-to-source-transition to the SPM. [Nicole Wilke, Germany]	Taken into account. The information was lifted to the SPM.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
10325	85	52	85	53	This statement does not apply if ocean-based CDR techniques that directly remove CO2 from surface waters are used e.g. ocean fertilisation, ocean alkalisation and artificial upwelling. [Chris Vivian, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. The reason the ocean continues to take up CO2 for several centuries is the lagged response to the earlier increase in atmospheric CO2 concentration. This effect is independent of the specific CDR method applied.
108669	86	20	86	21	I disagree with the statement that there's a near linear relationship between maximum global mean temperature increase caused by CO2. Is this meant to be the eventual peak before geophysical and biological processes remove the CO2? Elsewhere in the document its discussed how warming will still happen for a while after we stop emitting CO2. There's the 'committed' warming and so forth. This idea seems pretty central to how TS 3.4 is written, and I think it should be carefully revisited. [Jason Donev, Canada]	Taken into account - The statement was very carefully reconsidered. Section 5.5 details the reasons and processes why global CO2-induced warming is near-linearly related to the cumulative emissions of CO2. Furthermore, Section 4.7 describes how the central estimate of warming after a complete cessation of CO2 emissions is zero.
11067	86	20	86	29	Somewhat repetitive of prior discussion of carbon budget. [Robert Kopp, United States of America]	Taken into account. The summary paragraph has been rewritten.
97853	86	20	86	36	We suggest that this summarizing paragraph should be merged with other summarizing paragraphs in the subsections TS.3.X and moved to the beginning of TS.3. It is not clear whether this summary applies only to TS.3.4.2 or to the entire subsection TS.3.4. [Nicole Wilke, Germany]	Noted. The summary paragraph was moved to the beginning of section 3.5. It was decided to keep summary paragraphs for each subsection of TS.3 rather than merging them into a single summary.
54823	86	31	86	35	We would recommend adding an additional line here to this summary paragraph on CDR about the effectiveness of CDR, from page TS-85 lines 34-35: "Due to asymmetries in the climate-carbon cycle response, CO2 emissions are more effective at raising atmospheric CO2 than CO2 removals are at lowering atmospheric CO2, particularly for large emissions/removals (>100 PgC)". This is an important message as it drives home that avoiding emissions is more effective than trying to remove them from the atmosphere afterwards. [Nancy Hamzawi, Canada]	Taken into account. A line about CDR effectiveness was included in the summary paragraph.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
130601	86	33	86	36	side-effects related to water, food and biodiversity? What are side-effects? [Panmao Zhai, China]	Taken into account. This statement has been clarified.
113867	86	39	87	45	Check consistency with paras om SLC on page 84-85. [Jan Fuglestedt, Norway]	Consistency has been checked
16653	86	47	86	47	I think this intends to say that the "change" in SLCFs will cause a warming, not just the existence of SLCFs. [William Collins, United Kingdom (of Great Britain and Northern Ireland)]	Accepted, change has been done
16655	86	51	86	51	I think this intends to say that the "change" in SLCFs will cause a warming, not just the existence of SLCFs. [William Collins, United Kingdom (of Great Britain and Northern Ireland)]	Accepted, change has been done
54825	86	51	86	51	Consistency is needed in referring to the scenarios SSP3-7.0 and SSP5-8.5, which here are referred to as "low climate mitigation scenarios" whereas these are referred to as "no climate mitigation (or climate policy) scenarios" elsewhere. [Nancy Hamzawi, Canada]	Accepted, changed to "no climate change mitigation scenario"
40663	86	56	86	57	Policy makers may object/misconstrue the term "he middle of the road scenario" [TSU WGI, France]	Accepted, changed.
54827	87	8	87	11	This sentence is not entirely consistent with the same conclusion in Ch. 6 ES (page 6-7 lines 2-4). Here, in the TS, the high confidence statement that rapid decarbonization strategies lead to air quality improvements but are not sufficient on their own to achieve WHO guideleines is specified as being for strategies "beyond those considered in SSP scenarios". This is an important distinction and consistency between the TS and Ch. 6 ES is needed. Given that SSP1-1.9 in particular achieves net zero carbon emissions within a very few decades, and is therefore a very rapid decarbonization path, if even faster reductions in decarbonization still do not achieve WHO guidelines in the near-term, then this should be made clear. Perhaps the definition of 'near-term' is critical here. [Nancy Hamzawi, Canada]	Taken into account. Text has been revised to ensure consistency between TS and Ch6.
108671	87	26	87	26	What are the units for this climate sensitivity? Doubling of CO2? [Jason Donev, Canada]	Clarified

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97855	87	38	87	45	We suggest that this summarizing paragraph should be merged with other summarizing paragraphs in the subsections TS.3.X and moved to the beginning of TS.3. To provide a summary of a section that is only about one page long does not seem reasonable. [Nicole Wilke, Germany]	Considered but homogeneity all along the TS is necessary.
113865	87	40	87	41	Re "The peak near term warming.....likely occur before 2040": What is this based on? Need to make the basis for this clear [Jan Fuglestedt, Norway]	Accepted. Text has been revised based on updates in Chapter 6. References to 6.6 parts in chapter 6 have been added.
40381	87	44	87	44	I think that LLCF have not been introduced in the TS. Maybe refer to other well mixed greenhouse gases here? [TSU WGI, France]	Noted, text has been clarified.
97857	87	44			What is meant by "climate benefits in the longer term"? [Nicole Wilke, Germany]	Noted, text has been clarified.
87057	87	48	88	53	The section could better specify exactly what type of solar radiation modification that has the said effects on water cycles, plant respiration, ocean carbon uptake. [Oyvind Christophersen, Norway]	Taken into account. All SRM options have these effects. SRM options are discussed in the next paragraph.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
87059	87	48	88	54	It seems a little unbalanced to make an issue of "solar radiation modification" in TS 3.6. when the fundamental geophysical factors (i.e. albedo) in question have not been thoroughly described and accounted for in the TS. It could be beneficial if the TS describes that humanity influences climate mainly in two ways, by modifying the earths surface, and by altering the composition and radiative properties of the atmosphere. For a better understanding of albedo, and of the opportunities and shortcomings of solar radiation modification, quantification of the effects should be given in gross amounts, not only in net amounts (see also comment to page 46-48.) [Oyvind Christophersen, Norway]	Taken into account, text is revised.
18737	87	50	87	52	"deliberate" could be deleted as "intentional" is already mentioned in the same sentence. [Govindasamy Bala, India]	Taken into account. "intentional" removed.
5813	87	50	87	53	The glossary and Chapter 4 say that SRM refers to intentional changes in shortwave radiation, yet they include cirrus cloud thinning on SRM. These should all be consistent. I prefer including cirrus cloud thinning, although a creative definition might be needed. [Jesse Reynolds, United States of America]	Taken into account. Text is revised.
97859	87	50	87	55	Please do not use the expression "climate engineering" in L50 just as you do not use "geoengineering", as stated in the glossary. To this end, please remove the sentence "The other category of climate engineering.." in L53-55. [Nicole Wilke, Germany]	Not applicable. Sentence is deleted
87061	87	50	88	52	In the definition of SRM, the phrase "have been proposed" gives the impression that these techniquesd are more mature than they actually are. Please consider to use another phrase e.g. "studied as an alternative approach to offset...". Please coordinate between the WGs when defining SRM, also in the glossaries. [Oyvind Christophersen, Norway]	Taken into account. Text is revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
50539	87	52	87	53	This section defines SRM in line with SR1.5 definition as modifications of shortwave and longwave radiation, however, SR1.5glossary defines SRM as only modification of earth's shortwave radiation budget, and ch4 and ch5 (see separate comments) variously define SRM as including and excluding longwave radiation modifications (such as cirrus cloud thinning). Please clarify this and ensure consistency throughout the report. [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Text is revised.
113869	87	53	87	55	In my view, mentioning CDR here is not needed. Hence, this sentence can be deleted. [Jan Fuglested, Norway]	Taken into account. Text is revised
5815	87	54	87	54	The other category of "geoengineering," although this report generally does not use that term [Jesse Reynolds, United States of America]	Taken into account. Text is revised.
108069	87	55	87	57	The contrast posed in this sentence is false, as it distinguishes between human induced perturbations to the climate system due to SRM as are conceptually separate from perturbations caused by mitigation, land use changes, or CDR, all of which involve substantial changes to the climate system, if not the atmosphere itself. The climate impacts of CDR and other mitigation approaches should be mentioned along with SRM-induced perturbations. [Kelly Wanser, United States of America]	Taken into account. Text is revised.
50537	87	55	87	57	"SRM contrasts with climate mitigation and CDR, as it introduces additional human induced perturbations to the planet, rather than attempting to remove existing ones." While this is true, it is not really the main difference between CDR and SRM. As explained in the underlying report (eg. 4.6.3.3), the main difference is that SRM modifies the earth's radiation budget, whereas CDR directly modifies the CO2 concentration in the atmosphere. I suggest this distinction is made more obvious. [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Text is revised.
5817	88	1	88	1	It is inaccurate to say that "SRM approaches are largely hypothetical at present." This is not stated anywhere else in WH1 SOD. For more than a decade, there have been modeling, indoor tests, and some outdoor tests of SRM. No one questions whether SRM (or at least SAI) would counter global warming and whether humans could get a few Mt aerosol into the stratosphere. It would be more accurate to say that SRM remains at a research stage with substantial uncertainty. [Jesse Reynolds, United States of America]	Taken into account, text is revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
108071	88	1	88	4	<p>SRM approaches are no longer accurately characterized as "largely hypothetical", due to increased interest by governments and institutions in exploring their potential. Since the time of the last assessment report:</p> <p>In 2015, the United States National Academy of Sciences, Engineering And Medicine published an assessment of techniques for directly reducing warming in climate by increasing the reflection of sunlight away from Earth. The study assessed a broad array of proposed solar radiation management techniques. As part of its findings, it recommended research efforts in the United States and identified research in stratospheric aerosol injection and marine cloud brightening as priorities. (National Academies of Science, Engineering and Medicine (2015), Climate Intervention: Reflecting Sunlight to Cool Earth, NASEM, https://www.nap.edu/catalog/18988/climate-intervention-reflecting-sunlight-to-cool-earth)</p> <ul style="list-style-type: none"> • In 2015, the Institute for Advanced Sustainability Studies in Potsdam, Germany launched the Solar Radiation Governance Initiative (SRMGI) and DECIMALS (Developing Country Impacts Modelling Analysis for SRM) Fund to support research in solar climate intervention by scientists in developing countries. In the past few years, SRMGI held meetings in London, Berlin, Kenya and elsewhere for dialogue among representatives from developing countries and small island states including Kenya, Bangladesh, Barbados, Dominican Republic and others ("The Decimals Fund", http://www.srmgi.org/decimals-fund/); • In 2017, the Indian Department of Science and Technology 	Taken into account, text is revised.
54829	88	7	88	12	<p>Since there is a reference to cirrus thinning as a long-wave technique on line 31 below, suggest this option be included in this first paragraph outlining SRM methods. [Nancy Hamzawi, Canada]</p>	Taken into account, text is revised.
44275	88	7	88	12	<p>SRM options also include regional scale approaches, as for example the increase of surface albedo over agricultural and densely populated regions that could reduce temperature at local to regional scales (Seneviratne, S. I., et al., 2018: Land radiative management as contributor to regional-scale climate adaptation and mitigation. Nature Geoscience, 11, 88 - 96). [Nektarios Chrysoulakis, Greece]</p>	Taken into account, text is revised.
1933	88	11			<p>Change "volcanoes" to "volcanic eruptions" Volcanoes do not cause climate change on their own, unless they erupt. [Alan Robock, United States of America]</p>	Taken into account, text is revised.
5819	88	14	88	14	<p>SRM could potentially offset the GHG-induced *climate change*, as it could generally bring changes in precipitation, extreme T and P, and tropical cyclone intensity closer to pre-industrial levels as well. [Jesse Reynolds, United States of America]</p>	Taken into account, text is revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
41991	88	18			TS page 88 line 18. Sophisticated modelling. With the exception of Stjern 2018 the computer modelling of marine cloud brightening has been very basic. It has ignored vessel mobility and the high frequency response provided by a short life of condensation nuclei. It has used the wrong drop size. It has ignored the effects of electrostatic charge. The models have sprayed steadily in places with cloud or no cloud, rain or shine regardless of weather, place and season and the trans-ocean temperature gradients so important now for Kenyan floods and Australian droughts. It is like locking the steering and brakes of a road vehicle, ignoring road markings and preventing drivers improving their driving skills. [Stephen Salter, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. The text refers to the treatment of aerosols effects in climate models when compared to the AR5.
5821	88	29	88	31	SRM would reduce global mean precipitation relative to future CO2 emissions scenarios only when it is used at a magnitude to nearly or entirely offset mean global warming. At a more modest level, it would not reduce global mean precipitation. [Jesse Reynolds, United States of America]	Taken into account, text is revised.
97861	88	29	88	39	Please add the implications of such changes of the global circulation pattern and the water cycle (freshwater availability, floods, droughts,...?) [Nicole Wilke, Germany]	The current text provides assessments based only on available literature. We do not provide assessment where there is no literature

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97863	88	41	88	44	<p>It is only one side of the coin, that SRM deployment is likely to increase global land ocean sinks. However, there is more to the full picture, which we request the authors to take into account here, e.g.</p> <p>1) Ongoing ocean acidification will reduce biological drivers of carbon uptake (c.f. 5.4.4 (5-59:55 - 5-60:4))</p> <p>2) Maybe in the beginning of SRM deployment stopping warming will stabilize global land ocean sinks, but after a certain time (a few years?) and further emissions, the sinks will decrease again due to ocean carbonate chemistry and ocean carbonate buffering capacity (c.f. TS-47:17-19).</p> <p>3) Using SRM without deeply reducing emissions will increase the need for even more mitigation and possibly CDR afterwards to reach certain temperature levels. A hypothetical example: If we keep emitting ~40 GtCO₂ after passing the limits of the carbon budget and use SRM instead to mask warming, we would still need to remove this amount of CO₂ in the long run to reach certain warming levels. Considering the potential CDR scale provided in the SRCL (of 5-10 GtCO₂ per year), this would end up in many more years (in this example at least 4 to 8 years of CDR for one year of SRM). This relation should be also made clearer, as mentioned in the short summary of this subsection (TS-88:48-49) that SRM cannot undo GHG-induced warming.</p> <p>4) Please include an assessment of effects on global, regional and local photosynthesis. [Nicole Wilke, Germany]</p>	<p>Taken into account, text is revised. The current assessment of SRM impact on carbon cycle is based only on the available literature (only a few papers) on this specific topic.</p>
130387	88	41	88	53	<p>Have potential tertiary impacts of SRM been evaluated? Is there the potential for negative impacts outside of the potential positive impacts on reducing global warming? The level to which this has been evaluated should be discussed. [Trigg Talley, United States of America]</p>	<p>Taken into account, text is revised. The negative effects such as termination shock is discussed. Risk and impact assessments are not made in WG1. It should be also noted that the impacts to human natural systems from SRM is assessed in WG2.</p>
113871	88	43	88	43	<p>It would be useful if you could indicate something about how much atmospheric CO₂ conc can be affected by SRM; is this a small effect? [Jan Fuglestedt, Norway]</p>	<p>Taken into account, text is revised</p>

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97865	88	44	88	46	Please revise the low confidence statement. It seems inevitable that rapid termination of SRM will cause rapid increase in global warming as also discussed in the underlying chapters. [Nicole Wilke, Germany]	Taken into account, text is revised
44503	88	44	88	46	It is not clear from the sentence what the confidence statement (i.e. low confidence) refers to. It conflicts with the first part of the sentence, that was assessed with high confidence in lines 25-26 ("There is high confidence, as assessed in AR5, that a sudden and sustained termination of SRM would cause a rapid increase in temperature...") The sentence should be rewritten to avoid inconsistencies or misunderstandings. [Jana Sillmann, Norway]	Taken into account, text is revised
108673	88	48	88	49	This needs to be more specific, this sentence is too vague, even for a summary. [Jason Donev, Canada]	Taken into account, text is revised.
39939	88	48	88	53	Any reason there was no mention of the implications of SRM for ozone layer recovery? Was is not discussed in the relevant chapter? [TSU WGI, France]	Taken into account. Yes, the influence of SRM on ozone recovery issue is discussed in Chapter 4, however because of space limitations, it is not highlighted here.
97867	88	48	88	53	We suggest that this summarizing paragraph should be merged with other summarizing paragraphs in the subsections TS.3.X and moved to the beginning of TS.3. To provide a summary of a section that is only about 1 page long seems not reasonable. [Nicole Wilke, Germany]	In FGD, SRM is in a separate box. Summary paragraph is retained in the salmon box

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
44003	88	48	88	53	TS page 88 line 48 to line 53. This repeats comments made in the main chapters. 'Masking only climate effects' implies leaving bad things hidden behind the mask. Marine cloud brightening really does cancel temperature rise so 'masking' is the wrong word. I will repeat that we should not reject a solution to the acidity problem because it does not save Arctic ice. Many projects went through periods of uncertainty but that this should encourage rather than stifle research. [Stephen Salter, United Kingdom (of Great Britain and Northern Ireland)]	Masking here refers to the fact that when SRM is stopped, climate change reappears. It should be noted that the assessment is based only on available scientific literature on SRM
5823	88	49	88	50	The word "mask" is not used in Chapters 4 and 5 to describe SRM's effects [Jesse Reynolds, United States of America]	In FGD, the word "mask" will be used in CH4 of FGD
11069	88	51	88	53	Is it appropriate to say we have 'high confidence' in large uncertainties, as opposed to 'low confidence' in projections of the things that are highly uncertain? [Robert Kopp, United States of America]	Taken into account, text is revised.
19601	88	56	88	56	No need to repeat here comments made on passages of chapters 10 and 12 which are very close to the content of this part of TS. [philippe waldteufel, France]	Noted
111275	89	2	89	3	"regional messages of change" - should it be climate change? [Volodymyr Osadchy, Ukraine]	Not applicable, text revised
100401	89	4	89	6	This paragraphs should refer to {Atlas.2} section [Lincoln Alves, Brazil]	Not applicable, text revised
84647	89	18	89	27	the flow here in this paragraph is not fluent [Annalisa Cherchi, Italy]	Not applicable, text deleted

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97869	89	20			Why exclude mitigation policies? These are certainly motivated by regional information about climate risks. Therefore, please delete "adaptation and". [Nicole Wilke, Germany]	Not applicable, text deleted
84645	89	21	89	21	fig TS.33 seems a repetition of the introductory figure TS.7 [Annalisa Cherchi, Italy]	Accepted, figure deleted
97871	89	30	94	6	Section TS.4.1 provides information on the challenges involved with individual methods without informing about the methods themselves and their pros and cons. Without this context, the information is not useful and might even be misleading. The distinction between sections 4.1.1 and 4.1.2 including their titles is not entirely clear. There is also room for some streamlining when the text talks about the benefits of innovation without specifying in which way. Section TS.4.3.1 repeats some of the information again. Please improve. [Nicole Wilke, Germany]	Accepted, text significantly revised and confidence on methodologies included.
84649	89	33	89	33	the hierarchy of models do not rely on the resolution [Annalisa Cherchi, Italy]	Not applicable, text deleted

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
84651	89	33	89	34	what does "high resolution and variable resolution" mean? [Annalisa Cherchi, Italy]	Not applicable, text deleted
130389	89	40	89	41	There are some shortcomings associated with using observed records to vet the performance of GCMs and RCMs designed to project future climate. The issues that might be causing GCMs and RCMs to deviate from observed records for a hindcast period might be amplified or less of a factor in terms of the model's ability to project future conditions. This should be acknowledged. [Trigg Talley, United States of America]	Not applicable, text deleted
97873	89	46			Are observations "declining"? [Nicole Wilke, Germany]	Not applicable, text deleted
105129	89	52	89	54	true, but the assessment also needs to be made for climate different from the present one, i.e. paleoclimates! [Masa KAGEYAMA, France]	Not applicable, text deleted
11555	89	56	89	57	"There is very high confidence that GCMs are an important source of future climate information at the regional scale." Is the confidence language required here? Can't this simply be considered a fact? We'd certainly need a confidence statement if the sentence was "GCMs are a trustworthy source of future climate information", but IMHO it's a fact that GCMs are heavily used for climate projections. [Gerhard Krinner, France]	Not applicable, text deleted

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
41195	89	56	90	1	Would suggest a reformulation to be consistent with the uncertainty language from "There is very high confidence that GCMs are an important source of future climate information at the regional scale. There is medium confidence that increasing GCM resolution helps reduce systematic errors, although there is high confidence that higher resolution per se does not solve all performance limitations." -> "GCMs are an important source of future climate information at the regional scale. There is medium evidence that increasing GCM resolution helps reduce systematic errors, although higher resolution per se does not solve all performance limitations." i.e., statement of fact (first sentence), evidence statement to characterize a qualitative situation, followed by another statement of fact. [TSU WGI, France]	Not applicable, text deleted
97875	89	56			Why GCM and not ESM? [Nicole Wilke, Germany]	Not applicable, text deleted
41197	89	57	90	1	Would suggest a reformulation. As the statement reads now it sounds like improving resolution is not a helpful option for GCMs. [TSU WGI, France]	Not applicable, text deleted
41153	90	2	90	2	What are "errors in model formulations"? [TSU WGI, France]	Not applicable, text deleted
97877	90	2			The statement "Reducing errors in the model formulations of GCM" seems to imply that GCMs are full of errors. If this is not intended please revise the sentence. [Nicole Wilke, Germany]	Not applicable, text deleted

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
11557	90	6	90	10	"RCMs are dynamical models similar to GCMs..." It isn't written clearly that RCM are driven at their lateral (and sometimes upper) boundaries by global models, that is, that they downscale this large-scale information from global models. Maybe worth stating that to make the text more consistent? (although surely most readers know this) [Gerhard Krinner, France]	Not applicable, text deleted
97879	90	10			What does "such that climate response uncertainty is spanned as comprehensively as possible" mean? [Nicole Wilke, Germany]	Not applicable, text deleted
97881	90	14			The statement "in spite of errors in model formulation that affect performance." seems to imply that GCMs are full of errors. If this is not intended please revise the sentence. [Nicole Wilke, Germany]	Not applicable, text deleted
40043	90	30	90	33	Could examples be given for "unresolved or misrepresented processes", as well as for models that misrepresent relevant physical processes"? Otherwise, it would need to be explained why it is inferred earlier that models have improved and that we rely on them for projections. [TSU WGI, France]	Accepted, text revised.
11071	90	30	90	36	This discussion of bias adjustment is more categorically negative than the underlying assessment in Cross-Chapter Box 10.2, and accordingly may be damaging -- in a way not justified by the underlying assessment --- to end-users who apply bias adjustment appropriately [Robert Kopp, United States of America]	Accepted, text revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
84653	90	40	90	42	this sentence needs to be rephrased [Annalisa Cherchi, Italy]	Not applicable, text deleted
84655	90	49	90	49	reference to section 8.5.2 missing [Annalisa Cherchi, Italy]	Not applicable, text deleted
97883	90	55	91	1	Please see our comment on the entire report regarding storylines and narrative approaches as well as our comment on Box TS.1. [Nicole Wilke, Germany]	Not applicable, text deleted
11559	91	1	91	6	It might be worth defining what a storyline approach is. This approach is not that well known in our community. [Gerhard Krinner, France]	Not applicable, text deleted
106037	91	8	91	9	This statement should also cite {10.4} and {10.6}, which show examples of these. [William Gutowski, United States of America]	Accepted, text revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
26107	91	12	92	23	The TS.4.1.2 section can be reduced. The basic idea that all parties (scientists, providers, communicators and users) should be involved is somewhat redundant. [Don Alfonso Pino Maeso, Spain]	Accepted, text revised.
84657	91	15	91	15	reference to fig TS.38 is wrong here [Annalisa Cherchi, Italy]	Not applicable, text deleted
108675	91	21	91	21	handshake'? Huh? [Jason Donev, Canada]	Not applicable, text deleted
11561	91	32	91	33	"It is virtually certain that complex climate change information is understood differently by different groups of people": Again, this should be so obvious that you might want to state it as a fact (i.e. without calibrated uncertainty language)? [Gerhard Krinner, France]	Not applicable, text deleted
106039	91	39	91	43	These references, {2.3.3, 2.3.4, Cross-Chapter Box 2.4}, do not seem at all appropriate for this paragraph. Is {1.2.3} meant? Also, this paragraph should cite {10.5}, which discusses these points, especially the last sentence of the paragraph. [William Gutowski, United States of America]	Not applicable, text deleted
11073	91	39	91	43	Does not seem related to cited section of main report. [Robert Kopp, United States of America]	Not applicable, text deleted
84659	92	11	92	17	reference to a section in AR WGI is missing. Also this information were already in the introductory section of the TS [Annalisa Cherchi, Italy]	Not applicable, text deleted

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
106041	92	22	92	23	This text should cite {10.5} and {10.6} (the latter gives examples). {10.5.2.2}, especially, needs to be cited here, as it gives extensive discussion of this point. [William Gutowski, United States of America]	Not applicable, text deleted
84661	92	28	92	30	are we sure of this definition? Climate service is part of the definition of the term "climate service" [Annalisa Cherchi, Italy]	Not applicable, text deleted
57515	92	29	92	30	I'm not sure that climate services are institutions. Climate service providers are institutions. How about "IPCC AR5 WGI introduced climate services as bridging the generation and application of climate knowledge, and described the history and concepts of climate services"? [Chris Hewitt, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable, text deleted
84663	92	32	92	39	this is a repetition of text from sections before [Annalisa Cherchi, Italy]	Not applicable, text deleted
57517	92	46	92	47	I think that describing climate services as involving the generation of information and knowledge is a bit misleading, and open to misinterpretation (this could imply that all climate research is a climate service, which perhaps isn't a helpful way of describing it). How about "In general, climate services involve the provision and contextualization of information and knowledge derived from climate research for decision making at all levels of society" [Chris Hewitt, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable, text deleted
57519	93	1	93	1	it could be misleading to describe climate services as being developed just for timescales from sub-seasonal to multi-decadal. While the text may not mean to imply that services are mostly based on climate predictions and projections of the future, it could be misinterpreted. Many climate services are providing information about past and current climate, and not the future climate at all. How about "timescales (from historical climate information to future climate on sub-seasonal to multi-decadal) and target users (high confidence)"? [Chris Hewitt, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable, text deleted

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
57521	93	8	93	10	Is there a way of writing this in plain English? In particular I'm not clear on what is meant by "mode of knowledge production and transfer by scientists as a fluid understanding is required" [Chris Hewitt, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable, text deleted
84665	93	12	93	16	long sentence better to divide into shorter and clearer ones [Annalisa Cherchi, Italy]	Not applicable, text deleted
40575	93	18	93	23	No uncertainty language used. Statement of fact? [TSU WGI, France]	Not applicable, text deleted
44515	93	19	93	19	comma missing after "accessibility" [Jana Sillmann, Norway]	Not applicable, text deleted
44517	93	26	93	51	if text needs to be cut, this section is a good place. There is a lot of redundant information from previous sections. [Jana Sillmann, Norway]	Accepted, text deleted.
40577	93	53	94	6	No uncertainty language used. Statement of fact? [TSU WGI, France]	Not applicable, text deleted
40521	94	14	94	25	Maybe mention the Atlas URL here? [TSU WGI, France]	Accepted. "Interactive Atlas" contained in line of sight, URL will be added in final copyedit.
40621	95	4	95	4	Perhaps mention section TS3.1 (ERF) here. "ERF from anthropogenic aerosols, which is discussed in TS3.1, ..." [TSU WGI, France]	Not applicable, text deleted
82625	95	54	95	54	Should read "IPCC's Third" [Blair Trewin, Australia]	Not applicable. Sentence has been removed
108677	95	55	95	55	I like the phrase 'unequivocally detected' but it's not in italics and it seems to deviate from a carefully selected set of terms about certainty and confidence. [Jason Donev, Canada]	Not applicable. Sentence has been removed
113873	96	2	96	19	It seems strange that this para is not using any information from ch4. In particular section 4.4.4 Response to Short-Lived Climate Forcers and Volcanic Eruptions [Jan Fuglestedt, Norway]	Noted. The subsection has been totally re-drafted and information from all relevant chapters have been included

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
6419	96	15	96	15	The second "at the regional scale" should be deleted. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Typo has been corrected
80183	96	15	96	15	The phrase "at the regional" is duplicated by accident. [Lilian Fejes, Hungary]	Accepted. Typo has been corrected
44937	96	15	96	15	"At the regional scale at the regional scale extreme temperature": Duplicated phrase. [Masaki Satoh, Japan]	Accepted. Typo has been corrected
111277	96	15	96	15	Twice "at regional scale" [Volodymyr Osadchy, Ukraine]	Accepted. Typo has been corrected
84667	96	15	96	15	"at the regional scale" is repeated twice [Annalisa Cherchi, Italy]	Accepted. Typo has been corrected
44939	96	31	96	35	This paragraph is confusing. The first sentence seems to be contradict with the second sentence. [Masaki Satoh, Japan]	Not applicable. Sentence has been removed
6421	96	34	96	34	A word or more is missing here. Maybe "are" before "not detectable". [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Sentence has been re-drafted

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
40555	96	37	96	47	No mention of paleoclimate information? Was it missing in the underlying chapter(s)? [TSU WGI, France]	Noted. Volcanoes information in TS4.2 has been drastically reduced. However, it has been considered in previous section, including assessment with available paleoclimate information
108679	96	37	96	47	Unclear, could these lines be re-worked. I had trouble understanding what was being said. [Jason Donev, Canada]	Noted. Paragraph has been completely re-drafted
108681	96	38	96	38	This is different than any other phase locking I've ever come across. Is it really phase-locked? How? Why? [Jason Donev, Canada]	Not applicable. Sentence has been removed
84669	96	50	96	50	a paragraph/line about projections of the modes of variability (a general one) is missing [Annalisa Cherchi, Italy]	Noted. Modes of variability are included in the TS4.2 also in terms of projections. Table TS.4 now summarizes all the information (past, attribution and projections)
76821	97	1	97	18	This table should include a column for palaeoclimate evidence. Much stronger findings could (and should) be reached if paleoclimate information is used alongside the observational data and model simulations in assessing how the modes are changing. Relevant recent publications: Freund et al., 2019, Nature Geoscience (10.1038/s41561-019-0353-3); Grothe et al., 2019, GRL (10.1029/2019GL083906); Abram et al., 2020 Nature (10.1038/s41586-020-2084-4); Abram et al., 2020 Quaternary Science Reviews (10.1016/j.quascirev.2020.106302), Daywler et al., 2017, Climate Dynamics (10.1007/s00382-017-4015-0), Datwylar et al., 2019, Int J Climatology (10.1002/joc.5983). [Nerilie Abram, Australia]	Taken into account. Past information, including paleo, has been inserted in the table (Table TS.4 in the FGD)
79189	97	3	97	3	Because this subsection also includes MJO, "interannual" should be "subseasonal". [Yu Kosaka, Japan]	Not applicable. Sentence has been removed
111279	97	12	98	2	For ENSO cold teleconnection is associated with northern Asia. Is it includes Arctic? In terms of AR6 reference regions should be North Asia (included WSB, ESB and RFE) and RAR. For AMV again cold is over "eastern Cantral Asia" while the sub-region is West and Central Asia if not AR5 ref region meant [Volodymyr Osadchy, Ukraine]	Noted. Table TS.12 of the SOD (Table TS.4 in the FGD) has been totally re-drafted including information for AR6 regions specifically

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
82627	97	13	97	18	In Table 12, in the ENSO temperature section, northern Asia/Europe is split between the red (warm) and blu (cold) colour. Also, in observed trend, should read "no SST gradient trend". [Blair Trewin, Australia]	Noted. Table TS.12 of the SOD (Table TS.4 in the FGD) has been totally re-drafted including information for AR6 regions specifically
84713	97	14	97	17	Table TS.12: the row #5 about Atlantic meridional and zonal mode is duplicated [Annalisa Cherchi, Italy]	Noted. Table TS.12 of the SOD (Table TS.4 in the FGD) has been totally re-drafted including information for AR6 regions specifically
104481	97	14	98	1	Table TS.12: Modes of variability. Very limited information for Antarctica. Only mentioned SAM related cooling over East Antarctica. However there are a lot of studies showing relationship to ENSO, SAM, PSA, PDO,... Also, is it possible to include somehow information on the mode interaction which is important for many regions (eg, for Antarctica: ENSO+SAM, or ENSO+PDO/PSA). See, eg: Rahaman, W., Chatterjee, S., Ejaz, T. et al. Increased influence of ENSO on Antarctic temperature since the Industrial Era. Sci Rep 9, 6006 (2019). https://doi.org/10.1038/s41598-019-42499-x [Irina Gorodetskaya, Portugal]	Noted. Table TS.12 of the SOD (Table TS.4 in the FGD) has been totally re-drafted including information for AR6 regions specifically
79191	97	14	98	1	Table TS.12 may be better to be reordered from subseasonal to multidecadal variability (i.e. move MJO at the beginning). [Yu Kosaka, Japan]	Noted. Table TS.12 of the SOD (Table TS.4 in the FGD) has been totally re-drafted including information for AR6 regions specifically
99201	97	14			it might be easier when the table if formatted but at the moment, the colour coding for the response makes it hard to read and it would be easier if the boxes would be subdivided for warm/cold etc [Daniela Schmidt, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Table TS.12 of the SOD (Table TS.4 in the FGD) has been totally re-drafted including information for AR6 regions specifically

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
81655	97	18	97	18	In Table TS.12, the teleconnection of ENSO to eastern Australia precipitation is noted, but not to temperature [Michael Grose, Australia]	Noted. Table TS.12 of the SOD (Table TS.4 in the FGD) has been totally re-drafted including information for AR6 regions specifically
70289	97		97		Fantastic section. However, it seems odd to refer to paleo-climatic inferences of past ENSO changes as observations. I suppose this is reflected in the fact that we only have medium confidence in ENSOs past changes, but it would be much better to be explicit. I suggest adding an additional column that specifically refers to information from paleo-climatic archives. [Shayne McGregor, Australia]	Noted. The section has been drastically re-drafted. All the information and terminology is fully consistent with the treatment within the main chapters of the WG1 AR6 report
40315	98	1	98	1	For the term "no clear consensus", does this reflect a lack of consistent signal amongst simulations? Or does it also include theoretical aspects of understanding? Could the lines of evidence be included in the caption of the table? [TSU WGI, France]	Noted. Table TS.12 of the SOD (Table TS.4 in the FGD) has been totally re-drafted using IPCC confidence language and in agreement with chapters findings
1947	98	5	98	5	Atlantic meridional and zonal modes' seems to be twice in the table [Hugues Goosse, Belgium]	Noted. Table TS.12 of the SOD (Table TS.4 in the FGD) has been totally re-drafted and duplications avoided
44519	98	17	98	17	The acronym ENSO should be spelled out in the header. [Jana Sillmann, Norway]	Noted. Spelling of acronyms adjusted
44941	98	18	98	18	Table TS.12: "Atlantimeridional and zonal modes": This entry is duplicated. [Masaki Satoh, Japan]	Noted. Table TS.12 of the SOD (Table TS.4 in the FGD) has been totally re-drafted including information for AR6 regions specifically
44943	98	18	98	18	Table TS.12: "Madden-Julian Oscillation", Prejected trend: "increases in global warming conditions": It is not clear what aspect of MJO is increasing. Amplitudes or frequency? [Masaki Satoh, Japan]	Noted. Table TS.12 of the SOD (Table TS.4 in the FGD) has been totally re-drafted including information for AR6 regions specifically
112939	98		99		Hard to know what this section on ENSO is trying to accomplish. It also makes some statements that while not in complete disagreement with Ch2 findings on the climate-ENSO link, are not in perfect harmony to a casual reader. I suggest some dedicated work to synergize these, and I'm happy to help! [Kim Cobb, United States of America]	Noted. Text on ENSO and info in Table TS.12 of the SOD (Table TS.4 in the FGD) has been totally re-drafted in agreement with chapters findings

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
70291	99	8	99	12	This is so important, surely this or something like this should feature in Chapter 4. At present, only Nino34 SST changes are presented in CH4 (4.3.3.2). [Shayne McGregor, Australia]	Noted. The sub-section has been re-drafted and drastically reduced. The summary for ENSO replicates the assessment in relevant chapters
112941	99	14	18		The evaluation of model performance is quite lacking. There are many shortcomings that should be listed, that should give us pause about model projections of ENSO amplitude and frequency, apart from the noted consensus around ENSO-related precip anomalies. Here only some strengths are put forward, but in this case the weaknesses are just as important. Here the paleo data-model comparisons. The mismatches of the MH reduction (models say yes, paleo says no or maybe), volcanoes (models say yes, paleo data says maybe), and LGM (models says weaker, paleo-data says maybe). There are limitations in the amount of data we have, but in some cases we can begin to rule out some model-derived responses to external forcing that should give us pause in considering projections of the phenomenon projected over 21st century forcing. Here, we are really left with the paleo-data that helps us assess whether there has already been a detectable change against background variability. This will be the 1st report to present the emergent evidence in this regard, and should be highlighted appropriately. Some key references are presented in CH2 in this regard, whereas this list is missing some key elements as presented in the TS. [Kim Cobb, United States of America]	Noted. Model evaluation (also for the Modes of Variability) is not in this section but it is anticipated in TS1.2 section
108683	99	14	99	15	Is the figure this is talking about figure TS 34? Should state in the text what figure is being referred to. [Jason Donev, Canada]	Not applicable. Fig TS.34 has been removed from the FGD
70301	99	14	99	15	It would be nice to have some simple metric to rely on here, like the sign agreement between the observed and modeled teleconnections. So you state something like, the modeled teleconnections in 90% of all regions agree with the sign of the observed teleconnection, rather than relying on visual comparison. [Shayne McGregor, Australia]	Not applicable. The sentence has been removed.
111283	99	14	99	15	Poorly written sentence with very unclear message "is shown" [Volodymyr Osadchy, Ukraine]	Not applicable. The sentence has been removed.
84671	99	19	99	19	"shown" where? [Annalisa Cherchi, Italy]	Not applicable. The sentence has been removed.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
70299	99	22	99	26	It is unclear where the confidence for the change in ENSO teleconnection come from as CH8, section 8.4.2.9.1 suggests they are small relative to internal variability. [Shayne McGregor, Australia]	Noted. The consistency between ch 4 and ch 8 on ENSO has been solved
70297	99	26	99	26	Update reference to CH8, I believe ENSO teleconnections are covered in CH8, section 8.4.2.9.1 [Shayne McGregor, Australia]	Noted. All references have been included correctly
26325	99	31	99	52	Suggestion : units in the colobar (right side) in Figure TS.34 [María Santolaria-Otín, France]	Not applicable. Figure has been removed from FGD
6423	99	39	99	39	There is a mistake here. The ERA-20C reanalysis was run for the period 1900-2010. It does not provide data for 1881-2014. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. Figure has been removed from FGD
44527	99	55	99	55	The acronym NAM/NAO should be spelled out in the header. [Jana Sillmann, Norway]	Noted. Spelling of acronyms adjusted
108685	100	2	100	10	Unclear, could these lines be re-worked. I had trouble understanding what was being said. [Jason Donev, Canada]	Noted. The paragraph has been substantially re-drafted
26327	100	3	100	7	Chap3-> Chapter 3 [María Santolaria-Otín, France]	Noted. The note has been removed
111285	100	7	100	7	Notes on Chap3 is still there [Volodymyr Osadchy, Ukraine]	Noted. The note has been removed
26329	100	40	100	40	[XX] ? [María Santolaria-Otín, France]	Not applicable. Figure has been removed from FGD
44521	100	52	100	52	The acronym SAM should be spelled out in the header. [Jana Sillmann, Norway]	Noted. Spelling of acronyms adjusted
111287	101	8	101	8	Scenario SSP3-370? [Volodymyr Osadchy, Ukraine]	Accepted. Names of scenarios have been checked and spelled correctly

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
44523	101	12	101	13	Acronyms PDV and AMV should be spelled out at first appearance in this "Decadal modes" section. [Jana Sillmann, Norway]	Noted. Spelling of acronyms adjusted
81593	101	31	101	31	perhaps an opportunity may exist to link the assessments of atmospheric modes of variability with the assessment of the global and regional interannual and decadal variability in ocean CO2 fluxes as well as with terrestrial carbon variability via rainfall [Pedro Monteiro, South Africa]	Noted. The subsection has been drastically reduced. The choice has been to consider a specific case as example to show the complexity of the interplay between different sources at regional scale
111289	101	42	101	44	Is there possible to assign confidence level for the statement? [Volodymyr Osadchy, Ukraine]	Taken into account. The sentence has been re-drafted and confidence level statements have been included
44945	102	1	102	1	Need definition of "Antarctic amplification". [Masaki Satoh, Japan]	Not applicable. The term has been removed
39897	102	6	102	9	? For temperature, ...temperature change due to anthropogenic forcing will be the dominant facture to future multi -decade temperature trends...under high-end scenarios. Perhaps this sentence could be clarified. [TSU WGI, France]	Not applicable. The sentence has been removed.
26331	102	19	102	19	"For precipitation, it is" is bold in purporse? [María Santolaria-Otín, France]	Not applicable. The sentence has been removed.
44525	102	32	102	32	emission scenario [Jana Sillmann, Norway]	Editorial. Typo corrected
44947	102	45	103	11	There is no explanation of the color curves and shadings of Figure TS.36b. [Masaki Satoh, Japan]	Noted. Fig TS.36 of the SOD, Fig TS.21 in the FGD, has been re-drafted and the caption is detailed
26333	103	21	103	21	though or through ? [María Santolaria-Otín, France]	Not applicable. Summary section has been removed. A shorter summary of main findings is at the beginning of section TS4.2 (salmon box)
113875	103	30	103	30	re "under all SSPs": Important to use the full name SSPx-y. [Jan Fuglestedt, Norway]	Not applicable. Summary section has been removed. A shorter summary of main findings is at the beginning of section TS4.2 (salmon box)

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
29569	103	39	103	39	Suggest spelling out on first use SAM, NAM, etc because many readers will be unfamiliar with these terms (and may read these as geographical abbreviations. For example, many in my part of the world at least, are used to reading NAM as North America) and would have to dig back through text or turn to glossary to understand the summary section. [Steven Smith, United States of America]	Noted. Spelling of acronyms adjusted
113877	104	2	104	2	This sentence sounds strange. Please try to improve the formulate what you mean; e.g. in collaboration with ch4 and 7. [Jan Fuglestedt, Norway]	Not applicable. Summary section has been removed. A shorter summary of main findings is at the beginning of section TS4.2 (salmon box)
111291	104	2	104	12	This part is not clear enough, without any confidence levels reported. [Volodymyr Osadchy, Ukraine]	Not applicable. Summary section has been removed. A shorter summary of main findings is at the beginning of section TS4.2 (salmon box)
40989	104	17	106	29	The monsoons box was very helpful. That said there are >100 mentions of monsoons in TS4. Maybe these could be more consolidated? Or at least contained within this box and in TS4.3.13.2. Maybe decide for pages 109-112, info in the text body or table but not both. [TSU WGI, France]	Taken into account. All the information/assessments about monsoons is now consolidated into the dedicated box (Box TS.13 in the FGD)
18779	104	20	104	20	I wonder if changing "regimes" to "reversal" would be better characterization of wind reversals associated with monsoon system. [Govindasamy Bala, India]	Accepted. In FGD "regimes" is changed with "reversals"
106043	104	30	104	31	{10.3.3} and {10.6.3} should also be cited here, just as they are cited at the end of Box TS.6. [William Gutowski, United States of America]	Accepted. References to relevant sections in ch 10 have been included
84673	104	31	104	31	reference to section 8.4.2 (for projections of monsoons) is missing [Annalisa Cherchi, Italy]	Accepted. References to relevant sections in ch 8 have been included
108687	104	44	105	46	What does 'monsoon circulation' mean? It's not a term that seems to be defined anywhere. [Jason Donev, Canada]	Monsoon circulation is embedded into the definition of the monsoon (see Glossary or Annex V)
84675	104	50	104	50	to check exact section to refer in ch8, not ure it is 8.4.1 [Annalisa Cherchi, Italy]	Accepted. References to relevant sections in ch 8 have been included

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
18781	104	55	105	1	It is also likely that "fast adjustment" to an increase in CO2 has suppressed precipitation in monsoon regions so far. [Govindasamy Bala, India]	Not applicable. Text has been re-drafted
18783	105	20	105	22	It is also likely that "fast adjustment" to an increase in CO2 has suppressed precipitation in monsoon regions so far, while the warming (slow response) related increase in precipitation is likely to emerge in the mid and end of 21st century. [Govindasamy Bala, India]	Not applicable. Text has been re-drafted
100403	105	33	105	33	Replace Atlas to Atlas.5 [Lincoln Alves, Brazil]	Not applicable. That paragraph have been removed
11563	105	51	105	52	"An AMOC collapse by 2100 is unlikely..." - could refer to the underlying chapter subsection for this assessment (9.2.3) [Gerhard Krinner, France]	Not applicable. AMOC reference has been removed from the text
100405	106	6	106	6	Replace Atlas to Atlas.5 [Lincoln Alves, Brazil]	Not applicable. That paragraph have been removed
18785	106	12	106	12	"defined by the local summer-minus-winter precipitation rate exceeds" may be changed to "defined where the local summer-minus-winter precipitation rate exceeds" [Govindasamy Bala, India]	Noted. However, the caption has been completely rewritten and the figure partially re-drafted
18787	106	21	106	24	This refers to the precipitation shown in panel b): For what period is this precipitation shown? [Govindasamy Bala, India]	Noted. However, the caption has been completely rewritten and the figure partially re-drafted
108689	106	58	106	59	I think it's unwise to use a different baseline than has been used elsewhere. I know it's tough, but internal consistency will make this document stronger. [Jason Donev, Canada]	Noted This section has been completely revised and this figure has been replaced with a new one.
6425	106	59	107	1	The pre-industrial level is defined here as 1861-1890 not 1850-1900 as used earlier. Also, some different datasets are used. This is presumably because these datasets provide absolute values rather than the anomalies provided by GISTEMP, HadCRUT5 and the like, which are used elsewhere even if the absolute values are not needed for the trends shown in this figure. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Noted This section has been completely revised and this figure has been replaced with a new one.
111293	106	59	107	1	It is not clear why "pre-industrial" baseline is 1861-1890 and not 1850-1990? [Volodymyr Osadchy, Ukraine]	Noted This section has been completely revised and this figure has been replaced with a new one.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
84677	107	15	107	43	this seems to be similar (not exactly complementary) to TS4.1.2. It would be better to keep just one of the two or reduce as much as possible [Annalisa Cherchi, Italy]	Noted. This section has been completely revised and the text is no longer there.
44531	107	17	107	21	strange to start this section with a paragraph on attribution. This text fits well after sentence ending in line 35 (same page). [Jana Sillmann, Norway]	Noted. This section has been completely revised and the text is no longer there.
113879	107	18	107	23	I support the cross WG view on attribution here but some more nuances about how attribution is used in WGIII may be needed. Ch1 says: "...in WGIII attribution methods are used to identify the drivers of changes to emission trends (Chapter 2) and also to attribute mitigation efforts to changes in policy (Chapter 14)." See also page 62, lines 23-55 in WGI Ch1 for consistency. [Jan Fuglestad, Norway]	Noted. This section has been completely revised and the text is no longer there.
80185	107	20	107	21	This sentence is not true and should be rephrased: (If anthropogenic forcing is found to be a major driver of such an observed change, then it can be used to illustrate a narrative of the near future.). Near future cannot be predicted by these methods but keep this part of the sentence for instance: attribution methods can decide if an observed change was caused by an anthropogenic activity. [Lilian Fejes, Hungary]	Noted. This section has been completely revised and the text is no longer there.
44529	107	21	107	23	This sentence describes WG2 material and should not be in the TS of WG1. I commented the same in the respective underlying chapter (cross-chapter box 1.4). [Jana Sillmann, Norway]	Noted. This section has been completely revised and the text is no longer there.
97885	107	23			The statement "can include the results of adaptation or mitigation actions" is confusing. If we understand correctly, WG I does not attribute adaptation or mitigation actions as drivers of change but only anthropogenic forcing? Please clarify. [Nicole Wilke, Germany]	Noted. This section has been completely revised and the text is no longer there.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
106045	107	25	107	28	This sentence should refer to both global and regional models (both have been part of coordinated efforts, both have undergone various improvements). The end of the sentence should then cite {10.3}. [William Gutowski, United States of America]	Noted. This section has been completely revised and the text is no longer there.
90999	107	37	107	39	This is repeating almost verbatim a sentence at p.93, lines 34-36, though the statement there is a little clearer. [Wendy Parker, United Kingdom (of Great Britain and Northern Ireland)]	Noted. This section has been completely revised and the text is no longer there.
106047	107	41	107	43	This paragraph seems out of place here. How does it link with the rest of this subsection? At the least, the wording should change here. Which subset? Should perhaps say, "The subset of CMIP6 results that project more pronounced warming in many regions than CMIP5 have the clearest differences in high latitude regions." [William Gutowski, United States of America]	Noted. This section has been completely revised and the text is no longer there.
111297	107	41	107	43	The statement needs confidence level [Volodymyr Osadchy, Ukraine]	Noted. This section has been completely revised and the text is no longer there.
111301	107	54	107	56	This is a very confusing statement with a very low value. If authors see the specific value of this message, maybe at least change "increasing or decreasing" to just "changing" in order not confuse readers in the direction of changes [Volodymyr Osadchy, Ukraine]	Noted. This section has been completely revised and the text is no longer there.
11565	107	58	108	6	No traceability to underlying chapters at the end of this paragraph [Gerhard Krinner, France]	Noted. This section has been completely revised and the text is no longer there.
106049	107	58	108	6	The source(s) of this information need to be identified at the end of this paragraph, especially since there are confidence statements in it. [William Gutowski, United States of America]	Noted. This section has been completely revised and the text is no longer there.
44539	107		107		introduction to CIDs should contain some text from Annex VII describing what the criteria for selecting CIDs are or at least refer to AVII.3 [Jana Sillmann, Norway]	Noted This section has been completely revised and this figure has been replaced with a new one.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
34801	108	1	108	6	The SOD estimate of about 0.1°C/decade rise in global temperatures is in agreement with satellite observations. The 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 influences (likely partly due to UHI) which clearly are not global climate effects. Please see general comments #2 and #3 above. [Jim O'Brien, Ireland]	Noted. This section has been completely revised and the text is no longer there.
32807	108	4	108	5	Add "IRAN plateau" (0.5-C per decade) According to I. R. of Iran Meteorological Organization reports http://irimo.ir/eng/wd/600-IRIMO.html , Climatology Research Institute reports https://cri.ac.ir/index.php/fa/ , National Drought Warning and Monitoring Center (NDWMC) reports http://ndc.irimo.ir/eng/index.php and a lot of papers .. [sadegh zeyaeyan, Iran]	Noted. This section has been completely revised and the text is no longer there.
33137	108	4	108	5	Add "IRAN plateau" (0.5-C per decade) According to I. R. of Iran Meteorological Organization reports http://irimo.ir/eng/wd/600-IRIMO.html , Climatology Research Institute reports https://cri.ac.ir/index.php/fa/ , National Drought Warning and Monitoring Center (NDWMC) reports http://ndc.irimo.ir/eng/index.php and a lot of papers .. [Sahar Tajbakhsh Mosalman, Iran]	Noted. This section has been completely revised and the text is no longer there.
23257	108	4	108	5	after " the Arabian Peninsula" add" IRAN(0.3-0.5°C per decade) according to http://ndc.irimo.ir/ [Hamideh Dalaei, Iran]	Noted. This section has been completely revised and the text is no longer there.
44533	108	8	108	10	This sentence is difficult to read, consider rephrasing. [Jana Sillmann, Norway]	Noted. This section has been completely revised and the text is no longer there.
108691	108	22	108	24	Calling this out with an actual equation saying that $LST > SST$ as an equation broken out from the text will make this point easier to see. It's an important idea that the temperature over land is increasing more than the temperature over the ocean, even though more heat is going into the ocean. [Jason Donev, Canada]	Noted. This section has been completely revised and the text is no longer there.
100407	108	22	108	27	This paragraphs should refer to {Atlas.5} section [Lincoln Alves, Brazil]	Noted. This section has been completely revised and the text is no longer there.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
82631	108	49	108	49	Assuming this is drawing on the Atlas, should add "over the 1980-2014 period" (any changes made to that in the Atlas would then have flow-on implications here). [Blair Trewin, Australia]	Noted. This section has been completely revised and the text is no longer there.
80187	108	49	108	54	Even though there are more regions where there are significant trends in the observed annual precipitation, it depends on what the trend is assessed on (it is not mentioned here). Also, the seasonal trends are more interesting in most regions, and only for one region it is claimed that humans caused the trend. Is not it true for all regions? [Lilian Fejes, Hungary]	Noted. This section has been completely revised and the text is no longer there.
111595	108	49	108	56	Statement about significant positive trend in historical precipitation in Central Asia should be either deleted or specified that it is in its mountainous part. Taking into account measurement uncertainty in mountains (that particularly emphasized in Atlas ES for this region), better delete. At the same time looking at the map produced by IA on datasets positive trend is obvious in part of Africa and northern parts of South America. At the same time, from the IA negative trends are obvious for parts of both Americas, South, West and Central Asia as like as northern part of Arabian Peninsula. And it should be referred to Atlas at the end of the paragraph [Volodymyr Osadchy, Ukraine]	Noted. This section has been completely revised and the text is no longer there.
106051	109	8	109	16	The source(s) of this information need to be identified at the end of this paragraph, especially since there are confidence statements in it. [William Gutowski, United States of America]	Noted. This section has been completely revised and the text is no longer there.
111597	109	10	109	13	No scenario specified for both statements, could be just mentioned that for all. It is not obvious that mean precipitation will increase for South America, while TIB should be included. For mean precipitation decrease from IA it is not obvious for Indonesia, northern Arabian Peninsula should be excluded, southern Europe better specify as Mediterranean, and South-West Africa should be there. Reference to IA is better to include [Volodymyr Osadchy, Ukraine]	Noted. This section has been completely revised and the text is no longer there.
104351	109	12	109	12	Technical summary: replace 'were' with 'where' [Philippe Tulkens, Belgium]	Noted. This section has been completely revised and the text is no longer there.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
84679	109	18	109	24	these sentences are repeated so many times within the TS! [Annalisa Cherchi, Italy]	Noted. This section has been completely revised and the text is no longer there.
80189	109	31	109	33	Next to the mentioned areas, Central-Eastern Europe could be added too, where the expansion of arid areas during summer causes present and will future problems. [Lilian Fejes, Hungary]	Noted. This section has been completely revised and the text is no longer there.
84681	109	35	109	42	not needed this text here, it is a repetition of what is in the monsoons box [Annalisa Cherchi, Italy]	Noted. This section has been completely revised and the text is no longer there.
108693	109	39	109	40	Unclear, could these lines be re-worked. I had trouble understanding what was being said. [Jason Donev, Canada]	Noted. This section has been completely revised and the text is no longer there.
44535	109	44	109	44	emission scenario [Jana Sillmann, Norway]	Noted. This section has been completely revised and the text is no longer there.
84683	109	44	109	55	this is also in section of water cycle, there is likely no need to repeat [Annalisa Cherchi, Italy]	Noted. This section has been completely revised and the text is no longer there.
84685	109	51	110	4	this is also in section of water cycle, there is likely no need to repeat [Annalisa Cherchi, Italy]	Noted. This section has been completely revised and the text is no longer there.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
111317	110	6	110	11	It is not clear assessment without confidence levels in model performance [Volodymyr Osadchy, Ukraine]	Noted. This section has been completely revised and the text is no longer there.
111599	110	6	110	11	This paragraph is repeated fully. The first is on page 11 of TS. [Volodymyr Osadchy, Ukraine]	Noted. This section has been completely revised and the text is no longer there.
44537	110	6	110	11	there is no confidence statement in this paragraph [Jana Sillmann, Norway]	Noted. This section has been completely revised and the text is no longer there.
84687	110	38	110	38	acronym to expand the first time is used [Annalisa Cherchi, Italy]	Noted. This section has been completely revised and the text is no longer there.
40425	110	50	110	55	In other assessment processes, such as IPBES, drivers are all the factors that, directly or indirectly, cause changes. Here "drivers" seem to be used to describe things such as temperate and precipitation that *results* from changes in the climate. I am concerned that this may lead to confusion particularly among policy makers and the general public. [TSU WGI, France]	Noted. This section has been completely revised and the text is no longer there.
111319	110	56	110	57	"Specific zones" are considered in TS as typological domains [Volodymyr Osadchy, Ukraine]	Noted. This section has been completely revised and the text is no longer there.
111601	110	56	110	57	"Specific zones" should be "typological domains" (see Table of content in TS) [Volodymyr Osadchy, Ukraine]	Noted. This section has been completely revised and the text is no longer there.
108695	111	31	111	31	The phrase 'mean purpose' isn't really clear. I can't figure out what it means in this context. [Jason Donev, Canada]	Noted. This section has been completely revised and the text is no longer there.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
80191	113	9	113	19	See Figure on Page 232: 1) a, c and d do not correspond to the correct figure, also the lower row do not have letters. 2) d) and e) figures do not have the unit next to the scale, and f) figure do not have a scale and unit at all. 3) The figure as a whole is not unified: it is valid for several periods, using different names (change in 1/100jr and extreme) and scenario names as well, sources are not always shown in the description and units neither. [Lilian Fejes, Hungary]	Noted. This section has been completely revised and the text is no longer there.
108697	113	14	113	14	I think it's yr not jr [Jason Donev, Canada]	Noted. This section has been completely revised and the text is no longer there.
82639	113	20	134	35	Since these sections draw both from the Atlas which uses a standard 1980-2014 trend period, and other chapters which use other (often longer) periods, the text needs to make clear throughout what periods reported trends/deltas refer to. Any changes that occur in the assessments in the Atlas will also need to be carried back to this section. [Blair Trewin, Australia]	Noted. This section has been completely revised and the text is no longer there.
108955	113	22	114	44	Islands not included. Issues such as cyclones have and will continue to be a major risk for islands in the Indian Ocean - it is important to highlight this. [Siyasanga Sauka, South Africa]	Noted. This section has been completely revised and the text is no longer there.
108699	113	24	113	37	I'm not sure if there's supposed to be a difference between 'mean' and 'average'. Using two different technical terms for the same thing may read better, but it's confusing to the reader. If there is a difference (and I don't know what it would be here), then the difference should be spelled out clearly. [Jason Donev, Canada]	Noted. This section has been completely revised and the text is no longer there.
108701	113	39	113	40	Is this supposed to say 'of' rather than 'in the twentieth centry'? A bit unclear. [Jason Donev, Canada]	Noted. This section has been completely revised and the text is no longer there.
108703	113	39	113	43	Unclear, could these lines be re-worked. I had trouble understanding what was being said. [Jason Donev, Canada]	Noted. This section has been completely revised and the text is no longer there.
82633	113	40	113	41	Is this a fall to 60% of the century mean (in which case, delete "a deficit of"), or 60% below the century mean? [Blair Trewin, Australia]	Noted. This section has been completely revised and the text is no longer there.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
108705	113	45	113	46	This is a strong statement and is buried where it is. Can this be led with? [Jason Donev, Canada]	Noted. This section has been completely revised and the text is no longer there.
106053	113	45	113	54	This paragraph should also include information from the example case on the Cape Town drought {10.6.2}. [William Gutowski, United States of America]	Noted. This section has been completely revised and the text is no longer there.
41163	113	56	11	57	What is "drastically"? Also it would seem that such events would also increase under other RCP/SSPs. No mention of this? [TSU WGI, France]	Noted. This section has been completely revised and the text is no longer there.
108957	114	11	114	14	A basin level summary will be useful, not a regional. For instance, in Southern Africa, the Limpopo and Zambezi Basins are likely to experience seasonal flooding, while the Orange River Basin will experience droughts during the dry season. In Eastern Africa, Basins in Tanzania and Kenya will continue to flood during the rainy season. Such granularity will be usefull for decision makers. [Siyasanga Sauka, South Africa]	Noted. This section has been completely revised and the text is no longer there.
39931	114	34	122	4	Again why the emphasis on RCP8.5, in African, Asia, Central America...? Wouldn't policy makers be better served by more projections? [TSU WGI, France]	Noted. This section has been completely revised and the text is no longer there.
108959	114	37	114	44	Add a line or two highlighting which regions are at risk to SLR. Coastal cities and islands along the indian ocean should be highlighted. [Siyasanga Sauka, South Africa]	Noted. This section has been completely revised and the text is no longer there.
88435	114	48			Table TS.13 - Unclear where observational evidence in past trends in permafrost conditions comes from (Ch 2 and 9 do not discuss this). Isn't permafrost largely associated with high elevation areas - perhaps a note is required. [Sharon Smith, Canada]	Noted. The table has been updated now and the consistency is checked across chapters.
15465	115	8	115	26	The assessment/discussion on the observed and projected changes of tropical cyclone activity in Asia (western North Pacific) is completely missing. Relevant assessment from Chapters 11 and 12 should be incorporated as appropriate. [SAI MING LEE, China]	Noted. This section has been completely revised and the text is no longer there.
111321	115	14	115	16	It is not clear written [Volodymyr Osadchy, Ukraine]	Noted. This section has been completely revised and the text is no longer there.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
108707	115	21	115	22	Other sections talk about exceeding global average, this section is talking about exceeding global 'land' average. There should be consistency in how this is phrased and framed. [Jason Donev, Canada]	Noted. This section has been completely revised and the text is no longer there.
111603	116	4	116	4	Precipitation decrease in Indonesia is not obvious from IA but in West and Central Asia is not mentioned [Volodymyr Osadchy, Ukraine]	Noted. This section has been completely revised and the text is no longer there.
71141	116	13			Melting permafrost does not exist. It can thaw or degrade, but permafrost is not a material (see glossary) that can melt like ice or steal. [Lukas Arenson, Canada]	Noted. This section has been completely revised and the text is no longer there.
44541	116	25	116	26	How does this sentence relate to the sentence ending on line 1 (same page) that there is no "effect of climate change on Air pollution in Asia"? Isn't surface ozone also considered as air pollution? These two sentences should be checked and if possible appear together (not separated by other paragraphs). [Jana Sillmann, Norway]	Noted. This section has been completely revised and the text is no longer there.
108709	116	32	116	33	The negative signs in the numbers are visually confusing, can they be presented differently somehow? [Jason Donev, Canada]	Noted. This section has been completely revised and the text is no longer there.
130603	116	48	116	48	Xinjian should be Xinjiang [Panmao Zhai, China]	Noted. This section has been completely revised and the text is no longer there.
82635	118	37	118	37	The corresponding section of the Atlas presents evidence that ENSO affects temperature in the region on interannual timescales, but does not present evidence of its having affected observed long-term warming rates, as implied by the wording here. [Blair Trewin, Australia]	Noted. This section has been completely revised and the text is no longer there.
41797	118	57	118	57	In chapter 11 low confidence is stated. [Sergio Vicente-Serrano, Spain]	Noted. This section has been completely revised and the text is no longer there.
111605	119		120		In the Table TS14 for Arabian Peninsula mean precipitation is projected to increase mainly with very small part in north-west to decrease. Should corrected [Volodymyr Osadchy, Ukraine]	Noted. This section has been completely revised and the text is no longer there.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
41799	120	27	120	28	Low confidence is supported in Ch. 11 [Sergio Vicente-Serrano, Spain]	Noted. This section has been completely revised and the text is no longer there.
81657	121	4	121	6	The projected warming values given here are not specified what they refer to - Australasia as a whole, or regions within Asutralasia, and whether this is land-masked or not. Also, these values already seem out of date comapred to the interactive Atlas, and will need to be updated and made consistent with the Atlas once the final model list is set [Michael Grose, Australia]	Noted. This section has been completely revised and the text is no longer there.
108711	121	6	121	6	Is the SSP585 a typo? [Jason Donev, Canada]	Noted. This section has been completely revised and the text is no longer there.
108713	121	12	121	12	two periods [Jason Donev, Canada]	Noted. This section has been completely revised and the text is no longer there.
82637	121	12	121	12	"By contrast" should be deleted as these results are not inconsistent with the preceding sentence. [Blair Trewin, Australia]	Noted. This section has been completely revised and the text is no longer there.
81659	121	18	121	19	the comment about hydrological droughts refers to "South Australia", which is a state within Asutralia covering only the southern central part of the continent, this should refer to 'southern Australia' [Michael Grose, Australia]	Noted. This section has been completely revised and the text is no longer there.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
81661	121	33	121	33	I don't think the comment "Sea level rise is very likely to continue at a higher than the global average in Australasia..." is true over all of the Australasian coastline - there are areas of lower sea level rise. This needs checking, and if this refers to the average of all the coastlines, then it could be phrased this way, or else if it refers to 'much of the coastline' this may also fit [Michael Grose, Australia]	Noted. This section has been completely revised and the text is no longer there.
108715	122	1	122	1	The grey for 'not broadly relevant' and the colour for 'medium confidence of increase' are a little close, this colour choice was done throughout. Could those colours be shifted so they aren't quite so close together? [Jason Donev, Canada]	Noted. This section has been completely revised and the text is no longer there.
81663	122	1	122	1	As for Box SPM.3, Table 1, in the Table TS.15 for the line on Southern Australia (SAU), the box on frost needs to be coloured white or at least light brown. There is evidence for an increasing trend in frosts in some regions in southern Australia in some seasons (notably spring), .: https://link.springer.com/article/10.1007/s10584-016-1763-5 . This trend may or may not be due in part to a forced change in the circulation driver, that is perhaps detectable in individual frost events, e.g. http://www.ametsoc.net/eee/2016/ch29.pdf [Michael Grose, Australia]	Noted. The table has been updated now and the consistency is checked across chapters.
100359	122	15	122	15	According to Figure Atlas.5 North America Monsoon region is located in North America. But at Interactive Atlas it is over Central America and Mexico [Claudine Dereczynski, Brazil]	Noted. This section has been completely revised and the text is no longer there.
108717	122	22	122	22	two periods [Jason Donev, Canada]	Noted. This section has been completely revised and the text is no longer there.
44545	123	14	123	14	The title should be Central and South America since both regions are discussed (incl. Table) in this section. [Jana Sillmann, Norway]	Noted. This section has been completely revised and the text is no longer there.
44543	123	14	124	29	it seems that the text for this region (South America) follows a different logic than for the other regions. [Jana Sillmann, Norway]	Noted. This section has been completely revised and the text is no longer there.
100361	123	17	123	17	Change "Central and Northern South America" to SAM and NSA [Claudine Dereczynski, Brazil]	Noted. This section has been completely revised and the text is no longer there.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
41801	123	27	123	28	Medium confidence is stated in Ch. 11 [Sergio Vicente-Serrano, Spain]	Noted. This section has been completely revised and the text is no longer there.
108719	123	33	124	33	{{???} [Jason Donev, Canada]	Noted. This section has been completely revised and the text is no longer there.
100363	123	56	123	56	Change "Northeast Brazil" to "NES" [Claudine Dereczynski, Brazil]	Noted. This section has been completely revised and the text is no longer there.
100409	124	1	124	2	Reference needed for support this statement [Lincoln Alves, Brazil]	Noted. This section has been completely revised and the text is no longer there.
41803	124	1	124	2	Where is the support of this assessment. This is not included in Ch. 11. maybe Ch 12? [Sergio Vicente-Serrano, Spain]	Noted. This section has been completely revised and the text is no longer there.
100411	124	3	124	3	Replace "Southern Cone" for S.E. South Amercia [Lincoln Alves, Brazil]	Noted. This section has been completely revised and the text is no longer there.
93883	124	12	124	12	please use glaciers (a more general term) instead of ice caps. [Lucas Ruiz, Argentina]	Noted. This section has been completely revised and the text is no longer there.
111303	125	1	125	11	Ther is no Western Europe among European sub-regions [Volodymyr Osadchy, Ukraine]	Noted. This section has been completely revised and the text is no longer there.
108721	125	10	125	10	Is this averaged over land, over over the globe? Unclear, please contrast with with pg 115 lines 21-22. [Jason Donev, Canada]	Noted. This section has been completely revised and the text is no longer there.
80193	125	10	125	11	IPCC divided Europe into 3 sub-regions as a reference, which are Southern, Northern and Central Europe. Why are Eastern and Western Europe mentioned here instead? Also, the period is missing where the Celsius per decade trend is assessed. [Lilian Fejes, Hungary]	Noted. This section has been completely revised and the text is no longer there.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
41805	125	13	125	13	In Ch. 11 it is stated low to medium confidence (P65 L. 39) and decrease in the Mediterranean (P 55, L38) [Sergio Vicente-Serrano, Spain]	Noted. This section has been completely revised and the text is no longer there.
111305	125	16	125	20	Why heat stress reported only by the middle of the century and without confidence level? [Volodymyr Osadchy, Ukraine]	Noted. This section has been completely revised and the text is no longer there.
41807	125	23	125	23	Again, the assessment for extreme precipitation is different that of Ch. 11 [Sergio Vicente-Serrano, Spain]	Noted. This section has been completely revised and the text is no longer there.
100365	125		125		Table TS.16: Extreme Heat for Southern Central America - There is no attribution evidence, so the asterisk has to be erased [Claudine Dereczynski, Brazil]	Noted. The table has been updated now and the consistency is checked across chapters.
100367	125		125		Table TS.16: Cold spell for Northwestern South America - There is no attribution evidence, so the asterisk has to be erased [Claudine Dereczynski, Brazil]	Noted. The table has been updated now and the consistency is checked across chapters.
100369	125		125		Table TS.16: Drought for Southern Central America - Low confidence on projections, so use white color [Claudine Dereczynski, Brazil]	Noted. The table has been updated now and the consistency is checked across chapters.
100371	125		125		Table TS.16: Drought for Northern South America - medium confidence on projections, so use light purple [Claudine Dereczynski, Brazil]	Noted. The table has been updated now and the consistency is checked across chapters.
100373	125		125		Table TS.16: Drought for South America Monsoon - medium confidence on projections, so use light purple [Claudine Dereczynski, Brazil]	Noted. The table has been updated now and the consistency is checked across chapters.
100375	125		125		Table TS.16: Drought for Northeastern South America - medium confidence on projections, so use light purple [Claudine Dereczynski, Brazil]	Noted. The table has been updated now and the consistency is checked across chapters.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
100377	125		125		Table TS.16: Drought for Southeastern South America - medium confidence on projections (decrease of CDD), so use light brown [Claudine Dereczynski, Brazil]	Noted. The table has been updated now and the consistency is checked across chapters.
100379	125		125		Table TS.16: Drought for Southern South America - low confidence on projections, so use white color [Claudine Dereczynski, Brazil]	Noted. The table has been updated now and the consistency is checked across chapters.
7361	126	3	126	3	Seasonal mean' probably means 'summer mean' [Hans-Martin Füssel, Denmark]	Noted. This section has been completely revised and the text is no longer there.
99203	126	4	126	5	The sentence does not have a clear message, it basically states that some things will be changed over some scenarios [Daniela Schmidt, United Kingdom (of Great Britain and Northern Ireland)]	Noted. This section has been completely revised and the text is no longer there.
99207	126	7	126	8	the assessment what a critical threshold for health, agriculture and other sectors is, is not part of the remit of WG1, refer to WGII and avoid a judgment as adaptation options are not considered in this assessment here, [126 L18ff is a good example how to show the link without assessment [Daniela Schmidt, United Kingdom (of Great Britain and Northern Ireland)]	Noted. This section has been completely revised and the text is no longer there.
99205	126	7			by how much? [Daniela Schmidt, United Kingdom (of Great Britain and Northern Ireland)]	Noted. This section has been completely revised and the text is no longer there.
52807	126	9	126	10	I don't see evidence in Ch 11 that cold spells would "virtually disappear". On top of that, the statement makes sense only together with a definition of cold spells based on absolute temperature levels (compared to the mean, there will always be cold and warm spells in midlatitudes). However, no such definition is provided (TS, Ch 11, Glossary). [Petra Seibert, Austria]	Noted. This section has been completely revised and the text is no longer there.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
83629	126	9	126	10	The reference for temperature extremes should be 11.3.5 instead of 11.5.5 [Petra Seibert, Austria]	Noted. This section has been completely revised and the text is no longer there.
108723	126	9	126	10	The term cold spell can be taken to be relative. There will still be 'cold days' in the future under the new temperature normal. They won't be what we consider cold today, but they will happen. I suggest re-framing this with the future world in mind too. [Jason Donev, Canada]	Noted. This section has been completely revised and the text is no longer there.
80195	126	12	126	20	Supplementing the text is suggested: "There is high confidence that river floods and flash floods in hilly and mountainous regions and foothill areas will increase in Central and Western Europe and medium confidence that they will decrease in Eastern and Southern Europe, with respective changes in the 1:100 years river flow being larger for higher warming levels (see Figure TS.39). There is high confidence that droughts are increasing in the Mediterranean region and neighbouring parts of Central-Eastern Europe." Furthermore, the paragraph makes distinction between Central and Eastern Europe. What is the situation with Hungary, Slovakia, Serbia and Romania where all river floods, flash floods and droughts cause severe problems. Maybe a new interim category should be used, Central-Eastern Europe. [Lilian Fejes, Hungary]	Noted. This section has been completely revised and the text is no longer there.
111307	126	22	126	25	It is not clear - is this statement valid only for Europe? [Volodymyr Osadchy, Ukraine]	Noted. This section has been completely revised and the text is no longer there.
108725	126	27	126	27	Space between number and unit [Jason Donev, Canada]	Noted. This section has been completely revised and the text is no longer there.
80197	126	27	126	30	We are missing information about the Carpathians and other European mountain ranges. Why only the Alps are mentioned? [Lilian Fejes, Hungary]	Noted. This section has been completely revised and the text is no longer there.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97887	126	27	126	30	Please quantify the statements "drastic decrease of snow cover" and by "glaciers continue to lose mass". [Nicole Wilke, Germany]	Noted. This section has been completely revised and the text is no longer there.
97889	126	27	126	30	Please quantify what is meant by "marine heatwaves and ocean acidification increase". The current statement is quite trivial. [Nicole Wilke, Germany]	Noted. This section has been completely revised and the text is no longer there.
40383	126	33	126	33	I think the following needs to be amended: "and detected tornadoes are increased in Europe, but its trend depends on density of observation." What is the density of observation"? [TSU WGI, France]	Noted. This section has been completely revised and the text is no longer there.
97891	126	33			What is increased, the frequency or the amplitude? [Nicole Wilke, Germany]	Noted. This section has been completely revised and the text is no longer there.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97893	126	38			Please specify the risks at different warming levels, it is not sufficient to note "under climate projections". [Nicole Wilke, Germany]	Noted. This section has been completely revised and the text is no longer there.
99209	126	40			RSL is Europe is still impacted by glacioeustasy and hence it will not rise in all of Europe [Daniela Schmidt, United Kingdom (of Great Britain and Northern Ireland)]	Noted. This section has been completely revised and the text is no longer there.
111309	126	47	126	47	Is "ozone" a surface or tropospheric one? [Volodymyr Osadchy, Ukraine]	Noted. This section has been completely revised and the text is no longer there.
104843	127	1	127	9	I like this table a lot. However, it will be great if you can try to provide an assessment (literature allowing it) also for end of the century and for different scenarios. This will really help to build a consistent and complete storyline for WG2 authors assessing risks originating from these hazards. I also wonder how much can be said from a multihazard perspective, i.e. could you combine this table with a matrix exemplify the interaction across some of these hazards? This could be the case for compound heat and drought hazards for example. It will be great to capture this information somehow in this table, i.e. not the sum of the hazards but the compound events. [Veruska Muccione, Switzerland]	Noted. Thanks, this section has been completely revised and also the table. Indication of end of century or higher global warming levels can be found in the text.
99211	127	9			the assessment does not state the timeline (I might have missed). It would be important to repeat this in every table header as the reader might focus only on small parts of the report and the risks will differ near term and long term [Daniela Schmidt, United Kingdom (of Great Britain and Northern Ireland)]	Noted. This section has been completely revised and the text is no longer there.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
44547	127	18	127	23	this paragraph seems to be out of place/should come later in this section if following the logic of the other regional sections. [Jana Sillmann, Norway]	Noted. This section has been completely revised and the text is no longer there.
54831	127	25	127	26	It is difficult to align this statement about high confidence in observed changes to climate impact drivers in North America with the findings for North America presented in Table TS.18. First, should the results align or is this text for the North American continent as a whole (vs subcontinental regions in TS.18)? This needs to be made clear. If they should align, then we are concerned that they do not seem to. In Table TS.18, arrows indicate medium or high confidence in upward or downward trends and such changes are evident across multiple subregions of North America for mean temperature, extreme heat, cold spells, pluvial floods, mean wind speeds, snow and land ice, a number of coastal climate impact drivers etc. This text on lines 25-26 states that there is high confidence in observed changes (for North America) in mean precipitation, pluvial flooding, aridity, wildfire and coastal flooding, only two of which are consistent with results in Table TS.18. This statement about changes in mean precipitation also contradicts the conclusion on page TS-128 that for most places in North America, there is no significant trend in precipitation. [Nancy Hamzawi, Canada]	Noted. This section has been completely revised and the text is no longer there.
111607	127		127		In the Table TS17 seems projected increasing mean precipitation in Eastern and Northern Europe contradicts with decrease of flood [Volodymyr Osadchy, Ukraine]	Rejected. The decrease in flood in north and eastern Europe is due to the massive decrease of snow pack.
99213	127				it would be incredibly important for the narrative of the report to have any indication how this risk would look like under a lower emission scenario and hence what hazard could be avoided [Daniela Schmidt, United Kingdom (of Great Britain and Northern Ireland)]	Noted. This section has been completely revised and information on the lower emission scenario are included where possible.
130391	128	52			This section needs revision to be aligned/consistent with Chapter 11 and the SPM changes alluded to elsewhere in this review regarding tropical cyclones. Basically the confidence levels are too high. [Trigg Talley, United States of America]	Noted. This section has been completely revised and the text is no longer there.
130393	128	53	128	55	The document states "It is likely that tornado activity has increased in the United States over the 2000s with a decrease in the number of days per year where tornadoes are observed." This statement seems to contradict itself. Please clarify. [Trigg Talley, United States of America]	Noted. This section has been completely revised and the text is no longer there.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
130395	129	10	129	15	Snowpack is anticipated to decline throughout most of North America. However the document states that for some high latitude regions SWE will increase. Please provide a bit more specific explanation as to why and where. [Trigg Talley, United States of America]	Noted. This section has been completely revised and the text is no longer there.
108727	129	14	129	15	I agree with what's said about the glaciers losing mass, but this would be stronger (even in the technical summary) if this is put in the context of increasing water stress. I'm aware of this because I live near glaciers in North America and am concerned about this area's water stress. 'Glaciers losing mass' doesn't communicate the appropriate difficulties facing that eventuality. [Jason Donev, Canada]	Noted. This section has been completely revised and the text is no longer there.
82641	129	21	129	21	Suggest adding "river and marine" after "compound" as some readers will be unfamiliar with the term. [Blair Trewin, Australia]	Noted. This section has been completely revised and the text is no longer there.
54833	129	33	129	34	Table caption for Table TS.18: 1. The title for this table should reflect all the content of the table, including not only confidence in projected directional changes but also confidence in observed directional changes and in attribution of those changes. 2. The caption should include an explanation for how to interpret cells for which there is confidence in attribution of changes (stars) but no arrows indicating med-high confidence in any observed changes. This seems inconsistent and is confusing. 3. The caption should include a reference to the TS Appendix where source information for the information in the table is provided. [Nancy Hamzawi, Canada]	Noted. The table format and caption has been revised
54835	130	1	130	1	Table TS.18: In general, we find this presentation of subcontinental changes easy to read and understand with one exception (see comments on the Table caption regarding how to interpret cells with stars but no arrows). It would be helpful to add a map illustrating the subcontinental regions to this table (and other similar tables). If that is not done, then at a minimum, it would help to indicate that the subcontinental regions listed are shown in order from south to north. This is especially needed given that the text in section TS4.3.9 refers, as one example, to the "Southwest" and there is no region with that name so it's unclear to readers which subcontinental region is being referred to. Also, if possible, it would presumably be of interest to many to include extreme precipitation in this table as a separate indicator. [Nancy Hamzawi, Canada]	Noted. The table format and caption has been revised

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
108961	130	8	131	26	Very little mention and analysis of Islands in Africa - this section focuses on the Caribbean with a little mention of the Pacific Islands. This provides no useful insight to decision makers in Africa, which is likely to experience the most extreme climate related impacts. [Siyasanga Sauka, South Africa]	Noted. This section has been completely revised and the text is no longer there.
108729	131	12	131	13	Unclear, could these lines be re-worked. I had trouble understanding what was being said. [Jason Donev, Canada]	Noted. This section has been completely revised and the text is no longer there.
108731	131	12	131	13	The low confidence conflicts with the 'robust assessment'. [Jason Donev, Canada]	Noted. This section has been completely revised and the text is no longer there.
108963	131	31	131	31	Table TS.19: And the Islands in Africa? The Indian Ocean? These are not included. [Siyasanga Sauka, South Africa]	Noted. This section has been completely revised and the assessment of small islands is based on literature available.
71143	132	11			Comma missing between permafrost and glacier [Lukas Arenson, Canada]	Noted. This section has been completely revised and the text is no longer there.
111311	132	13	132	14	Please, provide confidence for this statement [Volodymyr Osadchy, Ukraine]	Noted. This section has been completely revised and the text is no longer there.
88437	132	20	20		Are you referring to permafrost extent - revise to indicate this. [Sharon Smith, Canada]	Noted. This section has been completely revised and the text is no longer there.
71145	132	20			What is decreasing permafrost? Do the authors mean permafrost degradation, or permafrost temperature warming? [Lukas Arenson, Canada]	Noted. This section has been completely revised and the text is no longer there.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
111313	132	21	132	22	Please, provide confidence for this statement [Volodymyr Osadchy, Ukraine]	Noted. This section has been completely revised and the text is no longer there.
39935	132	49	132	50	Antarctic Peninsula: has increased its surface mass balance. On p 39 it says "The grounded Antarctic Ice Sheet has likely contributed 0.0069 ± 0.0014 m to sea level rise over 1992-2018 and loss has accelerated over the last decades (medium confidence) dominated by ice discharge over the West Antarctic Ice Sheet and the Antarctic Peninsula" Is this because ice is being pushed on to the Peninsula and then into the ocean. Would like an explication on how it could increase its surface mass balance and have an accelerated loss? I ask because this the second statement used in the SPM (B.4.1) [TSU WGI, France]	Noted. This section has been completely revised and the text is no longer there.
11567	132	52	132	53	"It is likely that the increased surface mass balance has slightly compensated for the total Antarctic ice-sheet mass loss." To be more precise, SMB increase compensates for dynamical losses. The sum of the two is the total mass balance (if basal melting is neglected) [Gerhard Krinner, France]	Noted. This section has been completely revised and the text is no longer there.
44549	133	9	133	13	this paragraph should og to the beginning of section 4.3.11.1 [Jana Sillmann, Norway]	Noted. This section has been completely revised and the text is no longer there.
108733	133	11	133	11	two periods [Jason Donev, Canada]	Noted. This section has been completely revised and the text is no longer there.
40645	133	16	134	16	Please re-check for typos. E.g., "Mid-winter snowpack extent increases" -> Mid-winter snowpack extent is expected to increase? "could affect impact marine ecosystem" [TSU WGI, France]	Noted. This section has been completely revised and the text is no longer there.
11569	133	40	133	41	Traceability information lacking [Gerhard Krinner, France]	Noted. This section has been completely revised and the text is no longer there.
88439	133	40	133	41	Are you referring to only North American Arctic here - revise to indicate this. [Sharon Smith, Canada]	Noted. This section has been completely revised and the text is no longer there.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
111315	133	40	133	41	Is this about seasonal snow cover? [Volodymyr Osadchy, Ukraine]	Noted. This section has been completely revised and the text is no longer there.
111281	134	11	134	12	Please, provide confidence for this statement [Volodymyr Osadchy, Ukraine]	Noted. This section has been completely revised and the text is no longer there.
104479	134	26	134	27	Table TS.20: "Arrows indicate medium to high confidence trends derived from observations and asterisks indicate low, medium and high confidence in attribution of observed changes" - it should be indicated over which period (approximately) the observed trends are defined (recent decades, since 1950s, instrumental period, 20th century...). As availability of observations depends on the region - this should be regional information provided for each table. [Irina Gorodetskaya, Portugal]	Noted. This section has been completely revised but the assessment in the table is based on literature therefore the reference period it may be different for each of the papers used.
104845	134	28	134	29	I wonder whether you plan to have the same table for all cross chapter regions in WGII (e.g. mountains). This will be really interesting and useful but I am aware that the literature and uncertainties might now allow a robust assessment (as for mountains for example...) [Veruska Muccione, Switzerland]	Noted. This section has been completely revised and the text is no longer there.
40349	135	1	138	10	How consistent are these findings with SROCC? [TSU WGI, France]	Noted. This section has been completely revised and the text is no longer there.
82643	135	5	135	5	The 0.05 figure will need to be checked for consistency with other parts of the TS and with Chapters 2 and 9 [Blair Trewin, Australia]	Noted. This section has been completely revised and the text is no longer there.
108735	135	27	135	28	line break needed [Jason Donev, Canada]	Noted. This section has been completely revised and the text is no longer there.
87063	136	9	139	10	Please consider adding cropland and pastureland as to other typology domains. This enables to introduce more insights from the SRCLL on the various aspects of the "living world domain" (and which must be understood/solved at a context-specific level), to supplement perspectives on "large scale components" (which are currently dominating the technical summary, and which can be described simply at the global level). [Oyvind Christophersen, Norway]	Noted. This section has been completely revised and the text is no longer there.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
108737	136	13	136	13	Specifying the vital services would strengthen this writing [Jason Donev, Canada]	Noted. This section has been completely revised and the text is no longer there.
111295	136	18	136	20	Why only colapse of the former Soviet Union is mentioned here? [Volodymyr Osadchy, Ukraine]	Noted. This section has been completely revised and the text is no longer there.
108739	136	31	136	31	Stray } here. [Jason Donev, Canada]	Noted. This section has been completely revised and the text is no longer there.
111299	136	31	136	34	It is not clear statement and without confidence [Volodymyr Osadchy, Ukraine]	Noted. This section has been completely revised and the text is no longer there.
71147	137	16			Melting permafrost does not exist. It can thaw or degrade, but permafrost is not a material (see glossary) that can melt like ice or steal. [Lukas Arenson, Canada]	Noted. This section has been completely revised and the text is no longer there.
104847	137	20	137	21	I am not sure about the medium confidence. GLOFs depend on several aspects not necessarily related to climate change and not necessarily related with the increase in the number of glacier lakes. There are also considerable regional differences. I would rather say low confidence or elase say something more about the regional differences. [Veruska Muccione, Switzerland]	Noted. This section has been completely revised and the text is no longer there.
40045	137	23	137	26	Could the implications of mountain cryosphere change for downstream hydrology be mentioned? [TSU WGI, France]	Noted. This section has been completely revised and the text is no longer there.
84689	137	29	137	38	this is an exact repetition of the box on monsoons. No need to have both [Annalisa Cherchi, Italy]	Noted. This section has been completely revised and the text is no longer there.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97895	137	29	138	38	This section is largely redundant to Box TS.6 (p. TS-104, l. 15 to p. 106, l.31). Please streamline the text possibly by replacing section TS.4.3.13.2 by a reference to Box TS.6. [Nicole Wilke, Germany]	Noted. This section has been completely revised and the text is no longer there.
82645	137	29	138	38	There appears to be substantial overlap between this section and Box TS.6, which makes me wonder what the purpose of the box is. If it is to present a simplified/summarised presentation of the monsoon it might be better as an FAQ rather than a box. [Blair Trewin, Australia]	Noted. This section has been completely revised and the text is no longer there.
40449	137	29			Is duplication of text in this section and the monsoon box (p. 104-106)? If so could it be addressed, as it will reduce the length of the TS. [TSU WGI, France]	Noted. This section has been completely revised and suggestion taken into account
108741	137	34	137	34	The units of hPa are a little weird here, what are they talking about? [Jason Donev, Canada]	Noted. This section has been completely revised and the text is no longer there.
108743	137	38	137	38	What does 'monsoon circulation' mean? It's not a term that seems to be defined anywhere. [Jason Donev, Canada]	Noted. This section has been completely revised and the text is no longer there.
106055	138	4	138	9	This paragraph seems out of place here, as it does not discuss monsoons and appears to repeat earlier statements about precipitation. [William Gutowski, United States of America]	Noted. This section has been completely revised and the text is no longer there.
40357	138	46	138	48	I am missing regional details and confidence here. I would also like to know more about the regional CID tables results and the consistency with this statement. [TSU WGI, France]	Noted. This section has been completely revised and the text is no longer there.
41135	139	15	140	26	Urban box: is the urban heat island effects are accounted for and corrected for assessing regional land temperature trends ? Also, no reference to drought? [TSU WGI, France]	Taken into account. A link to chapter2 assessment is added.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
26109	139	33	139	34	The phrase 'Observations indicate a positive trend in urban heat islands over many major cities among which a number are by the sea' is not precise enough. Does it mean that urban heat island intensity, that it is the difference between the center city and its periphery, has increased? This has been observed in most of the cities if the city population has increased, but this is not true if the population has been stable or declined. [Don Alfonso Pino Maeso, Spain]	Accepted. Sentence removed in order to avoid confusion.
26113	139	33	139	46	Summing up the two previous comments we suggest, "global warming does not necessarily drive an increase in the intensity of heat islands; demographic evolution has a greater influence in this sense". "But the effects in the city center are now and in the future more serious because of the general rise in temperatures resulting from global warming, which give rise to very high minimum temperatures that have a negative impact on human health and comfort" Martin-Vide and Moreno-Garcia, 2020) [MARTIN-VIDE, J., MORENO-GARCIA, M.C. (2020): Probability values for the intensity of Barcelona's urban heat island (Spain). Atmospheric Research, DOI: 10.1016/j.atmosres.2020.104877]. [Don Alfonso Pino Maeso, Spain]	Accepted. Sentence reformulated.
26115	139	33	139	46	In Mediterranean cities it can be said that the urban heat island constitutes a new meteorological risk (Martin-Vide and Moreno-Garcia, 2020) [Don Alfonso Pino Maeso, Spain]	Noted. Only one paper is mentioned here on Barcelona city. It will be difficult to mention explicitly Mediterranean cities if a full assessment is not done for different Mediterranean cities. So the sentence can not be traced back in the urban box text in chapter10.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
44277	139	37	139	38	Cities contribution to global warming is mainly a result of greenhouse gases emissions rather than direct land use/cover change within urban areas. However, the indirect land use/cover change outside cities - to feed, supply power, supply resources and for transport of urban population is substantial (Oke, T.R., et al., 2017: Urban Climates. Cambridge University Press, Cambridge. Chapter 13: Cities and Global Climate Change, pp. 360 - 384). [Nektarios Chrysoulakis, Greece]	Noted. The indirect impact of historical urbanization on LULC change outside urban areas is not the focus here. A link to the assessment done in global chapter about the effect of urbanization on global temperature trend is done.
131961	139	40	139	46	These statements should also be part of the SPM. Otherwise in the SPM only risks related to precipitation/ floods are included. [Hans Poertner and WGII TSU, Germany]	Noted. HS11.5 of the revised SPM is about urban areas.
26111	139	45	139	45	This sentence ('Urban heat islands are generally projected to intensify (medium confidence) in the future') is not accurate, as explained in previous comment. A different fact is the effect of the heat island on the human health of people who live in the city center, which will be more serious in the future, due to the thermal excess that the heat island will bring in a warmer world. [Don Alfonso Pino Maeso, Spain]	Accepted. Sentence reformulated.
44279	140	8	140	10	See above comment No 24 on climate information and services for end-users. [Nektarios Chrysoulakis, Greece]	Accepted. A link is added to the climate service box

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
26117	140	8	140	16	It is needed to mention here the 'Citizen Science'. Meteorology in general and in urban areas is one of its best examples. [Don Alfonso Pino Maeso, Spain]	Accepted. Citizen science added with link traced back to the urban box 10.2.
80199	140	8	140	26	In this paragraph, next to the importance of information, a brief mention should be made about the importance of information and knowledge-sharing and elaboration of decision support systems in the urban climate adaptation - even the introduction of best practices could be mentioned here. [Lilian Fejes, Hungary]	Accepted. A link is added to the climate service box
108745	140	13	140	13	The phrase 'internet of things' means different things in different groups and is a bit 'buzzword'. Could it be stated differently somehow? [Jason Donev, Canada]	Taken into account. Term no longer appears in the revised document.
44281	140	22	140	22	See above comment No 3 on turbulent sensible heat fluxes. [Nektarios Chrysoulakis, Greece]	Taken into account. Sentence modified according to new text in the urban box in chapter10.
111223	140	31	143	56	It is not clear the order of continents in the summary, particularly why polar regions are among typological domains? [Volodymyr Osadchy, Ukraine]	Noted. This section has been completely revised and the text is no longer there.
106057	140	31	144	18	I think this section is not needed, as it largely appear to repeat what was presented in prior sections of the TS. Is it trying to function like an Executive Summary? [William Gutowski, United States of America]	Noted. This section has been completely revised and the text is no longer there.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
111215	140	36	140	36	Why it is "nearly all" and not all? Where are exceptions? [Volodymyr Osadchy, Ukraine]	Noted. This section has been completely revised and the text is no longer there.
108747	140	47	140	48	I think this is quite about more certain than 'likely'. The space of compound effects is huge, and I think the process of bad things happening concurrently is virtually certain depending on what's included in this. [Jason Donev, Canada]	Noted. This section has been completely revised and the text is no longer there.
108749	140	51	140	51	More rapid than which global average? Land? Total? [Jason Donev, Canada]	Noted. This section has been completely revised and the text is no longer there.
108751	141	13	141	44	Where is Mexico included? It's not mentioned at all... [Jason Donev, Canada]	Noted. This section has been completely revised and the text is no longer there.
44551	141	25	141	25	avoid the use of the phrase "thanks to ..." rewrite sentence accordingly. [Jana Sillmann, Norway]	Noted. This section has been completely revised and the text is no longer there.
44555	142	18	142	18	Marine heatwaves ... [Jana Sillmann, Norway]	Noted. This section has been completely revised and the text is no longer there.
44553	142	42	142	45	avoid the use of the phrase "thanks to ..." rewrite sentence accordingly. [Jana Sillmann, Norway]	Noted. This section has been completely revised and the text is no longer there.
111185	142	42	142	46	In the text twice "thanks" and "trend persist" without mention its direction. Can be written better [Volodymyr Osadchy, Ukraine]	Noted. This section has been completely revised and the text is no longer there.
111187	142	46	142	50	Very important information, but very difficult to read and understand. Please, write in more plain language [Volodymyr Osadchy, Ukraine]	Noted. This section has been completely revised and the text is no longer there.
111181	142	51	142	52	Please, specify the direction of "associated trends" [Volodymyr Osadchy, Ukraine]	Noted. This section has been completely revised and the text is no longer there.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
111189	142	52	142	53	There are no Western and Southern Europe among AR6 sub-regions [Volodymyr Osadchy, Ukraine]	Noted. This section has been completely revised and the text is no longer there.
111213	143	2	143	2	"Significant trends" at what level of significance? [Volodymyr Osadchy, Ukraine]	Noted. This section has been completely revised and the text is no longer there.
83633	143	25	143	25	"e lack and the decline of observations over mountain sites" should be AT mountain sites, instead of IN. [Petra Seibert, Austria]	Noted. This section has been completely revised and the text is no longer there.
111225	143	41	143	41	Is "snow cover" seasonal here? [Volodymyr Osadchy, Ukraine]	Noted. This section has been completely revised and the text is no longer there.
44557	143	45	143	45	remove reference to Box (no references used in any of the other regional summaries) [Jana Sillmann, Norway]	Noted. This section has been completely revised and the text is no longer there.
83631	143	54	143	54	I don't see why the change of urban heat islands should be "very uncertain". This does not derive from other chapters, and it is clear and obvious that general climate change trends will lead to exacerbation of the detrimental effects of UHI, especially insufficient nocturnal cooling. Increased solar radiation will increase the heat input into the city, and increasing water vapour will decrease further the nocturnal cooling. Given the importance to take measures against heat in cities, it is imperative to not use a language that can be used to argue that there would insufficient scientific knowledge about the future development of urban heat or UHI, which is certainly not true. [Petra Seibert, Austria]	Noted. This section has been completely revised and the text is no longer there.
7363	144	16	144	16	Annex 1' should probably read 'Appendix TS.A' [Hans-Martin Füssel, Denmark]	Noted. This section has been completely revised and the text is no longer there.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
405	144	21	144	21	"lake acidity" has not been defined anywhere in this chapter. Many lakes, especially in the tropical zone, have naturally acidic waters i.e. pH below 7, and because of a combination of pH and temperature act mainly as CO2 sources to the atmosphere. Eutrophic lakes may shift seasonally from CO2 sinks to sources, and hypertrophic lakes may have strong diel (i.e. within 24h - day/night) shifts in their sink-source behaviour. Temperate region lakes may display, especially during spring and summer, a strong stratification, where upper, productive and oxygenated waters may uptake atmospheric CO2 through biological processes (primary production). However mixing during autumn and winter times (if the lake is not ice-covered) may bring "acidified, low oxygen waters from deeper layers to the surface, and then the ecosystem acts as a CO2 source to the atmosphere. Do you mean here coastal lagoons, that have salty to brackish waters, are usually shallower (i.e. wind and turbulence mixing of the water column is more efficient), where alkalinity may indeed regulate surface lake water pH? "Lake acidification" in our present times are very often associated to increase in domestic or industrial sewage or atmospheric deposition enriched in sulphur or nitrogen compounds, which indeed affects the trophic structure of the systems, menaces biodiversity, etc, but the process is different from the "ocean acidification" resulting from the dissolution of the anthropogenic CO2 in seawater. Studies on the impacts of lake acidification are listed here: 1) Bell, G., Fugère, V., Barrett, R., Beisner, B., Cristescu, M., Fussmann, G., et al. (2019). Trophic structure modulates community rescue following acidification. Proc. R. Soc. B Biol. Sci. 286, 20190856. doi:10.1098/rspb.2019.0856. 2) Čtvrtlíková, M., Kopáček, J., Nedoma, J., Znachor, P., and Vrba, J.	Noted. Table has been updated now and consistency is checked.
132293	144	21	145	3	Table TS.22 and other regional tables in TS: Drought should be subdivided in 2 to 3 categories. There should be at least a distinction between precipitation-deficits based droughts ("meteorological droughts") and soil moisture/streamflow droughts (relevant for agriculture and water resources), or possibly between all 3 types of droughts. The reasons are as follows: 1) climate change signals are not the same for these 3 types of droughts, in particular not for the precipitation deficits vs the other types of droughts which are also affected by changes in evapotranspiration; 2) the impacts are very different for these 3 types of droughts [see chapter 11 assessment] [Sonia Seneviratne, Switzerland]	Noted. Table has been updated now and consistency is checked.
132295	144	21	145	3	Table TS.22 and other regional tables in TS: "Heavy precipitation" should be mentioned in these tables [Sonia Seneviratne, Switzerland]	Noted. Table has been updated now and consistency is checked.
132297	144	21	145	3	Table TS.22 and other regional tables in TS: "Severe wind storms" could be subdivided in "tropical cyclones" and "extratropical cyclones" [Sonia Seneviratne, Switzerland]	Noted. Table has been updated now and consistency is checked.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
132299	144	21	145	3	Consider possibly including compound events in this table (e.g. dry/hot events, humid/hot events). [Sonia Seneviratne, Switzerland]	Noted. Table has been updated now and consistency is checked.
132301	144	21	145	3	Why keep hail in this table? There are no interesting signals (either no signals or hail is not relevant in the given region). In addition, the chapter 12 ES did not even mention hail itself, which does not suggest that there are any relevant assessments to be mentioned. [Sonia Seneviratne, Switzerland]	Noted. Table has been updated now and consistency is checked.
132303	144	21	145	3	It is not intuitive that an increase in drought would be indicated in blue. Consider different categories, e.g. red for "worsening" (hazard) and blue for "improving" (benefit). Note that if different sectors might react differently to a given change (e.g. increase in mean precipitation), this could be indicated by a subdivision of the respective cells in subcells for the different sectors. [Sonia Seneviratne, Switzerland]	Noted. Table has been updated now and consistency is checked.
132239	144	21	146	11	Chapter 11 did not have a chance to sufficiently comment and contribute to these tables and other regional tables in the TS. They will need to be very carefully checked in the development of the FGD and harmonized with chapter 11 material. [Sonia Seneviratne, Switzerland]	Noted. Table has been updated now and consistency is checked.
54837	144	23	144	30	Table caption for Table TS.22: 1. The title for this table should reflect all the content of the table, including not only confidence in projected directional changes but also confidence in observed directional changes and in attribution of those changes. 2. The caption should include an explanation for how to interpret cells for which there is confidence in attribution of changes (stars) but no arrows indicating med-high confidence in any observed changes. 3. The caption should include a reference to the TS Appendix where source information for the information in the table is provided. [Nancy Hamzawi, Canada]	Noted. Table has been updated now and consistency is checked.
81665	145	1	145	1	As for Box SPM.3 Table 1 and Table TS.15, in Table TS.22 for the line on Southern Australia (SAU), the box on frost needs to be coloured white or at least light brown. There is evidence for an increasing trend in frosts in some regions in southern Australia in some seasons (notably spring), .: https://link.springer.com/article/10.1007/s10584-016-1763-5 . This trend may or may not be due in part to a forced change in the circulation driver, that is perhaps detectable in individual frost events, e.g. http://www.ametsoc.net/eee/2016/ch29.pdf [Michael Grose, Australia]	Noted. Table has been updated now and consistency is checked.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
80201	145	1	145	1	Table TS.22 - Climate Impact Drivers can be complemented within the "Wet and Dry" category. It should be "River and flash floods" and "Pluvial flood and inland water" if these assessments covered the flash floods or the inland water inundation, respectively. [Lilian Fejes, Hungary]	Noted. Table has been updated now and consistency is checked.
108753	145	1	145	1	The white used here makes it look blank, which may be a choice when there's low confidence, but is it the best choice? It looks like it's been forgotten rather than deliberately stating 'we have low confidence in this'. [Jason Donev, Canada]	Noted. The meaning of the colours is explained in the legend.
91133	145	1	145	1	Table TS22 : surface radiation is projected to increase in East Asia, not decrease (wrong color code): Also, why is the color code reversed compared to the Related Table 12.4? [Martin Wild, Switzerland]	Noted. Table has been updated now and consistency is checked.
32523	145				Regarding the colors used for the Climatic Impact Driver, on the first line of the table: as purple is already used in caption, those colours could interfere with instructions in caption. No colour should be used in this line. [Eric Brun, France]	Noted. Table has been updated now and consistency is checked.
88441	147	27			As mentioned above evidence for permafrost assessment in Africa is unclear. Ch2 and 9 do not mention anything about Africa. [Sharon Smith, Canada]	Noted. This table has been completely revised and placed in the main assessment.
104459	159	2	159	3	Traceback matrix Table TS.A.1: •Mean temperature : <ul style="list-style-type: none"> o Replace [Atlas 5.9.1.4] in blue by [Atlas 5.9.1.2] in blue for observations. o Put [Atlas 5.9.1.4] in black for projections. o Add reference to Chapter 9: {9.4.2.2} for projections [Irina Gorodetskaya, Portugal] 	Noted. This table has been completely revised and placed in the main assessment.
104461	159	2	159	3	Traceback matrix Table TS.A.1: •Extreme heat, Cold spell, Frost: <ul style="list-style-type: none"> o [12.4.9.2] has no reference for Antarctica [Irina Gorodetskaya, Portugal] 	Noted. This table has been completely revised and placed in the main assessment.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
104463	159	2	159	3	Traceback matrix Table TS.A.1: • Mean precipitation : o Add [Atlas 5.9.1.2] in blue for observations. o Add reference to Chapter 9: {9.4.2.2} for projections [Irina Gorodetskaya, Portugal]	Noted. This table has been completely revised and placed in the main assessment.
104465	159	2	159	3	Traceback matrix Table TS.A.1: • Landslide : o 12.4.9.2] has no reference for Antarctica [Irina Gorodetskaya, Portugal]	Noted. This table has been completely revised and placed in the main assessment.
104467	159	2	159	3	Traceback matrix Table TS.A.1: • Severe wind storm : o 12.4.9.4] has no reference for Antarctica [Irina Gorodetskaya, Portugal]	Noted. This table has been completely revised and placed in the main assessment.
104469	159	2	159	3	Traceback matrix Table TS.A.1: • Snow and land o Replace [Atlas 5.9.1.4] in blue by [Atlas 5.9.1.2] in blue for observations. [Irina Gorodetskaya, Portugal]	Noted. This table has been completely revised and placed in the main assessment.
104471	159	2	159	3	Traceback matrix Table TS.A.1: • Permafrost o 12.4.9.5] does not provide any justification as it only says: "Future projections indicate... the increasingly ice-free portions of Antarctica (Chapter 9)" (12-105, L23). [Irina Gorodetskaya, Portugal]	Noted. This table has been completely revised and placed in the main assessment.
104473	159	2	159	3	Traceback matrix Table TS.A.1: • Heavy snow and ice storms: o 12.4.9.5] has no reference for Antarctica [Irina Gorodetskaya, Portugal]	Noted. This table has been completely revised and placed in the main assessment.
104439	159	2	159	3	Traceback matrix TS.A.1 (TS-159, L2-3): Mean Precipitation for East Antarctica and West Antarctica: refers to 12.4.9.3 and Atlas 5.9.1.4. Need also reference to {9.4.2.2} [Irina Gorodetskaya, Portugal]	Noted. This table has been completely revised and placed in the main assessment.
8963	161	1	21	2	It is a bit unclear whether Table TS.A.2 contains evidence of detected change in the CID or the attribution of this change to anthropogenic contribution to climate change [Bart van den Hurk, Netherlands]	Noted. This table has been completely revised and placed in the main assessment.
19603	168	6	168	6	It is a pity that this table TS B1 of acronyms (120 items) is built specifically for the TS. A similar remark holds for exceedingly large table (about 700 items) built specifically for chapter 6. A single table for the whole report should be located in an annex of WG1, or still better added to the glossary file. Indicate in this table where in the report an acronym appears for the first time would be welcome. [philippe waldeufel, France]	Taken into account. The table has been removed from the TS but instead there is an annex containing acronyms for the whole report.
32525	168	6			Table TS.B.1: this table is very relevant. We suggest to transform it into an independent document and attach it to the report, in the same way as the glossary. [Eric Brun, France]	Taken into account. The table has been removed from the TS but instead there is an annex containing acronyms for the whole report.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
32527	168	6			Table TS.B.1: please add "NH" (Northern Hemisphere). [Eric Brun, France]	Not applicable. Table removed from revised TS.
100557	169	0	169	0	Add to Table TS.B.1: "MCO; Miocene Climatic Optimum" [Matthew Kohn, United States of America]	Rejected. Length limitations preclude the inclusion of all paleo reference periods in the TS. MCO is included in more complete list of reference periods (Cross-Chapter Box 2.1)
131963	172	0			Fig TS.1 The biosphere encompasses land and ocean - either change land and biosphere to terrestrial biosphere or add an ocean example eg coral bleaching [Hans Poertner and WGII TSU, Germany]	Not applicable. Figure dropped for FGD
34709	172	1	172	18	The precipitation trend graph is problematic. It is based on the GPCC global data and refers to Becker et al 2013. This paper clearly states that there are homogenisation problems in the global data set. I have contacted Andreas Becker and he has confirmed that data are not homogenised and therefore not well suitable for trend analysis. He suggested to focus on smaller regions that (1) have a good station density throughout the period and (2) show a very clear signal. The HOMPRA subset would be suitable for that, and one could use e.g. Scandinavia and Mediterranean regions to represent different types of trends. I think that at least any analysis of observed global precipitation trends should be labelled with an appropriate cautious confidence level. [Petra Seibert, Austria]	Not applicable. Figure dropped for FGD
112683	172	3	172	3	In the version downloaded on 5.6.2020 Figure TS.1 still says for Glacier mass loss "Data series to be updated" [Daniel Häüssinger, Switzerland]	Not applicable. Figure dropped for FGD

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
26119	172	3	172	4	Figure TS.1, in CO2 concentration, we suggest to use a graphical scale with the red colour, instead of the blue one. [Don Alfonso Pino Maeso, Spain]	Not applicable. Figure dropped for FGD
112685	172	10	172	11	Not only "glacier mass loss", but also "sea level" is depicted in integrated values - isn't it? [Daniel Häussinger, Switzerland]	Not applicable. Figure dropped for FGD
86529	172		232		It is much appreciated that the concept and specific layout of many diagrams has been established in former IPCC WG1 reports. This has high recognition value and facilitates convenient use by the serial user of the IPCC assessment reports. [Jochen Harnisch, Germany]	Noted with thanks
32529	172				Figure TS.1: some words are unreadable, because of the colors used: "Cryosphere", "Land and biosphere", "Cherry full-bloom, Kyoto, Japan", "Grape harvest, Beune, France". [Eric Brun, France]	Not applicable. Figure dropped for FGD
132421	172				Figure TS.1: The Earth System's realms need to include land. The present display is inconsistent with e.g. the GCOS ECVs (https://www.ncdc.noaa.gov/gosic/gcos-essential-climate-variable-ecv-data-access-matrix). It also seems at odd with having had IPCC special reports on respectively "oceans and cryosphere" (SROCC) and "land" (SRCL) in the AR6 cycle. The biosphere is not synonymous with the Land. [Sonia Seneviratne, Switzerland]	Not applicable. Figure dropped for FGD
132423	172				Please add a land-only climate variable in this graph (see also https://www.ncdc.noaa.gov/gosic/gcos-essential-climate-variable-ecv-data-access-matrix) [Sonia Seneviratne, Switzerland]	Not applicable. Figure dropped for FGD

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
11075	173	1	173	2	If you're using ECPs for GMSL change, we can include ECP 4.5. Note that ch 9 only assesses the extremely likely upper bound for ECP 4.5/8.5 in 2300, and I don't expect we will be better positioned to do this for scenarios with peak warming > ~2C in the future [Robert Kopp, United States of America]	Not applicable. Figure dropped for FGD
18879	173	9	173	12	Whiskers are shown in the left and right panels, not in the middle panels as the current text says. [Govindasamy Bala, India]	Not applicable. Figure dropped for FGD
100239	174	1	174	1	In Figure TS.3: Plotted at the top of the figure, is there supposed to be a "timeseries" of CO2 or air temperature measurements? Paleo then instrumental records? Since those are in Figure TS.4, maybe remove that part of this figure to give more space to some of the descriptions. [Carlye Peterson, United States of America]	Not applicable. Figure dropped for FGD
100241	174	1	174	1	<p>There are some errors in the details of the timeline of historical milestones at 1856 and 1861 discussed below. Ref used for this: EUNICE FOOTE, JOHN TYNDALL AND A QUESTION OF PRIORITY, Notes Rec. (2020) 74, 105–118 doi:10.1098/rsnr.2018.0066, Published online 13 February 2019, by ROLAND JACKSON It appears there is an autocorrect error in the "Theoretical understanding" timeline, "Footnote suggests carbon dioxide is a greenhouse gas" in 1956, the same year Eunice Foote published her findings from laboratory experiments that demonstrate various amounts of carbon dioxide and water vapor absorb infrared thermal radiation from the sun at different levels. She also posited that an atmosphere with a "larger proportion [of CO2 gas] than at present...it would give our earth a high temperature" and that this could have happened in Earth's past.</p> <p>In the "natural and human drivers" timeline, the "demonstration of infrared absorption by range of gases" is erroneously attributed to Tyndall, when Eunice Foote published her findings in the American Journal of Science and Arts in 1856. The improvement Tyndall made over Foote's work was demonstrating gases both trapped and emitted infrared thermal radiation which contributes to the basis of our understanding of the greenhouse effect.</p> <p>Hence, my suggested changes: 1856 – Eunice Foote demonstrates humid & CO2-rich air retains more (or absorbs more) heat than "common air" & suggests these gases (they) could warm Earth's atmosphere. 1861 – Tyndall demonstrates infrared absorption and emission by</p>	Not applicable. Figure dropped for FGD
100243	174	1	174	1	The second and third entry in human and natural drivers section are the same "Milankovitch characterizes Earth's orbital cycle variations" for both 1920 and 1938. [Carlye Peterson, United States of America]	Not applicable. Figure dropped for FGD

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
100245	174	1	174	1	The entry for 1957 “Revelle & Suess” doesn’t need the square brackets around “name anthropogenic CO2 increase a “great geophysical experiment”” [Carlye Peterson, United States of America]	Not applicable. Figure dropped for FGD
100247	174	1	174	1	Re-write: “2005 – EPICA ice core at Dome C (Antarctica) returns longest record, 800,000 years, of ancient atmosphere” (the bedrock mention makes it sound like it isn’t possible to retrieve a longer record but there is older ice elsewhere in Antarctica) [Carlye Peterson, United States of America]	Not applicable. Figure dropped for FGD
100249	174	1	174	1	Modeling, 1975 – use “&” instead of “and” between names to save space. [Carlye Peterson, United States of America]	Not applicable. Figure dropped for FGD
100251	174	1	174	1	1996 – “first definitive detection and attribution studies”...this is so vague...I now see the “example with detection and attribution studies” is described in the next figure. I suggest either mentioning in the Modeling timeline “details in Figure TS.4” or something to let the readers know more information is on the next page, or include some non-jargon or details in the 1996 modeling entry to clarify what is meant by “detection and attribution studies”. [Carlye Peterson, United States of America]	Not applicable. Figure dropped for FGD
1949	174	1	174	1	Milankovitch is twice in the figure (Natural and human drivers:1920 and 1938) [Hugues Goosse, Belgium]	Not applicable. Figure dropped for FGD
39081	174	1	174	1	In 'Theoretical understanding', Footnote should be Foote. Is there a reason for not reporting key events in the 20th century? [Federico Serva, Italy]	Not applicable. Figure dropped for FGD
31673	174	1	174	1	Both “Milankovich” time points have the same text associated with them. [Petra Seibert, Austria]	Not applicable. Figure dropped for FGD
108755	174	1	174	1	Milankovich cycles are listed twice, once in 1920, and in 1938. Can this be clarified or simplified? [Jason Donev, Canada]	Not applicable. Figure dropped for FGD
10891	174	1	174	2	Figure TS.3: Is there no room for the great Hubert Lamb in this figure? e.g., https://onlinelibrary.wiley.com/doi/full/10.1002/wcc.349 [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. Figure dropped for FGD

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97897	174	1			Colour of one point after 1922 on the "Modelling" Timescale is red but should be turquoise. [Nicole Wilke, Germany]	Not applicable. Figure dropped for FGD
116153	174		174		The figure needs to be grounded in the assessment and related to the assessment aspects. Several aspects of climate sciences are missing related to feedbacks and sensitivity, detection of global warming, aspects of paleoclimate research beyond ice cores (paleoceanography in the 1950s, studies of lake sediments or tree rings etc). Recently, an initiative on the same aspect has also been developed, see : https://cdn.knightlab.com/libs/timeline3/latest/embed/index.html?source=1yeljGGXmTePHLlOHnWvMPGpRnZbQ2yL0EKUvgCebfSc&font=Default&lang=en&initial_zoom=2&height=650 [Valerie Masson-Delmotte, France]	Not applicable. Figure dropped for FGD
18883	174		174		The descriptions for year 1920 and 1938 are the same. Shouldn't they be different? [Govindasamy Bala, India]	Not applicable. Figure dropped for FGD
32531	174				Figure TS.3: in the "theoretical understanding" line, year 1822, "uses" makes the sentence unclear. Please replace it by "using". [Eric Brun, France]	Not applicable. Figure dropped for FGD
84137	174				1856 Footnote suggests carbon dioxide is a greenhouse gas [reads as „Mr Footnote“ has found that] [Manfred Treber, Germany]	Not applicable. Figure dropped for FGD
86171	175	0	175	0	Figure TS4: The various measures of temperature are confusing. The one measure that was 1 deg above pre-industrial in 2017 is the most useful one for public consumption. It is confusing to see 0.74 deg in this figure. Should use the measure that matches the Paris Agreement. Anything else is confusing for messaging. [Debra Roberts and the Durban WGII TSU, South Africa]	Not applicable. Figure dropped for FGD

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
112687	175	1	175	1	Heading: Total CO2 emissions in billion tons ... [Daniel Häussinger, Switzerland]	Not applicable. Figure dropped for FGD
112689	175	1	175	1	Change in which temperature? Global mean surface temperature? [Daniel Häussinger, Switzerland]	Not applicable. Figure dropped for FGD
97899	175	1	175	4	Figure TS.4: We very much appreciate the synthesis of key attribution findings throughout the ARs and encourage the authors to keep this figure. We are only wondering about data of the lower panel (change in temperature) and how this is linked to other warming levels given in this report (e.g. warming of 1.10°C for 2009-2018 c.f. SPM B.2.1). What reference period is used here in this figure? Is it GMST or GSAT? How does 0.74 °C compare to the information provided in SPM B2.1? In addition, please add the attribution statement for AR6. Please clarify and revise accordingly. [Nicole Wilke, Germany]	Not applicable. Figure dropped for FGD
41081	175	1	175	5	This comment refers to all the TS figures showing observation, but for an example please see Figure TS.4 (page 175): Is there a reason that observational figures are presented without any error bars. Could something be added in the caption? (also, what is the CO2 dataset= global average estimate? Mauna Loa record?). [TSU WGI, France]	Not applicable. Figure dropped for FGD
12107	175		175		Only CO2 emissions and concentration are shown related to temperature change. So we are playing down all others, because to some extent they cancels each other and do not have long-lasting effect on climate [Prabir Patra, Japan]	Not applicable. Figure dropped for FGD
29231	176	1	176	1	Figure TS.5. A vertical bar between "Land Ice" and "Atm res" is recommended, as the meaning of the three colors becomes different. [Yugo Kanaya, Japan]	Not applicable. Figure panel has been split in two. The new Figure TS.2 now has 3 panels, separating model resolution (a), model complexity (b) and pattern correlation with observational references (c).

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
64691	176	1	176	2	In order to show if model also improve in the representation of a climate change, it should be possible to combine in this figure TSS.5 paleoinformation midHolocene change in seasonality and LGM change in annual mean for T and Pr from PMIP simulations . The successive phases of PMIP (PMIP2, PMIP3 and PMIP4) have provided paleoclimate simulations for these two paleoclimate periods with a subset (about 20) of the models used for CMIP3, CMIP5 and CMIP6. Such a figure could convey interesting messages on the credibility of future climate projections. [Pascale Braconnot, France]	Taken into account. This is taken up in the TS, but not in the new Figure TS.2 as this would have made the figure even more complex. However, the New Box TS.2 on Paleoclimate includes Figure 2 which compares global surface temperature as estimated from proxy records (reconstructed) and climate models (simulated).
108757	176	1	176	3	These two vertical axes are confusing me. [Jason Donev, Canada]	Not applicable. Figure panel has been split in two. The new Figure TS.2 now has 3 panels, separating model resolution (a), model complexity (b) and pattern correlation with observational references (c).
19221	176	1	176	12	Figure TSS. The top panel should be split in two for clarity. All panels could suggest "better models" moving upward on the y-axis: for model resolution, this could be achieved by plotting the square of the number of grid points rather than the resolution. A rough scale of resolution could be added to the plot. Changes will have to be coordinated with the figures in chapter 1. [Anne-Marie Treguier, France]	Taken into account. The new Figure TS.2 now has 3 panels, separating model resolution (a), model complexity (b) and pattern correlation with observational references (c).
15295	176	1	176	14	Figure TS.5. Upper panel. It took me a while to understand the axes here. It would be good to clearly indicate that the two right-hand categories (ocean resolution, atmos resolution) use the right-hand axis, but the others use the left-hand axis. Maybe a vertical line, or a break in the x axis. Or two separate panels. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. Figure panel has been split in two. The new Figure TS.2 now has 3 panels, separating model resolution (a), model complexity (b) and pattern correlation with observational references (c).
32533	176				Figure TS.5: first panel, a square should be added around the caption, otherwise, the 3 crosses (especially the black one) could be interpreted as part of the graph. You can also put the caption outside the graph. [Eric Brun, France]	Taken into account. The legend of new Figure TS.2 only uses colours to indicate the CMIP phase
32535	176				Figure TS.5: first panel, please add to the legend the definition for "ESM", "Ocean BGC", "Atm res", "Ocean res". [Eric Brun, France]	Rejected. This has not been taken up in new Figure TS.2. It would further lengthen the caption without much benefit. The abbreviations are largely self-explanatory together with the text in the caption. E.g., (a) Evolution of model horizontal resolution and vertical levels

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
32537	176				Figure TS.5: second panel, it is impossible to distinguish grey circles. An other colour should be used (black or red) and circles should be larger. [Eric Brun, France]	Taken into account. For the new Figure TS.2 we have increased the symbols and adapted the colours etc. for clarity.
32539	176				Figure TS.5: (a) and (b) must be added in front of each corresponding graph. [Eric Brun, France]	Editorial.
84139	176				not possible to understand what [km] means at the axis at right [Manfred Treber, Germany]	Rejected. The axes annotation is largely self-explanatory together with the text in the caption. E.g., (a) Evolution of model horizontal resolution and vertical levels. km stands for kilometres
97901	177	1	177	10	Figure TS.6: We do not understand, why these events are called low-likelihood events. From the discussion in the text not the events themselves are of low-likelihood, but the warming level. The warming level depends on the response to the climate drivers, but much more on the socio-economic scenarios that determine the climate drivers including GHG emissions. There is no probability associated with the realisation of scenarios, and hence any warming level. We do therefore not understand the approach of linking the RFC to the pdf to the ECS as assessed in the AR6. In addition, the RCF risk categories include many aspects (detection, attribution, adaptation, exposure...), which will be more deeply discussed in WG II. The caption "illustrating concepts of low-likelihood, high impact events" implies these events per se are of low-likelihood. Please revise and use figures that match the message of the text. Please see also our comments on Box TS.2. [Nicole Wilke, Germany]	Not applicable. Figure does not include RFCs now.
108759	177	1	177	10	I don't think the horizontal axis of climate sensitivity here really makes sense. [Jason Donev, Canada]	Noted. Figure and caption have been substantially changed.
131965	177	1			Figure TS.6 remove acronyms including pdf [Hans Poertner and WGII TSU, Germany]	Noted. Figure and caption have been substantially changed.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
32541	177	2	177	2	Please explain what "pdf" here means. [Eric Brun, France]	Noted. Figure and caption have been substantially changed.
32543	177	4	177	5	Please correct: a verb is lacking in this sentence. [Eric Brun, France]	Noted. Figure and caption have been substantially changed.
131967	177	4			Figure TS.6 'see Figure 1.12 for details. This figure refers the reader to Sutton et al 2018 for details. Please bring details into the chapter if not TS as they are required to understand the figures [Hans Poertner and WGII TSU, Germany]	Noted. Figure and caption have been substantially changed.
15297	177		177		Figure TS.6. It would be good to make a clearer link between the RFC1 in the legend of GMST change, and the graph for RFC1 in the bottom right. Same for RFC2 and the graph in the bottom left. Maybe an arrow going from the legend to the graph? Or better, place the GMST legend above the respective graph. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. Figure does not include RFCs now.
112691	178	1	178	1	4th line in Fig. TS.7 : Model data from different experiments [Daniel Häussinger, Switzerland]	Not applicable. Figure dropped for FGD

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97903	178	1			Figure TS.7: We are surprised to see "literature" and "climate experts" being mentioned as Inputs. How does this compare to the IPCC's guidance on grey literature? Please explain in the TS and in Ch10 how the storyline and narrative approaches are consistent with the quality standards of the IPCC. [Nicole Wilke, Germany]	Not applicable. Figure dropped for FGD
40611	179	1	179	1	On reasons for concern. They way the graph is presented, it looks like "RfC" kick in only at > 5 C warming level. [TSU WGI, France]	Not applicable. Figure dropped for FGD
54839	179	2	179	6	Figure TS.8: The caption for this figure would benefit from some additional explanation about the scenarios (DI1) to explain that these are represented by the coloured arrows and shaded uncertainty band. [Nancy Hamzawi, Canada]	Not applicable. Figure dropped for FGD
40455	180	1	180	1	Is the y axis really "climate"? [TSU WGI, France]	Not applicable. Figure dropped for FGD
112693	180	1	180	1	Top right marker scenario (dark red) read: "SSP5-8.5" NOT SSP1-8.5 [Daniel Häussinger, Switzerland]	Not applicable. Figure dropped for FGD
31675	180	1	180	1	Box labelled SSP1-8.5 should probably be SSP5-8.5 [Petra Seibert, Austria]	Not applicable. Figure dropped for FGD
54841	180		180		Figure TS.9: Consider whether it would be helpful to include an additional panel here to show the scenario space for the 5 SSPs along the axes of challenges for mitigation and challenges for adaptation. [Nancy Hamzawi, Canada]	Not applicable. Figure dropped for FGD

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
50549	180		180		Please clarify here that a range of different cumulative emissions are compatible with each RCP concentration pathway (as shown in AR5 WG1 Chapter 6 figure 6.25 and also more recent work such as Booth et al (2017) Narrowing the Range of Future Climate Projections Using Historical Observations of Atmospheric CO ₂ , J. Climate 30, 3039-3053 https://doi.org/10.1175/JCLI-D-16-0178.1 [Jolene Cook, United Kingdom (of Great Britain and Northern Ireland)])	Not applicable. Figure dropped for FGD
32545	180				Figure TS.9: The color box at the top right of the graph should be labelled SSP5-8.5 instead of SSP1-8.5. [Eric Brun, France]	Not applicable. Figure dropped for FGD
4535	181	1	181	1	This is a very emotional graph with a missionary background. The dark blues around 1850 reflect the end of the Little Ice Age, the coldest phase of the entire last 10,000 years. It in no way represents a temperature average for the Holocene or past few millennia. The average temperature of the past 10,000 years corresponds to the temperature the world reached in 1940-1970. This should be the baseline, also reflected by colour. See Lüning & Vahrenholt 2017 (doi: 10.3389/feart.2017.00104) for details. You may add another colour-coded bar graph of the temperature development of the past 2000 years which shows red colors during the Medieval Warm Period. Take e.g. graphs from Europe, South America or Antarctica, but avoid using the new hockey stick from PAGES2k which unfortunately is scientifically not robust. [Sebastian Luening, Switzerland]	Not applicable. Figure dropped for FGD
97905	181	1			Figure TS.10: We very much appreciate the illustrative character of this figure. It provides a holistic view observed and future warming for different scenarios in a fresh design that clearly conveys the interannual variability of past warming which overlays the overall warming trend. To add even more value to it, we suggest to show CMIP6 data instead of those from MIROC6. Also, we kindly request to add a legend clarifying the colour code of the stripes. This Figure would be very helpful to be used in the SPM to distinguish between different CMIP6 scenarios in terms of temperatures and emission pathways (peak, half, zero), conveying the message that we are at a crossroad for different futures. We feel that this Figure could complement Box SPM.2 Figure 1 nicely. [Nicole Wilke, Germany]	Not applicable. Figure dropped for FGD
18891	181	5	181	7	Fig. TS. 10: The color legend is missing. Without the color legend, there is no need to discuss which model has provided the projection. [Govindasamy Bala, India]	Not applicable. Figure dropped for FGD

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
111229	181	7	181	7	"The points in time" are rather "the year" [Volodymyr Osadchy, Ukraine]	Not applicable. Figure dropped for FGD
32547	181				Figure TS.10: please recheck: on the "high" possible futures, a cross with "peak" should be present (like the 4 others possible futures). [Eric Brun, France]	Not applicable. Figure dropped for FGD
32549	181				Figure TS.10: a caption should be added to indicate to which temperature each shade of colour corresponds [Eric Brun, France]	Not applicable. Figure dropped for FGD
40519	182	1	182	1	Maybe label the x axis ? Year : Fig 9 and Box TS.1, Figure 1 [TSU WGI, France]	Not applicable. Box TS.1, Figure 1 was deleted from the Final Government Distribution Draft.
97907	182	1	182	8	Box TS.1, Figure 1: The difference in GSMT and GSAT are not clear. Are these projections? observations? A hybrid? [Nicole Wilke, Germany]	Not applicable. Box TS.1, Figure 1 was deleted from the Final Government Distribution Draft. The former Box TS.1 on the Global Temperature Definitions does no longer appear in the revised FGD. The distinction between GMST and GSAT has been reassessed as part of the revisions for the FGD in Chapter 2, Cross-Chapter Box 2.3: New estimates of global warming to date and key implications. This is summarized in the new TS Cross-Section Box TS.1: Global Surface Temperature Change.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
111235	182	1	182	8	In order to show the problem better, SST should be in the figure to demonstrate retard in its rising [Volodymyr Osadchy, Ukraine]	Not applicable. Box TS.1, Figure 1 was deleted from the Final Government Distribution Draft. The entire Box TS.1 on the Global Temperature Definitions does no longer appear in the revised FGD. We refer to "TS Cross-Section Box TS.1: Global Surface Temperature Change" and "Chapter 2, Cross-Chapter Box 2.3: New estimates of global warming to date and key implications" for an in-depth assessment.
10893	182	1	182	8	Is the model chosen one with the biggest "GMST"/"GSAT" difference? [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. Box TS.1, Figure 1 was deleted from the Final Government Distribution Draft.
10895	182	1	182	8	Individual ensemble spread of model should be shown to highlight the significance of the difference, and show if detectable in simulated data or not. [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. Box TS.1, Figure 1 was deleted from the Final Government Distribution Draft.
10897	182	1	182	8	CMIP spread should be shown to highlight how important difference is compared to model uncertainty. [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. Box TS.1, Figure 1 was deleted from the Final Government Distribution Draft.
10899	182	1	182	8	Observational uncertainty should be included, to show significance of effect next to other uncertainties. [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. Box TS.1, Figure 1 was deleted from the Final Government Distribution Draft.
10901	182	1	182	8	Are you really showing a projection as a single line? Show ensemble spread, uncertainties are needed! E.g., https://link.springer.com/article/10.1007/s10584-011-0178-6 [Gareth S Jones, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. Box TS.1, Figure 1 was deleted from the Final Government Distribution Draft.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
32553	182	8	182	8	At the end of this sentence, please add: "until 2030". [Eric Brun, France]	Not applicable. Box TS.1, Figure 1 was deleted from the Final Government Distribution Draft.
18893	182	8	182	8	GSA should be GSAT [Govindasamy Bala, India]	Not applicable. Box TS.1, Figure 1 was deleted from the Final Government Distribution Draft.
32551	182				Figure Box TS.1, Figure 1: regarding the "Definition gap growing" panel: this information should be explained and the figures should be commented in caption below. [Eric Brun, France]	Not applicable. Box TS.1, Figure 1 was deleted from the Final Government Distribution Draft.
40203	183	1	183	1	Fig TS.11 Can't read the most of the legends. Could this be simplified? [TSU WGI, France]	Accepted. Legibility of figure has been improved and are now all legible.
15317	183	1	183	12	Figure TS11. This Figure has a low of independent panels, and the relationship between each is not always clear. It might be helpful if the timescales changes monotonically from top to bottom, or that there was some clear structure or "story" running through the Figure. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Figure TS.11 have been updated, with less panels (4) and improved inter-connection of the panels and story line included in the text.
15319	183	1	183	12	Figure TS11. The 4 panels to the right of element (b) are not readable and should be simplified. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Figure TS.11 have been updated, with less panels (4) and improved inter-connection of the panels and story line included in the text.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97909	183	1			Figure TS.11: Simplify this figure as much as possible! There is way too much information in too little space. [Nicole Wilke, Germany]	Accepted. Figure TS.11 have been updated, with less panels (4) and improved inter-connection of the panels and story line included in the text.
108761	183	6	183	11	Make this more clear and more direct. It's hard to follow and a bit wishy-washy. [Jason Donev, Canada]	Accepted. Figure TS.11 have been updated, with less panels (4) and improved inter-connection of the panels and story line included in the text.
32555	183	7	183	8	Regarding the term "which is highly unusual": this part of the sentence is unclear and should be reformulated. We propose to replace it by ". We can see that such a rate of change since 1920 are very unusual". [Eric Brun, France]	Not applicable. The sentence is no longer present in the FGD.
32557	183	8	183	9	What is the purpose of this sentence? We propose to delete it. [Eric Brun, France]	Accepted. The sentence expressed the intent of the Figure, but has been removed in the FGD
32559	183	9	183	9	We suggest to replace the beginning of the sentence by "Observing GHG growth rates shows that...", in order to make it clearer. [Eric Brun, France]	Not applicable. The sentence is no longer present in the FGD.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
54843	183		183		Figure TS.11: This figure is clearly designed as a poster. Posters should be separate products. What is needed in IPCC reports are figures that can be used in briefings (in slide shows) with separate panels that can be downloaded intact or at least easily extracted from the whole. Overall, there is too much information in this single figure. Recommend limiting graphs to at most 4 panels. Our recommendation would be to delete the 3rd figure from the top and the last one about growth rate. Also, in caption (c), the reason for selecting 2011 as a reference year needs explanation as there is no apparent reason from the graphs (showing trends since 1960) of selecting 2011 (we assume this is a reference to changes since AR5 results). Alternatively, the caption could describe changes over the observation period shown. [Nancy Hamzawi, Canada]	Accepted. Figure TS.11 have been updated, with less panels (4) and improved inter-connection of the panels and story line included in the text. The reference to 2011 was indeed related to the update of AR5, but has been removed in the final figure. Thank you for the good suggestion.
15323	184	1	184	1	Figure TS12. the errors bars for the LIG GMST look wrong. The text says +-0.5 degrees, but the error bars drawn are less than that. [Daniel Lunt, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Final assessed value in CH2 is 0.5 to 1.5°C.
111245	184	1	184	4	There is anomaly of global mean surface temperature in panel (a) [Volodymyr Osadchy, Ukraine]	Accepted. Y-axis title now includes "relative to 1850-1900"
131969	184	1			Figure TS.12 panel c - in description below panel specify this is land surface air temp and sea surface temperature [Hans Poertner and WGII TSU, Germany]	Not applicable. The figure is no longer being used in its SOD form.
54845	184		184		Figure TS.14: This figure is also clearly designed as a poster and while it is more legible than TS.13, and the production of separate posters as an IPCC-product is encouraged, we urge the IPCC to produce this figure in a way that each panel can be extracted cleanly to use in slide-show briefings [Nancy Hamzawi, Canada]	Not applicable. The figure is no longer being used in its SOD form.
32561	184				Figure TS.12: the uncertainty line for the Last Interglacial temperature should begin at 1.0 and finish at 2.0 °C. [Eric Brun, France]	Taken into account. Final assessed value in CH2 is 0.5 to 1.5°C.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
32563	184				Figure TS.12: the uncertainty line for the Last Glacial maximum corresponds approximately to -7.3 to -4°C and not to "-6 +/- 1.5 °C" (the line should begin at -7.5 and finish at -5.5 °C). [Eric Brun, France]	Taken into account. Last Glacial Maximum temperature not included in the FGD figure, but is stated in Box TS.2, Figure 1
32565	184				Figure TS.12: The panels should be names "a", "b", "c" and "d" as in the legend, not "A", "B", "C and "D". [Eric Brun, France]	Not applicable. The figure is no longer being used in its SOD form.
32567	184				Figure TS.12: The label "last interglacial" in the graph should be in black or in gold but not in red since the value as not been derived from thermometers! [Eric Brun, France]	Accepted. Colour changed
32569	185	2	185	2	Please specify, after "LSAT", "(Land surface air temperature)". [Eric Brun, France]	Not applicable. The figure is no longer being used in its SOD form.
32571	185	6	185	6	Please specify, after "OLS", "(Ordinary Least Squares)". [Eric Brun, France]	Taken into account. Text revised.
32573	185	6	185	6	Is it AR1 or AR(1)? Or FAR? [Eric Brun, France]	Taken into account. Text revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
32575	185	7	185	8	The purpose is unclear. Is it to show something? or to illustrate the key role of something? or something else? In fact, a verb is lacking in this sentence. [Eric Brun, France]	Not applicable. The figure is no longer being used in its SOD form.
108763	185	7	185	8	Unclear, could these lines be re-worked. I had trouble understanding what was being said. [Jason Donev, Canada]	Not applicable. The figure is no longer being used in its SOD form.
32577	186	14	186	14	Where are the GSAT changes shown ? [Eric Brun, France]	Not applicable. The figure is no longer being used in its SOD form.
108765	186	16	186	17	The 'purpose' at the end should be moved to the beginning, it nicely clarifies what these figures are doing. [Jason Donev, Canada]	Not applicable. The figure is no longer being used in its SOD form.
54847	186		186		Figure TS.13: The presentation of Other Forcings is confusing since agents with a warming effect on climate (BC on snow, ozone etc.) are shown here as contributing to global cooling. We assume that the positioning of the bar for these warming agents adjacent to the bar for aerosols and LUC is intended to be read as offsetting effects but this interpretation is not explicit in the caption, is not readily interpreted this way from the Y-axis and contravenes understanding of how these agents work. We are concerned this figure will not be readily understood. Also, no chapter source figures are given for the top left and right panels. Figures 7.11 AND 7.12 seem close but the values don't align completely. [Nancy Hamzawi, Canada]	Not applicable. The figure is no longer being used in its SOD form.
15021	186				Figure TS13 (SPM3) is crucial. The uncertainty limits on the 'other human forcings' (blue) line, principally due to aerosols, are too difficult to assess due to the complexity of the Report. It is made clear repeatedly in several chapters that the role of cloud-aerosol interactions with the radiation field and hence the energy budget remains quite uncertain and difficult to treat reliably. But see below. [Fredric Taylor, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. The figure is no longer being used in its SOD form.
108767	187	1	187	1	Switching the two vertical axes would strengthen this. Having more than one baseline is weird, are they both needed? Consistency will strengthen this document. [Jason Donev, Canada]	Rejected. Both baselines are needed as, on the one hand, 1995-2014 is a standard baseline for projections, on the other hand, key thresholds such as 1.5 C are defined with respect to 1850-1900. Figure 14 is no longer being used but a corresponding panel appears in Cross-Section Box 1 Figure 1.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
32579	187	8	188	2	It is not clear which one is cyan, and which one is light blue. [Eric Brun, France]	Not applicable. The figure is no longer being used in its SOD form.
108769	188	21	188	25	Could this be three different figures? I feel like too much has been crammed into the figure captions and the figures present different enough ideas that they could and should be seperated. [Jason Donev, Canada]	Not applicable. The figure is no longer being used in its SOD form.
97911	189	1			Please see our comment on Figure TS.6 regarding the attributing likelihoods to certain levels of warming. Likelihoods of warming levels are dominated by the emission/socio-economic scenario, not by but this message is not appropriately transported by this figure. Please revise. [Nicole Wilke, Germany]	The figures was substantially revised and moved to TS1.
131971	189	1			Figure TS.2 Figure 1 - the assessment for this Figure will be done in WGII. I cannot see any traceability back to where this information is assessed - other than the reference to the WGII SPM [Hans Poertner and WGII TSU, Germany]	The figures was substantially revised and now shows information on GWLs rather than risk. The figure was moved to TS1.
131973	189	1			Box TS.2 Figure 1 - here the figure uses GMST however the caption uses GSAT [Hans Poertner and WGII TSU, Germany]	The caption and legend have been revised when moving to TS1.
108771	189	3	189	3	Insufficient colour gradient to show what's being illustrated. [Jason Donev, Canada]	Figure has been revised
54849	189		189		Box TS.2 Figure 1: The full version of this Figure in Ch. 1 (Figure 1.12) is in some ways easier to understand because it walks readers through the different steps in a logical way. At a minimum, Figure 1.12 should be referenced in this figure caption so readers can seek out the more comprehensive version of this figure if they wish. [Nancy Hamzawi, Canada]	The figures was substantially revised and moved to TS1.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
111721	189				Box TS.2 Fig 1. It's extremely welcome that an attempt has been made to address low probability, high impact risks in this box, and in the figure. I think the figure needs clarification. Assuming a simple risk = probability x impact framework is being used, is the top bar representing the risk associated with different warming levels, or just the impact? This is a potentially valuable figure but it needs to be clearer what it is showing. [Richard Wood, United Kingdom (of Great Britain and Northern Ireland)]	The figures were substantially revised and moved to TS1.
97913	190	1	191	10	Box TS.2, Figure 2: The differences in warming (panel a-d) and precipitation (panel e-h) is not presented as significant as one would expect from the discussion in Box TS.2 (e.g. "only" one shading warmer, the red curves are only slightly flatter than the black mean curve). We recommend to provide other figures or at least to adjust the scales in order to make the differences more visible between the five high warming models and the multi-model mean. Particular for the four lower panels it looks like that the black line (CMIP6 mean) is not covered by the grey area (CMIP6 model range) which leaves us surprised. In addition, the title of the upper right figure should probably be "low warming storyline models". Please verify. [Nicole Wilke, Germany]	The colour bar has and the selection of storylines has been revised following the revisions of chapter 4.8.
131975	190	1			Box TS.2 Figure 2 - which temperature metric? GMST or GSAT? [Hans Poertner and WGII TSU, Germany]	GSAT. This has been clarified
18895	190		190		Legend of Fig. 2 of BOX TS 2 in panels e and g: "CMIP6 model range" should be changed to "CMIP6 model 5-95% GSAT range" for accuracy. [Govindasamy Bala, India]	The panels have been removed from this figure
84113	191	4	46	5	Eliminate this sentence. It contradicts the immediate next sentence, that establishes that the main driver is the accumulation over the past 200 years, and is not limited to the emissions of the 2nd half of the XXth century. [Marco Tulio Cabral, Brazil]	Not applicable. The part on carbon cycle (box TS.5) has been completely rewritten.
18897	191	6	191	6	"warming near the upper bound (thin red lines) and exceeding the upper bound (thin brown lines)": Does the upper bound correspond to the upper bound of the very likely range of the CMIP6 models? Or does it correspond to the upper bound of "assessed" very likely range as in panels b and d? It is better to clarify this in the caption. [Govindasamy Bala, India]	The panels have been removed from this figure

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
84103	191	31	8	31	proposal: In response to this objective, UNFCCC established several instruments and means of implementations, being the most recent one the Paris Agreement (2015), that set the goals... Just: as it is stated, the message is that since the establishment of its objectives, in 1992, nothing was accomplished, being the only valid instrument the PA. The Kyoto Protocol should be mention as part of the efforts to mitigate. [Marco Tulio Cabral, Brazil]	Not applicable. Section dropped for FGD
84111	191	38	26	42	the document mentions in other poitns some further sectors that contribute to emissions and warming, such as energy, indsutry, transportation, residential, waste... However, agriculture is the only sector that is repitedly used in detail regarding the related emissions. Please search for balanced examples and details. [Marco Tulio Cabral, Brazil]	Rejected. It is not clear what this comment refers to. Page 191 of the TS SOD showed the caption for CMIP6 multi-model mean change in 2081–2100 relative to 1995–2014 in different scenarios.
84105	191	41	8	41	AR6 will provide information of potential relevance - Just: the GST is an ongoing process, the AR6 is under development and discussion. [Marco Tulio Cabral, Brazil]	Noted and agreed. The TS has greatly improved between the SOD review and the submission of the FGD.
84115	191	44	46	46	the document mentions in other poitns some further sectors that contribute to emissions and warming, such as energy, indsutry, transportation, residential, waste... However, agriculture is the only sector that is repitedly used in detail regarding the related emissions. Please search for balanced examples and details. [Marco Tulio Cabral, Brazil]	Rejected. It is not clear what this comment refers to. Page 191 of the TS SOD showed the caption for CMIP6 multi-model mean change in 2081–2100 relative to 1995–2014 in different scenarios.
84107	191	53	8	54	while Climate change is a very transversal subject, the efforts to contain biodiversity loss are an objective on its own. It affects climate change, but its objective is not to constrain climate change. While trasnversality and multiple influences should be considered and respected, the lines of action and their scope should be respected as well, risking, otherwise to loose focus. [Marco Tulio Cabral, Brazil]	Not applicable. Section dropped for FGD
84109	191	57	10	13	(...) quality, quantity and geographical distribution of observations (...) just: climate science has considerably developed, but, as referred in section 1.7, the variety of regions and capacities of studies, and the limits to assessments such as AR6 are considerable. The strong dominance of studies and scientific development in certain parts of the world has shaped instruments, methodologies and interpretations - that although very valid, represent a very specific paradigm. [Marco Tulio Cabral, Brazil]	Not applicable. Section dropped for FGD

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97915	192	0			pH decrease: longitude is not clearly connected to the figure. At first sight it seems that the bar underneath is connected to the longitude. [Nicole Wilke, Germany]	Taken into account. Figure revised - see Figure TS.11.
108773	192	1	192	2	The ocean acidification graphic is confusing. [Jason Donev, Canada]	Taken into account. Figure revised - see Figure TS.11.
116157	192		192		What is the rationale for the choice of oceanic climate change, could it build on the figure from SROCC TS? What about sea level? [Valerie Masson-Delmotte, France]	Taken into account. We have adopted a similar presentation to SROCC in the revised Figure TS.11, which includes cryosphere components. Sea level is show in Box TS.4. See also Figure TS.2.
32581	192				Figure TS.15: for the marine heat waves, please replace "since 1982-2016" by "since the 1982-2016 average" [Eric Brun, France]	Taken into account. Figure revised - see Figure TS.11.
108775	193	1	193	2	Putting in a key danger line for the ocean pH would make the information in this graphic more appropriate to the technical summary by providing context and perspective. [Jason Donev, Canada]	Rejected. The impacts of ocean acidification for biology / ecosystems is the domain of WG2 and will be handled in their assessment.
100559	193	4	193	4	Fig. TS.16, it's possible to add in material for the MCO, but that will take some digging and data processing [Matthew Kohn, United States of America]	Noted. WGI report does not include an assessment of MCO global mean sea level or ocean pH.
112695	194	2	194	3	In Fig. TS.17 SSPs should be labeled according to the conventions used earlier: so instead of "ssp126" read : "SSP1-2.6" etc [Daniel Häussinger, Switzerland]	Editorial. Taken into account. The only time series from TS.17 that remains in the FGD is in TS.8, where the convention is properly applied.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
112697	195	1	195	1	In Box TS.3, Fig1 SSPs should be labeled according to the conventions used earlier: so instead of "ssp126" read : "SSP1-2.6" etc. [Daniel Häüssinger, Switzerland]	Accepted.
100561	195	4	195	4	For Box TS.3, Fig. 1, it's possible to add in material for the MCO, but that will take some digging and data processing [Matthew Kohn, United States of America]	Noted. WGI report does not include an assessment of MCO global mean sea level or ice sheet mass.
32583	195				Box TS.3 Figure 1: Please explain what is "Figure CCB92.1" [Eric Brun, France]	Taken into account. Figure has been revised substantially and caption rewritten.
32585	197				Figure TS.18: please explain in the legend what "wrt" (with respect to) and "piControl" mean. [Eric Brun, France]	Not applicable. Fig. TS.18 of the SOD is not included in the FGD
32587	198				Figure TS.19: the figures on the upper right of each planisphere should be bigger. [Eric Brun, France]	Not applicable. Fig. TS.19 of the SOD is not included in the FGD
109715	199	1	199	15	Need to define here what is meant by "runoff", as this term is commonly understood to be river runoff but global climate models are incapable of modeling that process. Physically plausible projections of future river runoff is only possible by downscaling climate model data to the watershed scale and using this information to drive river hydrology models (sometimes with local glacier and vegetation models in between) - which has been widely done, but is not what's shown here. At best, the runoff fields generated by climate models are a loose indicator of some general directions that future river runoff could take. [Sean Fleming, United States of America]	Noted: runoff is defined in the glossary and includes all surface and sub-surface flows of which streamflow is a part of - further description in this figure is not deemed necessary

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
32589	199	6	199	6	We are surprised by the results for runoff. A strong increase is projected over the south of Spain, the North of Italy, the french riviera, Morocco, which is not consistent with the previous IPCC report. Results over the southwestern USA are also different from what is expected. Note also that the results are sometimes not consistent with the figure in Faq 8.3 (figure p216 of chapter 8). Strange rectangular artefacts are also noted, near Bolivia for exemple etc. There are likely issues with re-gridding, or the sample of models used etc. Also check the results as a few CMIP6 models regularly show negative values of river flows. [Eric Brun, France]	Taken into account. Runoff of fig TS.20 of the SOD was computed based on 21 CMIP6 model. In the FGD it appears now in Box TS.6 Fig 1 computed with 32 models and the patterns has changed compared to the SOD. The unexpected increase in the regions highlighted by the reviewer are not there anymore (it was probably related to considering a small number of models). Anyway all the results shown for runoff (coming from ch 8) have been verified with available literature and theoretical understanding.
54851	199		199		Figure TS.20: since the phrase "precipitation variability" is by itself unclear in terms of what this refers to, recommend adding "interannual" to this label (RH panel, last row) so that it reads as in the caption "precipitation interannual variability". This would be helpful given that the figures are often used alone without the caption (e.g. on slides). [Nancy Hamzawi, Canada]	Not applicable. Fig TS.20 of the SOD is translated into Box TS.6 Fig 1 and the variable "precipitation variability" is not shown anymore
97917	200	1	200	7	Figure TS.21: It would be very helpful to also present the emissions and the concentrations of the two scenarios shown here. Thereby, it would be obvious that smaller sinks of the SSP1-RCP2.6 are caused by lower excess CO2 and not by an direct result of some climatic/physical feedback to low-emission scenarios. [Nicole Wilke, Germany]	Taken into account. We agree that it would be very useful to show both emissions and concentrations in addition to the panels in TS.21. Unfortunately, tight space constraints make it impossible to add both panels in the revised figure (now Box TS.5, Figure 1), so we can only add concentrations. However, we do think that the figure now conveys the message the reviewer wants us to make, as it becomes quite clear from looking at the figure that the differences in sink strength and sink fraction are linked to the concentrations.
66443	200	1	200	7	I'd suggest to apply some sort of decadal time smoother to the carbon flux data so as to better isolate that contribution of the uncertainty that is due to model disagreement rather than due to interannual variability. [Charles Koven, United States of America]	Noted. The original flux panel was replaced by a panel showing combined land and ocean carbon fluxes, which exhibit less interannual variability.
44929	201	1	201	70	The change of "frequencies of severe convective storms" is listed. In precicely, it is only for springtime. [Masaki Satoh, Japan]	Not applicable. The figure has been replaced with Figure TS.12 which is very different and does not address the frequencies of convective storms, so the comment does not apply.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
32591	201				Figure TS.22: in the middle of the graph, it is difficult to distinguish the 2 colors. The circle behind should be much darker. [Eric Brun, France]	Not applicable. The figure has been replaced with Figure TS.12 which is very different, so the comment does not apply.
32593	202	7	202	7	Please specify, after "MICI", "(Marine ice cliff instability)". [Eric Brun, France]	Accepted. Figure removed.
111723	202				I welcome the existence of Box TS.4 and I think it contains much excellent discussion. I'm not sure about this proposed figure though. Is the idea to somehow show how to produce a broader pdf by bringing in specific tipping points? I'm not sure this is useful. First, any probability assessment cannot be robust where it includes information on events for which there is deep uncertainty. Secondly, it tends to perpetuate the idea that pdfs are the only useful way to present uncertain information on climate risk. Especially where there is deep uncertainty, the use of narratives/storylines, and the development of robust early warning indicators seems a much more informative approach to allow explicit management of the risks. This is recognised at points in the box text. An epidemic would be a good analogy: there is little value in just estimating a pdf of the number of people who will suffer from an emerging disease in the next year, the expected value in any given year would be small and in any case it would not inform any useful action; more useful is to generate plausible scenarios and put in place scenario planning and early warning so that rapid response is possible if such an event emerges. I think it would be helpful for this box to emphasise such a different way of approaching management for low probability high impact risks, and for the figure (possibly more of a cartoon of risk management processes) to emphasise this. [Richard Wood, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Figure removed.
35863	203	1	203	10	I'm concerned that the ocean boxes don't cover the whole ocean, particularly upwelling & western boundary current regions. Someone needs to check to make sure this doesn't make a difference in the warming of different regions while making this plot. [Baylor Fox-Kemper, United States of America]	Taken into account. Only global ocean heat content is shown in the revised Figure TS.7.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
32595	203				Figure TS.23: in order to make the figure more readable, we propose to set it in landscape. [Eric Brun, France]	Taken into account. The figure has been revised substantially to improve clarity and now appears as Figure TS.7.
32597	205				Cross-Section Box 1, Figure 2: in order to have a caption in the same order as curves, SSP5-8.5 should be quoted first and SSP1-1.9 last. [Eric Brun, France]	Not applicable. Figure dropped for FGD
35865	206	1	206	10	The subpanels on this figure are very small, and while I get that the idea is to make sure of the "big picture" impacts, I'd hope that in coordination with the Atlas, there could be links here to each of these variables in the Atlas, so that readers can zoom into regions of interest. [Baylor Fox-Kemper, United States of America]	Not applicable. Figure dropped for FGD. Some material is retained for Figure TS.5.
32599	206				Cross-Section Box 2, Figure 1: in order to make the figure more readable, we propose to set it in landscape. [Eric Brun, France]	Not applicable. Figure dropped for FGD. Some material is retained for Figure TS.5.
35867	207	1	207	10	The subpanels on this figure are very small, and while I get that the idea is to make sure of the "big picture" impacts, I'd hope that in coordination with the Atlas & Chp 12, there could be links here to each of these variables in the Atlas, so that readers can zoom into regions of interest. [Baylor Fox-Kemper, United States of America]	Not applicable. Figure dropped for FGD. Some material is retained for Box TS.10, Figure 1.
97919	207	1			Figure Cross Section Box Fig 2 : The bars look all the same, and it remains unclear what they are showing since letters at the bottom of the bars are not explained. Please improve. [Nicole Wilke, Germany]	Not applicable. Figure dropped for FGD. Some material is retained for Box TS.10, Figure 1.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
54853	207		207		<p>Cross-section Box 2 Figure 2: 1. The RH panels for this Figure have not yet been developed (or so it appears as the maps seem identical to the LH panel); therefore, we cannot review this Figure in its entirety. Furthermore, there is no indication as to how future changes in specific extreme events, which have been assessed in an event attribution framework under specific past/current conditions, can be projected forward under different levels of future warming. By definition, attribution of changes relates to observed events, not future events. In order for the RH panels of this Figure to be included in the TS, they would have to be supported by content in the WGI report and we do not find this information presently. Overall, we consider Cross-section Box 2 Figures 1 and 3 to provide clear evidence to support the conclusions in this Box about observed and projected changes at different global warming levels. As the authors have run out of time to sufficiently develop the concept for this figure and as there is no underlying material to support this figure, given that TS will not be reviewed again, we do not believe this figure should be included in the FGD of the TS. [Nancy Hamzawi, Canada]</p>	<p>Not applicable. Figure dropped for FGD. Some material is retained for Box TS.10, Figure 1.</p>
54855	207		207		<p>Cross-section Box 2 Figure 2: LH panel - comments are the same as on Figure SPM.6. 1. The main concern is the risk that this Figure will be easily misinterpreted. In Ch. 11, this Figure was clearly presented as a summary of available literature on extreme event attribution and was intended to highlight the growing literature on event attribution covering events globally, rather than general attribution of human influence on relevant extremes. This figure can easily be perceived as representing general attribution of extremes for the whole region or anywhere within the region. But such an interpretation cannot be supported by the underlying assessment of Chapter 11. 2. It is not possible from the information provided with this Figure to know how to interpret an icon. For example is the icon for fire meant to be interpreted as wildfire intensity or area burned or duration of the fire or is it the weather condition that is prone/conducive to fire? Some icons are not at all readily understood as extreme events (e.g. sunshine hours, high pressure, stagnant air, sea ice extent (declining trend or a specific year's extent?). 3. Even if the icon is understood, there is not a clear and easy interpretation of the map. For example, if the fire icon in NWC is wildfire intensity, then how should the icon in NWC be interpreted? One interpretation could be that there is low confidence that anthropogenic influence has increased the intensity of wildfires in this region (or increased the frequency of wildfires of a given intensity?), but we don't know how many studies this assessment is based on or how broadly such a conclusion would be applicable. Overall it is difficult to understand and interpret this Figure properly without in-depth knowledge of the literature or the subject. [Nancy Hamzawi, Canada]</p>	<p>Not applicable. Figure dropped for FGD. Some material is retained for Box TS.10, Figure 1.</p>

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
54857	207		207		Cross-section Box 2 Figure 2: LH panel: SPM figures should ideally be clear, self-explanatory and simple. This figure is none of these. If it is to be used, it would be better placed in the underlying TS as most readers of the SPM will have considerable difficulty (correctly) interpreting the contents, and appreciating the caveats. The way the figure is constructed also leaves it open to misinterpretation by those who do not fully understand what event attribution is. For example, a casual reader will see that the figure is about extreme events, and looks at the legend which indicates that upward and downward facing arrows indicate an increasing or decreasing "signal". That casual reader could easily infer that the results are indicating attribution of *trends* in these extremes in various locations (which would be wrong). Likewise, the lack of symbols in some regions could be misinterpreted as a lack of signal (lack or change or trend) rather than what it actually indicates (which is that no event attribution study is available). [Nancy Hamzawi, Canada]	Not applicable. Figure dropped for FGD. Some material is retained for Box TS.10, Figure 1.
32601	207				Cross-Section Box 2, Figure 2: in the legend, RX5d must be explained in caption below: annual maximum five-day precipitation. [Eric Brun, France]	Not applicable. Figure dropped for FGD. Some material is retained for Box TS.10, Figure 1.
32603	207				Cross-Section Box 2, Figure 2: in the legend, the unit shouldn't be "K" (kelvin) but "C". [Eric Brun, France]	Not applicable. Figure dropped for FGD. Some material is retained for Box TS.10, Figure 1.
35869	208	1	208	10	If this figure is done right, it should synchronize well with the figure on pg 206, perhaps even making some of the columns there redundant (or at a minimum, supporting this figure). Significant thought into layout here needs to be taken, and it would be wonderful if after that thought the subpanels could be farmed out to the chapters so that the "visual language" of warming levels is consistent across the report. [Baylor Fox-Kemper, United States of America]	Not applicable. Figure dropped for FGD. Some material is retained for Figure TS.12
108777	208	1	208	20	This is too much information for one figure. The letter ordering required is odd. Please break this up, or at least present it differently. [Jason Donev, Canada]	Not applicable. Figure dropped for FGD. Some material is retained for Figure TS.12

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
108779	208	18	208	20	This linearity vs not discussed in these lines is really not clear from the figures. Opening with that would help, mentioning it throughout would help. Hiding the conclusion at the end means missing the conclusion. One could potentially put these graphs into 'linear responses' and 'non-linear responses' if that's the main focus one is trying to get across here. [Jason Donev, Canada]	Not applicable. Figure dropped for FGD. Some material is retained for Figure TS.12
54859	208		208		Cross-section Box 2 Figure 3: This figure presents a good and readily understood synthesis of how various indicators change as a function of global warming levels. as with some other TS figures, it is another "poster style" figure. Please ensure that each panel of this figure can be used independently. [Nancy Hamzawi, Canada]	Not applicable. Figure dropped for FGD. Some material is retained for Figure TS.12
32605	208				Cross-Section Box 2, Figure 3: the titles of the panels should be as big as the F one. Also, a title (panel H) is missing. [Eric Brun, France]	Not applicable. Figure dropped for FGD. Some material is retained for Figure TS.12
1937	209	1			This disagrees with Fig. 7.12, which has the response to the 1963 Agung eruption almost twice as large as that from 1982 El Chichón. This one is correct and 7.12 is wrong. I know one is response and one is forcing, but the ratio should be the same. Please make sure you explain why they should be different, if you don't fix the figures. [Alan Robock, United States of America]	Not applicable. Figure has been replaced
18793	209	14	209	14	Please make it clear here that the only the forcing from surface reflectivity change due land use land cover change is estimated here. [Govindasamy Bala, India]	Not applicable. Figure has been replaced
18795	209	15	209	15	"TSI" may be changed to "solar" for consistency with figure legend. [Govindasamy Bala, India]	Not applicable. Figure has been replaced
29233	210	1	210	1	Figure TS.25. Better to mention CO explicitly as VOC+CO. [Yugo Kanaya, Japan]	Accepted. Figure revised
108783	210	1	210	1	What's the CH4? Is there CO2 somewhere? This stacked bar graph makes no sense. [Jason Donev, Canada]	Figure has been revised
108785	210	1	210	1	Is it reasonable to put the 1850 to 2014 data on one graph? Isn't the more recent data the more relevant? How are the years weighted? What does this mean? [Jason Donev, Canada]	Taken into account. Figure has been revised to indicate forcing and GSAT changes over the 1750-2019 period
108787	210	1	210	1	The grey in the figure isn't clear. Is that graphing something? Show that differently somehow. [Jason Donev, Canada]	Figure has been revised

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
108781	210	1	210	24	Unclear, could these lines be re-worked. I had trouble understanding what was being said. [Jason Donev, Canada]	Clarified
97921	210	1			Figure TS.25: Please explain what is shown without abbreviations, and please separate explanations of content from those of colours/lines/signs. Please do not expect the reader to know what had been presented in the AR5. [Nicole Wilke, Germany]	Taken into account. Figure has been revised
97923	210	1			Figure TS.25a: The respective figure in AR5 included also the contribution of the most important GHG, i.e., CO ₂ . TS-74 (line 47) states this value as 2.15 W/m ² , and CO ₂ needs to be clearly visible also in TS25.a, since this iconic IPCC-figure must be also included into the SPM. (Figure TS.24e is just not adequate and clear enough for that purpose.) Hence we ask the authors to include the CO ₂ values and to give Figure TS.25a the space of a full, single figure, i.e. to separate it from Figure TS.25b. [Nicole Wilke, Germany]	Done!
18797	210	2	210	10	Panel a) of figure TS 25 is a bit complex. The forcing for CO ₂ is missing in this panel. What is meant by CH ₄ lifetime? This may be explained in the caption. Also, it is interesting that the cloud effect is always negative. The reason may be discussed in the caption. [Govindasamy Bala, India]	Figure has been revised

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97925	210	10			Figure TS.25b: Please separate this figure from TS.25a. Please explain why the figure shows a satellite-based estimate of -1.3 W/m ² and a model-based estimate of -1.2 W/m ² , but an overall AR6 assessment of only -1.1 W/m ² . Please explain on page TS-75 why the overall assessment value is lower than both of the two shown lines of evidence (we have learned from Ch.7 that this is due to different reference periods etc., but the TS lacks this information). [Nicole Wilke, Germany]	Taken into account. Overall assessment of aerosol forcing has been clarified. We keep the emissions-based ERF and GSAT plots together with the aerosol forcing plot
18799	210	12	210	13	How can we have satellite based estimates for the period starting from 1750?? [Govindasamy Bala, India]	Rejected. "satellite based" doesn't mean the estimates rely on satellites only.
108789	210	16	210	22	The intent stated here doesn't come through in this graphical illustration. [Jason Donev, Canada]	Figure has been revised to be consistent with stated intent.
54861	210		210		Figure TS.25: while we understand from the italicized text at the end of the caption that this figure is intended to show advances in understanding since AR5 of emissions-based ERF for SLCFs, it may get used as a stand-alone chart in which case the omission of CO2 ERF is problematic (also given chart title "Components of radiative forcing 1850 to 2014). recommend adding CO2 ERF to this chart. [Nancy Hamzawi, Canada]	Done!
84141	210				Different to Fig. TS.24 for Figure TS.25: where are contrails and cirrus clouds from aviation emissions? [Manfred Treber, Germany]	Noted. Smaller forcing agents like contrails are now lumped together as "other anthropogenic" in the time series of figure TS.13. The bar charts of Figure TS.15 focus on the strongest forcing agents. Forcing due contrails and cirrus clouds from aviation are assessed in section 6.6.2.3.1
23721	211	1	211	1	I don't understand why the total non-CO2 biogeochemical feedback in panel (b) is negative, which is inconsistent with the zero mean in panel (a). I wonder that this difference comes from different assessments across Chapters (5-7), and they have to be reconciled in FGD. By the way, using a different scale for the x-axis in (b) (an order smaller than (a)) is misleading, so the scales should be the same in the three panels. [Masahiro Watanabe, Japan]	Accepted - Inconsistencies in labelling different column across the panels have been revised in FGD. For readability, the different axis of panel b has been retained.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97927	211	1	211	24	Figure TS.26c: Are these feedbacks linear to the degree of warming as presented in this figure? The text referring to this figure (TS-76:42-52) indicates a reduced efficiency with increasing CO2 concentration. Also, for permafrost there is "low confidence in the timing of feedbacks or the degree of linearity as a function of global temperature change" (5-57:51-53). These non-linear relationships are not reflected in this figure. Please revise. If there is a linear relation in a certain temperature range, please provide information on the range and the reasoning behind in the caption. [Nicole Wilke, Germany]	Taken into account - 1) the underlying text (FGD TS-60 L40- TS-61-L7 provides clearer description of the limits of the linearity of these feedbacks. 2) A quantitative assessment of the non-linearity of these feedbacks is not available and therefore not included in the figure. This figure report values as described in Chapter 5.4
32607	211	4	211	4	Please specify, after "ECS", "(equilibrium climate sensitivity)". [Eric Brun, France]	Done!
108791	211	22	211	23	I think one should include the GHG driving for scale to give some idea of how big these are. [Jason Donev, Canada]	rejected - The GHG driving has a different unit (W m-2) compared to the feedbacks (W m-2 °C-1), so these terms cannot be directly compared
32609	212	3	212	3	Please specify, after "ECS", "(equilibrium climate sensitivity)". [Eric Brun, France]	Done!
112949	212		212		This is an intriguing figure of course, and it strikes me that GMSL estimates from the various reports should also be plotted in a similar vein. I have made this figure ad hoc for presentations, and it is very illustrative. Every report has yielded higher estimates. I think this would be a very popular figure and a good complement to the ECS figure. [Kim Cobb, United States of America]	Noted.
108793	213	1	213	4	A longer and more thorough explanation in the caption would help this figure. [Jason Donev, Canada]	Not applicable: this figure has been removed
108795	213	1	213	4	The text uses eta-a with no subscript. [Jason Donev, Canada]	Not applicable: this figure has been removed

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
97929	213	1			Figure TS.28: Please provide much more text for those who are not familiar with the concepts and explain the letters P, Q, S, H, etc. In the current form, the figure is not really helpful. [Nicole Wilke, Germany]	Not applicable: this figure has been removed
32611	213				Figure TS.28: orange and blue colours should be explained in caption. [Eric Brun, France]	Not applicable: this figure has been removed
108797	214	1	214	1	Is this temperature meant to imply an equilibrium? We haven't reached equilibrium yet. [Jason Donev, Canada]	Taken into account - No, the global average temperature increase shown here is the transient temperature, which, however, remains broadly constant when CO2 emissions are zeroed.
130397	214	1	214	14	Figure 5.31 is not cross-referenced to the main text (page TS-82) or in the caption. [Trigg Talley, United States of America]	Accepted. Figure 5.31 is now referenced in the text and figure caption
18821	214	3	214	18	Figure TS. 29 caption: There are 2sets of values along the x-axis of the left panel. These are not explained in the caption. [Govindasamy Bala, India]	Accepted - The two sets of values (for two different units) is now explained in the caption.
32613	214	8	214	8	Please make the circle and the vertical line more visible. [Eric Brun, France]	Accepted.
18823	214		214		Legend of Figure TS 29b: H=10 and H=100. What do these convey? Delete them? [Govindasamy Bala, India]	Accepted. The comment was in fact on Figure TS30b. The numbers referred to the time horizon. The figure, now TS20, has been redone and the two time horizons more clearly separated.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
108799	215	1	215	1	The text refers to the 'energy sector' this is significantly more clear. Please make the text consistent (and even more precise if possible, since this only says 'including', it should specify exactly what's being included here. [Jason Donev, Canada]	Clarified
108801	215	1	215	2	Do you mean 'electricity production' in the 'power sector? Better to say 'electricity' especially if this is different from 'energy production' (which it is, 'production' means extracting from nature, which is a misnomer, but you're using the right term there). The 'including' here should be laid out specifically in the text. List everything that's included. [Jason Donev, Canada]	Taken into account. Figure has been revised
108803	215	1	215	2	Likewise, with industry, what does this include aside from solvents? Does it include combustion for blast furnaces? [Jason Donev, Canada]	Taken into account. Details on what each of the sector include are provided in the caption for Figure 6.16. The sector labels are simplified here for the sake of brevity.
97931	215	1			Figure TS.30 is not explained in the text, but refers to individual sectors which seems out of scope for the WG I report. Either remove this figure from the TS or provide information on the concepts used including the emissions of each species for each sectors. The idea from Joeri might also worth considering. [Nicole Wilke, Germany]	Noted. This figure is based on figure 6.16. The methodology for this analysis is also presented in Ch6 (section 6.6.2) and is complementary to that presented in Ch8 of WGI AR5 report. We choose to make the figure consistent with the underlying chapter
32615	215	4	215	4	As "10 to 100 year" is only for a), this must not be mentioned here, but only in the a) presentation below. [Eric Brun, France]	The 10 to 100 time horizons apply to the top panel as well, therefore we keep this information here
32619	215	8	215	8	Please replace "the top panel" by "a)". [Eric Brun, France]	Editorial. We use top, left and right to describe the panels
108805	215	13	215	16	I agree, but this needs precise language. Sloppy language around the GHG emissions weakens the whole document. :([Jason Donev, Canada]	Noted

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
32617	215				Figure TS.30: please add "a)" and "b)" to the panels. [Eric Brun, France]	Taken into account - layout of figures follows editorial guidance from the TSU and consistently applied throughout the TS.
108807	216	1	216	2	The waterfall charts should match from the corner of the last negative to the next positive, I think, if I'm understanding this correctly, which I'm not sure I am. [Jason Donev, Canada]	Taken into account. It has been clarified that the mismatch arises because emissions from fossil fuels and land use and negative emissions are from the RCP2.6 scenario and do not match the compatible CO2 emissions diagnosed from the ESMs exactly.
108809	216	1	216	13	Unclear, could these lines be re-worked. I had trouble understanding what was being said. [Jason Donev, Canada]	Taken into account. The caption has been revised.
97933	216	1			What is the "land sink"? Does this only include natural sinks? Does it entail avoided deforestation, changes in LULUCF, managed land, how can this be distinguished between BE-CCS? Furthermore, the change from 2050 to 2100 seems to be 26 ppm, not 22 ppm. [Nicole Wilke, Germany]	Taken into account. "Land sink" has been renamed to "Net land flux" and includes CO2 fluxes due to land use change. The quoted numbers refer to differences in CO2 concentration between the different time periods. It has been clarified that CO2 concentration changes do not match the sum of the different terms in the diagram because emissions from fossil fuels and land use and negative emissions are from the RCP2.6 scenario and do not match the compatible CO2 emissions diagnosed from the ESMs exactly.
32623	216	4	216	4	Please specify, after "ESM", "(Earth system model)". [Eric Brun, France]	Taken into account. Acronym spelled out in figure ts.19
54863	216		216		Figure TS.31: Suggested edits to assist with interpreting this graph are: 1. move the arrows showing the change in CO2 concentrations up into the graph, showing change from one blue bar (atmospheric concentration) to the next. The current positioning along the X-axis is confusing, 2. add a 'year' label to the X-axis, 3. it might help to have an additional panel showing the pathway for CO2 emissions in the RCP2.6 scenario which would provide context for the labels for each panel that refer to emission changes over time. [Nancy Hamzawi, Canada]	Taken into account. The figure has been revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
32621	216				Figure TS.31: please add "for RCP2.6" after "Carbon dioxide concentrations" in the caption. [Eric Brun, France]	Suggestion unclear. There is no mention of "Carbon dioxide concentrations" in the caption
32625	217				Figure TS.32: regarding the "Scenario" panel, please specify what do these colors correspond to. [Eric Brun, France]	Taken into account. Figure has been revised
11077	218	1	218	2	this appears to be new material relative to the underlying assessment, and this tripartite categorization seems potentially problematic; this also seems to sideline the role of boundary organizations (perhaps mostly closely represented as 'providers' here) by indicating the strength of connection between users and researchers to be as strong as that between users and 'providers' [Robert Kopp, United States of America]	Not applicable. Figure deleted.
32627	219	7	219	7	What "text of the figure" refers to? [Eric Brun, France]	Taken into account. Caption revised.
32629	220				Box TS.5, Figure 2: France has a major concern with the current division of Europe into geographic domains, especially for the Central Europe domain. Indeed, the current "Central Europe" covers a domain with completely different climates. We strongly recommend to choose a new division which makes it possible to separate the Western part of Europe, which has a maritime climate, from the Eastern part which has a continental climate. If it is not the case, all Tables and messages in the vol1 SPM, TS and Chapters referring to the current "Central Europe" would be completely meaningless and useless for France. We recommend to adopt for the Atlas the division mentioned in the first paragraph of 12.4.5. [Eric Brun, France]	Not applicable. Figure deleted.
112943	222		222		Re Fig TS.34, would be good to include some information about EOF2. in the time and the space/impact domain. Though given space constraints, but this is really critical to stakeholders, esp bc there is mention of a possible shift to central Pacific ENSO CH2. [Kim Cobb, United States of America]	Not applicable. This figure is not longer included in the TS.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
82629	223	5	223	6	Using ERSSTv5 observations for Nino 3.4 back to 1881 should be done with caution, given the limited underlying SST data available before 1950 and the consequent potential for extreme events not to be fully resolved (Figure 2.34 only uses post-1950 data for this reason). If the pre-1950 data are retained, suggest that the green line for that period be shown in a lighter colour or some other indicator of lower confidence. [Blair Trewin, Australia]	Not applicable. This figure is not longer included in the TS.
32631	226	4	226	4	The terms "ANV, ENSO, PDV and SAM" should be explained in footnote. [Eric Brun, France]	Taken into account. The modes of variability are spelled out in the text, the 1st time they are used and in the caption of table TS.4
32633	226	21	226	21	Please specify, after "SESA", "(South-Eastern South America)". [Eric Brun, France]	Accepted. The acronym has been specified.
116159	226		226		What about responses to external natural drivers? [Valerie Masson-Delmotte, France]	Noted. This figure has been modified aiming to provide more clear information.
108811	227	1	227	1	The colours in the regions need to be more clear, and clearly different from the whisker plot diagrams. [Jason Donev, Canada]	Accepted. The colours used have been modified attending this suggestion.
108813	227	1	227	1	What's up with the Carribean and sub-Saharan Africa? That's an odd way of looking at it. [Jason Donev, Canada]	Noted. As specified in the caption, these two regions receive unimodal summer seasonal rainfall but their qualification as monsoons is subject to discussion. Therefore, they are not treated as monsoonal regions in this report.
108815	227	1	227	1	What are the OBS (CRU) vs. OBS (GPCP) Unclear. [Jason Donev, Canada]	We have modified this figure. We now use observed data from APHRO (only for the Asian monsoons), CRU and GPCP. This is specified in the figure caption.
11143	227	2	227	2	The readability of Figure 1 of Box TS.6 is not very good. Is it possible to plot the contour of the global monsoon domain in a different colour [Wen Wang, China]	Accepted. The colours used have been modified attending this suggestion.
108817	229	10	229	12	This shift in baseline seems unwise to me. [Jason Donev, Canada]	Not applicable. Figure deleted.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
32635	230				Figure TS.38: this figure is too little, especially the legend. [Eric Brun, France]	Taken into account in replacement figure.
108819	231	1	231	3	This is hard to read, I'm not sure what you're going for here. [Jason Donev, Canada]	Taken into account in replacement figure.
108821	231	1	231	3	Using white as the background colour and low makes this hard to process. Not sure how to do it differently though. [Jason Donev, Canada]	Noted.
32637	231				Figure TS.39: this figure is too little, especially the legend. [Eric Brun, France]	Taken into account in replacement figure.
35871	232	1	232	10	This figure should be generated from CMIP6 projections in chp 9 with some care, and then connected all the way to extreme sea level consistently with chp 12. This is perhaps one task in the coming months for the floods working group. [Baylor Fox-Kemper, United States of America]	Not applicable. Figure deleted.
32639	232				Please change the letters for the 6 panels to be a) to f), ordered. The legend depends on it. Also, please add a caption for the sixth graph. [Eric Brun, France]	Not applicable. Figure deleted.
55473	fig. TS.14				Include the term "projections" in the first sentence. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. This is reworded in the caption of the corresponding table (in Box TS1)
55439	fig. TS.4				The figure caption says "key attribution findings" but the temperature change shown seems to be the observed temperature increase not the attributed temperature increase (i.e. not the global warming index) it would be good to make the clearer in the caption. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. Figure dropped for FGD

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
55443	table TS.1				It is not clear what "relevance" means here, the text reads as if relevance is synonymous to whether or not something has been studied but that cannot be the correct interpretation. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	NOT APPLICABLE: Table 1 has been removed.
55451	table TS.1				This table doesn't seem to add much to the text and the descriptions only make sense if you know already exactly what the chapters are doing. And gives the impression as if these were the only lines of evidence used in the chapters which is not the case. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	NOT APPLICABLE: Table 1 has been removed.
116501					I would suggest to have a section on biosphere in the first part of the TS. The treatment of carbon feedbacks, including emergent constraints, could be placed in the second section (and needs to be more developed at the TS level). [Valerie Masson-Delmotte, France]	Taken into account. The biosphere is addressed in section TS2.6. The carbon cycle elements have been consolidated in Box TS.5.
40219					Figure TS.12: This figure is good and reflects well what is said in the main text. The title in C and D do really help to get the message straight. It would be good to have a title for A as well, reader might wonder why there is none for that panel - something like "Global mean surface temperature over different era". Is the thick black line in D added to highlight the change in sign? It is not clear at first. [TSU WGI, France]	Taken into account. The figure has been moved to Cross Section Box TS.1 and presentational aspects improved. Some panels have been swapped out to enable a presentation that covers the multiple aspects of surface temperature assessment more holistically. Due care has been paid to labelling and other matters
40221					Figure TS.10 great figure! It is however not clear how it links to the main text and which sentence(s) it illustrates [TSU WGI, France]	Noted. Following review comments, many figures have been modified. This figure is no more part of the TS.
40223					Figure TS.10 is not referenced in the main text [TSU WGI, France]	Noted. Following review comments, many figures have been modified. This figure is no more part of the TS.
40225					Figure TS.10 why not using sparklines in each scenario arrow to illustrate the peak/half/zero? It might be more visually intuitive. Please contact TSU for more guidance [TSU WGI, France]	Noted. Following review comments, many figures have been modified. This figure is no more part of the TS.
40227					Figure TS.11. This figure is very informative and does reflect the message in the main text (line24-25). However, it does look quite cluttered and the text labels should be refined. For more guidance, contact the TSU's graphic officer. [TSU WGI, France]	Accepted. Figure 2.11 has been substantially simplified and improved in the FGD

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40229					Figure TS.13. This is a nice figure and comprehensible figure. I was wondering what was the difference between bottom and top panels - although it is explain in the caption it would be nice to have that specified in the figure (Based on emulator or CMIP6) // avoid acronyms as much as possible (you could add (GHG) next to greenhouse gases on top panel, but then it is not clear what WM is (top right panel) // make sure x axes of right panels match the labels in left panel, if they are supposed to represent the same thing (i.e. GHG "forcing", this is not what is mentioned on the left panel) // top left panel: "other" anthropogenic is confusing: is this because "greenhouse gases " in grey is all antropogenic as well? if so, this should be specified in the GHG label, so "other" in the next label makes more sense. // right top panel: it is not clear why there is an uncertainty range for "contrails...ozone" bar but not for "aerosol-LUC" - why are the two bars next to each other? [TSU WGI, France]	Noted. This figure is no more present in the shortened FGD TS but note that some of the information is shown the SPM figures.
40231					Figure TS.14: for a/b panels, it is a bit confusing to have the YY and Y titles right next to each other. Contact the TSU for layout suggestions. In c, according to SOD figure guideline, the legend for stippling and hatching is missing in the figure. [TSU WGI, France]	Taken into account. The figure has been revised and incorporated into Cross-Section Box TS.1, Figure 1.
40233					Figure TS.15: It is not clear what the small world icons indicate in "ocean acidification". [TSU WGI, France]	Taken into account. Figure revised substantially - see Figure TS.11.
40235					Figure TS.17: it is not clear what the light grey lines starting circa 2019 onwards are. Could this be specified in the figure legend? [TSU WGI, France]	Taken into account. Fig TS.17 was entirely redrawn. The time series originally in TS.17 are now partially in TS.8 (sea ice), and there are no grey lines as in the original TS.17.
40237					Figure TS.18: for clarity, the name of the three variables (in full, not as acronyms) can be added in panel a, written in the color they represent. // the latitudes could be visually indicated as icons (see figure 2.7 in chapter 2) // the figure should be called out in the main text, ideally with indicating the figure panel (a/b/c...) for the corresponding section [TSU WGI, France]	Not applicable. Fig. TS.18 of the SOD is not included in FGD
40239					Figure TS.19: according to SOD figure guideline, the legend for stippling and hatching is missing in the figure // re-arranging the titles in the figure would highlight even more the time and scenario dependance of magnitude (contact TSU for more guidance) [TSU WGI, France]	Not applicable. Fig. TS.19 of the SOD is not included in FGD
40241					Figure TS.21: the colors for SSP585 and 126 should be the one suggested in the SOD figure guideline [TSU WGI, France]	Accepted. Figure redrawn using "official" scenario colours.
39987					Box TS.5 Figure 2: why some regions are highlighted in light orange and others not? [TSU WGI, France]	Noted but no more relevant as figures have been modified.

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40243					Figure TS.22: the intent of this figure is not clear (what does X axis represent as opposed to Y?)// some colors are not easily perceptible Contact the TSU for more guidance. [TSU WGI, France]	Taken into account. This figures has been entirely replaced with Figure TS.12 which has the intent to show linear responses of land-related extremes and other variables.
39989					Box TS.5, Figure 3: it is hard to follow and understand how the message is distilled based on this figure. More guidance should be provided to the reader, by using labels/annotations. Contact the TSU for support. [TSU WGI, France]	Taken into account. The figure has been simplified by removing 3 of the panels. Furthermore, the intent of the figure has changed and has been combined with Box TS.5, Figure 1 to visualise what is/what is not available in the interactive atlas .
40245					Figure TS.23: Alternative ways could be explored to display this information. For some support, please contact the TSU [TSU WGI, France]	Taken into account. Figure substantially revised as Figure TS.7.
39991					BOX TS.6, FIGURE 1: what do the dotted area represent as opposed to filled area? Why eqSamer and Safri have the same color? It would be better to spell out acronyms wherever possible in the figure. [TSU WGI, France]	Noted. The caption of the updated figure (Box TS.13, Figure 1) now indicates : "Equatorial South America (EqSamer) 13 and South Africa (SAfri) regions are also shown, as they receive unimodal summer seasonal rainfall although their qualification as monsoons is subject to discussion"
40247					Figure TS.25: non-expert (but still technical) readers might not understand the message of this figure in its current state: jargon and acronyms should ideally be explained/spelled out (i.e. IRFari, ERFaci - what is aci and ari?) // in b, colors are a bit misleading // adding some annotations, label would help. contact TSU for guidance. [TSU WGI, France]	Taken into account in what is now Figure TS.15.
39993					Box TS2, Figure 1: What does the dotted line at 10% represent exactly? Is it the definition of "low likelihood"? To enhance clarity, this should be annotated in the figure ideally.// The caption refers to GSAT changes while the figure shows GMST changes. [TSU WGI, France]	Noted. This figure is no more present in the TS. Figure TS.6 conveys related information with a different visual approach.
40249					Figure TS.26: good figure! some suggestions for improvement: acronyms could be spelled out in a (if space allows) and some elements could be changed to unclutter the figure (black lines around the bars, thinger black line for error, remove secondary tick marks, labels in the legend could be writtent in the color they represent). [TSU WGI, France]	Taken into account. Acronyms have been spelled out, and the design has been revised.

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39995					Box TS2, Figure 2: in the main text: "Over large parts of the Arctic annual mean temperatures increase by more than 10°C", the color bar should reflect this by having the right-hand ending finishing as an arrow (as indicated in the SOD figure guideline page 4) // titles in bold could be re-arranged - they could be associated with the color bar just above // It would be helpful to have the panels referred to the corresponding section in the box text (nice example for figure TS.17). Don't hesitate to contact the TSU for support. [TSU WGI, France]	Noted. The figure has been revised and the revised figure captions mentions "note the different colour bars".
40251					Figure TS.28: this figure might not be clear for non-expert, technical audience. Rearranging the design could clarify the concepts presented. Contact TSU for more guidance. [TSU WGI, France]	Taken into account. The design has been simplified as well as the sequence of the different panels. The bottom part of the figure has been removed.
40253					Figure TS.30: colors are not accessible for colorblind vision. Please refer to the color palettes in the SOD figure guidelines [TSU WGI, France]	Rejected. It is very hard to create a colour-blind friendly categorical palette beyond 8 colours (the SOD figure guidelines only goes up to 8 colours). 10 compounds should be represented in the figure.
40255					Figure TS.31: This is a good figure that reflects what is mentioned in the main text (although the "dependence on the negative emissions technologies" (one of the "purpose" of the figure) does not seem to appear in the main text). [TSU WGI, France]	Noted.
40269					figure ts-9 is not referenced in the main text [TSU WGI, France]	Corrected, thank you.
40271					Figures TS.34 / 35 / 36 : those figures seem too complex for the TS audience (technical non-expert audience). [TSU WGI, France]	Taken into Account. Fig TS.34 and TS.35 of the SOD have been removed from the FGD. Fig TS.36 of the SOD, Fig TS.21 in the FGD, has been re-drafted and simplified for a wider audience understanding
79187					Modes of variability are highlighted as a driver of regional climate variability and change. But many studies since AR5 identified ENSO, PDV and AMV (and seasonally, NAM) as an important driver of GMST/GSAT variability in examining the hiatus. This is an important advancement and can be highlighted. [Yu Kosaka, Japan]	Taken into account. The TS has an emphasis on modes of variability in section TS.1.2.3 and in section TS.4.2.2 (especially the corresponding table TS.4)
78943					In our view, the technical summary is much too long. [Martine Vanderstraeten, Belgium]	The TS has been substantially redrafted to be more synthetic; the text length has been reduced by nearly 10 pages and >20 figures were dropped or were made more synthetic.

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130399					The Paris Agreement does not discuss temperature targets. Please re-word to Paris Agreement 'temperature goals' to be consistent with other chapters in this report. [Trigg Talley, United States of America]	Taken into account. This has been changed to goals.
40801					some figures as called in the text (TS1 section) should be +1 (i.e. TS5 in the text seem to be TS6 as called in the figure caption) [TSU WGI, France]	Noted. Calls to figures have been carefully checked.
130401					RCP8.5 is referenced throughout text (e.g., page 108 line 23, page 118 line 55). The analogous SSP scenarios should be referenced (SSP5-8.5 for CMIP6?). Are there cases where assessment is still based on CMIP5 results only and not CMIP6? The dataset used to define trends needs to be clearly defined if not consistent. [Trigg Talley, United States of America]	Taken into account. Where relevant (e.g. CMIP5-CMIP6), RCP8.5 and SSP5-8.5 and mentioned. In other cases (CMIP5 only, CORDEX), only RCP8.5 is mentioned (now explicitly linked to CORDEX).
130403					The tables outlining trends by region (Tables TS.13-TS.21) are very useful, but sometimes not all trends are described in preceding text or at times text seems to contradict table entries. There should be some consistency between preceding content and tables for each region, and text should be reviewed for consistency with what is presented in the tables. [Trigg Talley, United States of America]	Taken into account. TS.4 has been redrafted to better show these regional trends and consistency carefully checked.
40059					Cross-Section Box 1, Figure 1: thermosteric is too jargony for the TS audience, better use "thermal expansion" in the figure // "global mean" could be placed in the same way as "thermosteric" so the reader understands that the four shaded lines correspond to that label. the legend could present ssp 5-8,5 first and SSP1-1,9 last, to match the order of the lines [TSU WGI, France]	Taken into account. In the TS, thermosteric is no longer used in this Cross-section Box.
40061					Cross-Section Box 1, Figure 2: this is a nice figure in terms of the information it delivers. Maybe its readability could be even more improved by adding some annotations (specially for the part displaying the "time where particular WL are reached". although it is in the caption, the reader might be confused as to what this represents when looking at the figure first. Also, full dots would be more visible than empty ones. // the legend could present ssp 5-8,5 first and SSP1-1,9 last, to match the order of the lines [TSU WGI, France]	Taken into account. A more narrative approach is now used in TS.1 related to GWLs.
40065					Cross-section Box 2, Figure 2: this figure is quite complicated (various levels of information - spatial, intensity, event category etc... and high density of info) and information is hard to read (+2C to 4C panels). [TSU WGI, France]	Taken into account. A more narrative approach is now used in TS.1 related to GWLs.
40067					Cross-section Box 2, Figure 3: the order of the panels is not intuitive // this figure is not adapted for the TS audience - adding labels and spelling out acroymns could facilitate accessibility of information. [TSU WGI, France]	Taken into account. A more narrative approach is now used in TS.1 related to GWLs.

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19375					I found this chapter, supposedly a summary, to be very difficult. I can't imagine a non-specialist, let alone a lay person, being able to read through it. I realize that this comment is not constructive, but somehow, a summary should not be this complex and should not be over 250 pages long. [Steve Colman, United States of America]	Noted. The TS has been substantially redrafted to be more synthetic; the text length has been reduced by nearly 10 pages and >20 figures were dropped or were made more synthetic.
116147					I suggest to expand the focus on the urban box here to also include insights from chapter 6 on air quality, and support key integrative messages for the SPM. [Valerie Masson-Delmotte, France]	Noted. Suggestion considered but not acted on due to space constraints.
116149					Work is needed to sharpen and shorten the regional parts possibly using synthesis tables for regional trends (detected in observations, attributed to drivers, projected to emerge etc). [Valerie Masson-Delmotte, France]	TS.4's length has been cut by ~50%.
116151					The part of the TS on regional aspects (TS4) is too long and needs to be sharpened and shortened building on the summary statements), I recommend to focus on key messages, use tables for descriptive, integrative aspects (for instance for regional trends, detected, attributed and projected / projected to emerge). The TS could be also used to develop several examples of storylines integrating information from multiple chapters (eg response to volcanic eruptions) and to develop short summaries of case studies on constructing a regional climate message to be used in the SPM. [Valerie Masson-Delmotte, France]	The TS has been substantially redrafted to be more synthetic; the text length has been reduced by nearly 10 pages and >20 figures were dropped or were made more synthetic.
132025					Cross-section box 2, Figure 1: The layout of the corresponding SPM figure is easier to understand and follow the information displayed. Would it be possible to have a similar display for this figure too? Could the "annual exceedance..." map projections have the same color palette as the GSAT? [TSU WGI, France]	Noted. A more narrative approach is now used in TS.1 to discuss GWLs.
40889					Table TS-1 should be redesigned for clarity [TSU WGI, France]	Taken into account. This table is not in the revised TS.
132027					Cross-Section Box, Figure 3: the SSP colors do not match the SOD color guideline for SSP - which might be updated for FGD. In any case, the SSP colors as presented in this figure will have to be updated for FGD // the panel order seems more intuitive in the corresponding SPM figure (rate on the left and frequency on the right) [TSU WGI, France]	Taken into account. All the colors of the SSPs have been updated to match the guidelines provided by the TSU.
116155					A visual representation related to examples of storylines would be very helpful, building on concepts of low likelihood high impact events. [Valerie Masson-Delmotte, France]	This is addressed now in Cross-section box TS.2.
132033					Figure TS.20: what does the stippling and hatching represent? It is not mentioned in the caption [TSU WGI, France]	Taken into account. Fig TS.20 of the SOD (now translated into Box TS.6 Fig 1) has been redrafted and the meaning of stippling and hatching is specified in the caption, and it follows the WG1 AR6 guidelines

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132035					All TS figures should apply the same model agreement methodology. For example, the methodology seems different in figure TS 37 compared to figure TS14 or figure TS.19 [TSU WGI, France]	Taken into account. The methodology for model agreement is now specified in a box (Ch Atlas) for the WG1 AR6. All figures have been redrafted accordingly. note Figure TS.37 now deleted.
116163					Please check the balance of figures for the various sections and lines of evidence and consider visual elements (tables or figures) providing clear information related to : biosphere (changes and feedbacks); feedbacks and climate sensitivity (incl. clouds); methodology for the remaining carbon budget; abrupt change and irreversibility. [Valerie Masson-Delmotte, France]	The TS has been substantially redrafted to be more synthetic; the text length has been reduced by nearly 10 pages and >20 figures were dropped or were made more synthetic.
116165					Consider introducing deep uncertainty [Valerie Masson-Delmotte, France]	Now mentioned in the core concept box (linked to a footnote).
116985					A narrative could be developed relating the changes in trends and spatial characteristics of aerosol emissions in the recent past and the assessment of detectable effects on climate trends during the past decades; and implications for future changes (including dimming / monsoon / etc). It is currently addressed in a rather patchy way based on current chapter ES information. [Valerie Masson-Delmotte, France]	Taken into account in revisions of the TS.