Comment ID	From Page	From Line	To Page	To Line	Comment
7077	1	1	22	35	The report is focused on the results and consequences which are more a basis for the adaptation responses and policies in different regions. It seems necessary to have reviews and conclusions on the SOURCEs of the climate changes which are mentioned in the report. Without such analysis and set of information - globally and officially are published through this report - it is very unlikely to access and reach an integration of actions in the mitigation process. [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]
5985	1	1	22	37	We appreciate that information supporting the understanding of the SPM is provided in footnotes. However, as a general approach we strongly suggest to refer to the glossary in footnotes instead of repeating definitions whenever possible. Otherwise, please ensure that all footnotes are clear also without the text they are specifically referring to. Examples that require improvements (if you do not agree referring to the glossary) are footnote 7, which should please be changed into "climatic impact drivers are physical climate system conditions...", and footnote 11. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
7989	1	1	38	1	The work done on the report has been a significant undertaking and we thank the authors for their work in very difficult circumsatnces [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
7991	1	1	38	1	the SPM is shorter and clearer than earlier versions and this is welcome [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
7993	1	1	38	1	Many of the points made earlier by have been addressed [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
7995	1	1	38	1	Some comments and issues have not been addressed or have been addressed in a manner that does not make the substance clear. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
7997	1	1	38	1	The line of sight to the AR5 and special reports in AR6 cycle can be clearer this is particularly needed as the AR5 played a key role in adopting the Paris Agreement, inclusion of the TS box on this issue here should be considered. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
7999	1	1	38	1	For WG 1 the line of sight is considered to include trends in key climate variable, and driver of climate change, at forcing by these, which have been reported and shown graphically in previous SPMs. A number of these are absent here. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8001	1	1	38	1	The role of the IPCC in informing policy and not prescribing policy needs to be carefully guarded, including in interpretation of the Paris Agreement, through models or other analysis [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8003	1	1	38	1	The WG1 SPM report should avoid going deeply into material which will be treated more fully in WGII or III reports. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]

Comment ID	From Page	From Line	To Page	To Line	Comment
8005	1	1	38	1	The treatment of aerosol cooling in the SPM is concerning in places in terms of possible messages for policy. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8007	1	1	38	1	The degree to which footnotes are used should be reduced [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8009	1	1	38	1	There are absences of quantified amounts and units in many sections which should be addressed [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
7835	1	1	38	1	The logic of numbering and hierarchy in the SPM is not fully evident. Headline Statements (HS) are consecutively numbered, but it is not clear what determines the increament of the first number. The top level titles "The Current State of the Climate", "Our Possible Futures", etc., are not reflected in the numbering of the HS. The grouping of HS.1.x, HS.2.x, ... is not made evident with e.g. a sub-title canvassing them. Thre is therefore a lack of structure. Some more logic in the structure could be helpful for orientation and would ease the flow of assessment findings. Needless to say, it makes the approval process easier. [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
7725	2	6	2	6	It is not necessary to mention Box SPM1 in the table of contents. [Government of Hungary, Ministry of Innovation and Technology - Climate Policy Department]
7727	3	0	3	0	In the footnote "medium confidence" should be in italics in the example sentence, for better readibility. [Government of Hungary, Ministry of Innovation and Technology - Climate Policy Department]
4219	3	0	3	0	Regarding explanation on "...the following terms to indicate the assessed likelihood of an outcome or a result: virtually certain 99–100% probability, very likely 90–100%, likely 66–100%, about as likely as not 33–66%, unlikely 0–33%, very unlikely 0–10%, exceptionally unlikely 0–1%." Our questions: (1) Is the term of "virtually certain" common? Or "most likely certain"?, (2) The basis used for classification of the percentage, how is about 10-33%, it's not classified yet? (3) Suggest to use "virtually certain >99%", "very likely 90-99%", "likely 66-90%" probability so it will not be confusing (footnote 5) [Government of Indonesia, Ministry of Environment and Forestry Indonesia]
3987	3	0	3	0	The example “medium confidence” in the footnote 3 should be written in italics. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
8389	3	0	3	0	Suggest correcting the likelihood statement in footnote 5: ‘more likely than not >50–100%’, which should read ‘>50%’. [Government of Australia, Department of Industry, Science, Energy and Resources]
8391	3	0	3	0	Suggest including a box to summarise key improvements from AR5 in terms of the modelling. Given there are debates in terms of whether we know enough about climate change progression and possible future pathways, it would be good to see a summary of what improvements have been made in the modelling. For example the sentence on p19, R27-28 should be in that table "A key development since the AR5 has been the quantification of when climate responses to emissions reductions would emerge above natural variability." [Government of Australia, Department of Industry, Science, Energy and Resources]
8393	3	0	3	0	Suggest authors provide an example of how the referencing system works. Curly brackets, vs square brackets and what abbreviations such as TS.1 mean. Policymakers and staff will not be immediately aware of all the abbreviations used. Consider having a list to be distributed with the SPM. [Government of Australia, Department of Industry, Science, Energy and Resources]

Comment ID	From Page	From Line	To Page	To Line	Comment
8395	3	0	3	0	Suggest making footnote 5 more prominent, for example as a separate page or Box. [Government of Australia, Department of Industry, Science, Energy and Resources]
8725	3	1	3	1	Explain the abbreviation HS (or H.S.) in the Introduction. [Government of United States of America, U.S. Department of State]
4565	3	1	3	19	The SPM doesn't expand the abbreviations "HS." and "H.S.". Could the expansion be included in the Introduction? [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
3035	3	1	3	20	Please indicate in the introduction that H.S. is abbreviation of headline statement. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
8727	3	1	4	1	The Introduction needs to provide context and perspective in terms of the extent of new material presented. Is this an assessment? How does the assesment build upon the findings of previous assessments? Wherever possible, flag points and conclusions that are new or much stronger in AR6 to add an additional punch to the present report. [Government of United States of America, U.S. Department of State]
4313	3	3	3	3	Would "the key findings" be appropriate, rather than just "key findings"? How extensively are the key findings included in the SPM, more of less all major ones, or just some selection? [Government of Sweden, Swedish Meteorological and Hydrological Institute]
8729	3	3	3	4	The introductory sentence should include a phrase on the topic of discussion (The Physical Science Basis) for the benefit of first time/new readers. [Government of United States of America, U.S. Department of State]
2163	3	4	3	4	Concerning the footnote 1 : We suggest that the authors specify the publication dates of the respective special reports [Government of France, Ministère de la Transition écologique et solidaire]
2159	3	4	3	5	We suggest that authors specify the time period corresponding to the publication of AR5 for example (AR5 2013-14) or in a footnote. [Government of France, Ministère de la Transition écologique et solidaire]
8011	3	5	3	5	It is not clear why the names of the three special reports are not included in the text rather than a footnote. The titles and publication years should be included in the text. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8013	3	5	3	5	The key human influence on climate is changes to the energy balance titled "Anthropogenic Forcing" in footnote 4. This should be included in the text as well how the understanding of anthropogenic forcing of climate will be presented in this SPM. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8015	3	5	3	5	Footnote 4 is problematic. E.g. it seems to suggest that all human emissions of GHG are driving climate change and seems to treat all emissions equallly. It should be corrected or deleted. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8017	3	5	3	5	Footnote 4 could usefully be replaced by more nuanced text in the paragraph on emissions, their historic and current impacts on the atmopsheric composition, which determine the Earth's energy balance. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
5987	3	5	3	5	Please change "AR6 special reports" into "special reports of the AR6 cycle" because the AR6 does not have special reports. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
6519	3	5			Replace "AR6 special reports" with "special reports of the AR6 cycle. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]

Comment ID	From Page	From Line	To Page	To Line	Comment
8731	3	7	3	7	Extra "31" in footnote 3 [Government of United States of America, U.S. Department of State]
3989	3	7	3	7	In footnote 3, "SR15" must be "SR1.5". [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
3991	3	7	3	7	The date '31' overlaps before and after 'January'. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
4315	3	7	3	7	Here, the full report should be referred to as providing the updated assessment, rather than only its SPM which is a summary of (key) findings. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
4321	3	7	3	7	Concerning footnote 3, the "31 January 31" should have one "31" fewer. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
8733	3	7	3	10	Regarding the phrase "updated assessment", explanation should be provided on how the SPM changed compared to AR5. For example, the reader receives only a very selected update to physical understanding of changes in modes of variability, except for the Southern Annular Mode. In the Introduction, the reader should be pointed to the Technical Summary for additional updates compared to AR5. In its current much shorter form, the SPM has the appearance of being selective with respect to elevated statements. [Government of United States of America, U.S. Department of State]
6521	3	7	3	10	It is stated that the assessment is 'physical understanding of the current state of the climate...on physical climate information relevant to regions and sectors…'. Physical do not seem ot be the only ones. Chemical and biological changes mentioned on page 9, row 15. Consider inserting "and biogeochemical" after "physical" in line 7, to read "of the physical and biogeochemical understanding of". [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
517	3	8	3	8	The info in footnote 4 on definition of human influence is quite important for the reader to understand, and we suggest to lift the sentence into the main text [Government of Denmark, Danish Meteorological Institute]
8737	3	8	3	8	"Human influence" is not a technical term. Humans do not warm the climate; rather, changes in the radiative balance caused by human activities does. Define "human influence" in the introduction very carefully when first used rather than in the difficult to find Footnote 4. [Government of United States of America, U.S. Department of State]
2165	3	8	3	8	Concerning the footnote 4 : It would be useful to specify that changes in natural emissions are not included, nor the changes in natural emissions due to human-induced climate change [Government of France, Ministère de la Transition écologique et solidaire]
8735	3	8	3	9	Using the preposition "about" instead of "on" in all three occurrences would make this sentence more understandable. [Government of United States of America, U.S. Department of State]
8019	3	8	3	9	The report should avoid going into detail that will be addressed in WGII and WGIII reports and regional analysis. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
223	3	8	3	9	The text needs to be revised as it reflects an opinion statement. State the finding of the literature without indicating possible or impossible outcomes by omitting the use of first-person pronouns and replacing "...and of the state of knowledge on our possible climate futures" with "...and of the state of knowledge on climate futures". [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
6523	3	9			The added value of "physical" is unclear. Most "climate information" is physical by default, but other types of information are also covered. Consider deletion. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
8739	3	12	3	12	Revise the statement "Some key findings are statements of fact" to reflect scientific fact/consensus rather than just fact. [Government of United States of America, U.S. Department of State]

Comment ID	From Page	From Line	To Page	To Line	Comment
5989	3	12	3	12	As also mentioned in Box 1.1. (Ch 1 of the underlying report, page 1-30), "where appropriate, findings can also be formulated as statements of fact without uncertainty qualifiers". In order to emphasize that these are (also) derived from a formal confidence assessment and thus avoid misunderstandings, please indicate/clarify in which cases it is "appropriate" to present key findings as statements of fact. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
5993	3	12	3	12	It is a major achievement that the AR6 now identifies key findings as "statements of fact". It is however very confusing not to indicate this quality in the text and to put it outside the IPCC's calibrated language. For example, SPM-4-15: is it a fact that humans have caused the observed increase in GHG, and in SPM-4-28: is tropospheric warming a fact while stratospheric cooling is virtually certain? We strongly urge the authors to explicitly indicate statements of fact in the SPM. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
7839	3	12	3	12	Write: "Some key results are statements of scientific fact" to clarify that these statements are statements of "well established" facts. In fact, this phrase is highly debated and controversial in the philosophical literature, and calling it "scientific" will clarify the situation in this SPM. [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
4317	3	12	3	12	The "statement of fact" should be explained (footnote?) as it appears somewhat opaque. Something like "thoroughly well-established by the science that…" or suchlike explanation could make the meaning more transparent. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
8741	3	12	3	13	Are readers to assume that, when key findings do not include confidence or likelihood levels, the provided statements are facts? [Government of United States of America, U.S. Department of State]
8743	3	12	3	13	The central value and ranges offered in square brackets are very important to the document, and it would be easy to miss footnote 8 on page 4, indicating the numbers within those brackets provide a statement of the very likely interval. It would be beneficial to revise the sentence spanning these lines to say (approximately) "Other findings are reported using the IPCC calibrated language^5 described within footnotes, for example by reporting a best estimate of a quantified value, and a range representing a 90% uncertainty interval" then perhaps point to other sections where more detail is provided about the calibrated language. [Government of United States of America, U.S. Department of State]
8021	3	12	3	13	The IPCC statements of fact are addressed in the uncertainty language hence no need to state this here. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8023	3	12	3	13	A simple statement on the use of IPCC uncertainty and confidence levels is all that is needed. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
6493	3	12	3	13	The IPCC calibrated language contains some intersections of probabilities. For example very likely (90%-100%) and extremely likely (95% - 100%). [Government of Chile, Ministry of Environment]
5991	3	12	3	13	Footnote 5: Please set "medium confidence" in "…, for example, medium confidence." in italics, too. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
6525	3	12	3	13	This paragraph implies that all statements without a calibrated language are statements of fact. Can that be generally stated? [Philippe Tulkens, European Union (EU) - DG Research & Innovation]

Comment ID	From Page	From Line	To Page	To Line	Comment
4241	3	12	3	19	As an Introductory, we suggest to include an objective, general methodologies, and major findings of the report. Thus all information related to additional information of data sources as indicated within those lines should be moved to the footnote sections. [Government of Indonesia, Ministry of Environment and Forestry Indonesia]
43	3	13	3	13	Editorial for footnote 5. To use italic for "medium confidence" Each finding is grounded in an evaluation of underlying evidence and agreement. A level of confidence is expressed using five qualifiers: very low, low, medium, high and very high, and typeset in italics, for example, medium confidence. [Government of Singapore, Ministry of Environment and Natural Resources]
2167	3	13	3	13	Concerning footnote 5 : "exceptionally unlikely" is not used in the spm. We recommend to delete it from the footnote [Government of France, Ministère de la Transition écologique et solidaire]
6527	3	13	3	13	Footnote 5: "A level of confidence is expressed using five qualifiers: very low, low, medium, high and very high, and typeset in italics, for example, medium confidence" The word "medium" (second occurence) should be typeset in italics, but it is not. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6529	3	13	3	13	footnote 5. This is a jungle of uncertainty qualifiers. Do we need the additional ones ('extremely unlike' etc)? Also in the text uncertainty intervals are between brackets, and the meaning can already be introduced here (now it is separate in footnote 8. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
7841	3	13	3	13	Footnote 5: the link between the level of confidence and the likelihood is not completely clear. The example "medium confidence" needs to formatted in italics. [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
4323	3	13	3	13	Concerning footnote 5, the "medium confidence" should be in italics. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
5095	3	13	3	13	Footnote 5 - "medium confidence" should appear in italics in the example. [Government of Belgium, Belgian Science Policy Office - Belspo]
8745	3	16	3	16	All references to TS text should be removed and, if necessary, replaced with chapter references. The TS is not an original document; it can have no material not in the chapters, and it is not reviewed at the same level as the chapters. Just use the chapter sections, not the TS callouts. A possible exception could be where the SPM cites a TS box that integrates across chapters and is only found in the Technical Summary. The difference between [ ] and { } is just too confusing, and adds little in the sourcing of information. [Government of United States of America, U.S. Department of State]
2161	3	18	3	18	The Interactive Atlas is a brilliant tool, and it could be better emphasized here. [Government of France, Ministère de la Transition écologique et solidaire]
1	3	18	3	19	It is not clear what is use of the statement 'The Atlas provide Access to climate Change Information", Since the entire SPM and the Entire working Group I report provide climate change Information. What is the use of this statement? [Government of United Republic of Tanzania, Tanzania Meteorological Authority (TMA)]
8025	3	18	3	19	This text is not needed here. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
4319	3	18	3	19	Mentioning the Interactive Atlas may not be needed in the Introduction to the SPM. (The main report is not referred to in such a fashion either). Suggest omitting the reference as it is not clear why it is included here. [Government of Sweden, Swedish Meteorological and Hydrological Institute]

Comment ID	From Page	From Line	To Page	To Line	Comment
8747	3	20	3	20	Footnote 4: Human influence on emissions of aerosols include primary aerosol particles and (secondary) gas precursors. The current statement is unclear on this. [Government of United States of America, U.S. Department of State]
8749	3	20	3	20	Footnote 5, line 2: "medium confidence" should be set in italics. [Government of United States of America, U.S. Department of State]
5205	3	20	3	20	Please, in the second footnote delete the space before the first colon (:). Besides, in order to keep consistency with the chapters of the AR6-WGI, please consider: Using "an IPCC Special Report" instead of "an IPCC special report". Using "(SR1.5)" instead of "(SR15)". Using "Special Report on Ocean and Cryosphere in a Changing Climate" instead of "The Ocean and Cryosphere in a Changing Climate". [Government of Argentina, Ministry of Environment and Sustainable development of Argentina]
5207	3	20	3	20	In the fifth footnote, use italics in "medium confidence". [Government of Argentina, Ministry of Environment and Sustainable development of Argentina]
45	3		3		Footnote #3: "The assessment covers literature accepted for publication by 31 January 31 2021." Remove one "31". [Government of Singapore, Ministry of Environment and Natural Resources]
7837	3		3		Interactive Atlas (checked on Firefox and Edge): some plots e.g. Seasonal Stripes cover the axis labels such as the years are thus difficult to read properly. Otherwise excellent atlas with a wealth of information. [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
7729	4	0	4	0	For better readability, it could be mentioned that the "HS" abbrevations are the headline statements with the main conclusions. [Government of Hungary, Ministry of Innovation and Technology - Climate Policy Department]
8031	4	1	4	1	The heading "current state of the climate" comes ahead of a reference to Paleoclimate in line 3. This is problematic, a suitable title is needed. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8027	4	1	5	16	The focus on emissions which is a WGIII area rather than on atmospheric composition and its changes which has typically been covered by WGI is problemtic for this section and for this SPM. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8029	4	1	5	16	WGI including the SPM should provide key information on atmospheric composition and composition change over time as well as their impacts on the energy balance. This information is not clear here in. These data need to be introduced including as figures. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8751	4	1	7	24	Many key findings ignore the role and impacts of Modes of Variability. The Technical Summary (see TS.4.2 Drivers of Regional Climate Variability and Change) is more scientifically balanced: "Since the late 19th century, major modes of variability (MoVs) exhibited fluctuations in frequency and magnitude at multi-decadal time scales, but no sustained trends outside the range of internal variability." Incorporate into H.S. statements explanations of the role of modes of variability and how seasonal, annual, interannual, and decadal variability can both amplify and modulate extreme values in the analysis of recent trends and exceptional conditions. [Government of United States of America, U.S. Department of State]

Comment ID	From Page	From Line	To Page	To Line	Comment
5995	4	1	8	37	Climate change is accelerating: There is plenty of information in the TS, the underlying Chs and other recent reports (in particular the SROCC) on the increasing rate of change in many climate system elements. Therefore, we are really surprised that the current version of the SPM does not contain much of this particularly policy relevant information, if any at all. We urge the authors to consider the TS and underlying Chs and collect information in a new paragraph about climate change acceleration in the first part of the SPM as a crucial message on the current state of the climate. Please include in particular the following findings and feel encouraged to further expand this list: - The increase of global surface temperature for the current decade compared to the ones before (c.f. CBB 2.3 Table.1 and Figure 1). - The increasing rate of mass loss of ice sheets as found in the SROCC and reconfirmed in Ch 2 and 9 (c.f. Figure 2.24 and Figure 9.16). - The permafrost temperature is increasing at an increasing rate, as shown in Figure 2.25 and discussed in the subChs 2.3.2.5 and 9.5.2. - The rate of ocean warming has more than doubled since 1993, as stated in the SROCC and reconfirmed in the assessment in AR6 (c.f. Figure 2.26). - The increasing rate of phenology changes and changes in the growing season in recent decades as discussed in Ch 2 (c.f. 2.3.4.3.1) and also apparent for grape harvest and cherry blossom (c.f. Figure 2.32). - The Earth energy imbalance (c.f. Ch 7 ES) and therewith the total anthropogenic effective radiative forcing that "has likely been growing at an increasing rate since the 1970s" (TS-35:11-12). - The global mean sea level is rising with acceleration in recent decades due to increasing rates of ice loss from Greenland and Antarctic ice sheets (very high confidence), as well as continued glacier mass loss and ocean thermal expansion, as found in the SROCC (SPM A.3) and confirmed in the underlying Ch 2 and 9 (e.g. c.f. Figure 2.28). - Increased permafrost degradation: "[...] high confidence that Permafrost degradation through fire (Jones et al., 2015; Gibson et al., 2018b) is currently occurring faster in some well-studied regions than during the first half of the 20th century, and medium confidence that thermokarst formation, to which about 20% of the northern permafrost region is vulnerable (Olefeldt et al., 2016), can lead to faster large-scale permafrost degradation in response to climate change." (9-87:38-43) [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
3	4	3	4	3	It is not clear what is meant by " Improvement in Observational Estimates" [Government of United Republic of Tanzania, Tanzania Meteorological Authority (TMA)]
5997	4	3	4	3	We assume that observational archives were improved as well (e.g. by update, digitization and reanalysis). Suggest to add this here. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
4837	4	3	4	3	Please consider claryfying what "observational estimates" refers to, as it might be unclear to some readers. E.g. replacing with "measurements" if suitable. [Government of Norway, Norwegian Environment Agency]
2169	4	3	4	4	The view of each component and its changes is not completely comprehensive yet, despite the improvements. A modification to "more comprehensive" would increase the accuracy of the sentence [Government of France, Ministère de la Transition écologique et solidaire]

Comment ID	From Page	From Line	To Page	To Line	Comment
8753	4	3	4	7	The paragraph is confusing. Do the "observational estimates" only refer to improvements in paleoclimate observations, or include observations over the historical period (1850 - present)? Or does "observational estimates" only refer to the historical period observations with no contribution from paleoclimate observations? Saying "new climate model simulations" suggests that this is a dramatic shift from what was understood from the previous climate model simulations. Rewrite the paragraph to be more clear: "Since AR5, improvements in observational estimates and updated paleoclimate information provide a more comprehensive view of each component of the climate system and its changes to date. Additional climate model simulations, as well as new analyses and methods combining multiple lines of evidence, have led to an improved understanding of human influence on a wider range of climate variables and for climatic impact-drivers, including weather and climate extremes." [Government of United States of America, U.S. Department of State]
8033	4	3	4	7	This text is quite general and in cases obvious. A more focused text could outline key developments, new material etc and advances also since the special reports. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8397	4	4	4	4	Suggest rephrasing: "changes to date" is ambiguous without reference to a starting point - e.g., is this since industrialisation, since the last glacial maximum etc. [Government of Australia, Department of Industry, Science, Energy and Resources]
5	4	5	4	5	What is meant by New Analyses and New Methods? [Government of United Republic of Tanzania, Tanzania Meteorological Authority (TMA)]
8035	4	5	4	5	Does the multiple lines of evidence indicate that further lines of evidence are used than in previous Assessment Reports? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8037	4	6	4	6	Can "wider range" be specified, e.g. in terms of domains, numbers, otherwise it is not clear? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
5999	4	6	4	6	Footnotes 7 and 11: please clearly explain the difference between "climate driver" and "climatic impact-driver" (Footnote 11, SPM-8-7). Do both expressions refer to CID? Unfortunately, neither "climate driver" nor "driver" are included in the Glossary (although "driver" is in some instances set in italics in glossary text, giving the impression there was a corresponding entry). Please add both "climate driver" and "climatic impact driver" (and CID) and refer to these glossary entries in the footnote. Please see also our general comment on referring to the glossary in footnotes instead of providing alternative explanations. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
2931	4	6	4	6	The term of climatic impact-drivers is firstly introduced in IPCC WGI report. It sounds a useful concept linking climate change to impact and risks. However, it seems not to be clearly framed in AR6 WGI SPM and TS. Confusion is that climatic impact-drivers tend to be seperately treated from mean and extremes in many parts of SPM and TS although they include aspect of changes in mean and extremes. Thus, clarification for the treatment of climatic impact-drivers separately from mean and extrems in many parts of SPM and TS would be very useful. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
2171	4	6	4	6	Concerning the term "climatic impact drivers" we found that it can be a confusing term here and we recommend to find another term to describe what it means. Indeed, here it focuses on climate/physical change whereas (i) chemical [e.g. ocean acidification] and (ii) land-use/deforestation are major drivers of ecosystem changes. Besides it doesn't tell anything on tipping elements nor compound events or how the combination of physical and chemical changes may interact leading to stronger impacts [Government of France, Ministère de la Transition écologique et solidaire]

Comment ID	From Page	From Line	To Page	To Line	Comment
2173	4	6	4	6	Concerning the footnote 7 : the term "system condition" might not be the most appropriate, we suggest to replace it with something like "system factors" [Government of France, Ministère de la Transition écologique et solidaire]
6531	4	6	4	6	Footnote nr 7 - physical climate system conditions - why not refer to the physical-chemical-biological procresses and conditions? Mentioned on page 9, row 15. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
3993	4	6	4	6	The climatic impact-driver appears a new concept. Footnote 7 needs reference to more elaborate explanations, such as those in Box TS.1. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
4325	4	6	4	6	Concerning footnote 7, does "ecological systems" cover all the natural systems that are affected (i.e. ice etc.)? [Government of Sweden, Swedish Meteorological and Hydrological Institute]
8039	4	6	4	7	The term "climate impact drivers" is not clear, if it is to be used then footnote 7 does not help. Perhaps use a clearer term [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8041	4	6	4	7	Footnote 7. The purpose or added value of this footnote is not clear. Perhaps develop or delete. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
2871	4	7	4	7	Weather and climate extremes should be defined. [Government of Chile, Ministry of Environment]
2175	4	7	4	7	This part of the sentence is already included in the footnote 7. We therefore recommend to either define the term after its first use, in the text, or to delete this part and leave it in the definition in the footnote [Government of France, Ministère de la Transition écologique et solidaire]
6533	4	7			"weather and climate extremes": The difference (if any) should be explained. According to the Glossary, "climate extreme" includes "extreme weather events", but "weather extreme" is not defined (neither is "weather" as such"). In this instance, it may be preferable to refer only to "extreme weather event" OR "climate extreme". [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
8757	4	10	4	10	Provide a definition for H.S. and the hierarchy nomenclature. [Government of United States of America, U.S. Department of State]
8043	4	10	4	10	The statements in the AR4 and AR5 that "warming of the climate system is unequivocal" is stronger an clearer than this statement. It should preferably be retained. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8045	4	10	4	10	The statements in that the "human influence is clear" is also a strong statement could usefully be included in the headline statement. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8047	4	10	4	10	Has the IPCC created a new confidence level for " Facts". The word "established" should not be included without clairty on this. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8049	4	10	4	10	It is not clear what changes are being referred to here? Is it in atmospheric composition or sea-level rise etc are all equally rapid? A more nuanced statement is needed. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]

Comment ID	From Page	From Line	To Page	To Line	Comment
6005	4	10	4	10	To ensure clarity, please replace "human influence has warmed the climate system" by "human influence has caused the warming of the climate system". [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
2177	4	10	4	10	We recommend to definie what HS (High Level statement) means when it is first used in the report [Government of France, Ministère de la Transition écologique et solidaire]
2179	4	10	4	10	We find this first sentence to be too qualitative. One could understand that human influence is only one cause of global warming, among natural others. The sentence should better highlight the fact that the human influence is (by far) the dominant cause of global warming (H.S.1.2). The period considered should also be specified. [Government of France, Ministère de la Transition écologique et solidaire]
6535	4	10	4	10	It is an established fact' consider deleting 'established'. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
7593	4	10	4	10	The first thing I learnt as a science student is that there is no such thing as a "FACT" in science. I propose that we use alternative wording. Perhaps "data very strongly suggest" and perhaps we can show a confidence level as well of "very high". Then the questions arise of what data. It is important to then indicate a line of sight to the "historical emissions data" that suggests that. [Government of South Africa, Senior Policy Adviser International Climate Change Cooperation Department of Environmental
7595	4	10	4	10	It is important to indicate which "human influence" is the main cause of the warming in this HS1, although it is in the supporting text below. The reader needs to know from the onset. In this case it is anthropogenic GHG emissions. Also important to indicate the line of sight to "historical emissions", and based on the regions. [Government of South Africa, Senior Policy Adviser International Climate Change Cooperation Department of Environmental Affairs]
8755	4	10	4	11	This banner statement sounds weak. "It is an established fact" suggests that the AR6 SPM is picking up from some previous document. Suggest making this a stronger banner statement. In particular, how much more strongly can one go from the AR4 and AR5 statements on the TWO separate and very strong points, based on all the work underlying AR6 (viz., from the individual chapters and TS): (i) warming of the climate system, and (ii) human influence. If anything, the AR6's impressive work demonstrates a much more strengthened underpinning than in previous assessments. Making clear the basis for the conclusion is important to include. Replace "It is an established fact has warmed the climate system and that widespread and rapid climate changes have occurred" with "Unprecedented trends in observations and definitive theoretical and analytical studies make clear that human influences have disrupted global weather patterns and that widespread warming and associated changes in climate have occurred." [Government of United States of America, U.S. Department of State]
311	4	10	4	11	This high-level statement is a reinforcement of the finding of AR5 and conveys a very important message of the SPM. In order to further strengthen it please add a time frame. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
2637	4	10	4	11	Recommend adding a reference in the curly brackets to section 3.8 of Ch. 3. As we see it, this is the most relevant reference from Ch. 3 for this headline statement (HS) as it synthesizes the evidence about human influence on multiple elements of the climate system. We also encourage the authors to carefully select the most relevant references to include in curly brackets for this HS. For example, 5 entire sections of Ch. 8 are referenced, including 8.4 and 8.5 on future changes to the water cycle which do not seem relevant to a HS about observed changes and human influence on these. [Government of Canada, Environment and Climate Change Canada]
6003	4	10	4	11	In HS.1. the statement may gain more attention if a time frame was added. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]

Comment ID	From Page	From Line	To Page	To Line	Comment
7543	4	10	4	11	Add: Observed warming to date has been driven by greenhouse gas emissions, roughly a third of which has been masked by cooling from aerosol emissions". [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
7053	4	10	4	11	HS1. It suggests adding the phrase "in recent years" after " the climate system" in this sentence: "It is an established fact that human influence has warmed the climate system in recent years and that widespread … have occurred." [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]
7577	4	10	4	11	The term 'established fact' is not part of the official IPCC likelihood terminology, see https://www.ipcc.ch/site/assets/uploads/2017/08/AR5_Uncertainty_Guidance_Note.pdf., which is standard use in IPCC reports when describing (un)certainties . The term 'established fact' in the SPM is based on the Exsum of Ch 1 (and is taken up in the TS) but this finding is not supported by the main text of Ch 1, and even not supported in Ch 3 which specifically deals with the human influence on climate change. One would have expected in AR6 ch 3 a 'virtually certain' statement on human influence as the main cause of global warming since pre-industrial times, as a logical follow- up of the AR5 statement with the'extremely likely' on human influence. The use of the wording 'established fact' that is not well founded in the main report, could lead to complications in the line-by-line SPM approval session. Our suggestion: consider a statement in the SPM with a virtually certain based on a statement that has to be added and justified in Ch 3, and avoid the 'established fact' in the SPM. Alternatively, the Guidance Note could be amended by adding a qualifier in italics (i.e. established fact = 100% certainty), or one could add something in the Glossary, however changing the gauged IPCC likelihood language should be part of a broader discussion within IPCC first. [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
8349	4	10	4	11	It is not clear "warmed climate system" while warming in atmosphere, hydrosphere and criosphere is understandable, what about biosphere and litosphere? Please, rephrase. [Government of Ukraine, Director Ukrainian Hydrometeorological Institute]
7843	4	10	4	11	HS.1: make it more compelling: widespread -> global, specify "rapid", e.g. faster than durign the past 2000 years or the like. [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
8399	4	10	4	11	Consider rephrasing: change "an established fact" to "It is a scientifically established fact", or simply, "Human influence has warmed the climate system ..." This wording is in the underlying chapter as well. [Government of Australia, Department of Industry, Science, Energy and Resources]
4567	4	10	4	11	The SPM uses the term "established fact" to describe the effect of human influence on the warming climate - it is good to see the IPCC assessment has confirmed that we now have this level of certainty regarding this matter and therefore we welcome this statement. The same term is used in the technical summary where it is explained in more detail and a justification of its use is given: "The Fourth Assessment Report (AR4) stated in 2007 that 'warming of the climate system is unequivocal', and the AR5 stated in 2013 that 'human influence on the climate system is clear'. Combined evidence from across the climate system strengthens this finding" [TS page 8, lines 5-8]. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]

Comment ID	From Page	From Line	To Page	To Line	Comment
4569	4	10	4	11	There is some concern that there may be an inconsistency with the terminology used in chapter 3. Note that the "established fact" term refers to the overall warming of the climate system under the effect of human influence rather than a specific manifestation of this change like, for example, the post-1950s increase in temperature. A synthesis assessment across earth system components presented in chapter 3 [section 3.8.1] provides evidence that may justify the term "established fact". More specifically, there is now stronger evidence than in previous reports: "The Fourth Assessment Report (AR4) stated in 2007 that 'warming of the climate system is unequivocal', and the AR5 stated in 2013 that 'human influence on the climate system is clear'. Combined evidence from across the climate system strengthens this finding" [ch3, page 91, lines 24-28]. The key summary statement comes later in the same section of chapter 3: "Combining the evidence from across the climate system (Sections 3.3-3.7) increases the level of confidence in the attribution of observed climate change to human influence and reduces the uncertainties associated with assessments based on a single variable. From this combined evidence, it is unequivocal that human influence has warmed the global climate system" [ch3, page 92, lines 1-4]. In conclusion, it appears that "unequivocal human influence" and "increased level of confidence in attribution" have been condensed to the term "establised fact" used in the SPM and the technical summary. It would be good to also adopt it in chapter 3 and clearly justify it on the basis of increased confidence in attribution findings. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
4571	4	10	4	11	We would suggest a slight extension of this sentence to make it more informative: 'It is an established fact that human influence has warmed the climate system and that this has lead to/caused widespread and rapid changes including global retreat of glaciers, loss of Arctic sea ice and global sea level rise.' [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
7101	4	10	4	13	The confidnce of the statement has not determined. [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]
4839	4	10	4	13	Please consider adding "and are occurring" to the end of the sentence. [Government of Norway, Norwegian Environment Agency]
4841	4	10	4	13	We appreciate that the SPM describes finding as established facts where it is appropriate. [Government of Norway, Norwegian Environment Agency]
431	4	10	4	14	The conclusion, not well formulated, without qualifications such as the applicable time period, fails to follow the quantitative assessment of anthropogenic impacts on the climate system in previous IPCC reports. To ensure the scientific accuracy of the SPM, avoid ambiguities, and maintain continuity with the key findings of previous assessment reports, it is suggested to modify this conclusion by adding relevant qualifications. [Government of China, China Meteorological Administration]
7057	4	10	4	44	In case of rapid climate changes /conceuquences and warming flactuations of the goelogical period and similar cases at the present time must be considered in studies (may be another study), so it is necessary to conduct ancient paleoclimate studies to approve these cases for a long term period. [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]
309	4	10	5	16	While the headline of this statement provides a very clear message, the underlying paras referring to attribution often contain either weaker language of low confidence statements. This seems in contradiction to the TS and the underlying report. In particular, HS.1, HS.1.3 and TS2.1 seem to provide inconsistent information. Please check of clarify why this is the case. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]

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6001	4	10	5	16	_Attribution statements: Some statements on the attribution of climate change to human influence associate a relatively low anthropogenic contribution (e.g. 'main driver') or even a qualitative statement (e.g. 'contributed to increase/change', 'influence') with a relatively low likelihood result in weak messages. This holds for example for the increases in tropospheric temperature, atmospheric moisture, precipitation pattern changes, and glacier retreat. We are also surprised about the lack of confidence/certainty in the attribution statements, which seems in contrast to the significant progress in understanding indicated elsewhere in the SPM. In particular, the attribution statements regarding global warming and the climate system in HS.1, HS.1.3 and TS2.1 provide inconsistent information. Please check and improve. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
6537	4	10	5	16	Somewhere it needs to be clarified what exactly has 'improved' compared to AR5 and the special reports. This section can also have 1 line to explain how 'attribution' of human influence is estimated using models, as it is the basis for HS1.2 to HS1.8. Also why are some numbers until 2018 and others until 2019? [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
8401	4	11	4	11	Suggest rephrasing: 'rapid' is a relative term. Better to state 'decadal scale' to make clear the time scale in which the changes have occurred. [Government of Australia, Department of Industry, Science, Energy and Resources]
8759	4	12	4	12	This is the first mention of Figure SPM.2. This figure is very important in the narrative, and primary text throughout the document (beginning here) needs to improve the consistent discussion of forcing agents (human drivers?), noting they include indirect greenhouse gases (GHGs) like CO, land used, and aerosols. The headline in SPM.2 needs to note and be very up front that forcing agents are NOT just the well-mixed GHGs, as incorrectly stated in H.S.1.1. This needs to be described in the figure caption explicitly and somewhere in the HS.1 sub-bullets. Add a new paragraph describing the relative contributions of GHGs and aerosols to warming to help explain Figure SPM.2 and how the new ERFs have affected understanding since AR5. [Government of United States of America, U.S. Department of State]
6539	4	12	4	12	If Section 3.4 is considered relevant for H.S.1.5, then it should also be listed as evidence for H.S.1. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
7691	4	15	4	15	The contribution from permafrost and polar ice sheets melting feedbacks may be mentioned in addition to direct anthropogenic contributions. [Government of India, Ministry of Environment, Forests and Climate Change]
7975	4	15	4	15	It is stated that "Anthropogenic emissions of well-mixed greenhouse gases are…" but GHG emission are not well-mixed when emitted from the sources. It would be better to reffer as "well-mixed" only to GHG concentratios [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
47	4	15	4	15	Suggest to add "primarily" after "greenhouse gases are" [Government of Singapore, Ministry of Environment and Natural Resources]
7731	4	15	4	15	Besides anthropogenic emissions the diminishing efficiencies of major carbon sinks and warming-induced enhancement of natural emissions of well-mixed greenhouse gases (e.g. permafrost thawing) are also responsible for the observed increases in greenhouse gas concentrations. [Government of Hungary, Ministry of Innovation and Technology - Climate Policy Department]
8051	4	15	4	15	This statement should be fact checked e.g. ozone is a key GHG, yet not encompassed in this statement. Please revise. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
6007	4	15	4	15	The term "responsible" is misplaced in a physical context. Please exchange with "caused by" or something similar. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
2183	4	15	4	15	We suggest to add a very relevant finding for policy-makers on the recent pace of CO2 increase such as "From 2011 through 2019 the annual increase in CO2 concentration was higher than that of any comparable time period since global measurements began" which is deduced from 2.2.3.3.1 [Government of France, Ministère de la Transition écologique et solidaire]

Comment ID	From Page	From Line	To Page	To Line	Comment
7597	4	15	4	15	Important to indicate line of sight to historical GHG emissions, since all the regions/countries have not equally contributed to the high concentration of anthropogenic GHGs in the atmosphere. [Government of South Africa, Senior Policy Adviser International Climate Change Cooperation Department of Environmental Affairs]
4529	4	15	4	15	The ”responsible for” could be rephrased, for example to read "The observed increases in GHG concentrations are due to anthropogenic emissions of well-mixed GHG." [Government of Sweden, Swedish Meteorological and Hydrological Institute]
8403	4	15	4	15	Consider updating the data: We do not understand why values for 2019 are provided for concentrations of CH4 and CO2, as temperature data in the next line goes to 2020. [Government of Australia, Department of Industry, Science, Energy and Resources]
8761	4	15	4	16	Provide an indication of the period of time being referred to for the observed increases in greenhouse gases. [Government of United States of America, U.S. Department of State]
2181	4	15	4	16	We recommend to change the sentence into something like "Anthropogenic emissions are responsible for the observed increases in well-mixed atmospheric greenhouse gas concentrations". Indeed, emissions of well mixed GHG are only partly responsible for the increase in ozone concentration. Same comment for the use of "well mixed" in the next sentence on the same line. We would also like to point out that it is important to precise that it is the atmospheric concentration here and therefore atmospheric needs to be mentioned. [Government of France, Ministère de la Transition écologique et solidaire]
7055	4	15	4	16	HS1.1 It suggests adding the phrase "in recent decades" after "concentration" at the end of this sentence: "Anthropogenic emissions or well-mixed ….. in green house gas concentrations in recent decades." [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]
4845	4	15	4	16	To enhance understandability of "Well-mixed greenhouse gases", please consider replacing it with "greenhouse gases" and to insert a footnote explaining what "Well-mixed greenhouse gases" refers to. [Government of Norway, Norwegian Environment
8053	4	15	4	17	The observed increase in GHG concentration is mentioned with no figures showing the increase and data for two gases only referenced to the AR5, 2019. This is not sufficient. A relevant time series is needed as well as data for other GHGs. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8055	4	15	4	17	The Figures SPM.1 and SMP.2 do not the key information required for this section. The should be revised or replaced. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8059	4	15	4	17	The absence of Figure showing radiative (anthropogenic) forcing is very problematic. This should provide updated estimates of forcing by short and long lived species including aerosols and aerosol cloud impacts as wells the related uncertainties. These analysis are of use for policy and for informing future research investments. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8061	4	15	4	17	The absence of Figure showing radiative (anthropgenic) forcing is very problemtic. This should provide updated estimates of forcing by short and long lived species including aerosols and aerosol cloud impacts as wells the realetd uncertainties. These analysis are of use for policy and for informing future research investments. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8063	4	15	4	17	Figure SPM 2 goes from emissions to temperature impacts. This likely includes the range of uncertainties that this encompasses, including those related to the global enhanced carbon cycle. Hence the figure suggests the uncertainty of the contribution of CO2 to warming is large while previous AR reports showes a high level of confidence in CO2 forcing of climate. To avoid such confusion including of a standard WG1 RF figure with the estimated contribution to temperature increase shown is preferred. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]

Comment ID	From Page	From Line	To Page	To Line	Comment
7329	4	15	4	17	The text reflected in Chapter 2, Pg. 5 Line 30-38 need to be expressed in the SPM findings. Specifically, the text states "In 2019, concentrations of CO2, methane (CH4) and nitrous oxide (N2O) reached levels of 409.9 (±0.4) ppm". Concentrations of N2O in well mixed GHGs are expressed in the underlying chapter, however CO2 and CH4 concentrations only are mentioned in the SPM (Pg. 4 Line 15-17). N2O concentrations should be expressed in the SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7815	4	15	4	18	Paragraph H.S.1.1 does not refer to the temperature increase, so Figure SPM.1 should not be referenced [Government of Poland, Ministry of Environment, Department of Air Protection and Climate]
3995	4	15	4	18	It will be reader-friendly to quote "Figure TS.9" instead of Figure SPM 1, and SPM 2, as this sentence refers to the values of concentrations for CO2 and methane. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
7079	4	15	4	18	Considering the impact of human activities on climate change in each region, it suggests that the necessary research can be conducted at regional level with the specific conditions related to each region. [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]
7103	4	15	4	18	The confidnce of the statement has not determined. [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]
4573	4	15	4	18	As the third largest individual GHG contributor to radiative forcing, it would be helpful to also include the atmospheric concentration of N2O in HS1.1. Also, is it possible to use 2020 figures for Co2 and ch4 ppm and to mention what they were previously? In general, it would be really helpful if different dates could be used consistently in the report or it was explained why they are used differently. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy
3319	4	15	4	18	There is no confidence statement. [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
8057	4	15	4	19	This is where the AR6 should look at atmospheric change and its impacts on radiative forcing (anthropogenic forcing). If its not addressed here where in the AR6 SPMs will it be addressed? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
7601	4	15	4	31	The level of confidence is not shown for these specific HS. Perhaps it would be important to standardize this across the entire document, in order to ensure that we either indicate or omit level of confidence. However, I think it is better to indicate the level of confidence, especially for policymakers. [Government of South Africa, Senior Policy Adviser International Climate Change Cooperation Department of Environmental Affairs]
4843	4	15	5	16	We believe these finding are important and reconfirms many of previous IPCC findings, however it is not obvious that readers are familiar with how such finding have evolved over the previous assessment reports. Please consider to include that many of these finding actually reconfirms trends already indentified in AR5, and that new findings and developements since AR5 are highlighted in the text. [Government of Norway, Norwegian Environment Agency]
7957	4	16	4	17	Since AR5...It would be great to put a year of reference since the assessement was done over a period of time, starting with special reports then the main cycle. [Government of Kenya, Kenya Meteorological Service]
107	4	16	4	17	In the phrase 'Since AR5, concentrations in well-mixed greenhouse gases have continued to increase in the atmosphere, reaching 410 ppm for CO2 and 1866 ppb for methane in 2019' the concentrations relate to 2019. Maybe the authors could replace them with more recent? [Government of Russian Federation, Institute of Global Climate and Ecology]
8351	4	16	4	17	"Since AR5" not very specific, better to add years [Government of Ukraine, Director Ukrainian Hydrometeorological Institute]

Comment ID	From Page	From Line	To Page	To Line	Comment
163	4	16	4	17	The text line omits other GHGs and only states CO2 and methane. Ch. 5, P. 6, Line 20-21 indcates "well-mixed greenhouse gases (GHGs) have increased at rates that have no precedent on centennial time scales in at least the past 800,000 years". The text needs to be revised to ensure consistency: This sentence should be reflective of IPCC's definition of all identified gases contributing to global warming. Add 33.2 for N2O, in addition to CO2 and methane of well-mixed greenhouse gases (GHGs). [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
8405	4	16	4	17	For consistency with other parts of the report, please include N2O concentrations in this sentence. [Government of Australia, Department of Industry, Science, Energy and Resources]
4575	4	16	4	17	It mentions that greenhouse gas concentrations have increased since AR5, but could there perhaps be an indication of by how much. This could show rate of change, which can be an important tool for communication. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
313	4	17	4	17	Please insert here also numbers for N2O to cover all "well mixed GHG". From Chapter 2 the right number seems to be 332 ppb. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
8763	4	17	4	17	Change to "… reaching an annual average of 410ppm". [Government of United States of America, U.S. Department of State]
8765	4	17	4	17	Include N2O as the other obvious greenhouse gas. [Government of United States of America, U.S. Department of State]
8767	4	17	4	17	Define ppm, ppb , etc., as mole fraction of dry air in a footnote. [Government of United States of America, U.S. Department of State]
7507	4	17	4	17	Are there no figures for 2020 already? The warming figures relates to 2020 already [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
6009	4	17	4	17	Please insert …methane 'and 332 ppb for N2O' in…. (as mentioned in the ES of Ch 2 [p:2-5; l:31] to cover the atmospheric concentration of all 'well mixed' GHGs. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
137	4	17	4	17	The concentrations in well-mixed greenhouse gases shows only CO2 and Methane concentrations. Greenhouse gases not limited to those two but include other gases. The paragraph should should all GHG concentrations. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
2185	4	17	4	17	Please, consider adding data on relative increase in CO2 and methane concentrations since 2011 (5.0 and 3.5%, respectively). In addition, please consider mentioning also the data for N2O which is less known than CO2 and CH4 among the general audience but of particular interest for the agricultural sector (332 ppb and 2.4%, respectively). [Government of France, Ministère de la Transition écologique et solidaire]
3997	4	17	4	17	Greenhouse gas concentrations in 2019 described here are different from that shown in the WMO Greenhouse Gas Bulletin No. 16 and WMO State of the Global Climate 2020. This is because the values referred in AR6 are representative of the remote, unpolluted troposphere, derived from one or more measurement networks, as explained in the caption of Table 2.2. Considering such importance of greenhouse gas concentration as an indicator for climate change and the fact that the Subsidiary Body for Scientific and Technological Advice (SBSTA) of UNFCCC noted with appreciation past issues of above-mentioned documents as submissions by WMO in its 51st sessions, it would be preferable for SPM to provide similar explanation to Table 2.2 to avoid unnecessary confusion and misunderstandings of readership. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
3999	4	17	4	17	N2O concentration could also be mentioned since it is also well-mixed greenhouse gas with a major contribution to climate change. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]

Comment ID	From Page	From Line	To Page	To Line	Comment
4273	4	17	4	17	How many CO2 in ton? [Government of Indonesia, Ministry of Environment and Forestry Indonesia]
8769	4	18	4	18	Inconsistency in naming chemical formulas vs. names of gases (CO2 vs methane). Replace methane with CH4. [Government of United States of America, U.S. Department of State]
2187	4	18	4	18	Although better suited than figure SPM.1, figure SPM.2 does not show any "observed increases in greenhouse gas concentrations". Panel b) of Figure TS.9 would be better suited. [Government of France, Ministère de la Transition écologique et solidaire]
6541	4	18	4	18	SPM.1 and SPM.2 are not relevant for HS1.1. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
4001	4	18	4	18	GHGs concentration trend is one of the most important indicators as well as global mean temperature to achieve the goal of the Paris Agreement. Therefore, it is essential for policymakers to include narrative and figures with regard to the GHGs concentration trend from 1866 to 2019, as it was included in the AR5/WG1 report. Also, we would like to request the chart of CH4 to be provided for the same period. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
8407	4	18	4	18	Consider edit for consistency: We question why Figure SPM.1 and SPM.2 are referenced against this statement, as the change in concentrations do not feature in either figure. [Government of Australia, Department of Industry, Science, Energy and Resources]
2855	4	20	4	20	Even when some policymaker could immediately acknowledge that 1850-1900 is the historical baseline considered to infer climate -or forcing- anomalies, this could not be so intuitive for others. Thus, I suggest making a clear statement about the meaning/usefulness for the period in this line or above it (introduction). [Government of Chile, Ministry of Environment]
8771	4	20	4	20	Insert a new Footnote 8 immediately after the first use of "Global Surface Temperature" in H.S.1.2, as follows: "Global mean surface temperature (GMST) and global surface air temperature (GSAT) are the two primary metrics of global surface temperature used to estimate global warming in IPCC reports. GMST merges sea surface temperatures (SSTs) over the ocean and 2m air temperature over land and sea ice areas. The GSAT metric is 2m air temperature over all surfaces and is the diagnostic generally used from climate models. 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. Hence the term global surface temperature is used in reference to both quantities in the text of the TS and SPM." [Government of United States of America, U.S. Department of State]
8773	4	20	4	20	Average should be 1.075 (or 1.08), not 1.09. Check the underlying document. In addition, the numbers in brackets accompanying values need a more thorough explanation than the current footnote in terms of the single value as a mean versus median and numbers in brackets denoting very likely range, or 90% uncertainty interval as a blend of a statistical value relative to an assumed distribution plus expert opinion. [Government of United States of America, U.S. Department of State]

Comment ID	From Page	From Line	To Page	To Line	Comment
6011	4	20	4	20	_Global surface temperature - time period to calculate warming levels: It is extremely important that the AR6 carefully distinguishes between the increase in global surface temperature and global warming. Since we are so close to the 1.5 °C limit of the Paris Agreement, this difference matters even more, both for the levels of warming and for the remaining carbon budgets. The glossary reads: "Global warming refers to the increase in global surface temperature relative to a baseline reference period, averaging over a period sufficient to remove interannual variations (e.g., 20 or 30 years). A common choice for the baseline is 1850-1900 (the earliest period of reliable observations with sufficient data, with more modern baselines used depending upon the application." Comparing temperature levels of 2003-2012 (AR6 GST = 0.9°C) and the ones given in the SPM for the recent decade 2011-2020 (AR6 GST = 1.09°C) it seems that within eight years the global surface temperature increased by 0.19°C. This increase is even higher if you compare the new AR6 levels with the SR1.5 levels published three years ago: GMST = 0.87°C for the period 2006-2015 resulting in a temperature increase of 0.32°C in only 5 years. And even if the update in the historical warming levels of 0.08°C is considered, there is still an increase of 0.24°C within 5 years. How much of this increase is due to natural variability? We are concerned that in a coming report (e.g. AR7) there will be GST changes provided that are similar or even smaller than the ones given now, just because of natural variability. We therefore strongly encourage the authors to use longer time periods that are less prone to natural variability. Current warming is defined in the SR1.5 SPM as "Present level of global warming is defined as the average of a 30-year period centred on 2017 assuming the recent rate of warming continues." We would understand this as equivalent to the "central estimates" used in AR6 WG I, but with a period of 30 years instead of 20. HS.1 and its sub paragraph, however, give values for global surface temperature increase for recent decadal averages relative to the pre-industrial period (1850-1900). In addition, the AR6 WG I SPM uses different decades for the current GST increase (2011-2020, 2010-2019, 1995-2014). According to the glossary, averaging over only one decade cannot represent global warming. The AR5 and the AR6 clearly show that the level of global warming also depends on the length of the modern period and the interpolation method used. Therefore, to quantify global warming in 2020, we suggest using a central estimate of 30 years as in the SR1.5, or otherwise clearly explaining the method used and why global warming can be represented by a decadal average. Future assessed warming is expressed as "central estimate" of 20 years, and as "GWL" in figure SPM.9 without a definition of this term or length of modern period used in the glossary. Please clarify. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
6017	4	20	4	20	Global surface temperature - definition of GST: This report introduces for the first time the "global surface temperature" while the AR5 only had GMST and the SR1.5 distinguished between GMST and GSAT. To avoid confusion, we strongly suggest to enhance the definition in the glossary, explaining the GMST and GSAT are now assessed to be equivalent and add a definition for global surface temperature as found in the TS (TS-27:48-49): "Hence, the term global surface temperature is used in reference to both quantities [...]". This very important information about the relationship GST = GMST = GSAT is only found in the TS and needs to be mentioned upfront as well as in the glossary. Please see also our general comment on referring to the glossary in footnotes instead of repeating definitions. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
6021	4	20	4	20	Please remove the second decimal digit. The measurements cannot be carried out with this accuracy. The second decimal digit therefore specifies an accuracy that does not exist on the basis of the available data. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]

Comment ID	From Page	From Line	To Page	To Line	Comment
2191	4	20	4	20	We suggest to briefly explain why this estimate is much larger than the one assessed in SR1.5 (0.87°C for 2006-2015). How much is due to more recent 10 years period, vs better temperature measurements. Otherwise it might be seen as there was a warming of 0.22°C over the last 5 years. [Government of France, Ministère de la Transition écologique et solidaire]
6543	4	20	4	20	The term Global Surface Temperature is not clearly explained in the report. Using such a term in the SPM is a welcome development (so as not confuse readers with issues of GMST/GSAT difference). However, its definition in the glossary needs to be improved. In particular, clarify that the term refers to the convention of using GMST for past and present temperature observations, and GSAT for projections (I assume this is the case, but do not see where it is stated clearly). [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
4003	4	20	4	20	It would be helpful for readers to add the definition of “global surface temperature”, as outlined in Cross-Section Box TS.1, because this metric has been newly introduced in the FGD AR6/WG1 and seems confusing with the past metrics of temperature such as global average surface temperature (GMST) and/or global surface air temperature (GSAT) used in the AR5 and AR6 SRs. It might be a good idea to add a footnote when it first appears. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
7609	4	20	4	20	Is it global surface temperature or global MEAN surface temperature? Initially GMST was always used. But now global mean surface temperature ised used across the report. [Government of South Africa, Senior Policy Adviser International Climate Change Cooperation Department of Environmental Affairs]
6361	4	20	4	20	Please, include the following text in the beginning of line 20: "Global Mean Surface Temperature (GMST) is a key indicator of the changing state of the climate system". [Government of Brazil, Ministry of Foreign Affairs]
8411	4	20	4	20	Suggest this sentence needs some clarification to avoid ambiguity. Should read "Global *average* surface temperature was 1.09 [0.95 to 1.20] °C higher in *the decade* 2011–2020 than *in the* 1850–1900 period *taken as representing the preindustrial climate.* [Government of Australia, Department of Industry, Science, Energy and Resources]
8775	4	20	4	21	Illustrate that the global mean temperature difference (warming) between the recent decade 2011-2021 and the 1850-1900 period is part of a long-term warming trend and not decadal variability. Recalculate comparison for an average for the most recent two decades (2001-2021) to the 1850-1900 time slice. [Government of United States of America, U.S. Department of State]
2645	4	20	4	21	This version of the SPM no longer includes a Box defining core concepts/terms. Here Global Surface temperature is used but it is unclear how this is defined. The glossary entry for this term just says "see Global mean surface temperature (GMST) and Global mean surface air temperature (GSAT)"; therefore, this also leaves it unclear to readers of the SPM how global surface temperature is defined. While Cross-section Box TS.1 does provide the needed information, we suggest a footnote here for this critical metric would be useful. The footnote could pull directly from Cross-section Box. TS.1 to say "Longterm changes in GMST and GSAT are presently assessed to be identifical; hence the term global surface temperature is used in the SPM to refer to both quantities." [Government of Canada, Environment and Climate Change Canada]
7263	4	20	4	21	This is the first time that the new AR6 temperature change assessment is presented. Since the underlying methodology has changed compared to AR5, a footnote has to be added here to point to the revised methology and the implications (+0.08°C). In addition, it would be very informative to present the most recent decadal warming rate here, as it helps to understand how quickly we are approaching the Paris Agreement long-term temperature goal. [Government of Saint Kitts and Nevis, Department of Environment - Ministry of Agriculture, Marine Resources, Cooperatives, Environment and Human Settlements]
6013	4	20	4	21	Climate: the classical period of averaging is a 30-year period (WMO, see glossary); may be to add for comparison the value for the period 1991-2020 (to 1850-1900). [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]

Comment ID	From Page	From Line	To Page	To Line	Comment
8075	4	20	4	21	For the estimated warming to the decade 2006-2015, assessed as 0.87°C in SR1.5, or the linear trend 1880-2012, assessed as 0.85°C in AR5, how are these compared/updated here? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
7607	4	20	4	21	It should be clarified that this warming is not consistent across all regions and that some warm at twice and even three times the rate of the GMST. [Government of South Africa, Senior Policy Adviser International Climate Change Cooperation Department of Environmental Affairs]
2797	4	20	4	21	Since this is the first instance that the new historical temperature change assessment is presented based on an evolved methodology, we would strongly suggest to add information that clarifies by how much the temperature assessment has changed compared to AR5 due to methodological changes only. Would it be possible to also present the most recent decadal warming rate here? [Government of Jamaica, Meteorological Service Division]
6385	4	20	4	21	The AR6 GSAT historical assessment is presented for the first time here, and the methodology has changed, some information should be included pointing to the revised methodology and its implications of an additional 0.08°C of warming, preferably in the form of a footnote. Furthermore, the most recent decadal warming rate could be presented here also in order to help understand how quickly the Long-Term Temperature Goal (LTTG) of the Paris Agreement is being approached. [Government of Saint Lucia, Department of Sustainable Development - Ministry of Education, Innovation, Gender Relations and Sustainable Developement]
315	4	20	4	22	We suggest limiting the numbers of temperature to one digit, as this kind of writing suggest an accuracy that is not realistic. Also concerning the time frame, they are changing from 2011-2020 to 2010-2019. Would be preferable to have one time frame for current or recent climate throughout the SPM. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
8777	4	20	4	22	The use of different periods, 2011-2020 vs 2010-2019 is confusing. While the analyses are separate and use different data, it still seems odd. Provide an explanation for the mismatch in a footnote. [Government of United States of America, U.S. Department of State]
6019	4	20	4	22	Please do not use different but very similar comparison periods in one text (2011-2020 and 2010-2019). That appears to be cherry-picking. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
4005	4	20	4	22	The 2011-2020 average and the 2010-2019 average are mixed. As a message for the general public, it would be easier to understand and communicate if the periods for which the averages are taken were aligned. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
433	4	20	4	22	According to WMO, 30 years is used as the average state of climate. Here, using the average of only 10 years from 2011 to 2020 to judge the magnitude of warming does not accurately represent the climate change characteristically. It is suggested to use the average value extended to the last 30 years to characterize the current warming. [Government of China, China Meteorological Administration]
7721	4	20	4	24	The final time period for temperature increase is fixed to be 2011-2020 whereas the final reference period for GHG forcings is fixed to be 2010-2019. For comparability, the two time periods should be taken to be the same. [Government of India, Ministry of Environment, Forests and Climate Change]

Comment ID	From Page	From Line	To Page	To Line	Comment
2189	4	20	4	24	The link between the confidence interval of the temperature increase (1.09[0.95 to 1.20]) and the difference between the greenhouse gas forcing contribution (1.0°C - 2.0°c) and the cooling caused by other forcings (0.0°c - 0.8°c) is not really straightforward.For example, citing the mean and the range, as given on Figure SPM2, would be easier to read and make the link with the global temperature change clearer. We suggest, if this is supported by the science, to reformulate the second sentence as the third one. It would look like " The likely range contribution of greenhouse gas forcing is 1.0°C-2.0°C of warming, the likely range of other human-caused forcings ..." This is to avoid any confusion regarding the use of "likely" in the sentence. [Government of France, Ministère de la Transition écologique et solidaire]
6015	4	20	4	25	From 1850-1900 to 2010-2019, the "likely range of net human-caused surface warming" stated in the SPM "is 0.8 °C- 1.3 °C, with a central estimate of 1.07 °C.", whereas the "Attributable warming in AR6 WGI" shown for this period in Cross-Ch Box 2.3, Table 1 in Ch 2 (page 2-39) is 1.06 (0.88-1.21) for GSAT [According to Ch 3 (page 3-4, lines 39-42), the range of human-induced warming mentioned in the SPM refers to global-mean surface air temperature (GSAT)]. Please specify the term "attributable" in order to avoid confusion/misinterpretation. Furthermore, even though the report clarifies that the likely ranges for human-induced GSAT and GMST warming are equal (medium confidence), it remains unclear, why the global warming estimate between 1850-1900 and 2011-2020 (line 20) "1.09 [0.95 to 1.20]" is presented as change in GMST, while human-induced warming -and also the increase from GHG forcing's- refer to GSAT. According to CCB 2.3, Table 1, the GSAT warming to present in AR6 WGI for 2011-2020 relative to 1850-1900 is "1.09 (0.91-1.23)". The reference to two different periods (2011-2020 and 2010-2019) makes a comparison even more difficult: Please clarify why the change in temperature (GMST) from 1850-1900 is referred to the most recent decade (2011-2020) in AR6 WGI. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
6545	4	20	4	25	H.S.1.2 It is not obvious why central estimate of net human-caused forcing (1.07°C) is lower than the observed surface temperature rise (1.09°C) even though natural forcing was net cooling. Can this be explained concisely in the paragraph? Is it merely due to the difference between the 2011-20 period used in the 1st sentence and the 2010-19 period used in the rest of the paragraph? One solution could to state the overall warming figure for both 2010-19 and 2011-20. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
5097	4	20	4	25	Could you consider using the same time period (2011-20 or 2010-19) in all statements? [Government of Belgium, Belgian Science Policy Office - Belspo]
8779	4	20	4	26	H.S.1.2 is not clear because it uses a number of metrics that are not clearly defined. It does not use those established in previous reports. [Government of United States of America, U.S. Department of State]
8781	4	20	4	26	Is "Global Surface Temperature" the same metric as in previous assessments -- i.e., global mean surface temperature (GMST)? It appears that, in the Chapter 2 Executive Summary, the GMST increase varies dramatically between 20-year mean (1995-2014) and 10-year mean for (2011-2020), but only the larger 10-year increase is reported and it's not explained why the increase went up so much. Recalculate the comparison for the most recent two decades (2001-2021) to the 1850-1900 period. Averaging over these two recent decades would at least partially include years from the hiatus period that was extensively assessed in AR5 and where it was concluded that the hiatus in global mean surface temperatures can partly be attributed to natural internal variability. This helps address the high-level issue on the mismatch of temporal and spatial scales and averaging when comparing most recent decade global conditions and rates of change to any multi-decadal period. [Government of United States of America, U.S. Department of State]

Comment ID	From Page	From Line	To Page	To Line	Comment
2643	4	20	4	26	For ease of understanding, and for consistency with descriptors in the caption to Figure SPM.2, use of the word 'forcings' could be avoided here in the SPM. "Greenhouse gas forcing" could be replaced with "greenhouse gas emissions" or "greenhouse gases". "Other human-caused forcings" could be replaced with "Other human drivers". "Natural forcings" could be replaced with "natural drivers". [Government of Canada, Environment and Climate Change Canada]
8065	4	20	4	26	Figure SPM 2 goes from emissions to temperature impacts. This likely includes the range of uncertainties that this encompasses, including those related to the global enhanced carbon cycle. Hence the figure suggests a high uncertainty range of the contribution of CO2 to warming while previous AR reports shows a high level of confidence in CO2 forcing/warming. To avoid such confusion including of a standard WG1 RF figure with the estimated contribution to temperature increase shown is preferred. This should also include ozone and aerosol forcing rather than that of their precursors. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8071	4	20	4	26	It is noted that a 10 year average is used here while the IPCC 1.5 Report used a 30 year average for current warming can this be explained or compared? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8073	4	20	4	26	Can the main uncertainty in the estimates be identified, e.g. what is the uncertainty around current global average temperature value as presented for the period 2011 to 2020 and that for the period 18-50-1900 as provided here. Also how has that uncertainty enveloped changed over the intervening period? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
6547	4	20	4	26	It is confusing to to start with presenting very likely (more narrow) ranges, and then continue with likely ranges in the second part of HS1.2. Can all ranges be presented on the same 90 % uncertainty interval scale? [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
7845	4	20	4	26	The "°C" sometimes has a space after the number, sometimes not. Please make it consistent. [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
4287	4	20	4	26	Further clarity is required in the global surface temperature increase, what could be attributed to data set changes and what to recent warm years. [Government of Italy, CMCC - Centro Euro-Mediterraneo per i Cambiamenti Climatici Instituto Nazionale di Geofisica e Vulcanologia (INGV)]
8409	4	20	4	26	H.S.1.2 contains useful information. Suggest separating it into two points, with a new paragraph sub-point starting at "From 1850-1900 to 2010-2019 …" The first statement is observed, the second two sentences are statements of attribution, and thus are inferences based on inputs and reasoning in addition to the observations. [Government of Australia, Department of Industry, Science, Energy and Resources]
4577	4	20	4	26	We suggest H.S.1.2 should be reordered to maximise understanding by bringing the statement “The likely range of net human - caused surface warming is 0.8°C – 1.3°C, with a central estimate of 1.07 °C.” before the statement about greenhouse gas forced warming. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]

Comment ID	From Page	From Line	To Page	To Line	Comment
4579	4	20	4	26	Upon reading HS1.2, policymakers and the public are likely to compare the temperatures given here to the most recent assessment in the Special Report on Global warming of 1.5°C, which combined observations and future projections to give an estimated attributable warming to date of 1.0C in 2017. However, there is no such directly comparable figure in this report, which may lead to confusion – as the attributable warming quoted in HS1.2 is for the 2010-2019 historical period, which gives a less up-to-date estimate than SR1.5. To increase the usefulness and policy relevance of this section, we would encourage the authors to produce a more comparable number for attributable warming to date, synthesising the information throughout this report (including observations, future projections, climate sensitivity etc) to give an estimate over a long-term (30-year period) whose midpoint is as up-to-date as possible. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
4581	4	20	4	26	Policymakers will be interested to understand how much actual warming (as opposed to increases in a warming resulting from methodological/data changes) has occurred since AR5. Therefore we request that the authors include here (or in a footnote) the actual warming since the 1986-2005 baseline. Furthermore, we request that the authors include an updated rate of warming, which is of value to policymakers. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
4583	4	20	4	26	In HS1.2, the slightly different reference periods may be confusing to the reader – particularly as it makes the total warming larger than the attributable warming, when in fact this is not true when using looking at the most recent period where both values are available in the underlying report (2010-2019). Could the authors update and align these figures such that they are all using the same reference period. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
4585	4	20	4	26	The causes and implications of improved understanding of historical warming are highly policy relevant and very important to explain in order to understand the observed and projected warming quoted in this report. We would therefore propose lifting the following text from the technical summary into section HS1 of the Summary for Policymakers – “Dataset innovations, particularly more comprehensive representation of polar regions, and the availability of new datasets have led to an assessment of increased global surface temperature change relative to the directly equivalent estimates reported in AR5. The contribution of changes in observational understanding alone between AR5 and AR6 in assessing temperature changes from 1850–1900 to 1986–2005 is estimated at 0.08 [–0.01 to 0.12] °C.” as well as a short summary of the following text from chapter 2, cross-chapter box 2.3: “The assessment of global warming to date now being larger than previously assessed has no consequence on the assessment of past climate impacts, nor does it generally imply that projected climate impacts are now expected to occur earlier. The implications are mainly that the level of warming associated with a particular impact has been revised… The future impacts previously associated with 1.5C warming are now associated with 1.58C warming. However… the ostensible difference in impacts associated with a 0.08C difference in global mean temperature will be small in comparison with the uncertainties. There is therefore high confidence that assessment of the magnitude and timing of impacts-related climate quantities at 1.5°C is not substantially affected by the revised estimate of historical global warming.” [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
4587	4	20	4	26	Could the authors add a line to indicate the current rate of warming to give an indication of how rapidly the climate is changing now compared with the past to support the line in HS.1: "…rapid climate changes have occurred". [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
4847	4	20	4	26	We appreciate the advancement in Figure SPM 2 going from RF to temperature. Please add here, or elsewhere in the section, quantification of the share of the warming that the main drivers of global warming have contributed to the observed warming since pre-industrial. [Government of Norway, Norwegian Environment Agency]

Comment ID	From Page	From Line	To Page	To Line	Comment
8783	4	20	5	10	For the various statements about changes over periods of time, it would be helpful to provide explanations of why various specific years (e.g., 1979) are being chosen. In virtually every case, it appears that the years are being chosen because that is the starting year for comprehensive global observations rather than a year when there was a change in what is causing the warming (e.g., going from natural to human influences, etc.). This could generally be done quite easily with a phrase of explanation to help policymakers understand limitations in homogeneous observational records. This helps address the high-level issue on the mismatch of temporal and spatial scales and averaging when picking time periods to compare most recent global conditions and rates of change to any previous multi-decadal period. [Government of United States of America, U.S. Department of State]
8785	4	21	4	21	Regarding Footnote 8, change "90% uncertainty level" to "90% confidence level". What is needed is to express confidence in numbers. The numbers in brackets accompanying values need a more thorough explanation than the current footnote in terms of the single value as a mean versus median and numbers in brackets denoting very likely range, or 90% uncertainty interval as a blend of a statistical value relative to an assumed distribution plus expert opinion. [Government of United States of America, U.S. Department of State]
2193	4	21	4	21	Please clarify the number 1.59 for the warming over land as the value given in the Technical Summary is 1.61 not 1.59 (p TS-48, line 42). However, the value given in Chapter 2 is 1.59 (Table 2.4, p. 2-46) [Government of France, Ministère de la Transition écologique et solidaire]
6549	4	21	4	21	It would be useful to mention (e.g. in the footnote that the convention of using that 1850-1900 period to approximate pre-industrial global temperature is the same as adopted in the 1.5°C Special Report. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6551	4	21	4	21	Footnote 8 could be merged into footnote 5. The meaning of uncertainty intervals between brackets could be introduced with other uncertainty language. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
7947	4	21	4	24	Maybe minor, a reader expects the start year to be a single year instead of a range. Consider this "It is likely that greenhouse gas forcing contributed 1.0-2.0C of warming, other human-caused forcings (principally aerosols) contributed a cooling of 0C-0.8C, and contributions form natural forcings were smaller than 0.1C over the years between 1850-1900 and 2010-2019. [Government of Kenya, Kenya Meteorological Service]
4589	4	21	4	24	The uncertainty range proportionally of attributable GHG warming is larger than the uncertainty range on TCR (proportionally) which implies that information that could reduce the uncertainty in the attributable GHG warming is not being incorporated into the uncertainty in this quantity. The SPM states that "a key advance in this report is the development of projections of surface warming, ocean warming and sea level rise that are fully consistent with the assessment of climate sensitivity" so it would be good if the estimates of attributable warming were also consistent with the assessment of climate sensitivity and TCR if the literature supports this. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
8787	4	22	4	22	To emphasize that forcings are global, change "it is likely that ..." to "it is likely that global ..." [Government of United States of America, U.S. Department of State]
6023	4	22	4	22	Please clarify that "greenhouse gases" for this forcing contribution to warming refers to well-mixed greenhouse gases (as specified in Ch 3, footnote 1). [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]

Comment ID	From Page	From Line	To Page	To Line	Comment
2195	4	22	4	24	It is not clear if this sentence is about well-mixed GHG forcing or all anthropogenic greenhouse gas forcing (including that from ozone) for the two mention of forcings in this sentence. Furthermore, we suggest to make sure that "forcing" is understandable outside of the scientific community. For exemple, maybe it is not needed on line 22 and could be replaced by increase. Or when used in line 23 it could be replaced by factor, unless of course forcing is important because it is a way to tell by which mechanisms (i.e radiation and energy) it affects climate. Finally, we recommand to precise what is behind the terms « natural forcings ». Warming limitations due to natural processes are apparently not accounted in this formulation. [Government of France, Ministère de la Transition écologique et solidaire]
6553	4	22			Insert "anthropogenic" before "greenhouse gas forcing". [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6555	4	23	4	24	Suggest to add "in absolute value" after "contributions from natural forcings were smaller than 0.1°C.". It will make clearer that contributions from natural forcing could lead to both temperature and negative impacts, but in any case negligible. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
8789	4	24	4	24	What are natural forcings? It's not defined and unclear; no uncertainty is reported and no confidence. What is surface warming? Is it GMST? Add parenthetical phrase after natural forcings (like variations in the sun's intensity). Specify "air temperature" if it is not "skin temperature". [Government of United States of America, U.S. Department of State]
4243	4	24	4	24	Is there any explanation within the text related to the term "net human-caused".? [Government of Indonesia, Ministry of Environment and Forestry Indonesia]
2639	4	24	4	25	What is the time period for which this statement is true? Is this for 2010-2019 vs 1850-1900 or 2011-2020 vs 1850-1900? Figure SPM.2 indicates it is for 2010-2019. [Government of Canada, Environment and Climate Change Canada]
6025	4	24	4	25	Please add the timeframe of this 1.07°C human-caused surface warming - we guess it is said in the sentence before but we are not sure. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
2197	4	24	4	25	It is not obvious how the different ranges of this paragraph connect to each other and lead to this estimate: the non-human contributions are estimated to be "smaller than 0.1 deg", and the observed warming is estimated as 0.95-1.20 deg. Therefore we suggest to add the natural variability with its likely range. Giving the value of the global mean temperature change for the same period 1850-1900 to 2010-2019 to compare with would also help. [Government of France, Ministère de la Transition écologique et solidaire]
7847	4	24	4	25	Insert this last very important sentence: "The likely range of net human-caused surface warming is 0.8°C-1.3°C, with a central estimate of 1.07°C" as the second sentence in this paragraph right after "… than over the ocean (0.88 [0.68 to 1.01] °C)." [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
2879	4	25	4	25	A note could be added stating why the addition of the central estimates of anthropogenig warming, cooling and natural warming does not equal the estimated total. [Government of Chile, Ministry of Environment]
6027	4	25	4	25	The term "central estimate" is used for the first time in a SPM. We assume that it is the median? Please define. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
2199	4	25	4	25	Maybe another term than "central estimate" would be better for the wide public [Government of France, Ministère de la Transition écologique et solidaire]

Comment ID	From Page	From Line	To Page	To Line	Comment
6557	4	25	4	25	"The likely range of net human-caused surface warming is 0.8°C–1.3°C, with a central estimate of 1.07 °C". The numbers stem from Box TS.1 as indicated, however, one cannot trace them easily back to Section 2.3, which is also indicated as a contributing source. Assuming that the numbers are presented in some of the other sections (3.3, 6.4, 7.3), the reference to Section 2.3 could be deleted. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
4007	4	25	4	25	If there is a different nuance in "a central estimate" from “the best estimate”, please clarify the meaning of both terms. It not, it would be better to use the same term throughout the report to avoid confusion. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
435	4	25	4	25	The term "central estimate" appears several times here and in the subsequent texts. It is suggested to clarify the specific meaning of the term, for example, whether it represents Mean or Median, or something else, to avoid misunderstanding. [Government of China, China Meteorological Administration]
6559	4	28	4	28	Sentence reads strange without an uncertainty statement ('certain'?) connected to the tropospheric warming. It would be useful to explain the added information compared to HS1.2 (surface temperatures). Is the tropospheric warming different from the surface warming. HS can be made more quantitative. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6561	4	28	4	28	In Chapter 2, the sentence that it is "virtually certain that the stratosphere has cooled" refers only to the lower stratosphere. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
7733	4	28	4	29	No confidence level is provided with the statement ‘Since the 1950s, the troposphere has warmed...”, unlike in the second part of the sentence: “it is virtually certain that the stratosphere has cooled.” [Government of Hungary, Ministry of Innovation and Technology - Climate Policy Department]
8079	4	28	4	29	Has all of the stratosphere cooled? Is the cooling more evident in polar regions? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
7	4	28	4	31	Need explaination Why warming reference is made from 1950s and 1979 instead of starting during pre-industrial period. [Government of United Republic of Tanzania, Tanzania Meteorological Authority (TMA)]
7701	4	28	4	31	It will be useful if quantified cooling is given for stratosphere [Government of India, Ministry of Environment, Forests and Climate Change]
7469	4	28	4	31	H.S.1.3 lacks the statement on causes of the higher stratospheric cooling due to increasing CO2 levels. We think it is essential to include all reasons for stratospheric cooling. The statement in its present form suggests there is no effect of CO2 increases. [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
317	4	28	4	31	The first sentence of the paragraph on troposphere and stratosphere might be very difficult to understand by a policy maker. For those that understand this information it is available in the TS, so we would suggest deleting it form the SPM. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
8791	4	28	4	31	Improve consistency of confidence/likelihood statements, quantify, and add attribution. There is no statement of confidence level/likelihood assessment for tropospheric warming, in contrast to stratospheric cooling which was assessed to be "extremely likely". How much has the troposphere warmed and the stratosphere cooled? Indicate if it is attributed to GHGs, ozone, etc. Are there no natural factors playing important roles in these trends? Regarding the phrase on lines 30-31, it would make more sense to make clear that stratospheric cooling since 1950 has been dominated by increased CO2-induced cooling, and then say that during the 1980s and early 1990s stratospheric ozone depletion became important but that its influence has subsided with the actions taken to implement the Montreal Protocol and its various amendments. [Government of United States of America, U.S. Department of State]

Comment ID	From Page	From Line	To Page	To Line	Comment
6029	4	28	4	31	The relevance of tropospheric warming may not seem obvious to policymakers; most might not know what the troposphere is. Please contextualize (or delete) the statement. The information can still be found in the TS. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
8077	4	28	4	31	The terms troposphere and stratosphere may not be widely understood can more accessible wording be used? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
2203	4	28	4	31	This paragraph retains that the lower stratosphere cooled as a consequence of ozone depletion. The technical summary (TS.2,3) retains that the upper stratosphere cooled as a combined effect of CO2 increase and ozone depletion. It is important to mention both impacts since the stratospheric cooling has been presented in the past to the public as an evidence of the increase of the greenhouse effect. Thus more information could be provided here about the contribution of GHG and/or ozone depletion after 1990 in lower/upper stratospheric cooling. This is even more important than AR6 sentence is about the tropospheric warming while AR5 had a higher confidence interval about surface warming, which makes both statement right but there is a risk if this subtle difference not being fully understood and reader having the impression IPCC is less sure than it was before. [Government of France, Ministère de la Transition écologique et solidaire]
7107	4	28	4	31	It's not clear the rate of ozone changing up to the recent years. [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]
8413	4	28	4	31	Suggest the statements about tropospheric warming and stratospheric cooling are separated into two distinct sentences, as the two phenomena are attributed to different drivers. [Government of Australia, Department of Industry, Science, Energy and
5099	4	28	4	31	Three different time periods are referred to in this statement (1950s to present, 1979 to present, 1979 to mid-1990s). We would like to ask for an explanation about the reasons to use a specific year (1970). That could explained either in the main text, in an additional footnote, or possibly inside footnote 9 if it is related to the year when the climate change signal reaches 50%. [Government of Belgium, Belgian Science Policy Office - Belspo]
4849	4	28	4	31	Here is a suggested rephrased paragraph: "The troposphere is warmer now than it was in 1979, and it is virtually certain that the stratosphere has become cooler. It is very likely that the warming mainly was caused by human-caused greenhouse gas increases. It is also extremely likely that the cooling in the lower stratospheric cooling between 1979 and the mid-1990s mainly was connected to human-caused stratospheric ozone depletion.". Related clarifying questions: Why use both 1950 and 1979? And why not use calibrated language on the troposphere and only for the stratosphere? Is this due to that it is a state of fact for the troposphere? [Government of Norway, Norwegian Environment Agency]
3321	4	28	4	31	It is stated in the first sentence that the troposphere has warmed since 1959 while in the second sentence it s stated that human intervention is the main cause for this warming since 1979, which begs the question of what was the main driver between 1950 and 1979. This is a comment for the sake of clarity. [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
3323	4	28	4	31	It is stated in the first sentence that the stratoposphere has cooled since 1959 while in the second sentence it s stated that human intervention is the main cause for this cooling between 1979 and mid 1990, which begs the question of what was the main driver between 1950 and 1979 and what happened after mid 1990. This is a comment for the sake of clarity. [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
8353	4	28	4	44	In H.S.1.3 and H.S.1.5 using of the specific 1979 year is not clear. In these H.S. "late 1970s" seems better words [Government of Ukraine, Director Ukrainian Hydrometeorological Institute]

Comment ID	From Page	From Line	To Page	To Line	Comment
2201	4	29	4	29	Concerning the reference to greenhouse gas increase, perhaps adding the word "concentration" enhance the text comprehensibility for non experts [Government of France, Ministère de la Transition écologique et solidaire]
4531	4	29	4	29	In footnote 9: the ”responsible for”, could be changed to "account for" or "has caused". [Government of Sweden, Swedish Meteorological and Hydrological Institute]
5101	4	29	4	29	The word "concentration" is missing between "greenhouse gases" and "increases". [Government of Belgium, Belgian Science Policy Office - Belspo]
4591	4	29	4	29	"It is very likely that human-caused greenhouse gas increases were the main driver of tropospheric warming…" but the headline statement (line 10) says "It is an established fact that human influence has warmed the climate system". These statements could appear to be inconsistent to readers so could the authors rephrase the former sentence to be clear why there is reduced uncertainty for this statement? Could the authors also please consider adding the analysis from the TS on this topic e.g. "tropospheric warming and stratospheric cooling are virtually certain to continue with continued emissions of greenhouse gases (TS2.3)"? [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
7489	4	29	4	30	This sentence indicates that greenhouse gases were very likely the cause of troposperic warming since 1979. How can it be consistent with HS.1 stating that it is a established fact that humans warmed the climate? This needs more explanation. [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
6491	4	29	4	31	is there any chance to add an information about the statosphere after the mid 1990s? [Government of Austria, Federal Ministry of Agriculture, Forestry]
6563	4	29			Replace "human-caused greenhouse gas increases" with "human-caused increases in greenhouse gas concentrations". [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
7735	4	30	4	31	The sentence “…was the main driver of lower stratospheric cooling between 1979 and the mid-1990s.” is not clear whether it refers to the cooling of the lower stratosphere or to the lower rate of stratospheric cooling? [Government of Hungary, Ministry of Innovation and Technology - Climate Policy Department]
2649	4	30	4	31	H.S.1.3 is incomplete with regards to drivers of stratospheric cooling, because it only mentions the lower stratosphere. We suggest adding "It is extremely likely that anthropogenic forcing, both from increases in GHG concentration and depletion of stratospheric ozone due to ozone-depleting substances, was the main driver of upper stratospheric cooling since 1979." {3.3} [TS.2.3] [Government of Canada, Environment and Climate Change Canada]
8793	4	30	4	31	Very strange that the year 1979 is pulled out of nowhere in the discussion. Either explain or generalize (the 1970s?). Also, since greenhouse gases also contributed to the stratospheric cooling, it would be good to say so. [Government of United States of America, U.S. Department of State]
2647	4	31	4	31	This phrasing is ambiguous and it isn't clear if it is referring to cooling in the lower part of the stratosphere or a lower amount of cooling in the stratosphere. [Government of Canada, Environment and Climate Change Canada]
8415	4	31	4	31	Please clarify what is meant by 'lower stratospheric cooling'. Suggest 'stratospheric cooling' is sufficient, as ‘lower stratospheric cooling’ doesn't follow from previous sentence which says the stratosphere has cooled. [Government of Australia, Department of Industry, Science, Energy and Resources]
6565	4	31			"lower stratospheric cooling between 1979 and the mid-1990s": This seems to imply that the stratosphere cooled less than before (perhaps between 1950 and1979?). Is that the message? If so, is the change in the rate of cooling important enough to note in the SPM? Or is the fact of cooling itself enough, in which case "lower" should be deleted. Please clarify. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
8797	4	33	4	33	"likely" is far too weak a statement. With human influences clearly responsible for warming, the atmospheric moisture will follow based on the physics and thermodynamic principles. Change to "Human-induced global warming has contributed to ..." [Government of United States of America, U.S. Department of State]

Comment ID	From Page	From Line	To Page	To Line	Comment
2209	4	33	4	33	We undestand that "atmospheric moisture" means here "specific humidity". However, "atmospheric moisture" has no definition in the glossary, in contrast with "specific humidity". Therefore we recommend either to define mositure in a footnote, to add the definition of "atmospheric mositure" in the glossary or to use "specific humidity". [Government of France, Ministère de la Transition écologique et solidaire]
4593	4	33	4	33	Human influence on atmospheric moisture. The SPM statement ("Human influence likely contributed to increases in atmospheric moisture") is not as precise as the conclusion in chapter 3 [page32, lines 35-36], which makes it clear that this refers to changes in the upper troposphere since 1979. Could the authors please consider aligning the two sections and clarify whether they're referring to the upper troposphere or the atmosphere more generally? [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
6495	4	33	4	34	The statement here is "...human influence extremely likely contributed to changes in ocean salinity". However, in chapter 2 (Changing state of the climate system), page 76, lines 37-39 establish that changes in salinity are virtually certain in the near-surface and very likely that these change extends to the ocean interior. Then, I think it is not correct assign the same likelihood for changes in salinity regarding the ocean as a whole [Government of Chile, Ministry of Environment]
8799	4	33	4	34	The comment on salinity is confusing. Is this referring to the global amount of salt in the ocean? For salinity, patterns of salinity changed and this occurred for several reasons, not only due to the changes in atmospheric moisture (i.e., evaporation and precipitation) as sentence implies, but also as a result of glacial melt, changes in sea ice formation, and so on. At the very least this needs to be referring to changes in the distribution of salinity and also indicate that there are several factors affecting salinity. Net ocean salinity has not (or barely) changed; "extremely likely contributed to changes in ocean salinity" is much less informative than TS-40, lines 35-36: "It is virtually certain that upper ocean salinity contrasts have increased since the 1950s and extremely likely that human influence has contributed." The changes are in the upper ocean salinity spatial patterns/contrasts. This needs to be clarified. Also, quantification and confidence level for ocean salinity changes are missing. Recommend to separate 'atmospehric moisture changes' from 'ocean salinity changes' statements as the two are not directly linked (link is more between precipitation/evaporation and salinity pattern changes). Either include a separate 'salinity' bullet, or list 'salinity changes' in H.S.1.6. [Government of United States of America, U.S. Department of State]
2205	4	33	4	34	This statement might be understood as if the increase in atmospheric moisture was due to human emissions of water vapor, while it was mostly a consequence of human-induced warming. This misunderstanding could be avoided by saying 'Through their contribution to warming, human activities likely contributed to increases in atmospheric moisture...." [Government of France, Ministère de la Transition écologique et solidaire]
6567	4	33	4	34	human influence ...extremely likely contributed to changes in ocean salinity'. Consider changing to 'virtually certain'. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
211	4	33	4	34	It is stated that Human influence "extremely likely" contributed to changes in Ocean Salinity in the SPM, however, in Chapter 2 P. 76 L. 39 to P. 76 L.41 it is stated that it is "very likely" that some basins such as Atlantic, Pacific and Southern Oceans experienced said changes. Consistency of likeliness/confidence accross the SPM and underlying reports is required. Please change "extremely likely to "very likely" [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral
4595	4	33	4	34	Human influence on ocean salinity. The SPM statement ("Human influence ... extremely likely contributed to changes in ocean salinity"), does not mention that this is for "near-surface and subsurface salinity changes across the globe since the mid-20th century" (chapter 3, page 63, line 1). Could the authors please consider aligning the two sections? [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
4245	4	33	4	35	It is quite hard to understand correlations between atmospheric moisture and changes in ocean salinity. [Government of Indonesia, Ministry of Environment and Forestry Indonesia]

Comment ID	From Page	From Line	To Page	To Line	Comment
8081	4	33	4	36	Can numbers or values be included as well as statements about" faster since the 1980" being included? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
4225	4	33	4	38	"There is high confidence that storm tracks and associated precipitation in the Southern Hemisphere have shifted poleward in summer since the 1970s, associated with the poleward shift of the extratropical jet that was very likely caused in part by human influence." --> although it is supported by scientific evidence, mentioning changes in storm track and precipitation only for the Southern Hemisphere would be unwise and imbalanced. Tropical storms shifting away from the equator might be unvalid due to the evidences rose up lately such as TC Seroja (2021), Cempaka (2017), Vamei (2001) that happen very close to or inside the Indonesia region. Some of these near equator storm tracks have been documented as scientific article such as: Chang and Wong (2008) https://core.ac.uk/download/pdf/188768349.pdf; We hope that this SPM rise also the storm track near the equator in which seems to be happen more frequence in the recent decades in comparison to the past time. [Government of Indonesia, Ministry of Environment and Forestry Indonesia]
9	4	33	4	39	This need a very clear clarification , the notation that Globally averaged Land Precipitation has likely increased since 1950, with a faster increase since 1980s (Medium Confidence) might be confusing. We know in some many areas rainfall has been decreasing like here in Tanzania [Government of United Republic of Tanzania, Tanzania Meteorological Authority (TMA)]
7703	4	33	4	39	It will be useful if quantified changes are given [Government of India, Ministry of Environment, Forests and Climate Change]
8801	4	33	4	39	H.S.1.4 is lacking quantification of changes in the state of atmosphere and oceans -- e.g. atmosphere moisture, ocean salinity, land precipitation. Quantify the described changes. [Government of United States of America, U.S. Department of State]
7085	4	33	4	39	Climate is a large system, so to study all parts of the climate change including atmosphere, lithosphere, hydrosphere and cryosphere, must be examined in relation to each other and attention should be paid to the emergence of its geographical landscapes. [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]
7105	4	33	4	39	The rate of atmosphere moisture and ocean salinity should consider here. [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]
4851	4	33	4	39	Please consider adding a sentence about observed changes in the storm tracks, associated precipitation and the extratropical jetstream of the Northern Hemisphere, even if these changes are less distinct than in the Southern Hemisphere. [Government of Norway, Norwegian Environment Agency]
4853	4	33	4	39	Here is a suggested rephrased paragraph: "It is likely that the average rainfall over land has increased since 1950, with a faster increase since the 1980s (medium confidence). The changed pattern of observed precipitation changes is likely a result of human influence. There is also high confidence that storm tracks and associated precipitation in the Southern Hemisphere have shifted poleward in summer since the 1970s. This shift has been associated with the poleward migration of the polar jetstream, with a very likely influence from human influence. There have also been increases in atmospheric moisture which are likely due to human activities." [Government of Norway, Norwegian Environment Agency]
7709	4	33	4	44	In sections H.S.1.4 and H.S.1.5, the quantitative values of increases in atmospheric moisture, globally averaged land precipitation storm, poleward shift of tracks and associated precipitation in the Southern Hemisphere, global retreat of glaciers since the 1 [Government of India, Ministry of Environment, Forests and Climate Change]

Comment ID	From Page	From Line	To Page	To Line	Comment
437	4	33	4	44	The time points of human influence on atmospheric humidity from line 33 to line 39 emphasize the period since 1950, while the time points of human activity influence from line 41 to line 44 emphasize the period since the 1990s and 1970s. This section also highlights the decrease in spring snow cover since 1950 and the change in sea ice in 1979. It is suggested to verify and explain the reasons for using these different time points. [Government of China, China Meteorological Administration]
6569	4	33	5	39	HS1.4 could benefit from giving numbers. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
7783	4	34	4	34	„contributed to changes in ocean salinity" - what change of salinity – increase or decrease? [Government of Poland, Ministry of Environment, Department of Air Protection and Climate]
2207	4	34	4	34	For clarity this change in surface salinity could be moved further down as it directly relates to changes in the hydrological cycle of the atmosphere over the ocean. Furthermore, "contributed to increases in ocean salinity contrast" would be more precise (TS.2.4) [Government of France, Ministère de la Transition écologique et solidaire]
6571	4	34	4	34	Strictly speaking, section #.5.2 is largly about near-surface and subsurface salinity, so you may want to consider adding this qualifier here as well. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
8417	4	34	4	34	Suggest rephrasing: 'land precipitation' to 'precipitation over land'. [Government of Australia, Department of Industry, Science, Energy and Resources]
8795	4	34	4	35	How much has globally averaged land precipitation increased? Add a quantitative statement (e.g., % increase of comparable intervals). [Government of United States of America, U.S. Department of State]
49	4	34	4	36	"Globally averaged land precipitation has likely increased since 1950, with a faster increase since the 1980s (medium confidence), and with likely human influence on the pattern of observed precipitation changes." Suggest to specify what "pattern" refers to. [Government of Singapore, Ministry of Environment and Natural Resources]
8803	4	35	4	35	Clarify what is meant by a faster increase in global precipitation by changing to read "faster rate of increase". [Government of United States of America, U.S. Department of State]
2211	4	35	4	36	For the second part of the sentence, we suggest to split the sentence in two sentences and say in the second that 'It is likely that human activities contributed to the observed pattern of precipitation change'. [Government of France, Ministère de la Transition écologique et solidaire]
4597	4	35	4	36	Human influence on precipitation. The SPM statement ("likely human influence on the pattern of observed precipitation changes") is consistent with the information in chapter 3, page 36, lines 34-35: "it is likely that human influence has contributed to large-scale precipitation changes observed since the mid-20th century", but it is not obvious that this refers to changes since the mid-20th century. Could the authors clarify that this statement in the SPM refers to the period from the mid 20th century? (The first half of the sentence already refers to this period so it could be something as simple as adding "over this period" at the end of the sentence.) [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
7175	4	36	4	37	To avoid confusion about the term storm and tropical cyclones we suggest replacing "… that storm tracks …" by "… that extratropical storm tracks …". [Government of Madagascar, National Meteorological Service]
2641	4	36	4	38	Having a conclusion here about changes in storm tracks and associated precipitation in the Southern hemisphere begs the question "what about the Northern Hemisphere?" Can conclusions for the NH be included as well? We note that the Ch. 2 ExSumm concludes that "extratropical storm tracks have likely shifted poleward in both hemispheres." Consier adding a statement about observed changes in the NH storm track even if a confident assessment of human influence cannot be made. [Government of Canada, Environment and Climate Change Canada]
7545	4	36	4	38	Rephrase "very likely caused in part by human influence". Statement is too general. Can the degree of human influence not be quantified (i.e. main driver)? [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]

Comment ID	From Page	From Line	To Page	To Line	Comment
4235	4	36	4	38	It seems to be worth considering to clarify the definition of “storm” in the It seems to be worth considering to clarify the definition of “storm” in the local sense (Hurricane, Typhon, Tropical Cyclone). Storm tracks in the southern hemisphere are considered to shift poleward, however, to those who live in the equatorial region, their concern is very likely more on the fact that the birth-place of storm (read: tropical cyclone) is shifted from subtropics toward the tropics. BMKG records show that in the last 13 years more and more tropical storms have been born in tropical areas, such as: (1) TC Durga , 20 – 25 Apr'08, (2) TC Kirrily, 26 – 28 Apr'09, (3) TC Orchid, 29 Oct – 5 Nov'10, (4) TC Bakung,, 11 – 13 Dec'14, (5) TC Cempaka, 17 Nov – 1 Dec '17, (6) Dahlia, 30 Nov – 2 Dec'17 , (7) TC Flamboyan, 28 April – 2 May'18, (8) TC Kenanga, 15 – 18 Dec'18, (9) TC Lili, 8 – 9 May'19, (10) TC Mango, 21 – 22 May'20, (11) TC Seroja, 5 – 12 Apr'21 (Ref: www.bmkg.go.id). Those records show a strong evidence that shift of the birth-place of strom (read: tropical cyclone) toward the tropics could also very likely be associated partly with anthropogenic activities. [Government of Indonesia, Ministry of Environment and Forestry Indonesia]
3043	4	36	4	38	It is better to provide information on the Northern Hemisphere (e.g. Strom tracks, etc.). [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
8083	4	36	4	39	Can this shift and other statements be quantified? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
6573	4	36	4	39	There is no information about the NH storm track and jet: why is this the case? [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6575	4	36	4	39	The high-confidence in near term SH jet projections is a bit surprising. It could be argued that near-term is more uncertain than end-of-century GHG-forced signal for SH. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
8805	4	37	4	37	Change to read "… austral summer ..." [Government of United States of America, U.S. Department of State]
2213	4	37	4	37	Concerning the term "summer" presumably, it probably means southern hemisphere summer but it might be better to clarify. [Government of France, Ministère de la Transition écologique et solidaire]
6577	4	37	4	37	The reference to "in summer" cannot easily be found in the referred Section 2.3. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
8807	4	37	4	38	Change to read "… associated with a human influence on the poleward shift of the extratropical jet." [Government of United States of America, U.S. Department of State]
8809	4	38	4	38	There is a clear basis for attributing the tendency toward the expansion of the subtropics to human-induced global warming (or influences, plural as aerosol-induced cooling contribution in the Northern Hemisphere could also be a factor) and no natural factor. Change "in part" to "largely". [Government of United States of America, U.S. Department of State]
2215	4	38	4	38	We recommend to change the formulation of "was very likely caused in part by" as it seems too complex. Furthermore, "was caused" reads like it is past and over. Shouldn't be "the poleward shift that is very likely caused"? [Government of France, Ministère de la Transition écologique et solidaire]
8419	4	38	4	38	Suggest rephrasing: ‘that was very likely caused in part', this text does not read well. [Government of Australia, Department of Industry, Science, Energy and Resources]
4855	4	38	4	38	As policy makers are not familiar with the term, please define "extratropical jet". [Government of Norway, Norwegian Environment Agency]
8085	4	38	4	39	"Very likely caused in part" is not a very useful use of the confidence statement, please reconsider? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]

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6579	4	38			The sentence "caused in part by human influence" could be replaced by "a result of human influence". [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6031	4	41	4	41	Please insert: …of the increased rates of global… (as mentioned in the ES of Ch 2 [p:2-7;l:9]) to address the increasing rates of glacier retreat since the 1990s [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
2219	4	41	4	41	The "very likely" appears a weak statement. Is it because the whole statement if about human influence being the main driver (ie > 50% according to footnote 9) ? and a stronger statement could be made about human influence in a broader sense? We suggest to clarify this point [Government of France, Ministère de la Transition écologique et solidaire]
2221	4	41	4	41	Please clarify whether the reference to 1990s refers to the beginning of global glacier retreat or to the beginning of the period where human influence dominates [Government of France, Ministère de la Transition écologique et solidaire]
4327	4	41	4	41	It would be useful to also note about the global retreat of glaciers prior to the 1990s (is this decade as a starting point chosen because of the confidence level?), so that it is clearer that the phenomenon is not so recent. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
4857	4	41	4	41	Please consider adding the clause ", including the Greenland and Antarctic ice sheets," between '1990s' and 'and' for clarity. [Government of Norway, Norwegian Environment Agency]
2633	4	41	4	43	The human influence is not direct but is through the change in climate that these cryospheric change occurs, i.e. isn't it the climate that is the main driver of these changes. Shouldn't the statement better reflect this. [Government of Canada, Environment and Climate Change Canada]
8811	4	41	4	43	"very likely" seems understated. Yes, the really solid observational record goes back to the start of the satellite record and there are variations, so the statistical analysis gives limited confidence, but this is due to the limited record rather than because there is some possible alternative explanation. Hence this conclusion is based really only on particular aspects of the statistical analysis and not because of lack of confidence that human influences are responsible. In providing an interpretation for policymakers, this type of qualification of a conclusion fails to recognize that framing of findings is not based so rigorously on statistics, but on relative likelihood of alternative explanations. This is a Summary for Policymakers, not an abstract for a scientific article. Since a virtually certain statement is hard to make given the length of record and role of natural variability in glacial extent, sea ice, and snow cover, add a "high confidence" statement. [Government of United States of America, U.S. Department of State]
2217	4	41	4	43	We recommend to introduce numbers for quantifying some of the observed cryospheric changes as in TS.2.5 [Government of France, Ministère de la Transition écologique et solidaire]
2881	4	41	4	44	This paragraph should clarify whether the indicated years correspond to observation availability or to an observed phenomenon restricted to a certain period within a longer record. [Government of Chile, Ministry of Environment]
6581	4	41	4	44	How much was the retreat since the 1970s? How much has arctic sea ice reduced since the 1970s, last sentence needs to be better connected to the decline in the 1970s, and also an interpretation of no further decline would be helpful. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
8421	4	41	4	44	Please clarify whether the statements for the Arctic and Antarctic covering "since the late 1970s" and "since 1979" refer to same period. [Government of Australia, Department of Industry, Science, Energy and Resources]
4859	4	41	4	44	There is no mentioning of premafrost melt/temperature increase in the Current state of the Climate section. Please consider adding information based upon e.g. Ch 2: Recent (2018–2019) permafrost temperatures in the upper 20–30 m layer (at depths where seasonal variation is minimal) were the highest ever directly observed at most sites (Romanovsky et al., 2020), with temperatures in colder permafrost of northern North America being more than 1°C higher than they were in 1978. Increases in temperature of colder Arctic permafrost are larger (average 0.4°C –0.6°C per decade) than for warmer (temperature >–2°C) permafrost (average 0.17°C per decade) of sub-Arctic regions (Figures 2.25, 9.22). [Government of Norway, Norwegian Environment Agency]

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8087	4	41	4	45	The statement is of interest but where is the quantification of the "observed retreat" etc etc. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
2835	4	42	4	43	H.S.1.5: Decrease in snow cover only mentions the Northern Hemisphere. Snow cover in South America has decreased as well {9.5.3.1, 12.4.4.4}. [Government of Chile, Ministry of Environment]
8813	4	42	4	43	How much glacier retreat and Arctic sea ice reduction? Quantify described changes. [Government of United States of America, U.S. Department of State]
2635	4	43	4	43	Doesn't the statement refer specifically to Snow Cover Extent rather than all indicators of changing snow cover. [Government of Canada, Environment and Climate Change Canada]
6035	4	43	4	43	Please insert: ...observed melting of the Greenland Ice Sheet over the past two decades and the decrease… (as mentioned in the ES of Ch 3 [p:3-6;l: 19-20]), to address the very likely human influence on the melting of the GIS. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
7959	4	43	4	44	consider indicating here the reason why the Arctic Ice has reduced and not the Antartic…just a line or few words with calibrated language will help preempt questions and concerns [Government of Kenya, Kenya Meteorological Service]
6033	4	43	4	44	In addition, climate-driven effects as Antarctic calving shelf ice and higher numbers of drifting ice berg and its fragments may be mentioned to give hints on the dramatic change of the cryosphere (comparable to glacier retreats). Please consider moving the text from SPM-8-24 to H.S.1.5 (noting that there are also other subparagraphs to H.S.1 that contain statements on changes without attribution to human influence. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
2223	4	43	4	44	In this sentence, the use of the term "overall" might be confusing since some regional patterns changed. We suggest to write : "Average Antarctic sea-ice area has experienced no significant change since …" [Government of France, Ministère de la Transition écologique et solidaire]
6583	4	43	4	44	Besides providing the information that ice area has experienced no significant overall change since 1979, it would be useful to provide information about the mass of Antarctica ice cover. [Philippe Tulkens, European Union (EU) - DG Research &
4291	4	43	4	44	Antarctic sea ice has significantly changed from november 2016 with a trend inversion. The ice decrease in some regions is significant (see chapter 9, page 9-49, lines 33-37) [Government of Italy, CMCC - Centro Euro-Mediterraneo per i Cambiamenti Climatici Instituto Nazionale di Geofisica e Vulcanologia (INGV)]
8423	4	43	4	44	Please re-write to provide more accurate information, this statement is misleading: 'Antarctic sea-ice area has experienced no significant overall change since 1979'. The underlying observations in Chapter 9 are that there has been no significant long-term trend in Antarctic sea ice, mostly because a large negative excursion over 2016-2020 interrupted a significant long-term increasing trend up to 2015. So the net temporal result obscures temporal variability, and indeed the net spatial result obscures significant regional variability. The statement therefore has three problems: (i) it doesn't clearly define whether it refers to temporal or spatial change since 1979 (ii) it overlooks significant periods of temporal change (iii) it overlooks significant regional change. The statement uses the term "overall change" which doesn't help, as it is even more imprecise than the term "net change" as in the TS2.5. It would have been preferable to separate out the correct observation of no significant *trend* and then talk about temporal and regional variability. [Government of Australia, Department of Industry, Science, Energy and Resources]

Comment ID	From Page	From Line	To Page	To Line	Comment
5103	4	43	4	44	By contrast to all previous statements in this paragraph, the one on Antarctic sea-ice does not relate to an explanation about human influence. There should at least be an explanation about this. A possible alternative would be to move this sentence to HS2.3. Please consider moving this sentence to where it is most appropriate. [Government of Belgium, Belgian Science Policy Office - Belspo]
4599	4	43	4	44	Despite the uncertainty, is there anything that can be said about the Antarctic ice sheet in this section? [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
4601	4	43	4	44	Human influence on the Antarctic sea-ice. The SPM statement ("Antarctic sea-ice area has experienced no significant overall change since 1979") is subtly different from the statement in chapter 3, which refers to a small increase that is not captured by models and there is low confidence in attributing causes (chapter 3, page 6, lines 12-14). Better consistency between the two statements would be beneficial. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
3325	4	43	4	44	There is no confidence statement. [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
4861	4	43	4	44	The notion that the Antarctic sea ice area is not experiencing loss (read as a statement of fact as no confidence is indicated) might create some confusion when considered together with statements on page 8 line 24 and page 15 line 2, which state that the Antarctic Ice Sheet will continue to lose mass. Please consider clarifying or explaining the difference between these formulations. [Government of Norway, Norwegian Environment Agency]
8815	4	44	4	44	Add a statement on the change in Antarctic land-ice or lack thereof. [Government of United States of America, U.S. Department of State]
8817	4	44	4	44	To help policymakers understand why "1979" is used as a cutoff, a phrase should be added to the end of the sentence to say "... when comprehensive satellite observations first became available." [Government of United States of America, U.S. Department of State]
7225	4	48	4	49	[Chapter 6] Biogeochemical Cycles Over the historical period => Biogeochemical Cycles over the historical period (Correction of broken sentence) [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
7227	4	54	4	55	[Chapter 6] A blank line looks necessary between different summaries [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
7109	4		4		The issue of cooling should be separated from the issue of heating, and relevant explanations should be provided to policymakers(https://doi.org/10.1016/j.enbuild.2014.03.084 and Wang,H, Chen,Q,Impact of climate change heating and cooling energy use in buildingsin the United States,Energy and Buildings 82 (2014) 428–436) [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]
6497	5	1	5	1	The statement here is "It is virtually certain that the global ocean has warmed …". However, in chapter 2 (Changing state of the climate system), page 73, lines 12-13 establish that "global ocean warming was virtually certain for the upper 700 m and likely for the 700–2000 m layer". Then, I think it is not correct assign the same likelihood for change in temperature regarding the ocean as a whole. [Government of Chile, Ministry of Environment]
8819	5	1	5	1	How much global ocean warming? Change to read: "The global ocean has warmed over the past five decades ..." H.S.1.6 has a very high level of confidence but no quantitative estimates to back it up. Perhaps modify the time period statement, changing "the past five decades" to "since 1970" to include a date span (both for precision, and so that if this is quoted in the future it remains clear). [Government of United States of America, U.S. Department of State]
6585	5	1	5	1	Technically speaking, "virtually certain" here refers to the OHC of the upper 700 m to not "global ocean warming" directly, although the two can be used interchangably. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]

Comment ID	From Page	From Line	To Page	To Line	Comment
6037	5	1	5	2	Please add here or in H.S.2.4 that ongoing increase in ocean heat content is a long-term commitment and "essentially irreversible on human time scales (high confidence)". (see TS-14:39-41) [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
261	5	1	5	5	The H.S.1.6 is limited to effects of CO2. The exclusion of other potent GHGs may be, unintentioally, misleading. Include the effects from all GHG emissions. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
4227	5	1	5	5	It is needed to add a sentence addressing local warming that happen vary in response to global warming. We propose "the local warming, especially in the urban area, has happened strongly with the degree of warming vary in response to global warming" after the sentence "Over the past half century, the land biosphere has changed in ways that are consistent with large-scale warming: climate zones have shifted poleward and the growing season has lengthened in the Northern Hemisphere extratropics (high confidence). This local warming has been proven by several studies such as in Jakarta (Siswanto et al 2016, https://rmets.onlinelibrary.wiley.com/doi/abs/10.1002/joc.4548) and other cities in the world with easily searchable references. This issue is quite relevant to the local impact of global warming which may have become a challenge for policy makers and occurs in almost every country in the world. [Government of Indonesia, Ministry of Environment and Forestry Indonesia]
8089	5	1	5	5	The really important SPM statement about the ocean uptake of 90% of the additional energy being trapped by GHGs is missing here as well as a quantification of. It is essential that WGI provides such information including to frame WGII. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8091	5	1	5	5	The quantification of the enery uptake, in the Earth's climate systems and particularly the oceans is a really important SPM information. AR5 and SROC indicated hat ocean uptake of 90% of the additional energy being trapped by GHGs. This information is missing here. It is essential that WGI provides such information including to frame WGII. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
165	5	1	5	5	The text should provide the full assessment that could help policy makers understanding the impacts of global warming on ocean, this include any difficulties as indicated in Ch.5 P. 53 Line 44-45 saying that quantifying the oxygen decline and variability and attributing them to processes in different regions remains challenging [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
171	5	1	5	5	The text lacks the inclusiveness on the importance of Carbon Dioxide Removal on reversing the ocean acidification. According to Ch. 5 P56 Line 7-9, reversing the increase in atmospheric CO2 concentrations through negative emissions will reverse ocean acidification at the sea surface. This should be reflected in the SPM for the importance of CDR. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
173	5	1	5	5	The text lacks the discussing the other factors for the impact on marine organisms. According to Ch.5 P56 Line 53-55., the increased bioavailability of toxic elements such as arsenic and copper, in addition to deoxygenation for the negative impacts on marine organisms. This should be added as well. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
6587	5	1	5	5	Quantification would be helpful for all statements. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
4603	5	1	5	5	Given most other physical changes highlighted in HS1 have an attribution statement attached to them, it would be helpful for policymakers if one were also attached to the statement on deoxygenation by inserting 'in part due to human influence' (as stated in p42 of the technical summary) and if simple to, explaining what other influences contribute. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]

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4009	5	1	6	26	Similar units of time such that "years", "decades", "century" are expected to be adopted in a consistent manner. Though we can find "over the past five decades", "over the past half century" and "over the last 50 years" in this section, it is hard to understand the difference. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
6589	5	2	5	2	Sugested CO2 'uptake' instead of 'emissions'. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
8821	5	2	5	3	"It is virtually certain that CO2 emissions are the main driver of global ocean acidification" is an unbounded statement in term of time -- human influence, geologic timescales. Change to: "It is virtually certain that CO2 emissions are the main driver of recent global ocean acidification" to be consistent with statement in H.S.2.4 and TS-40, lines 37-38. [Government of United States of America, U.S. Department of State]
6039	5	2	5	3	Please add the words “anthropogenic” and "current" to get "anthropogenic CO2 emissions are the main driver of current global ocean acidification" to clarify that CO2 emissions are anthropogenic emissions, not natural. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
2225	5	2	5	3	We would like to draw attention to the fact that 'Virtually certain' is only linked to 'open ocean' and ' surface ocean' - at least the latter should be clarified. Otherwise this does not reflect the assessment correctly. [Government of France, Ministère de la Transition écologique et solidaire]
7083	5	2	5	5	Some contribution in global warming is related to the earth's natural cycles and the impact of climate forces, including changes in the intensity of sunlight that must be considered. [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]
6041	5	3	5	3	Please insert after ...acidification. "It is extremely likely that human influence has contributed to observed near surface and subsurface oceanic salinity changes since the mid-20th century." There… (as mentioned in the ES of Ch 3 [p:3-6;l:37-38] to address the human impact on ocean's salinity.) [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
8093	5	3	5	3	Is the statement on ocean acidification basic chemistry and therefore a statement of fact? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
7711	5	3	5	4	In section H.S.1.6 The amounts of drop in oxygen levels in different ocean regions since the mid-20th century needs to be mentioned [Government of India, Ministry of Environment, Forests and Climate Change]
7705	5	3	5	5	Quantified oxygen depletion range for oceans may be given [Government of India, Ministry of Environment, Forests and Climate Change]
8823	5	3	5	5	Replace the last sentence in H.S.1.6 with language from TS-42, lines 1-2: "There is high confidence that oxygen levels have dropped in many ocean regions since the mid-20th century, in part due to human influence (medium confidence)." In addition, the reason for the decline in oxygen needs to be explained drawing on text from the Technical Summary. [Government of United States of America, U.S. Department of State]
167	5	3	5	5	The text focussed at the beginning on ocean warming, then introduce oxygen level in a way that assunme all of the oxygen loss is due warming. However as indicated in Ch. 5 P.53 Line 39-41, 50% of the oxygen loss for the upper 1000 m is due to anther factors such as mixing and respiration, in addition to warming. Therefore, this should be reflected as well giving the whole picture of the cuases of oxygen loss in the ocean [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]

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169	5	3	5	5	The text indicates that there is high confidence that oxygen levels have dropped in many ocean regions since the mid-20th century and that the geographic range of many marine organisms has changed over the last two decades. However, according to Ch.5 P54 Line12, it is with medium confidence not high confidence the oxygen content of subsurface ocean is projected to transition to historically unprecedented condition with decline over the 21st century (medium confidence). This should be also reflected clearly. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
4011	5	3	5	5	Before this sentence, human influence is asserted for warming and acidification. It is desirable that human influence is also assessed for oxygen decrease. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
6043	5	4	5	5	If possible, please be more specific about how the geographic range has changed. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
8095	5	4	5	5	Not clear why marine organisms are included here, this can be a general feature of this section, and developed otherwise it can be dropped and more fully addressed in WGII. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
2227	5	4	5	5	We think that the SPM of the WG1 report should not mention changes in marine organisms, except if a link is made with the change in the CO2 ocean sink. Indeed, some of these changes are due (at least in part) to other factors than climate change, e.g. fisheries. Some geographic ranges have even moved the "wrong way" [Government of France, Ministère de la Transition écologique et solidaire]
4013	5	4	5	6	“The geographic range of marine organisms has changes over the last decades” sounds assessment of climate change impact on marine biology. If this understanding is correct, this assessment would be better to be included in WG2 report instead of WG1 report. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
4275	5	7	5	7	in "Global mean sea level increased by 0.20 [0.15 to 0.25] m between 1901 and 2018.", to be consistent with others the range prefer from 1901-2019 rather than 1901 to 2018 [Government of Indonesia, Ministry of Environment and Forestry Indonesia]
8425	5	7	5	7	Suggest including a confidence level for this statement, or rephrasing: ‘Global mean sea level increased by 0.20 [0.15 to 0.25] m between 1901 and 2018'. The lack of confidence statement following this sentence implies it is a statement of fact. Can we be confident about the precision of the central estimate and range quoted given uncertainties in data, methods of estimation etc.? [Government of Australia, Department of Industry, Science, Energy and Resources]
7547	5	7	5	9	Replace 'rise' by 'sea level rise' [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
6045	5	7	5	9	Please elaborate on the reasoning behind the increase in sea level rise rate "to 3.7 [3.2 to 4.2]" in the time frame between 2006 and 2018. What caused the rise between 1990 and 2006? You may insert some components mentioned in the ES of Ch 3 [p: 3-6;l:48-50]: "Combining the attributable contributions from glaciers, ice sheet surface mass balance and thermal expansion". [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate
4015	5	7	5	9	Global mean sea level rise between 1991 and 2005 is excluded in this description and does not seem right. It is better to show a comparison of GMSL between 1991 to 2005 and 2006 to 2018, or a comparison of GMSL between 1901 to 2018 and 2006 to 2018, like H.S.4.2. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
2229	5	7	5	9	We suggest to precise the rate of the different contribution to sea level rise, as they are largely mentionned in the report [Government of France, Ministère de la Transition écologique et solidaire]
8097	5	7	5	10	The word average should be included at least twice in this section. A figure showing this would be useful. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]

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8427	5	7	5	10	Please add context to clarify why the observational period is split into 1901-1990 and 2006-2018, while the attribution statement is post 1970. [Government of Australia, Department of Industry, Science, Energy and Resources]
8825	5	9	5	9	Define human activity in this context relative to the previously defined 'human influence'. [Government of United States of America, U.S. Department of State]
2231	5	9	5	9	Concerning the last sentence of the paragraph, we suggest to quantify the human contribution to sea level rise with its likely range otherwise this sentence could be misunderstood, knowing that anthropogenic warming is the main driver of sea level rise. Furthermore, in previous paragraphs, the phrase "human influence" is used. If there is no reason to use specifically "human activity" here, it is suggested to harmonize. Finally, the use of "was" reads like past tense so we recommend to use the term "has been" instead to show that it is still on going [Government of France, Ministère de la Transition écologique et solidaire]
8827	5	9	5	10	It would be helpful to include the reason for going back to 1970 and not further. This is presumably when extensive global observations became available. Explain why limited to 1970 to present if citing data on sea level changes since 1901 and the apparent acceleration starting in 2006 as part of addressing the high-level issue on the mismatch of temporal and spatial scales and averaging when comparing most recent decade global conditions and rates of change to any multi-decadal period. [Government of United States of America, U.S. Department of State]
8829	5	9	5	10	Add a best guess and range for the human contribution to sea level rise (SLR). What was causing MSLR before 1970? Need that information to quantify human vs. natural contributions. [Government of United States of America, U.S. Department of State]
3327	5	9	5	10	Instead of "human activity" which is a very broad term, it woud be better human induced climate change. [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
8831	5	12	5	12	"Over the past half century" and other similar but slightly different phrases ("over the past five decades/50 years") are used throughout this SPM. Could this be more standardized and specific to use a phrase like "Since 1970"? "Half century" or "five decades" could sound different to different people reading this at different times. Change the sentence to: "Since 1970, aspects of the land biosphere have changed in ways that are responses consistent with large scale warming: temperature-based climate zones have shifted poleward and the growing season has lengthened in the Northern Hemisphere extratropics (high confidence)." [Government of United States of America, U.S. Department of State]
2233	5	12	5	13	We suggest to delete the part "the land biosphere has changed in ways that are consistent with large scale warming" and rather mention the consequences on CO2 sinks as done in TS.2.6 page 48 lines 36-40 [Government of France, Ministère de la Transition écologique et solidaire]
4605	5	12	5	15	H.S.1.8 could be improved by quantifying some of the important changes in the biosphere that are mentioned in the SPM and the TS (e.g. shift in climate zones, growing season changes, vegetation greenness, land species distribution etc.). [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
4607	5	12	5	15	Can any generalisations be made about which regions are experiencing greening/browning? [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
2571	5	12	5	16	Regional greening : Not all the greening is due to global warming but also to land management (irrigation, fertilization, ..) - This sentence seems to attribute the greening to warming alone [Government of France, Ministère de la Transition écologique et
7509	5	12	5	16	How has the earth's albedo changed due to land-use change etc. [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
8099	5	12	5	16	Has the growing season lengthened in all the Northern hemisphere extratropics? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]

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6591	5	12	5	16	How about the ocean biosphere? [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
4863	5	12	5	16	H.S.1.8: This paragraph appears Northern-hemisphere-centric and could give the impression that biospheric changes due to global warming are primarily positive. Please consider balancing the paragraph, e.g. indicating severe consequences of browning. [Government of Norway, Norwegian Environment Agency]
6499	5	13	5	13	Here is not clear if climate zones have shifted poleward in both hemispheres or only in the Northern Hemisphere. [Government of Chile, Ministry of Environment]
2235	5	13	5	13	We suggest to add "vegetation" before "growing season" in order to precise what the term is related to. [Government of France, Ministère de la Transition écologique et solidaire]
4543	5	13	5	13	Could it be made explicit that (if) the “climate zones have shifted poleward” refers to both hemispheres? [Government of Sweden, Swedish Meteorological and Hydrological Institute]
2837	5	13	5	14	H.S.1.8: Lengthening of the growing season also occurs in the Southern Hemisphere (box 5.1) [Government of Chile, Ministry of Environment]
7229	5	14	5	14	[Chapter 6] The abbreviation 'ERF' was already used above continuously [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
8833	5	14	5	14	Incorrect and inconsistent definition of greening. The SRCCL SPM defines greening in Footnote 19: "Vegetation greening is defined in this report as an increase in photosynthetically active plant biomass which is inferred from satellite observations." It needs to be stated that the occurrence of browning is also an expected result in regions where net available soil moisture is dropping, such as where the subtropics are expanding poleward. So, perhaps change "(decreases)" to "(decreases, for example where moisture availability is dropping)". Or perhaps: "Satellite inferred regional greening (increases in plant production) and browning (decreases reflecting lower moisture availability) have been observed since the 1980s, with an overall global average greening (high confidence)." [Government of United States of America, U.S. Department of State]
2237	5	14	5	14	Concerning the "high confidence" interval here, it seems to be in contradiction with chapter 2 :"In summary, there is very high confidence that the amplitude of the seasonal cycle of atmospheric CO2 has increased at mid-to-high NH latitudes since the early 1960s. The observed increase is generally consistent with greater greening during the growing season and an increase in the length of the growing season over the high northern high latitudes". Therefore it seems that when combining all the confidence levels, we get an CI higher than "high" [Government of France, Ministère de la Transition écologique et solidaire]
7685	5	14	5	15	"Regional greening (increases in plant production) and browning (decreases) have been observed since the 1980s, with an overall global average greening". The sentence does not make it clear if it is talking about greening and browning in forests or in all kinds of vegetation including agriculture. Does it only imply that the overall plant production has increased and does not give any indication of the creation of long term carbon stock (net ecosystem productivity)? [Government of India, Ministry of Environment, Forests and Climate Change]
117	5	14	5	15	Suggestion: 'IN DIFFERENT REGIONS, BOTH greening (increases in plant production) and browning (decreases) have been observed' [Government of Russian Federation, Institute of Global Climate and Ecology]
6047	5	14	5	15	Please add a short specification which kind of "plant production" is referenced by the word "greening". E.g. total biomass or mass of green leaves? [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]

Comment ID	From Page	From Line	To Page	To Line	Comment
5105	5	14	5	15	The term "an overall global average greening" can sound quite sympathetic but that could be misleading: this information would benefit from being put in perspective with some other information on global changes on the land biosphere (wide scale destruction / degradation of habitats, collapse of ecosystems, loss of biodiversity...). A formulation such as in SRCCL SPM A.2.3 might be clearer than "an overall global average greening": "Globally, vegetation greening has occurred over a larger area than vegetation browning". [Government of Belgium, Belgian Science Policy Office - Belspo]
4865	5	14	5	16	please include language to illustrate that despite an overall global greening, some ecosystems such as tropical forests and peatlands are still being lost at an alarming rate. The statement as it is, disguises these trends. [Government of Norway, Norwegian Environment Agency]
7737	5	15	5	15	Please add "in plant production" after "decreases" , or indicate this connection with a footnote. [Government of Hungary, Ministry of Innovation and Technology - Climate Policy Department]
4329	5	15	5	15	Suggest adding "in plant production" after "decreases", for added clarity. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
6593	5	15	5	16	What is the reason of the 'overall greening', and how much has been the global greening? HS1.8 [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
7739	5	19	5	33	SPM.1: The text above panel a) is not needed since the figure contains something else than 125k years ago temperatures.; Description lines 9-10: What is the purpose of showing this wide, almost full range? Very likely range could be enough, and the figure is a bit frightening too as some models reach already 1.5 °C by 2020. It could be considered to omit or lower the range. [Government of Hungary, Ministry of Innovation and Technology - Climate Policy Department]
8429	5	19	5	33	Suggest including the temperatures from paleoclimate archives in the right-hand frame to demonstrate that where the palaeo-proxy temperatures and historical temperature overlap in time they are coherent with each other. [Government of Australia, Department of Industry, Science, Energy and Resources]
8101	5	20	5	21	Figure SPM 1 should include information on other key climate variables including sea-level rise. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8103	5	20	5	21	Figure SPM.2 The purpose of panel b is unclear. Why is the period from 1750 chosen? What are the messages for policy that such a figure provides? How would this differ in terms of contributions and uncertainty values if data from 1950 rather than 1750 were provided? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8105	5	20	5	21	Figure SPM.2 Panel b combines too much information thereby obscuring it, more transparency on the contributions is needed. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8107	5	20	5	21	Figure SPM.2 This figure should be replaced by a standard radiative forcing figure based on current atmospheric composition. Temperature outcomes can be shown in a side panel as done in previous WGI SPMs. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
2651	5	21	5	22	Figure SPM.1 caption: there seem to be conflicting statements about the time period for the reconstructed global temperature in the caption and in the figure labels: years 1-2000, 1-2020 or 1-1850. This is confusing. [Government of Canada, Environment and Climate Change Canada]

Comment ID	From Page	From Line	To Page	To Line	Comment
8835	5	21	5	31	In the SPM.1 figure caption, is global surface temperature in the plot GMST or some other temperature metric? Are models' temperature constructed similarly to observations (SST over oceans and surface air temperature over land)? [Government of United States of America, U.S. Department of State]
8431	5	21	5	31	Suggest including the note 15 from page 10 to explain the reference period used 1850 – 1900: The multi-century period prior to the onset of large-scale industrial activity around 1750. The reference period 1850–1900 is used to approximate pre-industrial global surface temperature. [Government of Australia, Department of Industry, Science, Energy and Resources]
6595	5	22	5	22	The figure caption of SPM.1 refers to the Common Era. This is not defined in the SPM. In general this caption is quite technical, perhaps a bit of rewriting would be needed to make this summary accessible to policy makers. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
8433	5	22	5	22	Suggest revisiting "The rate of global mean sea level rise beginning around 1900 has risen faster." As written, this implies the "acceleration" is faster. [Government of Australia, Department of Industry, Science, Energy and Resources]
2653	5	23	5	24	Figure SPM.1 caption: As written, it is somewhat unclear that the Holocene refers to the whole interglacial period vs the warmest period of the interglacial. This sentence might be more readily understood if rephrased to say "The vertical bar on the left shows the estimated multi-century peak global surface temperature during the warmest interval of the current ~10,000 year interglacial period (the Holocene), prior to the Industrial Era." [Government of Canada, Environment and Climate Change Canada]
8837	5	23	5	24	It needs to be clearly stated that this is the departure of the temperature from the reference period -- not the actual temperature. And it would be useful to somewhere note that the warmer period during the Holocene was due at least in part to the natural cycling of the shape of the Earth's orbit, so not just a random fluctuation. That past climate has been different makes clear that climate can change, but it is critical for policymakers to understand that these past conditions were not just random fluctuations that could happen next year or next century. These are differences that are due to long-term changes in various natural forcings, forcings of an amount comparable to or even less than being imposed by human activities. [Government of United States of America, U.S. Department of State]
4017	5	23	5	24	At the left end of Figure SPM.1, there is a vertical bar ranging the temperature of about 6500 years ago, but how this bar is derived is not clearly shown. In the corresponding Cross-Section Box TS.1 Figure 1 (a) (TS-111), the same vertical bar on the right side is collocated in the same range with time series of "estimated global surface temperature for mid Holocene" on the left side. The former is a consensus assessment by the lead authors (Chapter 2, page 2-34, lines 42-44), while the latter derives from a single paper, Kaufman et al. (2020a), which may result in confusion. What is also confusing is that the range of the former bar (0.2-1.0 degree C) is not consistent with the "5th to 95th percentile ranges" of the latter. This inconsistency should be clearly stated in the TS caption, which may require supplemented description of the vertical bar in Figure SPM.1. Another option would be to adjust the percentile range of Kaufman et al. (2020a) in Cross-Section Box TS.1 Figure 1 (a) (TS-111) and Figure 2.11 (a) (2-181) to be more consistent with the vertical bar. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
2877	5	24	5	24	panel a, legend: "during the Holocene" should be "during the Mid-Holocene (6500 yrs ago)" [Government of Chile, Ministry of Environment]
7803	5	24	5	26	The grey shade with white diagonal lines shows the very likely range of the multi-method reconstruction ensembles. - what methods were used in multi-method reconstruction ensembles? The note is intended to increase the credibility of the description [Government of Poland, Ministry of Environment, Department of Air Protection and Climate]
8839	5	26	5	26	The plot is not of the actual temperature. Change "Observed temperature" to "Changes in global average temperature based on the thermometer record since the mid-19th century". [Government of United States of America, U.S. Department of State]
8435	5	28	5	28	Suggest the caption of figure SPM-1 should also explain the CMIP6, or refer reader to that page or section. [Government of Australia, Department of Industry, Science, Energy and Resources]

Comment ID	From Page	From Line	To Page	To Line	Comment
8841	5	29	5	29	Some model simulations include orbital forcing. Change to "natural drivers (solar, volcanic activity, orbital forcing in some models, green)". [Government of United States of America, U.S. Department of State]
8437	5	30	5	30	Suggest revise for accuracy: Is the 5-95% range the very likely range? If so, please maintain consistency with the rest of the caption. [Government of Australia, Department of Industry, Science, Energy and Resources]
7603	5	33	5	49	Unable to locate the two figures referred to on this page. [Government of South Africa, Senior Policy Adviser International Climate Change Cooperation Department of Environmental Affairs]
8439	5	36	5	49	SPM 2 risks misinterpretation. SPM2 a shows contributions to warming in degrees C over 1850-1900 to 2010-2019. SPM2 b indicates contributions to warming over 1750 to 2019 also in degrees C, but there is no observed warming 1750 to 2019. Suggest SPM 2 b is removed, or alternatively the contributions should be expressed in radiative forcing watts per meter squared. [Government of Australia, Department of Industry, Science, Energy and Resources]
8441	5	38	5	38	Suggest that the 'two lines of evidence' mentioned in the title of the figure are included in the caption e.g. Assessed contributions to observed warming based on ... [Government of Australia, Department of Industry, Science, Energy and Resources]
4019	5	38	5	47	It would be helpful to have a brief explanation of how the temperature response was assessed in Figure SPM.2. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
4021	5	38	5	47	The reader could naturally interpret that the bars with “CO2” to “Volatile...” in panel b are the breakdown of “Greenhouse gasses” in panel a. That does not seem to be the case because the evaluation periods are different and the sum of those bars in panel b does not match “Greenhouse gasses”. The relationship between panels a and b should be clearly stated, or a simple solution would be to omit either one of the two panels. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
4023	5	38	5	47	Although it is an improvement from the previous radiative forcing diagram in AR5 to Figure SPM.2, there is little explanation of this diagram in the text. This figure is very important because the policymaker will understand from Figure SPM.2 which substances will be reduced and by how much the temperature will change. Each element should be explained one by one. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
6417	5	38	36	49	figure a and b show two different timescales. It would be good to clarify why two different timelines are used to avoid any confusion. [Government of Saint Lucia, Department of Sustainable Development - Ministry of Education, Innovation, Gender Relations and Sustainable Developement]
7009	5	38			Figure SPM.2: While the difference in reference periods for panels a) and b) is of course owing to the respective chapters, it would be key that the panels are directly comparable. [Government of Fiji, Fiji Meteorological Services]
7265	5	38			Figure SPM.2: While we understand that the different reference periods are elevated directly from the respective chapter assessments, we would like to ask the authors to go the extra mile and rebase the right panel to 1850-1900 to arrive at directly comparable panels. [Government of Saint Kitts and Nevis, Department of Environment - Ministry of Agriculture, Marine Resources, Cooperatives, Environment and Human Settlements]
7143	5	38			Figure SPM.2: It would be important that the two panels can be compared directly, which is why the right panel should be presented also relative to 1850-1900 and until 2010-2019. [Government of Samoa, Ministry of Foreign Affairs and Trade]
2799	5	38			Please provide the data for the same reference periods in panels a and b of Figure SPM.2. It is important for the reader to directly compare both panels. While the chapter assessment should remain as is, of course, for this summary figure it is crucial to show consistent time periods. [Government of Jamaica, Meteorological Service Division]

Comment ID	From Page	From Line	To Page	To Line	Comment
6387	5	38			Figure SPM.2: The difference in reference periods for panels a) and b) understandably stems from the underlying chapters; yet for clarity, the two panels should be directly comparable. We therefore suggest rebasing panel b) to 1850-1900 and 2010-2019. [Government of Saint Lucia, Department of Sustainable Development - Ministry of Education, Innovation, Gender Relations and Sustainable Developement]
7239	5	40	5	42	[Chapter 9] SROCC(2019) by IPCC reported Marine heatwaves is significantly impact to marine organism, fisheries and ecosystem(SROCC, 611page). Actually, mass mortalities and economic damage of fisheries was occurred by MHWs in several ocean areas. Therefore, this sentence should be change like follow. "Marine heatwaves – sustained periods of anomalously high near-surface temperatures that can lead to severe and persistent impacts on marine organism, fisheries and ecosystems". [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
7805	5	41	5	41	"land-use change" - perhaps it would be better to use the term "land-use changes" [Government of Poland, Ministry of Environment, Department of Air Protection and Climate]
6049	5	41	5	41	Please correct: 'aerosol' without 's' or 'aerosol particles' is the correct term (here and many other places). [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
4331	5	41	5	41	Panel A (in Figure SPM.2) does not display ozone as such, but rather its precursor gases. This should be clarified in the caption, or in the figure. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
2655	5	42	5	43	Figure SPM.2 caption: Please clarify in the caption why in panel (b) of this figure, the warming contributions from individual forcers are quantified for the period 1750 -2019 rather than 1850-2019 as in panel (a). To facilitate use of this Figure, ideally some text would be added to the caption to state how the results of the two panels can be compared. For example, if information were added about the net anthropogenic warming from 1750-1850/1900, this might allow a basis for saying something about the relevance of panel (b) to the results in panel (a). Alternatively, panel (b) could show results for the same time period as in panel (a). [Government of Canada, Environment and Climate Change Canada]
441	5	45	5	47	"For example, emissions of methane increase its atmospheric concentration, enhance its own lifetime, cause ozone and CO2 production, enhance stratospheric water vapor, and influence aerosols" tends to lead to ambiguity. It is especially unnecessary to give an example in the caption, which is suggested to be deleted. [Government of China, China Meteorological Administration]
8443	5	46	5	47	Suggest adding to the end of this sentence "… and all of these effects are included in the bar labelled CH4", for clarity. [Government of Australia, Department of Industry, Science, Energy and Resources]
7231	5	48	5	51	[Chapter 6] This sentence includes too many commas, so it looks not readable. Separation into two sentences may be better. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
7111	5		5		The contribution of each of the greenhouse gases mentioned in global warming should be presented to policymakers in order to understand the effect of each gas(http://wmr.sagepub.com/content/27/8/754 [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]
5203	5		24		Pages 5 and 24. In the descriptions related to Figure SPM.2, there are mentions to " land-use change" both related to Panel a and Panel b. We propose to add the word "DIRECT" before "land-use change", to make reference only to "direct land-use change", avoiding an open concept of land-use change that would go beyond the internationally agreed term, and that could have, otherwise, trade implications. Thus, the term must be limited in scope to "direct land-use change". [Government of Argentina, Ministry of Environment and Sustainable development of Argentina]

Comment ID	From Page	From Line	To Page	To Line	Comment
8843	6	1	6	1	Odd phrasing of "Large-scale indicators of climate change in the atmosphere, ocean, and cryosphere" since the climate system is made up of those components. "unseen in ..." is very awkward and hard to make sense of. Change to read: "Large-scale indicators of global climate change are reaching levels, and changing at rates, that have not occurred for many thousands of years." [Government of United States of America, U.S. Department of State]
6051	6	1	6	1	Policymakers might not understand the term "large-scale indicators" in the Headline Statement. Please reformulate. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
7173	6	1	6	2	To convey a clearer and more concise message, we suggest to replace "… unseen in centuries to many thousands of years" by "… unseen in many thousands of years". It will reflect more the statement in the TS.2.2, page 35, line 6 to 8 that these levels are unprecedented in at least 800,000 years. It will also better reflect the Figure SPM1a showing a rate of changes unprecedented in at least 2000 years. [Government of Madagascar, National Meteorological Service]
2239	6	1	6	2	We recommend to revise how messages are formulated in this section. Indeed, the wording could be more explicit so as not to leave room for false interpretations that would go in the opposite direction of what the authors want to demonstrate : although the purpose of this section can be understood, some statements may be counter-productives: something that is changing for the first time since a few centuries or even a few thousands years could be seen as "normal", and that the climate is just "changing" again... Not that it is a human interference. This is especially the case for H.S.2.3 and H.S.2.4, with "short" temporal statements, some with medium confidence. Also, unfortunately, it can be complicated to understand what it means exactly to have a concentration of CO2 higher than the previous 800 000 thousand years, as most people do not know how CO2 changed and influenced the climate during this period, and because it is difficult to apprehend such temporalities. [Government of France, Ministère de la Transition écologique et solidaire]
4867	6	1	6	3	The sentence is not very clear: "Large-scale indicators of climate change in the atmosphere, ocean, and cryosphere are reaching levels, and changing at rates, unseen in centuries to many thousands of years (high confidence)". The term "indicator" can be confusing to readers. Please consider reformulate the begining of the sentense to something like "Observations indicate changes in the atmosphere, the oceans and cryosphere that are unseen...". Perhaps this also could be the first HS statement? [Government of Norway, Norwegian Environment Agency]
7541	6	1	6	3	Add: "Human influence has warmed the climate system at a rate that is unprecedented in at least the last 2000 years" [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
7849	6	1	6	3	HS.2: make it more compelling by spelling out the technical term "Large-scale indicators", e.g. "Global temperature, sea level ,... have reached levels ...". [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
8109	6	1	6	4	Consider reworking this text for clarity e.g. is the word indicator useful here? How many changes were "seen" consider using the word record or similar. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8111	6	1	6	4	The confidence level may be misunderstood here unless the text is clarified. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]

Comment ID	From Page	From Line	To Page	To Line	Comment
6055	6	1	6	26	We really appreciate the paleoclimate work done in this report. We also think the prominent inclusion of paleo evidence in the SPM in HS.2 is very reasonable. To further strengthen the message paleoclimate evidence teaches us, we strongly encourage the authors to put current climate developments in context with paleo findings even more. This would help policy makers to draw conclusions much easier. For instance, in HS 2.1 it is stated that current CO2 concentrations have not been experienced for at least 2 million years. This message will be much more policy-relevant, if the authors include more information about the climate 2 million years ago, e.g. - if scientifically reasonable - that the temperature level was 2.5-4°C higher and the sea level 5-25 meters higher (see Figure F2.34, FAQ 1.3 Figure 1). Please strengthen the messages drawn from paleoclimate evidence in section in HS.2 and elsewhere in the SPM and put them into context, which is relevant for policy makers. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
4025	6	1	6	26	Although the intention of splitting HS.1 and HS.2 is understandable, the key message as a summary is eventually duplicated in HS.1. For those who are not experts in climate change, HS.1 and HS.2 will be seen as almost identical. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
319	6	1	6	37	Although we think that the current draft of the SPM has a good narrative and flows logically, we would propose to move present HS.2 after current HS.4, so that the order would be HS.3; HS.4 and then HS.2. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
6053	6	1	6	37	The "large-scale indicators" may fit better after the descriptions of current HS.3. and HS.4. So, please think about shifting the HS.2. to the end of section "The Current State of the Climate" as HS.4. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
8113	6	1	6	43	Inclusion of individual paragraph which makes clear the changes in each of the key GHGs and industrial gases would be more useful than combining all these in one section. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8115	6	1	6	43	Detail on the differing sources for these GHGs including terrerstrial and fossil for CO2 and fossil and non-fossil for Methane would be very useful information for Policy [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8117	6	1	6	43	A figure which should the fossil and non fossil contributions to warming would be useful or a table that quantifies these. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8445	6	3	6	3	Suggest redrafting "has contributed to drought in particular during the dry season over most land", it is vague and could be clarified. [Government of Australia, Department of Industry, Science, Energy and Resources]
2243	6	6	6	6	We suggest to use "CH4" instead of "methane" for ensuring the consistency with the other gases [Government of France, Ministère de la Transition écologique et solidaire]
7511	6	6	6	8	For clarity better focus first on CO2 and then on other GHGs to avoid double figures for CO2 [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
8845	6	6	6	8	Statement needs to include a bit of context and make much clearer what the basis of the assessment is. Consistently use chemical shorthands (e.g., CH4, N2O, etc.). Change to read: "Ice core records indicate current atmospheric concentrations of CO2, CH4, and N2O are higher than any time in at least the last 800 thousand years, and the longer geologic record indicates the current atmospheric CO2 concentration is higher than any time in at least the last 2 million years. (high confidence)" [Government of United States of America, U.S. Department of State]

Comment ID	From Page	From Line	To Page	To Line	Comment
2241	6	6	6	8	We suggest to split CO2 from CH4 and N2O in the first part of the sentence in order to avoid 2 different messages for CO2. In order to do that we suggest to put the sentence regarding current CO2 first : "The current CO2 concentrations have not been experienced for at least 2 millions years and atmospheric concentrations of CH4 and N2O are higher than ..." [Government of France, Ministère de la Transition écologique et solidaire]
8119	6	6	6	9	If the CO2 concentrations are higher than experienced for 2 million year why mention 800K years? It would be useful to have a clearer structure to the material being provided. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
4609	6	6	6	10	The first sentence of HS2.1 should be amended to read 'Atmospheric concentrations of methane and N2O are higher than at any time in at least 800 thousand years, and current CO2 concentrations have not been experienced for at least 2 million years.' so that the reader is not confused by the inclusion of CO2 twice, or misquoted without the full context of co2.. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
7081	6	6	6	10	The theory indicating increased CO2 emissions lead to global warming has not been accepted by many scientists and should be re-evaluated scientifically and regionally as well. [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]
175	6	6	6	10	According to Ch. 5 P14 Line16-18, it is with medium confidence (not very high confidence) that the rate of change of the reconstructed GHG rise was also unprecedented compared to the lower resolution of the records of the past 800 kyr. Therefore, this should be reflected clearly in the SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
8447	6	6	6	10	Suggest separating the statement comparing the current GHG concentrations to the past 800 thousand years from that comparing to the last 2 million years. We have direct measurements of atmospheric CO2 and other GHGs in ice core air bubbles for the past 800 thousand years. For earlier periods CO2 concentrations are inferred from marine and terrestrial indirect proxies, as Chapter 2 makes clear. [Government of Australia, Department of Industry, Science, Energy and Resources]
8847	6	6	6	26	Need to decide on consistency when making statement of years ago. Probably most obvious comparing line 13 "last 2000 years" with line 23 "last three thousand years". The editing issues of consistency rather than reading as inputs from individual subject matter experts permeate the SPM but this is a most obvious example on page 6. [Government of United States of America, U.S. Department of State]
4533	6	7	6	7	Here, instead of "experienced", "occurred" could be a useful alternative to avoid overly human-centric expression. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
519	6	8	6	8	"CO2 and methane have increased" - should probably be: CO2 and methane emissions have increased [Government of Denmark, Danish Meteorological Institute]
8849	6	8	6	8	Should read: "Since 1850, atmospheric concentrations of CO2, CH4, and N2O have increased at rates and by amounts that exceed the natural changes between glacial and interglacial periods over at least the last 800 thousand years (very high confidence)." [Government of United States of America, U.S. Department of State]
2245	6	8	6	8	In the TS page 35 line 29, it is written “far exceeds”. Thus, it could be good to be more precise here and write “that far exceed”. [Government of France, Ministère de la Transition écologique et solidaire]
6597	6	8	6	8	Not clear what is the usefulness of the word 'amount' in the context of changing concentrations.The sentences seems not completely consistent with TS2.2. Suggestion: "CO2 and CH4 changes since 1750 exceed the natural variations between etc". Why is methane spelled out, and N2O and CO2 in chemical notation? [Philippe Tulkens, European Union (EU) - DG Research & Innovation]

Comment ID	From Page	From Line	To Page	To Line	Comment
221	6	8	6	8	The text line omits other GHGs and only states CO2 and methane. Ch. 2.2, pg. 5, Line 31-33 indcates "well-mixed greenhouse gases (GHGs) have increased at rates that have no precedent on centennial time scales in at least the past 800,000 years". The text needs to be revised to ensure consistency: This sentence should be reflective of IPCC's definition of all identified gases contributing to global warming. Replace CO2 and methane with well-mixed greenhouse gases (GHGs). [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
8121	6	8	6	9	Since when to when and what are the units being used? Also some numbers would be useful. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8123	6	8	6	9	Refence to geological periods along with years is not very useful. What is the message to policy? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
2249	6	8	6	9	This sentence is not easy to interpret because contemporary changes (rate and amount) are for a 170 years period, but the glacial-interglacial periods lengths are not specified. [Government of France, Ministère de la Transition écologique et solidaire]
51	6	8	6	10	"Since 1850, CO2 and methane have increased at a rate, and by an amount, that exceed the natural changes between glacial and interglacial periods over at least the past 800 thousand years (very high confidence)." Suggest to specify what "rate" and "amount" refers to. [Government of Singapore, Ministry of Environment and Natural Resources]
219	6	8	6	10	H.S.2.1 First starts with a finding that includes three GHGs (CO2, CH4, N2O). However, in the middle of the paragraph, the statement excludes N2O from the finding and only mentions CO2 and methane. Additionally, in the underlying report, the same finding CH.2, P.5 L.34 - P.5 L.36 includes the three GHGs (CO2, CH4, N2O) without excluding N2O. Please reflect N2O information in the SPM throughout the finding and in accordance with the underlying chapter. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
321	6	9	6	9	Please also add information on N2O that is available in chapter 2 in the last sentence in a similar way to the first sentence. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
6057	6	9	6	9	Please insert at the end of this statement: ....800 thousand years "and is of comparable magnitude for N2O" (very high confidence). As it is addressed in the ES of Ch 2 to characterize the state of N2O concentration [p.2-5; l:35-36]. Minor additional comment: somewhat unusual way of writing the numbers partly as digits partly written out; a uniform way of writing would be preferable, i.e. '800,000 years' would be preferred (here and in other places). [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
2247	6	9	6	9	For a non-native english speaker this hybrid way of writing figures is strange. We recommend to write either 800 000 or eight hundred thousand. This appears in several locations in the document [Government of France, Ministère de la Transition écologique et solidaire]
4869	6	10	6	10	Please consider including a panel of figures showing the long term growth in concentrations/RFs/balances resulting from various forcing agents, as well as of the long term contributions of various CO2-sources (land use vs. fossils) and their partitioning into various CO2 sinks (land, ocean, atmosphere). This gives a better picture of the overall trends in concentrations that mitigation efforts need to counteract, and the trends in the land sinks that needs to be maintained. For forcing agents, we suggest to include a simplified version of panel d) from figure TS.9. [Government of Norway, Norwegian Environment Agency]
4871	6	12	6	13	A simpler more plain text version could be something like 'The global surface temperature increase over the last 50 years represents the fastest global warming seen over at least the last 2000 years...'. [Government of Norway, Norwegian Environment

Comment ID	From Page	From Line	To Page	To Line	Comment
8851	6	12	6	13	Change to read: "Since 1970, observed global surface temperature has increased at a rate unprecedented in the relatively high-resolution proxy records that span the last 2000 years (medium confidence)." [Government of United States of America, U.S. Department of State]
4611	6	12	6	15	We observe that the second part of the H.S.2.2 statement seems lacking in confidence for the SPM (“more likely than not”). Furthermore, it is difficult to meaningfully compare a decade with a multi-centennial period. Is there a higher confidence statement that can be made instead? [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
4613	6	12	6	15	Could you say what the current rate is? [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
4873	6	12	6	15	Please consider adding another sentence describing how current temperature level relates to the level during the mid-Holocene (6500 yrs ago). This was a relative warm interval during the current interglacial. Also since the temperature level is currently illustrated in Figure SPM.1, it would benefit from having text that describes this feature. [Government of Norway, Norwegian Environment Agency]
8853	6	12	6	15	H.S.2.2 makes a statement about the unprecedented rate of increase in the last 50 years for observed global surface temperature, but does not provide a quantitative estimate and uncertainty range. [Government of United States of America, U.S. Department of State]
7087	6	12	6	15	Different GCM models and diffusion scenarios have different estimation of meteorological variables, therefore it is necessary to take attention for selecting relevant model and scenario in each region. [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]
443	6	12	6	15	The paragraph points out the rapid increase in temperature observed in the last 50 years and it is suggested to clarify whether the last 50 years refers to the period since 1970s or since 1950s. [Government of China, China Meteorological Administration]
8125	6	12	6	15	The last 50 years is a relative term. Can the period be specified? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8127	6	12	6	15	Is it appropriate to compare a decade with a multi-centennial period. A simpler and clearer statement may be better. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
7961	6	13	6	13	the most recent decade…a bracket with the decade period would be great [Government of Kenya, Kenya Meteorological Service]
6059	6	13	6	13	For readability reasons, please define how the "recent decade" is defined. The periods 2010-2019 or 2011-2020 are used as a reference period - which is used here? [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
4029	6	13	6	13	It is better to clarify "the most recent decade" in terms of period. Especially, the starting year of the period is important. If it is not appropriate to refer a year, it would be better to revise "the most recent decade" to "recent decades." [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
6599	6	13	6	14	Comparing a decadal mean with a multi-centennial average is odd. It would be better to clarify: "… that the most recent decade was globally warmer than any discernable period of the last 125 thousand years ago" (acknowledging that such periods may extend over several centuries). [Philippe Tulkens, European Union (EU) - DG Research & Innovation]

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4333	6	13	6	14	The comparison here is between two very different periods. While there probably are not decadal data from further back in time, one still wonders what the power of the comparison is. Wouldn't it be possible that some decades during the past multi-centennial periods could have been warmer than the past multi-centennial periods (as whole)? [Government of Sweden, Swedish Meteorological and Hydrological Institute]
2859	6	13	6	15	It's quite confusing to call the Figure SPM.1 within a sentence that compares the current global warming with the peak event that occurred at about 125,000. This is because Figure SPM.1 just shows the trend reconstructed for the latest Holocene. [Government of Chile, Ministry of Environment]
8855	6	13	6	15	"It is more likely than not that the most recent decade was globally warmer than any multi-centennial period since the peak of the last interglacial, about 125 thousand years ago." What does this mean to anyone? Authors are comparing a decadal average with a multi-centennial 'period'? Is that an average over 100s of years? It does not make sense to compare a single decade average with a multi-century average since there is a chance there could be a decade in the multi-century period that was equally warm. This is a weak statement and the "more likely than not" does not rise to an SPM-worthy level finding. It is inconsistent with the statement embedded in Figure SPM.1 that "temperatures are reaching levels last seen during the previous interglacial ..." Delete this sentence as it exemplifies the mismatch of temporal and spatial scales and averaging when picking time periods to make comparisons, which is prevalent throughout the SPM. [Government of United States of America, U.S. Department of State]
4027	6	13	6	15	Does "any multi-centennial period" mean "any given period spanning over multiple centuries"? If so, it is unfair to compare the average of the last ten years with the average over a few hundred years, giving the impression that the recent high temperature is totally unprecedented for 125,000 years. It may be less misleading to say something like "The temperature in the last ten years is anomalously high compared to the range of variability on a multi-centennial time scale since 125,000 years ago". [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
2253	6	13	6	15	We question the utility of putting a "more likely than not" statement here as it isn't a very strong confidence statement. We would recommend to start the paragraph with a strong statement (that this decade is the warmest of all decades since the last 2000 years, in terms of temperature and not the rate, for example). This could balance the second statement. We also suggest to rephrase the sentence in order to avoid questions on misleading use of statistics concerning the comparaison of a decade to muti-centennial periods [Government of France, Ministère de la Transition écologique et solidaire]
2251	6	14	6	15	In order to be consistent with figure SPM 1 we suggest to harmonize the time period : either be 6500 years in the text or 125 000 years in the figure as well [Government of France, Ministère de la Transition écologique et solidaire]
6601	6	15			Only Fig. TS.1 really reports on the 125 kyr scale - Cross Section Box TS.1 does not really do this. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
8451	6	16	6	19	Suggest clarification: It is not clear whether "retreat" refers to the glacier extent, or the rate of change. [Government of Australia, Department of Industry, Science, Energy and Resources]
8449	6	17	6	17	Suggest clarification: "During the last decade" in this sentence is ambiguous - it could refer to the decadal average, or to an individual year in the last decade. [Government of Australia, Department of Industry, Science, Energy and Resources]
8857	6	17	6	17	It would be better to include specific dates rather than "last decade". [Government of United States of America, U.S. Department of State]
439	6	17	6	17	The terms "sea ice extent", "sea ice area" and "sea ice coverage" are alternately used in the SPM. It is suggested to clarify the use of those terms. [Government of China, China Meteorological Administration]
4031	6	17	6	17	Panel (a) of Figure 2.20 in chapter 2 shows that average Arctic sea ice coverage has been descending for 40 years. Anytime in the panel, the averaged ice coverage reached the lowest at that time. Referring only "the last decade" could lead to trivialize this trend over the half century. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]

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8859	6	17	6	18	To give an indication of the lengths of the records, change to " ... since at least 1850 when observations began to become available (high confidence), and late summer coverage was less than anytime during at least the past 1000 years for which proxy records are available (medium confidence)." [Government of United States of America, U.S. Department of State]
4877	6	17	6	19	A more reader-friendly version may be something like this: 'The Arctic area covered by annual sea-ice during the last decade, reached its lowest level since at least 1850, and late...' [Government of Norway, Norwegian Environment Agency]
4875	6	17	6	20	Please consider to add quantification of the glacier's mass loss rate at different times in history. [Government of Norway, Norwegian Environment Agency]
7741	6	17	6	20	H.S.1.5 could be placed here instead for coherence reasons. [Government of Hungary, Ministry of Innovation and Technology - Climate Policy Department]
7089	6	17	6	20	Due to the large amount of data, using combined indicators recommends for the logical analysis . [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]
8129	6	17	6	20	Some quantification of these statements would be useful. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
4293	6	17	6	20	it would better to mention the decrease in sea ice volume instead of only sea ice cover due to the evident decrease in sea ice thickness (mainly in the arctic) [Government of Italy, CMCC - Centro Euro-Mediterraneo per i Cambiamenti Climatici Instituto Nazionale di Geofisica e Vulcanologia (INGV)]
8861	6	19	6	19	Change to " ... 2000 years for which proxy records are available (medium confidence)." [Government of United States of America, U.S. Department of State]
3329	6	19	6	20	It would be useful to define the temporal extent of what is meant by "Recent global glacier retreat" [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
2657	6	19	6	20	Please clarify if it is the rate of recent retreat that is unprecedented, or the global scale of the recent retreat. TS.2.5 was not clear about this either. Nor was Ch.2 executive summary. [Government of Canada, Environment and Climate Change Canada]
4513	6	19	6	20	The reference to "recent" is rather unspecific. Suggest stating the period/years that are referred to. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
2883	6	22	6	22	Clarify whether observations are available from an earlier time or not. [Government of Chile, Ministry of Environment]
7807	6	22	6	22	"H.S.2.4 The rate of global mean sea level rise beginning around 1900 has risen faster than…" - it is difficult to accept construction. Perhaps it is worth simplifying it. [Government of Poland, Ministry of Environment, Department of Air Protection and Climate]
6603	6	22	6	22	"The rate of global mean sea level rise beginning around 1900 has risen faster than over any preceding century in at least the last 3 thousand years" seems not clear. Shouldn't it be: " Since around 1900, mean sea level has risen faster than.."? [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
2255	6	22	6	22	We suggest to reformulate this sentence that can be a bit confusing with the use of a rate of rise that has risen faster than. We suggest to replace it with an adpation of the sentence in chapter 2 p79, l18-19: "The global mean sea level is rising, and the rate of rise since the 20th century is faster" for the beginning of the sentence and to adapt the rest of the sentence [Government of France, Ministère de la Transition écologique et solidaire]
4335	6	22	6	22	Is it the "rate" of "the rise" than has risen? Or that the rise has been faster? [Government of Sweden, Swedish Meteorological and Hydrological Institute]

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8453	6	22	6	23	Suggest clarification: Is the sentence describing an increase in the rate, or just the rate of SLR? Please re-word. [Government of Australia, Department of Industry, Science, Energy and Resources]
4615	6	22	6	23	Could this sentence be changed slightly to something like, "the rate of global mean sea level rise has risen faster since the beginning of 1900 than…", just to make it slightly clearer. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
7471	6	22	6	23	This sentence may suggest that sea level rise started at 1900. Please rephrase: The rate of global mean sea level rise since (not: beginning around) 1900 has risen faster than over any 23 preceding century in at least the last 3 thousand years (high confidence). [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
8863	6	22	6	23	This sentence uses "the last 3000 years" whereas previous sentences said "last 1000 years" or "last 2000 years". Determine a consistent usage on how numbers < 10,000 will be stated. [Government of United States of America, U.S. Department of State]
7851	6	22	6	23	Sentence very hard to understand ("The rate of … rise … has risen ..."). [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
8131	6	22	6	24	Is this the annual rate of sea-level rise or another unit? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8133	6	22	6	24	See earlier comments on energy up take in oceans the current annual zJ number should be provided. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8865	6	22	6	26	Chapter 2 (page 78, line 33) states: "New analyses demonstrate that it is very likely that GMSL rise over the 20th century was faster than over any preceding century in at least 3 kyr (Kopp et al., 2016a; Kemp et al., 2018a) (Figure 2.28)." Saying 'the rise has risen faster' in the SPM is ambiguous and potentially confusing. Suggest rewording to: "Global mean sea level rose faster in the 20th century than over any preceding century in at least the last 3 thousand years (high confidence)." [Government of United States of America, U.S. Department of State]
2257	6	22	6	26	We suggest to add a sentence about ocean deoxygenation as it is a great indicator of climate change in the ocean and as the results of recent projections illustrate a greater decline since SROCC (See TS.2.4) [Government of France, Ministère de la Transition écologique et solidaire]
2261	6	23	6	24	We suggest to reformulate the sentence " The rate of ocean .." with "The ocean has gained more heat over the past century than." [Government of France, Ministère de la Transition écologique et solidaire]
2263	6	23	6	24	Ocean heat-content increase is only introduced here with a reference to the rate of gain. Before in the text (H.S.1.6) refers to the warming of the ocean. Would it not be preferable to include in H.S.1.6 a reference that the warming of the ocean translates into the ocean heat-content increase and that such increase is about 90% of the total surplus of energy generated by the anthropogenic GHGs emissions? Otherwise, a non scientific reader will not be able to appreciate the meaning and implication of H.S.2.4. [Government of France, Ministère de la Transition écologique et solidaire]
6605	6	23	6	26	It is a bit difficult to find out exactly where in Section 2.3 the following sentences refer to: "The rate of ocean heat content gain was greater over the past century than at any time since the ending of the last ice age (medium confidence). Acidification of the open surface ocean is greater now, and has been increasing faster, than anytime in at least 26 thousand years (very high confidence)" [Philippe Tulkens, European Union (EU) - DG Research & Innovation]

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2259	6	23	6	26	Considering the order announced in "HS.2. ([...] atmosphere, ocean, and cryosphere), we suggest placing the current "H.S.2.4" before the current "H.S.2.3" [Government of France, Ministère de la Transition écologique et solidaire]
8455	6	24	6	24	Suggest clarification: "since the ending of the last ice age" is unclear. Does this include the period of rapid warming at the end of the ice age, or not? [Government of Australia, Department of Industry, Science, Energy and Resources]
2885	6	24	6	24	"since the ending of the last ice age": include a reference in years. [Government of Chile, Ministry of Environment]
8867	6	24	6	24	Give an explict date. Readers should not be expected to know when the 'ending' occurred, and might confuse with the Little Ice Age. Change to read: "… since the end of the last ice age, about 12,000 years ago." [Government of United States of America, U.S. Department of State]
2265	6	24	6	24	For the general public, having a range of time is much clearer than "the last ice age" [Government of France, Ministère de la Transition écologique et solidaire]
4247	6	25	6	25	The term “is greated now’ is refer to what years? [Government of Indonesia, Ministry of Environment and Forestry Indonesia]
6607	6	25	6	25	Acidification is the process of becoming more acid, and it means the same as the second part of this sentence. Probably it was intended to write "acidity levels are greater now", or pH levels are lower now… [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
2269	6	25	6	25	We suggest to clarify if this means that "the ocean is now more acidic " (a state), or really that acidification is greater (a rate). If the later please clarify the next bit of the sentence which appears to repeat the same point. [Government of France, Ministère de la Transition écologique et solidaire]
4617	6	25	6	26	In SR1.5, the rate of ocean acidification is mentioned as being unprecedented compared to any time in the last 65 Ma. Is there anything here that could perhaps reflect this, or the change in confidence? Is the difference because one report looks "open ocean surface" whilst the other looks at the "ocean"? It would be good if the authors could clarify these differences. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
8457	6	25	6	26	Suggest correction to read: 'Acidification of the open surface ocean is greater now, and has been increasing faster, than anytime in at least the last 26 thousand years (very high confidence).’ [Government of Australia, Department of Industry, Science, Energy and Resources]
4285	6	25	6	26	The penetration of acidification into the ocean interior deserves mentioning, e.g. chapter 5 page 53, lines 18-19 and 25. [Government of Italy, CMCC - Centro Euro-Mediterraneo per i Cambiamenti Climatici Instituto Nazionale di Geofisica e Vulcanologia (INGV)]
2267	6	25	6	26	We suggest to reformulate "in at least 26 000 years" to "in at least the last 26 thousand years" [Government of France, Ministère de la Transition écologique et solidaire]
8869	6	26	6	26	Continue sentence to read "… 26 thousand years when glacial conditions prevailed as a result of long-period cycles in the Earth orbital parameters." [Government of United States of America, U.S. Department of State]
8459	6	29	6	29	Suggest clarification: ‘Climate change is already affecting every regions across the globe…" Figure SPM 3 shows a number of regions where the figure indicates 'no significant change'. The text needs to be consistent with the figure. Suggest it reads ‘most' or ‘many’. [Government of Australia, Department of Industry, Science, Energy and Resources]
8871	6	29	6	29	In HS.3, "already affecting every region of the globe" has been stated since the AR4. What is the added significance of this statement repeated two cycles later? H.S.3.1 identifies some of the prominent enlightenments relative to AR5, but the banner statement needs to emphasize the important advances in knowledge. Change to: "Human influence has contributed to many observed changes in extremes and to many other climate drivers." Then add confidence level or likelihood assessment. [Government of United States of America, U.S. Department of State]
6609	6	29	6	29	What is meant with 'already'? Was this not the case in AR5? [Philippe Tulkens, European Union (EU) - DG Research & Innovation]

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3331	6	29	6	30	There is no confidence statement. [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
7853	6	29	6	30	HS.3: make it more compelling. "human influence contributing" is weak. Note that a D&A statement on the average variables is missing. So you could extend to sth like: ".... increases in temperature, changes in precipitation, ocean acidification and sea level rise of the last 50 years are caused by the anthropogenic increase in GHG. Human influence is now also detected in changes in the intensity and frequency of extreme climate events." [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
7605	6	29	6	30	Regions are not equally affected and their ability to cope vary as well. Some regions are also more vulnerable than others, especially the developing country regions. This is not highlighted in this section. [Government of South Africa, Senior Policy Adviser International Climate Change Cooperation Department of Environmental Affairs]
4033	6	29	6	30	I understand that this is not an established fact. Providing a confidence level would be desirable if it is not an established fact. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
323	6	29	6	32	This is a very important message of the SPM and it comes over in a very clear way. We would however suggest replacing "contribute" by "dominating" to better reflect the attribution made in the paragraphs below. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
7513	6	29	6	32	Here two different messages are mixed: on occurrence of CC around the world and attribution of extreme events to human induced climate change. Better separate by changing text into: "Climate change is already affecting almost every region across the globe, with many regionally observed changes in extremes and other climatic impact-drivers that can be attributed to human induced climate change.". This statement also needs to be substantiated or given a confidence level.. [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
6061	6	29	6	32	Good and clear message. It would however become even more policy relevant if the level of human influence could be clarified, "contributing" is too vague and does not seem consistent with all of the sub paragraphs and the general finding of this report, that attribution research has progressed significantly. We suggest at least "dominating" instead of "contributing". [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
8135	6	29	6	32	It may be better to state that changes are observed around the world first and then mention impacts. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8873	6	30	6	30	"climatic impact-drivers" is a new term within AR6 and certainly open to misreading. This shorthand means 'climate change drivers of societal impacts' as derived from the underlying text. The current compound word with the hyphen makes that more difficult to understand. Consider a foonote to define the shorthand expression at first callout or, at minium, drop the hyphen. [Government of United States of America, U.S. Department of State]
2271	6	30	6	30	Concerning CIDs, a specific bullet on fire weather here would be good given its importance and its use in the figures of this SPM [Government of France, Ministère de la Transition écologique et solidaire]
8137	6	31	6	32	See earlier comments on term climate impacts drivers, this is not clear. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]

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6611	6	34	6	34	How can attribution advance? Our ability to attribute can advance. Here it would be good to devote one sentence to explain why we have become better. Is it because of longer time series allow more robust analysis? Or did mathematical methods inprove? Or both? What are the most important changes since AR5? What do we know now that we didn't before? Note that this is the first statement that discuss the progress since AR5, and more statements would need a similar approach. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
8875	6	34	6	35	The statement "The attribution of observed changes in extremes to human influence has substantially advanced since AR5, in particular for extreme precipitation, droughts, tropical cyclones, and compound events (high confidence)" is non-informative. This reads as if the term "high confidence" applies to the conclusion that attribution science has substantially advanced. Confidence levels should not be applied to how well scientists feel their scientific skills have been improving. Delete since this sentence. It seems redundant with the actual explanations found in H.S.3.2-H.S.3.5. [Government of United States of America, U.S. Department of State]
4035	6	34	6	36	The attribution of droughts to human influence is described as high confidence, but Chapter 11 and TS indicate medium to low confidence for all types of droughts, and Figure SPM3 for agricultural and ecological drought indicates low confidence except for two medium confidences. It is desirable to clearly express evidence for high confidence. Also, the title of panel c in Figure SPM.3 shall be “agricultural and ecological” instead of “agricultural”, in line with its caption. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
6613	6	34	6	36	Align with Chapter 11, p6, l10-13 where precipitation is not mentioned. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
2273	6	34	6	36	We suggest to delete this first sentence and to move its information in the description of the theme "the current state of climate" in italic to provides some complementary explanation of why attribution has advanced. It might be helpful to strengthen by using language based on TS1.2.4 lines 13-15, for example adding after the comma "... with new techniques and analyses drawing on several lines of evidence providing greater confidence in attributing changes in regional weather climate extremes to human influence (high confidence) ..." as a base of confidence for such advancements. [Government of France, Ministère de la Transition écologique et solidaire]
4337	6	34	6	36	Isn't substantial advancement of attribution a statement of fact? Why is a confidence statement needed here? [Government of Sweden, Swedish Meteorological and Hydrological Institute]
2659	6	34	6	41	What this paragraph seems to be missing is a statement about human influence on the observed changes in frequency and intensity of hot and cold extremes. The conclusion about this on page TS-74 would be useful to include here in the SPM as well: "It is very likely that human influence is the main contributor to the observed increase in the frequency and intensity of hot extremes and the observed decrease in the intensity and frequency of cold extremes at continental scales." Since Figure SPM.3 doesn't provide attribution statements for continental scales changes, this would be new information to include in the SPM and not simply repeating information provided in the figure. Also, I suggest the conclusion about extreme event attribution on lines 40-42 be positioned immediately following this proposed new text (matching the presentation of conclusions on these topics in the TS page 74 lines 12-15). [Government of Canada, Environment and Climate Change Canada]
4879	6	34	6	42	The advancement since AR5 should be explained, not just refer to the current standardised language associated with the climate change impacts. No policy-maker will remember how these impacts were described in AR5. [Government of Norway, Norwegian Environment Agency]
4881	6	34	6	42	Please consider moving the sentence 'The attribution of observed changes in extremes to human influence has substantially advanced...' to the end of the paragraph and start with the most important message about the frequency and intensity of hot extremes. [Government of Norway, Norwegian Environment Agency]

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8139	6	34	6	42	Can these be quantified including the sub-set? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
4619	6	34	7	2	This section would be strengthened if the increased frequency and intensity of extreme events were quantified [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
8461	6	35	6	35	Consider adding a sentence about the relevance of compound events to disasters in Footnote 10. [Government of Australia, Department of Industry, Science, Energy and Resources]
7233	6	35	6	35	[Chapter 6] (SSP3-7.0, SSP5-8.5,) => (SSP3-7.0 and SSP5-8.5) [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
2933	6	35	6	35	Is this sentence (particularly droughts) for global scale? Please specify the regions where the attribution of observed changes in drought to human influence has substantially advanced. In the report, Miditerranean, Centerl Chile, and Western North America. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
4037	6	35	6	35	It would be helpful for readers to add the definition of “extreme precipitation”, as explained in Figure SPM.6: extreme precipitation events are defined as the daily precipitation amount that was exceeded on average once in a decade during the 1851 – 1900 reference period. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
2275	6	35	6	35	Please, consider to insert 'natural' between 'compound' and 'events' to avoid possible misunderstanding (e.g., natech risks are not considered here) [Government of France, Ministère de la Transition écologique et solidaire]
2281	6	36	6	36	Concerning the footnote 10 : This definition is difficult to understand especially for non-specialists. Maybe one could better explain that such events can have a spatio-temporal dependence ? [Government of France, Ministère de la Transition écologique et
7241	6	36	6	37	[Chapter 9] Although it is very interesting for researchers in this field, there is no reason to emphasize "no tipping point" of Arctic summer sea ice. More detianed description is included in the mian text (Page 9-48 line 28-30) and so it is more objective to merely describe the linearity between temperature and sea ice. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
3037	6	36	6	37	Is it also virtually certain that the cold extreme have become less frequent and severe? Might be strong regional dependency. Virtually certain only for warm extreme? The confidence level may be different [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
3333	6	36	6	38	It would be useful to have for the three extremes described (hot extremes, heat waves, cold extremes) the same information on the three main variables (duration, intensity/severity and frequency), for the three extremes cited before only two of these variables are analysed in the text. [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
8355	6	36	6	38	"since 1950" sounds overprecised. Better to use "since the middle of the 20th century" [Government of Ukraine, Director Ukrainian Hydrometeorological Institute]
8877	6	36	6	38	Change to read: "It is virtually certain that the frequency and intensity of hot extremes have increased and cold extremes have decreased over most land areas since 1950." [Government of United States of America, U.S. Department of State]
6615	6	36	6	38	The second sentence contains no statement of attribution (how much of the change can be due to human influence?). Does the confidence statement ("virtually certain") apply to the changes only or (also) to their attribution to human influence? Please clarify. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
4621	6	38	6	38	For clarity, suggest: "less frequent and less severe". [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]

Comment ID	From Page	From Line	To Page	To Line	Comment
4623	6	38	6	38	It would be good to reference the 21st century here in addition to the 20th Century (or say "since the 20th C" or similar) as this implies that there are no data or no trends from the 21st Century. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
2887	6	38	6	38	"more frequent in the 20th century" than during which period? [Government of Chile, Ministry of Environment]
4509	6	38	6	38	Instead of the "less frequent and severe", writing "less frequent and less severe" would increase clarity. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
8879	6	38	6	38	Why only the 20th century? Should say "and also for the first 20 years of the 21st century". Change "in the 20th century" to "since the later part of the 20th century" to make clear the trend is continuing into the 21st century. [Government of United States of America, U.S. Department of State]
445	6	38	6	38	The time in the sentence "Marine heat waves have become more frequent in the 20th century..." is unclear. It is suggested to directly give the time when "Marine heat waves" start to increase. [Government of China, China Meteorological Administration]
7125	6	38	6	38	"and human-influence has very likely contributed to 84–90% of them since at least 2006." This sentence does not correspond to the results of the article mentioned in the text of Chapters 9 and 11 of the report. According to Article's Frölicher et al., (Nature, 2018): "This implies (under the assumption that the models simulate naturally occurring MHWs with fidelity) that 87% of the currently occurring MHWs (defined relative to preindustrial conditions) can be attributed to global warming". As we can see, there is not a range (84-90%), and if there is not more similar article to verify this result, so we cannot to use "very likely" for this resulting. [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]
6617	6	38	6	38	20th century only? Does it not include the 21st? [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
2277	6	38	6	38	We suggest to add a time reference here? "more frequent than in the XX years before" because it is unclear whether the sentence says that marine heatwaves are more frequent in the 20th century compared to previous centuries or that they have become more frequent over the course of the 20th century (ie more frequent at the end of the 20th century than at the beginning of the 20th century). Indeed, "since at least 2006" would be inconsistent with the mention of the 20th century in the first part of the sentence. [Government of France, Ministère de la Transition écologique et solidaire]
4339	6	38	6	38	Would the finding extend to the last two decades as well (i.e., the first two decades of the 21st Century)? [Government of Sweden, Swedish Meteorological and Hydrological Institute]
3335	6	38	6	39	It is stated that marine heatwaves have become more frequent due to human influence. However, for the the other extremes described in the previous sentences there is no attribution to human influence. [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
11	6	38	6	39	While cold extremes have become less frequent and Sevre, Please clarify what is meant here, does it mean cold extremes have become less Severe? Or have become severe, but less frequent? [Government of United Republic of Tanzania, Tanzania Meteorological Authority (TMA)]
4625	6	38	6	39	The assessment that human influence has very likely contributed to 84-90% of marine heatwaves is a very complex one convolving two different uncertainties (the very likely and the 84-90% range) and including the non-trivial concept of "contributed to". Is it possible to express the effect of human influene on marine heatwaves more simply and succinctly? [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
4627	6	38	6	39	The attribution statement in the SPM about marine heatwaves (i.e. that human-influence has very likely contributed to 84–90% of them since at least 2006) is not reported in chapter 11, which states that "marine heatwaves, extreme ocean waves and sea level are addressed in Chapter 9 and Cross-chapter Box 9.1" (chapter 11, page 6, lines 6-7). Given this, could the authors please check the line of sight included with this passage? [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]

Comment ID	From Page	From Line	To Page	To Line	Comment
2935	6	38	6	39	How to get the "84-90% of them"? No related information can be found in TS and Ch11. Perhaps "most of them" or similar wording would be better if there is no clear evidence for the range. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
7817	6	38	6	41	In paragraph H.S.3.1 it is not clear what is the definition of "marine heatwaves". Do the postulated changes in the frequency of this phenomena refer to modelled trends only? Does the last statement refer to all hot extremes observed (over the land and the ocean)? [Government of Poland, Ministry of Environment, Department of Air Protection and Climate]
4039	6	38	6	41	A paper which can reinforce this assessment was published just before the literature cut-off date (https://doi.org/10.1029/2020GL090956). It said that the August 2020 record high sea surface temperature (SST) in the northwestern Pacific likely occurred once per 12 – 18 years in 2001 – 2020 owing to historical anthropogenic forcing, unlikely occurred without human influences, and is projected to be the new normal by 2031 – 2050, even if the 2.0°C goal of the Paris Agreement is achieved. The August 2020 record high SST in the northwestern Pacific had a notable impact in the region. So, adding this paper as a reference in the underlying chapter would help readers to understand the seriousness of the assessment. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
6063	6	38	6	42	When reading the last two sentences, it is not clear whether "subset of recently observed hot extremes" in the last sentence is still related to marine heatwaves or not. Please clarify. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
7473	6	39	6	39	84-90% sounds very precise. Maybe rephrase: "almost all" instead of "84-90%" [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
2985	6	39	6	39	"human influence" is more appropriate than "human-influence" unless there is a clear reason. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
8881	6	39	6	39	Are authors really sure that the contribution is very likely between precisely 84 and 90%? Or do authors intend "has very likely contributed to at least 84% of them since at least 2006"? In this context, however, "at least" is unclear and why 2006? Replace with language from TS.2.4: "... and most of them have been attributed to anthropogenic warming since 2006 (very likely) ..." with an added explanation for why "since 2006". [Government of United States of America, U.S. Department of State]
8883	6	39	6	40	"A subset of recently observed hot extremes ..." is vague and can be perceived as selectively using worst-case conditions. Clarify whether the reference here is to hot extremes over land or over oceans. Delete completely the sentence or replace it with a sentence from the TS (page 48, lines 54-55): "Some recent extreme events would have been extremely unlikely to occur without human influence on the climate system." [Government of United States of America, U.S. Department of State]
8463	6	39	6	41	Suggest including the basis for the "subset", similar to the percentage provided for marine heatwaves. [Government of Australia, Department of Industry, Science, Energy and Resources]
4629	6	39	6	41	The statement that a subset of extremes would have been extremely unlikely to occur seems a statistically unsatisfactory one. (eg cf a subset of people - who happened to be lottery winners - were extremely unlikely to win the lottery). Is it possible to define this subset in the sentence in a way as to avoid this statistical issue? [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
4279	6	39	6	41	It's unclear if this refers to hot extremes on land, in the ocean or both. [Government of Italy, CMCC - Centro Euro-Mediterraneo per i Cambiamenti Climatici Instituto Nazionale di Geofisica e Vulcanologia (INGV)]
6619	6	39	6	41	"A subset of" appears too vague. If it is about a particular subset (bearing a "fingerprint"), it might be useful to elaborate on this subset (perhaps thorough examples), including what fraction of overall hot extremes they represent. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]

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2279	6	40	6	40	We suggest to reformulate the sentence with "Studies on a subset of recently observed hot extremes revealed than those would have been extremely unlikely to occur without human influence on the climate system" [Government of France, Ministère de la Transition écologique et solidaire]
4341	6	40	6	40	The meaning of "subset" is unclear. Does it refer to some of the studied events? Or some of the experience events (of which not all have been studied)? Or something else. This should be clarified. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
4631	6	40	6	41	The SPM statement that a "subset of recently observed hot extremes would have been extremely unlikely to occur without human influence on the climate system" is assigned medium confidence in chapter 11 (page 6, lines 46-47). Can the authors please check that these statements are consistent? [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
7113	6		6		The concept of heat wave and its effects on the human environment has not well explained.(DOI 10.1007/s10584-011-0231-5) [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]
8885	7	1	7	1	What is the definition of a "heavy precipitation event"? Regularly occurring or unusual? Provide a definition as a footnote. The term needs to be highlighted better in the TS as well, since it is buried in Box TS.10 (i.e., "changes in metrics based on one-day or five-day precipitation amounts using global and regional studies") and in Figure TS.12 (i.e., "intensity change in %"). [Government of United States of America, U.S. Department of State]
4535	7	1	7	1	Over which period of time does the "The frequency and intensity of heavy precipitation events have increased … " apply? [Government of Sweden, Swedish Meteorological and Hydrological Institute]
8887	7	1	7	1	The events have increased over what time period? Or relative to which time period? Since 1950 (high confidence, Box TS.6, Table TS.2)? [Government of United States of America, U.S. Department of State]
4041	7	1	7	1	It would be helpful for readers to add the definition of “heavy precipitation”, as explained in Figure SPM.3: for heavy precipitation, the evidence is mostly drawn from changes in metrics based on one-day or five-day precipitation amounts using global and regional studies. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
521	7	1	7	2	The sentence may be read as if the observational coverage is important for the precip change, while it is the confidence statement that it relates to. Also the reader is not sure whether good observational coverage is widespread or sparse. Can the "with good observational coverage" be entirely deleted or alternatively moved in the parenthesis with the confidence statement. [Government of Denmark, Danish Meteorological Institute]
3337	7	1	7	2	The text focuses on "land regions with good observational coverage", it would interesting to know how representative these lands are over the whole amount of land. [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
13	7	1	7	2	The Paragraph does not make sens and it is is portraying a wrong message, whereby one may interpret the frequency and intensity of heavy precipitation is increasing in land areas with good observational coverage, which is wrong. Secondly what is the threashold of good observational coverage?. Suggest to delete the words "With good observational coverage" [Government of United Republic of Tanzania, Tanzania Meteorological Authority (TMA)]
4633	7	1	7	2	Human influence of heavy precipitation extreme events. The SPM statement mentions changes in both "frequency and intensity" of extreme events, but the concluding statement in chapter 11 mentions "intensification of heavy precipitation in land regions" (chapter 11, page 62, lines 52-53). Better consistency beterrn the two statements would be beneficial. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
6065	7	1	7	2	This could be perceived as if the frequency and intensity have increased only over areas with good observational coverage but not elsewhere. We suggest to change it to: "[...] have increased over the majority of land regions, as demonstrated for areas with good observational coverage (high confidence)" [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]

Comment ID	From Page	From Line	To Page	To Line	Comment
2283	7	1	7	2	First, it is difficult to link this statement with the figure SPM3 b) where only 19/44 regions show an increase and most others have insufficient evidence. Second, we suggest to clarify the time reference of this increase. since when? with respect to which period? [Government of France, Ministère de la Transition écologique et solidaire]
7463	7	1	7	4	In chapter 11, P.22-23, Table 11.2 (Synthesis table on projected changes in extremes) Row 3 (Heavy precipitation events: increase in the frequency, intensity, and/or amount of heavy precipitation) dictates a "high confidence that increases take place in most land regions" for projected changes at +1.5°C global warming, and "Likely that increases take place in most land regions" for projected changes at +2°C global warming. In pg. 7, Line 1-4 of the SPM, the text states, "the frequency and intensity of heavy precipitation events have increased over the majority of land regions with good oberservational coverage (high confidence)." This demonstrates the use of a confidence level pertinent to +1.5°C. This would appear as a misinterpretation of the text and does not align with Article 2.1 of the PA that states, "holding the increase in the global average temperature to well below 2C above preindustrial levels and pursuing efforts to limit the temperature increase to 1.5C above pre-industrial levels." The confidence level relavant to 2°C is the appropirate use in this sentence because it aligns with Article 2.1 of the PA, while also aligning with Article 4.1 of the PA to reflect balance. State the same confidence level relavant to 2°C to ensure consistency. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
2925	7	1	7	4	It should be specified in which geographic area the frequency and intensity of heavy rainfall have increased and what good observational coverage refers to. [Government of Chile, Ministry of Environment]
8889	7	1	7	5	Clarify what aspects of human influence? Be consistent in use of 'human influence' versus 'human activities'. [Government of United States of America, U.S. Department of State]
447	7	1	7	5	This paragraph indicates that the frequency and intensity of heavy precipitation events have increased over the majority of land regions with good observation. In the corresponding Figure SPM.3, 19 regions are labeled as "increase" and 21 regions are labeled as "insufficient evidence". In view of the fact that more regions lack observational conditions, it is suggested to add a description and give certain qualifications in the text to avoid the misunderstanding that "heavy precipitation has increased over the majority of land regions". [Government of China, China Meteorological Administration]
8141	7	1	7	5	What is defined as good observational coverage in both spatial & temporal terms and what proportion of land is included? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
4249	7	2	7	2	Please explain and quantify the term "good obsevational coverage". How to objetively determine "good coverage" [Government of Indonesia, Ministry of Environment and Forestry Indonesia]
8891	7	2	7	2	"good" means what? Provide a definition of good observational coverage as a footnote. Needs to be better defined in the TS as well. [Government of United States of America, U.S. Department of State]
7855	7	3	7	3	It would be usefull to specifiy which kind of drought is refered to here (meteorological? hydrological?). [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
2289	7	3	7	3	Could it be possible to define the term "contribution", does it mean "has increased the probability of occurence by some amount" and if yes by which amount? If no could you clarify the sentence? [Government of France, Ministère de la Transition écologique et solidaire]

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15	7	3	7	4	drought is a complext meteorological phenomena and has different definition, Meteorological, hydrological, agrometeorological. If we focus on Meteorological drought, the concept of drought during dry season is not clear and may be confusing. This need clarification [Government of United Republic of Tanzania, Tanzania Meteorological Authority (TMA)]
4635	7	3	7	4	Human influence on droughts in the dry season. The SPM assigns medium confidence to the human contribution to droughts, but chapter 11 assigns high confidence: "there is high confidence that human influence has increased the potential for worsening of drought conditions and increased the tendency towards drying in the dry season since the beginning of the 20th century" (chapter 11, page 87, lines 46-48). This inconsistency needs to be resolved (unless I am looking at an older version of chapter 11). [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial
6067	7	3	7	4	How do humans amplify the drivers of evaporation? Please be more specific and briefly explain the cause, including the word “demand”. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
8893	7	3	7	4	Key issue - Drought: From where in Sections 11.6 or 11.9 was this statement taken? There is little discussion of seasonal aspects of drought in Sections 11.6 or 11.9, and in fact the report states that increases in atmospheric evaporative demand are poor metrics for soil-moisture drought under climate change (page 11-70, line 1; page 11-71, lines 27-28). As a result, recommend this statement be deleted, unless it can be backed up more specifically from the report. The vast majority of regions in Tables 11.6, 11.9, 11.12, 11.15, 11.18, and 11.21 have little or no reported confidence in human influence on drought trends, and the cited Figure SPM.3(c) shows "low confidence" over the vast majority of regions, all of which also contradicts this statement. [Government of United States of America, U.S. Department of State]
2287	7	3	7	4	We suggest to clarify this sentence, indeed 1) it can be read as if human infuence has contributed to drought over most land areas, which is not seen in Figure SPM3c, 2) TS.2.6 indeed states that the increase in evapotranspiration has decreased water availability over most land areas, but does state that it has influenced drought over most land areas (TS p 49, lines 5-7). We also suggest to delete the term "particular" for clarity [Government of France, Ministère de la Transition écologique et solidaire]
4883	7	3	7	5	Please consider also including language on the role of deforestation in changes in rain pattern due to changes in evaporation, surface structure etc [Government of Norway, Norwegian Environment Agency]
8895	7	3	7	5	A very vague statement. First, the contribution could be miniscule and it would still be true. Second, what is the net anthropogenic contribution to drought in various areas? If precipitation is increasing as well as evaporative demand, these are acting in opposite directions, so which is dominant? Where is this demonstrated in the report? Chapter 11 didn't discuss drought from a seasonal perspective much at all, and it's highly disputed that evaporative demand is increasing in any meaningful, practical way for plants, rivers, etc. Recommend deletion of this sentence. [Government of United States of America, U.S. Department of State]
8143	7	3	7	5	Can the source of the evaporative demand be identified? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
4885	7	4	7	4	Please consider to replace "demand" with a more appropriate and undersatandable word in this context. We are not sure if we fully understand what you want to convey, but if it is the fact that warmer air can hold more moisture it would be good to clarify this in the sentence. [Government of Norway, Norwegian Environment Agency]
4887	7	4	7	4	As policy makers are not familiar with the term, please define "atmospheric evaporative demand" [Government of Norway, Norwegian Environment Agency]
7475	7	4	7	4	It is clearer to say "due to the temperature increase" instead of "due to increases in atmospheric evaporative demand" [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]

Comment ID	From Page	From Line	To Page	To Line	Comment
2937	7	4	7	4	It would be useful to add a link to Box TS.10. Also TS.2.6 summary paragraph needs a sentence for drought. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
4043	7	4	7	4	"evaporative demand" is not readily understandable for many policymakers. "Increase in evaporative demand" should be replaced with something like "temperature rise leading to intensified evaporation". [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
2285	7	4	7	4	We suggest to clarify as much as possible the term "atmospheric evaporative demand" as this is not an easy concept to understand for policymakers. If an easier term isn't found, a short definition could be added either in a footnote or in the glossary. [Government of France, Ministère de la Transition écologique et solidaire]
2291	7	4	7	4	We recommend to clarify to which aspect the confidence interval applies to. "Human influence has contributed to drought", or to "due to increases in atmospheric evaporative demand". The latter being largely accepted, one would think that medium confidence applies to "Human influence has contributed to drought" [Government of France, Ministère de la Transition écologique et solidaire]
4889	7	7	7	7	As policy makers are not familiar with the term, please define "Global land monsoon precipitation". [Government of Norway, Norwegian Environment Agency]
4251	7	7	7	7	Is there any specific reason to state the range of global monson on 1950 – 1980?. The year of 1950 also stated in the sevaral paragraph to start the analysis years (time) [Government of Indonesia, Ministry of Environment and Forestry Indonesia]
8897	7	7	7	8	The sentence needs a rewrite since it gives the wrong impresson that monsoonal rainfall declines 1950-1980 were completley attributable to aerosol forcing, rather than also involving internal decadal variability as has been extensively demonstrated in studies of the Sahel rainfall time series, for instance. The statement that monsoon precipitation has increased "as a result of greenhouse gas forcing and large-scale multi-decadal variability" is vague and imprecise. The salient question is whether it can be shown that GHGs have led to an increase. With regard to the phrase "large-scale multi-decadal variability", this has presumably been going on for many centuries. Rephrase to: "the particular phase of ongoing, large-scale, multi-decadal variability." If one is going to just mention the variability as a cause of the increase, would it not be appropriate to be saying that the intensity of the variability is plausibly contributed to by human-induced climate change? H.S.3.3 needs to be reworded to better clarify the competing influence of GHG increase, aerosol change, and internal variability during the course of the second half of the 20th century. Be more precise in using the terms "precipitation decrease" versus "precipitation strengthening" versus "weakening of regional monsoon circulation". Describe the impact on North American Monsoon. [Government of United States of America, U.S. Department of State]
2295	7	7	7	8	Please clarify the baseline reference for this global land moonson precipitation change [Government of France, Ministère de la Transition écologique et solidaire]
4637	7	7	7	9	Human influence on monsoon precipitation. The SPM statement (medium confidence with regard to anthropogenic forcings) is consistent with the statement in chapter 3, page 43, lines 51-54. The subsequent SPM statement about specific regions (South Asia, East Asia, West Africa), does not appear in chapter 3, but may be in other parts of the report that I have not seen. Given this, could the authors please check the line of sight? [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
7551	7	7	7	9	Multi-decadal variability of what? Specify what parameter or phenomenon this concerns. [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
8145	7	7	7	9	Can the different contributions be separated out with confidence levels? How much is due to multi-decadal variability? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
2293	7	7	7	12	The second sentence is a bit confusing. Perhaps it would be better to list the monsoon regions where the increase of precipitation has started and those where it is still masked by the aerosols. [Government of France, Ministère de la Transition écologique et

Comment ID	From Page	From Line	To Page	To Line	Comment
17	7	7	7	13	Surprisingly no Mention of East African Monsoon. The Assessment need to balanced, The author may need to explain why East African Monsoon is excluded from the discussion in this paragraph [Government of United Republic of Tanzania, Tanzania Meteorological Authority (TMA)]
7493	7	7	7	13	Does this statement imply that if aerosols would decrease again, monsoons precipitation will increase to higher levels than before the climate started to change? If so, please indicate. [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
2661	7	8	7	8	Again, for readability, we suggest replacing "greenhouse gas forcing" with "Increases in anthropogenic greenhouse gases". This would also match the phrasing in the sentence about "increases in anthropogenic aerosols". [Government of Canada, Environment and Climate Change Canada]
4891	7	8	7	9	Please concider explaining the difference between "human-caused forcings/aerosols" and "anthropogenic aerosol forcings", and if possible, use one term only. See also page 16, lines 7 and 39, and page 22, line 8, where it says "human-caused aerosols". [Government of Norway, Norwegian Environment Agency]
53	7	8	7	9	"Global land monsoon precipitation decreased during 1950–1980, partly due to increases in anthropogenic aerosols, but has subsequently increased as a result of greenhouse gas forcing and large-scale multi-decadal variability (medium confidence)." Here increases due to "greenhouse gas forcing" and "large-scale multi-decadal variability" (natural forcings) may be separated and given corresponding confidence levels. [Government of Singapore, Ministry of Environment and Natural Resources]
4343	7	9	7	12	The first sentence speaks about global weakening precipitation in land monsoon, followed by increases. The second sentence mentions monsoon circulation in some specific regions (over the whole 50-year period?). It is not entirely clear how these two sentences relate to each other, or what the overall picture and regional deviations is. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
8147	7	10	7	13	The use of the word "expected" has a strong impact on what the confidence levels refer to. Can this be clarified? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
6621	7	15	7	15	By how much has the proportion of tropical cyclones increased? [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
2297	7	15	7	15	We suggest to add a sentence on other categories of cyclones, even if there is no clear signal. [Government of France, Ministère de la Transition écologique et solidaire]
4639	7	15	7	16	Increase in intense tropical cyclones (likely) that cannot be explained by natural variability (medium confidence). The SPM statement on the likely increase is consistent with the information in chapter 11, page 95, lines 46-47. The medium confidence statement, however, is not as specific as the information in chapter 11, which assigns medium confidence to the poleward shift of tropical cyclones (chapter 11, page 95, lines 50-51). Can the authors please check that these statements are consistent? [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial
4045	7	15	7	16	There seems to be inconsistency in the meaning of the word "intense" of tropical cyclones. According to the Chapter 11 (Page 11-9, line 29-30) or Kossin et al 2020 referred there, "intense" means Simpson category 3 to 5. Meanwhile for future projection (Page 12, line 3), "intense" means Simpson category 4 and 5. Clarification would be required for precise understandings of readers. It would be better to add “global” before “proportion of tropical cyclones” as well, based on the explanation in L.29-30 P.11-9 of Chapter 11: it is likely that the global proportion of major TC (Category 3–5) intensities over the past four decades has increased. It will lead to a clear understanding. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
8149	7	15	7	17	Can numbers be given on the number of intense cyclones that are outside the normal distribution? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]

Comment ID	From Page	From Line	To Page	To Line	Comment
19	7	15	7	18	The Author need to focus on explaining the causes of the increase in the severity of Tropical Cyclones instead of saying the increase can not be attributed to the natural variability [Government of United Republic of Tanzania, Tanzania Meteorological Authority (TMA)]
4641	7	15	7	18	Concerning HS3.4, it will be important for policymakers to know the number of tropical cyclones, not just the proportion of intense ones (i.e. more intense ones or just fewer weak ones, or both?). This section should also be clearer on what is meant by 'classified as intense' since both categories 3-5 and 4-5 have been used to describe findings in the underlying chapter - precisely what cetagories does 'intense' correspond to? [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
7713	7	15	7	18	In section H.S.3.4 basin wise details on tropical cyclones may be given [Government of India, Ministry of Environment, Forests and Climate Change]
7011	7	15	7	18	The inclusion of information on tropical cyclones is highly relevant to the Pacific region and is thus very welcome here. [Government of Fiji, Fiji Meteorological Services]
7267	7	15	7	18	We would like to congratulate the authors for their efforts in assessing and compiling this highly impact-relevant information and explicitly attributing observed changes in climate extremes to anthropogenic interference. This high quality climate information is very much needed and will receive our full support. [Government of Saint Kitts and Nevis, Department of Environment - Ministry of Agriculture, Marine Resources, Cooperatives, Environment and Human Settlements]
7145	7	15	7	18	We welcome the information on tropical cyclones and on the attribution of changes to human drivers and would like to thank the authors for their hard work in order to provide this assessment. [Government of Samoa, Ministry of Foreign Affairs and Trade]
2801	7	15	7	18	Thanks a lot for providing this key assessment of attributing observed changes for tropical cyclones. This is extremely valuable information for us as a Small Island nation. [Government of Jamaica, Meteorological Service Division]
7419	7	15	7	18	H.S.3.4 in the SPM does not also mention that " there is low confidence that a global anthropogenically forced trend in TC 7 precipitation has been detected (Knutson et al., 2019), partly due to observational data limitations" found in the underlying chapter 8, page 57, line 5-6. This statement must be added to H.S.3.4 in the SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
4893	7	16	7	16	Please consider rewriting the clause behind the semicolon in terms of human influence rather than natural variability for clarity. [Government of Norway, Norwegian Environment Agency]
8899	7	16	7	16	What is the definition of an "intense tropical cyclone"? Regularly occurring or unusual? Remove "this change cannot be explained by natural variability alone" as this is assumed for all these climate assessment statements. Consider replacing the sentence with that of the TS (page 88, lines 50-51): "It is likely that the global proportion of major tropical cyclone (TC) intensities (Categories 3–5) over the past four decades has increased (medium confidence)." [Government of United States of America, U.S. Department of State]
2299	7	17	7	17	We suggest to modify the sentence because here "event attribution studies" mentions a methodology leading to a result, but in other paragraphs, methodologies are rarely mentioned. To be consistent, here the sentence could be revised as: 'There is high confidence that heavy precipitation associated with individual tropical cyclones is caused by human influence." [Government of France, Ministère de la Transition écologique et solidaire]
4643	7	17	7	18	The SPM states that there is "high confidence for human-caused increases in heavy precipitation associated with tropical cyclones". Chapter 11 assigns high confidence to the increase in "average tropical cyclone rain rates" [chapter 11, page 100, lines 25-26], so there is some inconsistency in the language. Can the authors please address this? [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
8901	7	17	7	18	The real question is how much EXTRA damage. Without confidence on those numbers, this statement may not warrant elevation to the SPM. Change to be consistent with the TS (page 74, lines 32-33): "... for human-caused increases in precipitation associated with strong tropical cyclones." [Government of United States of America, U.S. Department of State]

Comment ID	From Page	From Line	To Page	To Line	Comment
6623	7	17	7	18	"Event attribution studies provide high confidence": Why mention "studies" here, but in not other statements on attribution? If other sources/methods (apart from "attribution studies") are used for attributing events and phenomena, it may be useful to mention them. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
8465	7	20	7	20	Suggest clarification: Should this sentence refer to "compound extreme events" as in line 23? [Government of Australia, Department of Industry, Science, Energy and Resources]
325	7	20	7	20	Please highlight the anthropogenic cause of this increase as is done in the TS. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
7819	7	20	7	20	Paragraph H.S.3.5 --> the "compound event" is a mathematical term relating to the probability of the occurrence of the independent events. This is not the case for heatwaves/draughts/fire weather. It is suggested to change the wording [Government of Poland, Ministry of Environment, Department of Air Protection and Climate]
8357	7	20	7	20	"since 1950" sounds overprecised. Better to use "since the middle of the 20th century" [Government of Ukraine, Director Ukrainian Hydrometeorological Institute]
6069	7	20	7	20	Please insert: …has likely increased "due to human-induced climate change" since 1950. … to highlight the anthropogenic causes of increasing probability of compound events as it is addressed in the Technical Summary [TS-49;l:28]. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
8903	7	20	7	20	Are these compound extreme weather events? As defined in Footnote 10, refer to these as "compound extreme events". [Government of United States of America, U.S. Department of State]
2301	7	20	7	20	Please, consider to insert 'natural' between 'compound' and 'events' to avoid possible misunderstanding (e.g., natech risks are not considered here) [Government of France, Ministère de la Transition écologique et solidaire]
2303	7	20	7	20	We suggest to revisit the sentence "this include increases…", because it is unclear which events are compound events depending on the exemples provided in the sentence [Government of France, Ministère de la Transition écologique et solidaire]
21	7	20	7	21	Not clear what is meant by "Fire Weather" [Government of United Republic of Tanzania, Tanzania Meteorological Authority (TMA)]
4645	7	20	7	23	Increase in the frequency of compound events. The SPM statements on concurrent heatwaves and droughts (high confidence) and regional fire weather (medium confidence) agrees with information in chapter 11 [page 112, lines 29-31]. However, the SPM statement on compound flooding (high confidence) disagrees with the information in chapter 11 (page 9, lines 34-35) which assigns meduim confidence instead. This inconsistency needs to be resolved. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
4647	7	20	7	24	The reader may not understand the term 'compound flooding' which is not in the glossary, so this should either be explained here, or added to the glossary [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
2927	7	20	7	24	Similarly as fire weather, I suggest to include examples of regions that exhibit heat waves and droughts and compound flooding. [Government of Chile, Ministry of Environment]
6625	7	20	7	24	How about the compound events in the ocean? (E.g.marine heatwaves co-occuring with very low nutrient levels, high temperature and low chlorophyl). [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
7495	7	21	7	21	What is 'fire weather'? Please give definition. [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
6071	7	21	7	21	Please check: could it be useful to substitute 'Mediterranean region' by 'Southern Europe' as it is expressed in Ch 11 [11-109;l.26] [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]

Comment ID	From Page	From Line	To Page	To Line	Comment
6073	7	21	7	21	The term "fire weather" is used for the first time in a SPM. Please refer to the glossary or explain. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
6627	7	21	7	21	The term fire weather has not been introduced. Weather conductive to increased risk of wildfires? By how much has the probability increased (from to). [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
2839	7	21	7	22	H.S. 3.5: South America is missing in the fire weather list. Unfortunately, fires in Chile have been overlooked in Chapter 11.8.3, but not in 12.4.4.2 where increased fire weather in Chile is mentioned. [Government of Chile, Ministry of Environment]
2665	7	21	7	22	It would be better to refer to parts of North America (western, southern) instead of just the United States for fire weather. This would also improve consistency with Table TS.5. Additionally, consistency with the fire weather column in Table TS.5 should be checked for the other parts of the world as well. [Government of Canada, Environment and Climate Change Canada]
2939	7	21	7	23	Which areas are more vulneratble to compounded extremes, particularly droughts and heatwaves? Specifyinig regions for concurrent heatwaves and droughts (over many dry regions?) and compound flooding (in some regions?) would be useful. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
2305	7	22	7	23	It seems that this confidence level (high confidence) is in contradiction with 11.8.2, l.21-22, where medium confidence is mentioned [Government of France, Ministère de la Transition écologique et solidaire]
5107	7	22	7	23	"fire weather" and "compound flooding" are jargon. Please explain or reformulate. [Government of Belgium, Belgian Science Policy Office - Belspo]
3339	7	23	7	23	It shuld be specified the time frame (presumable since 1950) [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
8905	7	23	7	23	Should this read "The total land area being affected ..."? Or might it be that this conclusion would be better phrased in the plural, namely: "The areas being affected by concurrent extremes are increasing"? [Government of United States of America, U.S. Department of State]
2941	7	24	7	24	Adding a link to TS.2.6 would be useful to cover compound flooding. Box TS.10 does not have that information. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
2929	7	27	7	27	What methodology was employed to indicate that there was no significant drought change in the SWS zone? Because the SWS zone presents differences in water availability in sub-regions, when averaged it might make invisible the significant drought in the central zone in Chile. [Government of Chile, Ministry of Environment]
8467	7	27	7	51	Suggest including ‘ecological drought' in the diagram legend, to make clear that panel comprises both agricultural and ecological drought. [Government of Australia, Department of Industry, Science, Energy and Resources]
7743	7	27	7	51	SPM.3: Add to the figure itself that changes are shown from 1950. Panel c) Why naming it ecological drought instead of simply calling it a drought since it is based on various indices and assessments (and some are purely meteorological based)? [Government of Hungary, Ministry of Innovation and Technology - Climate Policy Department]
4789	7	27	7	51	There's some useful information in this diagram but also some important information missing for key regions, such as small islands, which can't be captured in the current format. Could the authors consider an alternative format that provides a more complete picture, drawing in other information from the Atlas. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
4791	7	27	7	51	Panel c, droughts: could the authors please consider adding the clarification on the figure label that by 'human contribution', in this context, it means human influence over weather/climate rather than human contribution to direct ground conditions (politically, socio-economically, physically) that could exacerbate the impacts resulting from climate change. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]

Comment ID	From Page	From Line	To Page	To Line	Comment
4793	7	27	7	51	Could it perhaps be explained what the three letters are in each of the hexagons? It took me a few looks to realise what they meant. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
4795	7	27	7	51	SPM.3 figure should include ocean regions also (or in additional panel) to reflect similar messaging about observed changes in extremes and other climate impact drivers across all ocean areas [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
8151	7	28	7	50	This figure may not add much to the text. It might be best in the TS or as an inpute to WGII [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8469	7	29	7	29	Suggest clarification: Figure SPM.3 captioning and header: "Climate change is already affecting every region across the globe". However the IPCC AR6 regions depicted do not include Antarctica, or indeed oceans. Some work is required to give context to "IPCC AR6 regions" and note this point clearly in the caption. [Government of Australia, Department of Industry, Science, Energy and Resources]
6077	7	29	7	29	Figure SPM.3: Please explain in the caption, why Antarctica and other regions that are mentioned in other figures (e.g. SPM.9) are missing here. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
23	7	29	7	31	In Panel c, in the figure there is mention of ecological drought, however, here it is appearing. The concept of ecological drought need more description [Government of United Republic of Tanzania, Tanzania Meteorological Authority (TMA)]
27	7	29	7	49	Both rainfall and Precipitation have been used in Figure SPM3 [Government of United Republic of Tanzania, Tanzania Meteorological Authority (TMA)]
6501	7	29	7	49	Figure SPM.3 This figure is displayed as hexagons with identical size, which means that boundaries of the AR6 regions are not coincident with natural boundaries that are able to produce changes atmospheric processes and climate change responses. For example, the natural boundary between western South America (SWS) and eastern South America (SES) is the Andes Mountains. In fact, it is possible observe the opposite response to climate change in precipitation west and east of the Andes (Figure SPM.5 b)). Thus, considering that SWS is a region that contain west and east the Andes, I think that show changes in the SWS region as a whole is obscuring the documented mega-drought in the western side of South America (west of the Andes). [Government of Chile, Ministry of Environment]
2663	7	29	7	49	Figure SPM.3 caption: Recommend adding to the caption some text to explain how to properly interpret a single dot (low confidence of human influence) in hexagons that are white (representing no significant change observed). It is unclear how an assessment of human influence on an observed change can be made when there is no observed (significant) change. In this regard, was 'no signficant change" part of the assessment provided in Ch. 11.9 (referenced in curly brackets for this Figure)? We didn't find such language in section 11.9. Rather this section speaks to the assessment of low confidence in evidence of any change. The authors might also consider whether regions coloured white (low confidence in evidence of change OR possibly no significant change) need to show the assessment of confidence in human influence (dots). Since all the white hexagons have low confidence about observed change and low confidence in the human contribution to changes, it may be sufficient to leave the dots out for the white colured regions. [Government of Canada, Environment and Climate Change Canada]
6075	7	29	7	49	Figure SPM.3: line 2: "agricultural and ecological drought" --> in the figure it is "agricultural drought" only (panel c). Please explain these concepts and how the differ from a meteorological drought. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]

Comment ID	From Page	From Line	To Page	To Line	Comment
8907	7	29	7	49	The following Figure SPM.3 caption improvements are suggested: Lines 30-31: It would be clearer if the phrase ""IPCC AR6 regions displayed as hexagons with identical size ..."" were taken out of this sentence and made into a new first sentence for the caption. Lines 32-35: The color descriptions in the caption are confusing and may not be matching up with the figure itself. Lines 35-37: The extremes assessment is made using trends from 1950 to present. Going back to 1950 is generally insufficient to capture the ""baseline"" of extremes, as many of the largest extremes occurred before 1950. This is especially true when claiming that events are outside the range of historical variability. It should, at a minimum, be noted that assessments made on shorter or longer time frames may yield different results. Line 36: Missing a semicolon before ""thus"". Should read: ""... and for the timeframe from 1950 to present; thus, ..."" Line 37: Add 's' to ""assessment"" (plural) Line 43: Replace common with semicolon. Should read: ""... temperatures; regional studies using other metrics ..."" [Government of United States of America, U.S. Department of State]
7013	7	29			Figure SPM.3: There are inconsistencies in the regional coverage in this figure as the Pacific region is not included, even though the region is resolved well in other parts of the WGI assessment. It is strongly suggested that the Pacific region is added here (even in case of an assessment of “insufficient evidence”), analogous to the Caribbean region. [Government of Fiji, Fiji Meteorological Services]
7269	7	29			Figure SPM.3: We understand from explanations received by authors that the presented assessment is based on land data, we would like to flag our concerns regarding an inconsistency related to regional coverage. The largest geographical region of SIDS, the Pacific Islands, is missing despite other parts of the AR6 WGI assessment resolving this region well. Of course, the land area of Pacific SIDS is small. However other regions like the Caribbean (CAR), which are also dominated by ocean area are reflected in the assessment. Please add the Pacific area and show the related assessment results for this region, even if the assessment would result in an "insufficient evidence" assessment. [Government of Saint Kitts and Nevis, Department of Environment - Ministry of Agriculture, Marine Resources, Cooperatives, Environment and Human Settlements]
7147	7	29			Figure SPM.3: Unfortunately, we have to point to inconsistencies in this figure relating to the coverage of SIDS. Fully understanding that the assessment is based on land data and that the land area of the Pacific island states is comparatively small, there is in fact information on this region in other parts of the AR6 WGI assessment. Also, the Caribbean region with similar geography is represented in this figure. We therefore strongly suggest that the Pacific region is added here, even in case of insufficient evidence. This emphasises the wider issue that the process in which IPCC authors access regional information needs to be improved. [Government of Samoa, Ministry of Foreign Affairs and Trade]
2803	7	29			While there may be scientific reasons for the current display choice, it is still important to show all AR6 regions in Figure SPM.3 and include the Pacific in the maps shown. If no data is available for the Pacific (there is insufficient evidence displayed for other regions, too), this can still be displayed. [Government of Jamaica, Meteorological Service Division]
6389	7	29			Figure SPM.3: We strongly suggest adding the Pacific region to the assessment also seeing that the Caribbean region is also represented. [Government of Saint Lucia, Department of Sustainable Development - Ministry of Education, Innovation, Gender Relations and Sustainable Developement]
25	7	30	7	30	What are the AR6 Regions? [Government of United Republic of Tanzania, Tanzania Meteorological Authority (TMA)]

Comment ID	From Page	From Line	To Page	To Line	Comment
2861	7	30	7	46	The legend for Figure SPM2 indicates “agricultural and ecological drought”, but the corresponding figure (panel c) apparently only shows assessment results for agricultural drought. [Government of Chile, Ministry of Environment]
7553	7	31	7	35	Figure SPM.3: Colour codes as described in caption do not consistently match colour coding in figure. [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
2863	7	32	7	33	There is no correspondence between figure and legend for depicting categories “increase” and "decrease”. [Government of Chile, Ministry of Environment]
2889	7	32	7	33	3 categories of confidence vs 5 introduced in the text: this could be harmonized. [Government of Chile, Ministry of Environment]
4047	7	32	7	33	The expression "red/green for an observed increase with at least medium confidence; blue/yellow for a decrease with at least medium confidence;" is not accurate. The explanation is applicable to (a) and (b), whereas in (c), the colors indicate the opposite (yellow for an increase and green for a decrease). [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
29	7	33	7	34	The nottion of nsufficent evidence is very frustrating and as to lead to disbalance report of which developing countries are the main victim. How insufficient is Insufficient Evidence [Government of United Republic of Tanzania, Tanzania Meteorological Authority (TMA)]
4895	7	34	7	36	"Region as a whole" is mentioned three times. If possible to improve readability, please consider varying the language. [Government of Norway, Norwegian Environment Agency]
4345	7	36	7	36	Suggest starting a new sentence here, i.e. "… from 1950 to present. More local and…" [Government of Sweden, Swedish Meteorological and Hydrological Institute]
7235	7	45	7	45	[Chapter 6] SSP1's => SSP1-2.6's ; SSP3's => SSP3-7.0's [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
4347	7	45	7	45	The "using global and regional studies" could be omitted, not really needed for understanding / does not provide information that is needed. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
31	7	46	7	46	Clarification is needed on ecological drought [Government of United Republic of Tanzania, Tanzania Meteorological Authority (TMA)]
6433	7	48	7	48	The Term „atmospheric evaporative demand“ is difficult to understand given that this term has not been explained in the glossary. Either add this explanation in the glossary or include it in the SPM. [Government of Austria, Federal Ministry of Agriculture,
327	7	48	7	48	The term "atmospheric evaporative demand" should be added to the glossary. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
6079	7	48	7	48	Since the very technical term “atmospheric evaporative demand” is used for the first time in an SPM, we suggest adding a definition to the glossary and reference this glossary entry, or explain in the SPM. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
7115	7		7		The effects of different levels of climate change onwater resources and consumption in the world should be presented based on optimistic to pessimistic scenarios.(https://doi.org/10.1073/pnas.1222475110 and DOI 10.1007/s00477-010-0423-y) [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]
7747	8	0	8	0	In the the description of the 11th index on the bottom of the page, an "of the" may be missing in the following sentence: An agent or process "of the" climate system that influences a component of a human or natural system. [Government of Hungary, Ministry of Innovation and Technology - Climate Policy Department]
8909	8	1	8	1	Is it more "Understanding of Preindustrial to Present Climate Change" rather than just a knowledge of the state of climate? Change to read: "Our scientific understanding of how much the climate system warmed since the Preindustrial in response to greenhouse gas increases ..." [Government of United States of America, U.S. Department of State]
523	8	1	8	2	GHG increases - please state whether this is emission or concentration increases [Government of Denmark, Danish Meteorological Institute]

Comment ID	From Page	From Line	To Page	To Line	Comment
2307	8	1	8	3	We recommend to reproduce in HS.4 some of the numbers provided in the H.S.4.i, for example the rate of energy increase and the assessed equilibrium climate sensitivity [Government of France, Ministère de la Transition écologique et solidaire]
3341	8	1	8	3	There is no confidence statement. [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
8471	8	1	8	3	Suggest clarification: This statement would be more useful if it included information about what understanding has been strengthened. If not quantitative statements, a description of variables for which understanding has strengthened (eg ECS, RF, energy imbalance…) [Government of Australia, Department of Industry, Science, Energy and Resources]
7059	8	1	8	3	HS.4: It suggests adding the phrase "for short, medium and long terms" at the end of this sentence: "Our understanding of how much … in the climate system for short, medium and long terms." In this section just short-term has been mentioned. [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]
7857	8	1	8	3	HS.4: Motherhood statement of scientifc progress which is not very specific. Make more it compelling, e.g. by elaborating on the increase in energy content of the ocean, along with the melting of polar and terrestrial (now also available, Hugonnet et al., 2021) ice masses of ca 1.7 km3 per day. [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
4897	8	1	8	5	H.S.4: Please consider rephrasing the sentence to ease understandability. We suggest "Improved quantification of climate drivers, feedbacks, and the observed energy increase in the climate system has strengthened our understanding of how much the climate system warms in response to increasing anthropogenic greenhouse gas emissions.". Please also consider to include some of the concrete descriptions of findings related to climate drivers and feedbacks that are not mentioned but described in the underlying paragraphs e.g. sea-level rise and climate sensitivity. [Government of Norway, Norwegian Environment Agency]
4899	8	1	8	5	To a certain degree it is somewhat obvious that a new assessment report of this nature will increase our understanding. Please consider reformulating this paragraph, and perhaps focus it more on actual findings. [Government of Norway, Norwegian Environment Agency]
7515	8	1	8	5	This is a meta finding; better focus on substance: Move this text to a subparagraph and replace by the statement in HS4.4: "Improved knowledge of climate feedbacks, past climate states and the observed energy gain have led to a reduction in uncertainty in equilibrium climate sensitivity; with an assessed likely range of 2.5°C to 4°C compared to the AR5 likely range of 1.5°C to 4.5°C." . The fact that the likely range of the climate sensitivity has decreased (especially the change of the lower end) is of utter importance and will raise a lot of (media) attention. [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
2943	8	1	8	5	One of iimportant scientific advances since AR5 includes a better understanding of the Water Cycle response to aerosol and GHG change as stated in TS (TS-9 lines 12-18). It would be great if HS.4 also include this aspect. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
8153	8	1	8	5	The heading text is likely a statement of fact based on research since the AR5 but its purpose is not clear. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8155	8	1	8	5	The text should be clear that the "GHG increases" are increased GHG concentrations in the atmosphere otherwise feedbacks may be misused here? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]

Comment ID	From Page	From Line	To Page	To Line	Comment
8157	8	1	8	5	The observed energy increase needs to be explained. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
4349	8	1	8	5	It would be useful if the statement here also said something about how much the system responds, not just that the understanding of this has increased. For example, reference could be made of the narrower estimate of the ECS. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
8911	8	1	8	37	The HS.4 summary should include an explicit, high-level statement about the possibility of abrupt changes and climate change tipping points. The summary gives the impression that a linear, gradual perspective on climate response is taken here. However, the most damaging climate change impacts on society are those associated with a tipping point (or catastrophic change). Given the chaotic dynamics of the climate system, the climate change tipping points must exist somewhere, and anthropogenic forcing, if unabated, has the potential to push them across the threshold. This SPM should include a statement that gives consideration to the probability of tipping points, referring to the underlying material in Box TS.9. [Government of United States of America, U.S. Department of State]
2309	8	2	8	2	Concerning the term "impact drivers", we fear that there might be a risk of confusion in the vocabulary with climatic impact drivers. Furthermore, the definition in footnote 11 could be clearer and less generic . We could understand that a change in water vapor would be "climate driver" for example. [Government of France, Ministère de la Transition écologique et solidaire]
6435	8	2	8	2	Insert „since the AR5“ after „has been strengthened“ [Government of Austria, Federal Ministry of Agriculture, Forestry]
6629	8	2	8	2	Consider another (more scientific) word for 'increases', i.e. emissions, uptake, accumulation, etc. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
3689	8	2	8	3	Add "past climate states" in HS.4: ...improved quantification of climate drivers, past climate states, feedbacks, and the observed energy increase… [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
2311	8	3	8	3	We recommend to change the word "increase" (which might be understood as if energy was not conserved in the climate system). by "accumulation" (which is maybe more suggestive of a transient effect that will disappear after some time) [Government of France, Ministère de la Transition écologique et solidaire]
2313	8	3	8	3	Concerning the term "feedabck", we find that there is a lack of mention of climate feedbacks. The largest positive feedback, the water vapour feedback, is not mentionned, nor the cloud feedback, the most uncertain. The words "water vapour" and "clouds" are totally absent from this summary. This is very disturbing for an assessment of the physical understanding of climate change, even if it is dedicated to policy makers. [Government of France, Ministère de la Transition écologique et solidaire]
8475	8	7	8	7	Suggest clarification: ‘Since 1750 ..' could include a parenthetical phrase to note this is a different baseline year than the 1850-1900 baseline period adopted to represent global 'preindustrial' average temperature. [Government of Australia, Department of Industry, Science, Energy and Resources]
4903	8	7	8	7	Footnote 11 seems to be incomplete, please revise. Perhaps "... of the climate system..."? [Government of Norway, Norwegian Environment Agency]
2349	8	7	8	7	Concerning the footnote 11 : The expression "agent or process climate system" is very unclear. We recommend to provide in the footnote a clearer definition with a full list of these drivers or a reference to the panel b) of Figure SPM.9 [Government of France, Ministère de la Transition écologique et solidaire]

Comment ID	From Page	From Line	To Page	To Line	Comment
2669	8	7	8	7	Footnote 11: this definition of climate driver is very unclear and awkward to read. Also, climate driver does not appear in the WGI glossary. Climate impact-driver does, but that is defined differently than climate driver is here. Given that on page SPM-1 there is a footnote defining "human influence on the climate system", can that phrase be used here instead? That is, "Since 1750, changes in human influence on the climate system have been dominated by....etc.". [Government of Canada, Environment and Climate Change Canada]
7859	8	7	8	7	Write: "An agent or process OF THE climate system …" [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
6081	8	7	8	7	Footnote 11: “An agent or process climate system that influences a component of a human or natural system.” Is this sentence correct? You may want to add "in the" before "climate system". [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
8913	8	7	8	7	Again, why a specific year like 1750? Perhaps use "early to mid-1700s" instead or, at minimum, "roughly 1750"? [Government of United States of America, U.S. Department of State]
2315	8	7	8	8	concerning the term "increasing greenhouse gas concentration" , it might be better to be explicit: "increasing GHGs atmospheric concentrations" [Government of France, Ministère de la Transition écologique et solidaire]
4901	8	7	8	8	When mentioning "the accumulation of energy in the climate system", please consider adding "which causes warming", to help the reader connect "accumulation of energy" and global warming. [Government of Norway, Norwegian Environment Agency]
6631	8	7	8	8	"climate driver": The explanation in footnote 11 is similar (but not identical) to the definition of "climatic impact-driver" in the Glossary. However, the use in this sentence appears to relate to climate forcers, rather than impact-drivers. "Climate driver" is not defined in the Glossary. Please clarify. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
2317	8	7	8	11	We find this paragraph in general to be quite difficult to understand. One of the reasons is probably the mixing of what concerns the energy balance at the surface and the evolution of the energy content of the planet. They are related, but only partially. The use of the terms energy gain or energy increase mixes forcing and response. We would really recommend here to use the wording 'accumulation of heat' or at least 'accumulation of energy - mostly in the form of heat' - but it seems that there had been a discussions / agreement between authors, and it would be interesting to understand why, and maybe clarify it here. Furthermore, it mainly led to an increase of the surface temperature. Mentioning only the accumulated energy gives the false impression that the accumulation of energy is controlling the amplitude of the warming when it affects the rate of warming. [Government of France, Ministère de la Transition écologique et solidaire]
4049	8	7	8	11	The physical quantities are different between the text in lines 7-11 and Figure SPM.2. The text is “a rate of energy increase in 2019 relative to 1750, W/m2”, while Figure is “observed warming in 2010-2019 relative to 1850-1900, degree of Celsius”. It might be easier to understand if some explanations about the relationship between these quantities are inserted. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
8915	8	7	8	11	H.S.4.1 uses "energy accumulation", "energy increase", and "energy gain". Somebody must have had their thesaurus handy. Provide an estimate for energy gain. Authors contend it is less but there is no quantitative estimate. [Government of United States of America, U.S. Department of State]
7061	8	7	8	12	What about the back casting of models for projections of surface warming, ocean warming and sea level rise in previoius ceturies and paleoclimate? [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]

Comment ID	From Page	From Line	To Page	To Line	Comment
449	8	7	8	12	This text is not directly related to Figure SPM.2. Therefore, it is suggested to delete the reference to Figure SPM.2. [Government of China, China Meteorological Administration]
8917	8	7	8	12	Is the change in the rate of energy increase from AR5 to now due to advances in methods or due to an accelerating rate? This could be noted in a footnote. [Government of United States of America, U.S. Department of State]
8919	8	7	8	12	How relevant is a single year (2019) for EEI? Shouldn't this be a rate over at least a decade, if not longer? In H.S.4.2, the longer-term net increase is only 0.6 W/m^2. What is the significance of 2019 (versus, for example, a 'cooling' year)? If this is a snapshot to compare to 2011 (AR5), then indicate such. [Government of United States of America, U.S. Department of State]
6633	8	7	8	12	This is a good statement on the effects of greenhouse gas concentrations on the global heat balance. Still missing is a statement that clarifies our detailed understanding of SLCFs and their multiple feedbacks. Such a statement should be added after H.S.4.1, and refer to sections 6.4 and 7.3. Text suggestion: "Understanding of the influence of atmospheric trace constituents, the short-lived climate forcers (SLCF), has been improved. Contributing to surface cooling, their influence has been decreasing since the 1970s. Also climate feedbacks induced by SLCF with natural processes and atmsopheric chemistry is considered in total a negative feedback parameter, leading to cooling (low confidence). While the aerosol-cloud interactions still are scientifically challenging, also here negative effective radiative forcing was confirmed such that the negative effective radiative forcing of aerosol in total can be considered virtually certain. " Statements and qualifiers taken from Exec. summaries of Ch. 6&7. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
8159	8	7	8	13	A lot of material has been compressed in a not very transparent manner. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8161	8	7	8	13	This paragraph is very unclear. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8163	8	7	8	13	The reason to use 1750 as base year needs to clear? For policy a later period is used. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8165	8	7	8	13	Can the statement be made with high confidence for the period since 1750? Perhaps uses clearer wording. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
6635	8	7	8	17	It would be useful for these paragraphs to clarify whether readers can simply understand "energy gain" as "heat" or "warming". Is it possible to express a 20% energy gain in everyday terms? In lines 16-18 for example, the NASA website says "More than 90 percent of the warming that happened on Earth between 1971-2010 occurred in the ocean". This kind of phrasing is easier to follow than the existing formulation which refers to "90% of energy gain". [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
4649	8	7	8	18	Between HS4.1 and HS4.2 it is not clear what the figures quoted actually represent. By "rate of energy increase" do you mean "effective radiative forcing? If the 2.72 W m-2 value corresponds to effective radiative forcing, this is a well established concept from previous reports, and it would be helpful to note this in brackets after the value. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
6485	8	7	8	18	The two bullet points H.S.4.1 and H.S.4.2 are very difficult to read and to understand. [Government of Austria, Federal Ministry of Agriculture, Forestry]

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8473	8	7			Suggest clarifying note 11: 'agent or process of the climate system'. Please describe 'agent' and a 'process'. [Government of Australia, Department of Industry, Science, Energy and Resources]
6083	8	8	8	10	Please clarify whether the increase is larger, or its rate. In addition, is this huge increase in the past 10 years due to a methodological improvement or is it due to enhanced energy increase? Or both? Please clarify, also explaining the relation to increases in radiative forcing. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
8167	8	8	8	10	Why is it 20% larger than in 2011? A RF figure would be useful here. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
4905	8	8	8	16	Please consider to relate the energy increase of 2.72 W/m2 to the radiative forcing levels used in the emission scenarios (e.g. 1.9, 2.6, etc.) that also are expressed in W/m2. For us it is currently somewhat unclear how these numbers align, e.g. is the radiative forcing from the scenarios only refering to contribution from CO2 emissions (and if so what about uptake), how is changes in the longwave radiation from Earth covered both with respect to the energy increase and in the scenario descriptions covered and energy changes from warming and cooling agents (GHG and aerosols) and natural vs. human-caused. Throughtout the SPM it is now used energy increase, energy gain, energy balance and forcing, and it would be benefitial if similar terms are used consistently. We would prefer "energy increase" instead of "energy gain". [Government of Norway, Norwegian Environment Agency]
8477	8	8			Suggest including an explanation of how energy is accumulated in the climate system due to greenhouse gases concentrations increasing. [Government of Australia, Department of Industry, Science, Energy and Resources]
4353	8	9	8	9	The superscript 12 is confusing, at first read it risks mistaking for power (raised to). Although the metric considered quickly reveals that it indeed is a superscript (from the order of magnitude), perhaps it could be placed somewhere else? [Government of Sweden, Swedish Meteorological and Hydrological Institute]
2319	8	9	8	9	medium confidence is indicated in TS 2.2, l.11, we recommend to clarify this point [Government of France, Ministère de la Transition écologique et solidaire]
2323	8	9	8	9	concerning "a rate of energy increase" : If this is scientifically supported, we recommend to replace "the rate of energy increase" by "the level of energy forcing" as this is what is illustrated by the number 2.72 W/m² [Government of France, Ministère de la Transition écologique et solidaire]
8481	8	9	8	9	Please clarify that this is effective radiative forcing. Using a descriptive term here hinders understanding, especially of comparison with earlier reports. If necessary, expand the explanation in the footnote. As it stands, the "rate of energy increase" in this statement is easily confused with the "rate of energy gain" in H.S.4.2 [Government of Australia, Department of Industry, Science, Energy and Resources]
4907	8	9	8	9	Please consider moving footnote 12 to appear following "combined effect" or "energy increase" to reduce misunderstandings, currently it seems to belong to the number 2.72 (i.e. that it should be read 2.72^12) [Government of Norway, Norwegian Environment Agency]
451	8	9	8	9	The phrase "a rate of energy increase" is difficult for policymakers and general readers to read, and it is suggested to replace it by "radiative forcing". [Government of China, China Meteorological Administration]
4351	8	9	8	9	Could clarify better that this refers to per year (for 2019). [Government of Sweden, Swedish Meteorological and Hydrological Institute]

Comment ID	From Page	From Line	To Page	To Line	Comment
2321	8	9	8	10	concerning the sentence "that is 20% larger than the value for 2011 assesd by AR5" we recommand to clarify this sentence as it can be confusing. Does the 20% increase in the rate of energy increase between 2019 and 2011 correspond to a real increase in radiative forcing, or is it partly the result of a change in the methodology used ? Please clarify if it is revised upwards or if the increase of energy is because of different time period. Maybe the value from AR5 could be replaced here [Government of France, Ministère de la Transition écologique et solidaire]
8479	8	9	8	10	Suggest clarification: "…a rate of energy increase … that is 20% larger than the value for 2011 assessed by AR5." This risks being misread as saying there was a 20% rise in energy imbalance between 2011 and 2019. However the energy gain from 1750 to 2019 has been revised and re-assessed as 20% larger than that previously assessed for 1750 to 2011 by AR5. The chapter text finds that the 20% arises from 'upwards revisions of [GHGs'] radiative efficiencies and a 22 +0.10 W m-2 from re-evaluation of the ozone and stratospheric water vapour ERF". [Government of Australia, Department of Industry, Science, Energy and Resources]
6637	8	9	8	11	2.72^12 can be read as to the power. Sentence on NET climate system energy gain, is somewhat redudant [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6503	8	9	8	16	In H.S.4.1 the values of the rate of energy exhibit the confidence level (high confidence). But in H.S.4.2 the values of the average rate of energy does not show the confidence level. [Government of Chile, Ministry of Environment]
6639	8	9			It is unclear if "high confidence" really refers to a value provided with uncertainty bands, or rather to the 20% difference to AR5 results. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
8921	8	10	8	10	Explain the cause: (i) a change in understanding/data of the greenhouse gas RFs; or (ii) more simply that GHGs have increased over that period? In past assessments, both reasons have been provided. Include the AR5 (2011) rate. [Government of United States of America, U.S. Department of State]
8923	8	10	8	10	Change to either "climate system's energy" or "energy gain in the climate system" [Government of United States of America, U.S. Department of State]
3343	8	10	8	11	There is no confidence statement. [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
2325	8	10	8	11	We suggest to merge this last sentence with the beginning of the sentence of the H.S 4.2.As it is it could be confusing. Also, it does not only concern the energy gain, but also the surface temperature increase. Finally we suggest to change "more ernergy" to "more infrared radiation to space" [since this sentence is meant to explain things physically, it could be more specific] [Government of France, Ministère de la Transition écologique et solidaire]
2945	8	10	8	11	Why is this sentence necessary for policy makers? I think it should be considered whether this information would be helpful or necessary to readers. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
7821	8	10	8	11	Consider moving the last sentence from H.S.4.1 to H.S.4.2 [Government of Poland, Ministry of Environment, Department of Air Protection and Climate]
8359	8	10	8	11	The last sentence sounds too much technical and should be either rephrased or omitted [Government of Ukraine, Director Ukrainian Hydrometeorological Institute]
8483	8	10	8	12	Suggest rephrasing, as this may be hard to understand for many readers. Instead: "The climate system *net* energy gain is less than that associated directly with climate drivers because as the Earth warms it emits more energy to space, *and this partly offsets the gain from climate drivers.*" [or similar] [Government of Australia, Department of Industry, Science, Energy and Resources]
2671	8	10	8	12	1. Figure SPM.2 does not help clarify the conclusions of this paragraph (doesn't provide information on changes in energy in the climate system) and so we suggest it may misdirect readers to refer to it here. Figure TS.9 would be helpful to refer to. 2. Since the information about the energy gain in the climate system is provided in the next paragraph, we suggest lines 10-11 are moved down to be part of that paragraph. [Government of Canada, Environment and Climate Change Canada]

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453	8	10	8	12	It is suggested to delete the sentence "The climate system energy gain is less than that associated directly with climate drivers because as the Earth warms it emits more energy to space". Because it is generally difficult for policymakers and readers to understand the principle of the radiative balance of the climate system, and this statement instead creates new confusion for them. [Government of China, China Meteorological Administration]
8169	8	10	8	12	Is the Earth radiant energy not being trapped by GHG? It is not clear what message is being provided? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
6641	8	10	8	12	The sentence "The climate system energy gain is less than that associated directly with climate drivers because as the Earth warms it emits more energy to space." should be moved at the beginning of the next paragraph, where it is more consistent. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6643	8	11	8	12	Nothing in the statement refers to Chapter 6 - it is suggested to delete the references. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6479	8	12	8	13	Here, a reference is made to Fig SPM2 but that shows °C amounts while in H.S.4.1 we read only about Wm^-2. [Government of Austria, Federal Ministry of Agriculture, Forestry]
2327	8	14	8	14	A rate of energy gain is not easy to understand. Shouldn't the unit relate to a period of time? (W m-2 per year/decade/etc). The term energy imbalance used in TS p56 l1-2 sounds clearer. It could also be reformulated as "..the climate system gained energy at a rate of 0.57 W/m2 [ ] on average, with a higher rate.." if the term rate is appropriate [Government of France, Ministère de la Transition écologique et solidaire]
4051	8	14	8	14	TS 3.1 uses the word "earth system" instead of "climate system" here. It is better to define the usage of these words and use consistently. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
6645	8	14	8	15	Suggest to use the term *net* energy gain. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
7717	8	14	8	16	What is the relevance of the comparison between 'the average rate of energy gain in the climate system' and ''the rate of global primary energy consumption' ? What is the correlation between the two, if any? [Government of India, Ministry of Environment, Forests and Climate Change]
7555	8	14	8	16	Unclear what the comparison between the average energy gain from 2006-2018 and the rate of global primary energy consumption in 2018 is meant to illustrate; needs to be elaborated on. [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
4253	8	14	8	16	Consider to re-write this para, as it uses two different time range (i.e. 1971–2018 and 2006 – 2018). [Government of Indonesia, Ministry of Environment and Forestry Indonesia]
6087	8	14	8	16	We appreciate the idea to contextualize this number, but the comparison with global primary energy consumption seems a bit arbitrary in the current formulation. Please explain that the information on energy consumption is given as an example, e.g. by writing "This value is equivalent to, for example, about 20 times ...". In addition, does the comparison refer to the first or to the second period for which energy gain is provided? [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
8925	8	14	8	16	How many policymakers are going to understand the difference between "average rate of energy gain in the climate system" and "the rate of global primary energy consumption". Need to include a footnote that provides clear definitions for the non-science expert. [Government of United States of America, U.S. Department of State]

Comment ID	From Page	From Line	To Page	To Line	Comment
8485	8	14	8	18	Suggest clarification: Please define the technical term 'Global primary energy consumption' as it could be confused e.g. with energy captured by primary productivity. Add a definition or describe the meaning. e.g. global *human* primary energy consumption. Also the rate of energy gain in the climate system (in Wm-2) is being compared to a rate of energy consumption that is usually expressed in TWh. Suggest give the TW or TWh conversion of the rate of energy gain and give the value of TWh global primary energy consumption in 2018, to make it more clear what is being done with this comparison. [Government of Australia, Department of Industry, Science, Energy and Resources]
6085	8	14	8	18	Please simplify the message by disassembling both sentences and separating the important but very dense information; e.g., "For the period 1971-2018, the average rate of energy gain in the climate system was 0.57 [0.43 to 0.72] W m-2. A higher rate of 0.79 [0.52 to 1.06] W m-2 was detected during 2006-2018 which is equivalent to about 20 times the rate of global primary energy consumption in 2018. Ocean warming accounts for about 90% of this energy gain. In contrast, land warming, melting of ice and atmospheric warming account for about 5%, 3% and 1%, respectively." [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
8171	8	14	8	18	Again confusion, why not include a figure showing a time series of radiative forcing by main GHGs? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8173	8	14	8	18	The point on energy consumption is not clear. Perhaps delete. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8175	8	14	8	18	The breakdown in energy uptake is very important and should be a unique bullet or figure. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
4053	8	15	8	16	It would be helpful to add reason for comparing the average rate of energy gain in the climate system with the rate of global primary energy consumption, because this sentence could be misunderstanding for policy makers. Detailed explanations are not found in the underlying chapters. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
6647	8	15	8	16	It is not clear what the comparison of the energy gained by the climate system with the average anthropic energy consumption could suggest. These are two completely different processes, hard to be compared each other and with very different consequences. It could leave non-expert readers with the feeling that the "natural part" is much larger than the human-induced part of climate change. Suggest to delete. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
8927	8	15	8	18	Change "2006-2018 that is equivalent" to "2006-2018. This rate is equivalent". Recommend removing "that is equivalent to about 20 times the rate of global primary energy consumption in 2018". Seems out of context and could be misinterpreted. If authors want to make a comparison to energy consumption, suggest making separate sentence with clearer context at the end of the paragraph. When summing up the percentages showing where the excess energy has gone, one gets 99, not 100%. There should be uncertainties associated with each number. [Government of United States of America, U.S. Department of State]
7237	8	15	8	27	[Chapter 6] Many COVID-19 analysis for the air quality was so simple, not to consider the other effects (e.g., meteorology, climate variability, etc). This inaccuracy of previous work should be more considered for more accurate evaluation of COVID-19 effect to the air quality and the variation of SLCF. I recommend to add a sentence related to this idea. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]

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2329	8	16	8	16	Concerning "global primary energy consumption" Should the reader appreciate the meaning of this comparison? If energy consumption is to be compared to anything, it is more to anthropogenic forcing than to the energy stored by th Earth system. Also, in the TS.3.1 section, there is no reference to the type of energy consumption (primary, final). In the SPM, "primary energy consumption" is mentioned, which is then not fully consistent with the TS. Also the value of the primary energy consumption in 2018 could be given. [Government of France, Ministère de la Transition écologique et solidaire]
8487	8	16	8	16	Suggest rephrasing: unclear what is mean by 'global primary energy consumption'. [Government of Australia, Department of Industry, Science, Energy and Resources]
2947	8	16	8	16	"more than 90%" is more appropriate than "about 90%" as expressed in TS.3.1, because the sum of all doesn't equal to 100%. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
2331	8	16	8	17	Concerning the sentence "Ocean warming …" We suggest to clarify this sentence as it seems that it is not ocean warming which 'contributes to the energy gain', it is the imbalance at the top of the atmosphere, which in turn - if positive - leads to an accumulation of heat in the Earth system, and this in turn is 'stored' in the ocean, ... , and this storage in turn leads to ocean warming, cryosphere loss, atmosphere warming, land warming - with in turn known (observed) consequences for change (sea level rise, ...). This is a very critical 'concept', and somehow incorrect with the sentences as it is stated here. [Government of France, Ministère de la Transition écologique et solidaire]
2923	8	16	8	18	specify "ANNUAL global primary energy consumption in 2018" [Government of Chile, Ministry of Environment]
4055	8	16	8	18	In H.S.4.2, The sum of contributions of the different components to the global energy gain does not match 100% (90%, 5%, 3% and 1%). We suggest describing the contribution of ocean warming as 91% in line with the original data of this summary shown in table 7.1 chapter 7. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
2333	8	20	8	21	Firstly, we would suggest to delete this sentence from the paragraph and move it into the subsection explaining the theme "the current state of climate". If this part stays here, we suggest to complement "process of global sea" with "the processes that contribute to global sea level rise". We also wonder if it is a processes or factor contributing to ? Processes sounds good if the processes leading to mass loss for example are better understood. Factors would be better if it refers to the different contributions listed in next sentence. Finally we suggest to clarify what are the energy changes mentioned here [Government of France, Ministère de la Transition écologique et solidaire]
8929	8	20	8	21	This sentence needs work. Have the processes been consistent since the 20th century, or is understanding to the relative contributions of processes been consistent? Also, assessed energy changes is an odd way to describe the contribution of thermal expansion to sea level rise. [Government of United States of America, U.S. Department of State]
329	8	20	8	23	The -8% for "changes in land water storage" seem confusing. Does it mean that this storage compartment has increased? Please clarify. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
6089	8	20	8	23	What does "-8%" of the observed sea level rise for "changes in land water storage" mean? Please explain. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
4653	8	20	8	25	The paragraph mentions "ocean warming" but is it clear that this refers to the thermal expansion contribution to sea level rise? Could "ocean warming" be changed to "ocean warming/thermal expansion"? [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]

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331	8	20	8	25	Please add that sea level rise is accelerating in the last few decades as done in SROCC as well as in Chapter 9 of the present report. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
6649	8	20	8	25	Explain how this modifies the findings of the SROCC. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6091	8	21	8	22	Please add here some words to address the accelerating and dynamic increase of SLR, which is very relevant for policymakers, as found in the ES of Ch 9 [p:9-8;l:32-36]: "...GMSL rose faster in the 20th century than in any prior century over the last three millennia (high confidence). It has accelerated since the late 1960s, with an average rate of 2.3 [1.6-3.1]mm/y over the period 1971-2018 increasing to 3.7 [3.2-4.2]mm/y over the period 2006-2018 (high confidence)." [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
8489	8	21	8	23	Suggest rephrasing, a negative percentage contribution is not meaningful. [Government of Australia, Department of Industry, Science, Energy and Resources]
269	8	21		23	In the finding starting with "For the period 1901–2018, glacier mass loss accounts for about 41% of the observed sea level rise, with ocean warming, ice sheet mass loss and changes in land water storage accounting for about 38%, 29% and -8%, respectively." there is no mention of the level of confidence of the finding wherase findings in which are mentioned in the SPM should have the level of confidence of the finding. Hence, the level of confidence should be added. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
2335	8	22	8	22	We would suggest to add a footnote that would precise the distinction between ice sheets and glaciers. [Government of France, Ministère de la Transition écologique et solidaire]
8931	8	22	8	22	Replace "accounts" with "accounted". Past tense should be used throughout for historical data. [Government of United States of America, U.S. Department of State]
8933	8	22	8	23	If the word "about" is to precede the numbers, it is strange to report them to two significant digits. The numbers over these two lines should be 40%, 40%, 30%, and -10% if using that construct. A possible fix would be to replace 'about' with 'approximately'. [Government of United States of America, U.S. Department of State]
6651	8	23	8	23	The -8% contribution of "land water storage" (implying an increase of liquid water on land) would benefit from an explanation, given the apparent trend towards losses of fresh water bodies (including major lakes), wetlands as well as many aquifers. It would be useful to mention where the increase of land water comes from (melting permafrost/glaciers?). [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
2337	8	24	8	24	A reader could be surprised that a 10yr period (2010-2019) is compared to a 8yr period (1992-1999). One guesses that this choice of an 8-yr reference period was made to get a factor 4 exactly for the ice sheet mass loss but this should be changed if that was not the intention. [Government of France, Ministère de la Transition écologique et solidaire]
4655	8	24	8	24	"Four times" appears without any uncertainty quantification. Would it be more appropriate to say "about four times"? [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
3039	8	24	8	24	It will be better to show respective values for the Greenland and Antarctic Ice sheet, separately. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
2667	8	24	8	25	Is this statement referring to the total ice loss from both ice sheets that occurred during these two periods rather than the rate of ice loss. If values in Table 9.SM1 (9.A.1 seems to be incorrect ref) are used the 2010-19 total mass loss (GT) is over 5 times greater than 1992-1999. However the rate of loss (GT/y) is approximately 4 times larger. Some clarification is probably required, i.e. refer to rate of mass loss being 4 times larger in the more recent period. [Government of Canada, Environment and Climate Change Canada]

Comment ID	From Page	From Line	To Page	To Line	Comment
6093	8	24	8	25	This sentence gives an easy to read number: Mass loss four times larger now than before (good to be picked up by policymakers). The message may gain more attention, if there was an absolute number (in Gt) added for one of the dates. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
8935	8	24	8	25	Chapter 2 states that there is only medium confidence that the AIS mass loss rate has increased. Since these are different period rates, the calculation (four times larger) should be phrased in terms of the mass loss rate rather than the total mass loss. Section 9.4.2.1 states: "The mass-loss rate was on average 49 Gt yr-1 over the period 1992-1999, ... and 148 Gt yr-1 over the period 2010-2016 ... However, recent work suggests that the mass loss has not further increased since 2016 ..." So this contradicts the SPM statement. Reconcile the numbers presented in the SPM for Greenland and Antarctic ice mass loss with those in Chapter 2. Clarify whether or not 'four times larger' refers to each ice sheet separately, or only to their sum? [Government of United States of America, U.S. Department of State]
8937	8	24	8	25	"… mass loss ANNUAL RATE was four times ..." Authors are comparing two different length periods, so the 10-year period should have greater total mass loss. Change 'mass loss' to 'annual mass loss rate'. [Government of United States of America, U.S. Department of State]
6653	8	24	8	25	Tthat the lack of dedicated discussion on ice sheet tipping points is a major shortcoming of section HS.12 [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
2339	8	25	8	25	Table 9.A.1 could not be found and we believe it is actually Table 9.SM.1: Observed mass loss of Greenland (The IMBIE Team, 2020, 2021) and Antarctic (The IMBIE Team et al., 2018, 2021) ice sheets for three different periods. Values are expressed as the total loss over each period (Gt) along with the equivalent rate (Gt yr-1) and very likely ranges. Periods include both end years. The cumulative mass loss uncertainty from IMBIE is assumed to be zero at the start of each period. [Government of France, Ministère de la Transition écologique et solidaire]
8939	8	25	8	25	Opening bracket before "2.3" should be curly bracket ({) rather than open parenthesis -- i.e., it should be "{2.3, 9.2, ..." [Government of United States of America, U.S. Department of State]
4057	8	27	8	27	It seems to be reader-friendly to insert "in the Earth system" after "observed energy gain", as mentioned in TS (p.8) [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
6655	8	27	8	28	reduction in uncertainty of estimates of cimate sensitivity': It is a bit complicated for a policy maker to understand why a very likely range is larger than a likely range or why it matters. Needs to be clarified. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]

Comment ID	From Page	From Line	To Page	To Line	Comment
2341	8	27	8	29	This statement is true, but will be very misleading if it is not accompanied by some additional information saying that this significant reduction in uncertainty in climate sensitivity does not come from a reduction in the spread of ECS among CMIP models: on the contrary, CMIP6 models exhibit the largest ECS spread than ever, and cloud feedbacks remain the primary cause for this large spread. The narrowing of the assessed range of ECS comes from other lines of evidence (observations, process studies, proxies, etc), as discussed in Sherwood et al. 2020 and in chapter 7. If it is not mentioned explicitely, most readers of the SPM will think that climate models now agree much more than in the past regarding ECS estimates. It will be very misleading, and also confusing given that a lot of communication has already been made about the ECS estimates of CMIP6 models (eg Meehl et al. 2020, Real climate blog, Carbon brief, and much more). It might be argued that regarding climate policy, the most relevant information is the assessed range of ECS and not how it has been obtained. Nevertheless, I would argue that the SPM does need to be clear about the fact that this narrowing does not come from a better consensus of the current generation of models because: 1) ECS has always played (and keeps playing) an important role in climate change research and has always received a great attention in every IPCC report so far; we can thus expect a wide range of readers to consider this issue carefully, 2) the significant narrowing of the assessed range of ECS (for the first time in four decades!) is one of the most novel results of the AR6, 3) this range has been assessed using a different methodology (Stevens et al. 2016, Sherwood et al. 2020) than in the past. If the AR6 compares its assessed range with that of the AR5 (line 29), it should also be clear about the fact that the methodology of the assessment is based on more lines of evidence than in previous reports, and that the narrowing occurs despite the larger range of CMIP6 model estimates. [Government of France, Ministère de la Transition écologique et solidaire]
8361	8	27	8	29	Two indicated ranges could be mixed as it is written. We propose "the AR5 likely range of 1.5°C to 4.5°C" to move to the footnote and to have: "a reduction in uncertainty in equilibrium climate sensitivity compared to AR5(footnote), with an assessed likely range from 2.5°C to 4°C." [Government of Ukraine, Director Ukrainian Hydrometeorological Institute]
4059	8	27	8	30	It seems better to use the term of “the best estimate” instead of “a central estimate” as shown in TS or Chapter 7. Furthermore, it would be better to describe the new estimation of TCR, too, 1.4 to 2.2 C with the best estimate of 1.8 C, comparing to the AR5 likely range of 1 to 2.5 C. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
2343	8	27	8	31	We suggest to also assess TCR as was done previously. Two paragraphs could be separated, one for the ECS and one for the TCR [Government of France, Ministère de la Transition écologique et solidaire]
4657	8	27	8	31	HS.4.4 in the SPM provides likely and very likely ranges for the equilibrium climate sensitivity. However the confidence levels of the various bounds provided here are not stated. Confidence levels are given for various other ranges in the SPM and so should be given for the equilibrium climate sensitivity too. In particular, the technical summary provides confidence levels for the equilibrium climate sensitivity, stating on page TS-58 line 23-25 that "... it is not possible to rule out ECS values above 5°C. Therefore, the 5°C upper end of the very likely range is assessed with medium confidence and the other bounds with high confidence." We think this is an important point that should be emphasised in the SPM too, i.e. that we have high confidence in the lower bound of equilibrium climate sensitivity but only medium confidence in upper bound. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
7497	8	27	8	31	This statement is quite sensational and will probably achieve major media attention (especially the finding that climate sensitivity below 2.5 degrees has become less likely for the first time in 40 years). It should be more explicitly included in the main statement HS.4 (i.e. that the uncertainty of the climate sensitivity has decreased). Also, a few more words could be spent on the reasons why it has changed (for example: what feedbacks are better understood?) [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]

Comment ID	From Page	From Line	To Page	To Line	Comment
8177	8	27	8	31	The Climate Sensitivity is very important both equilibrium and transient and information on how this differs from AR5 is also needed, this is not clear how this is address here while the transient sensitivity is highlighted later, including both here would be useful. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8179	8	27	8	31	Can information on the Transient Climate Sensitivity be included here as well? This is important for policy and mentioned later in the SPM. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8181	8	27	8	31	Can a clear statement on the timescales for reaching Equilibrium Climate warming be included? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
6657	8	27	8	33	Clarify the meaning of "assessed" in instances like "with an assessed likely range". What is the added value compared to "with a likely range"? Does it mean that other estimates exist but are outside of this assessment? Or that other estimates exist but they do not result from an assessment? [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6095	8	27	8	35	_Clarifying the assessment of the ECS: Please clarify what "constraining with multiple lines of evidence" means, and that this procedure results in the "assessed range". This issue is of high policy relevance, and there was some media coverage on higher ECS values from CMIP6. Therefore, a clear explanation is required. Please explain as well which scientific improvements are achieved by the models with the very high ECS values (e.g., how much better they reproduce aerosol-cloud interactions etc.) and that on the other side, the TCRE values of all models show a much smaller spread than the ECS. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
7745	8	27	8	37	H.S.4.4 and 4.5 could be moved to the next chapter (possible future climate) as it is about the climate model sensitivity. [Government of Hungary, Ministry of Innovation and Technology - Climate Policy Department]
2673	8	27	8	37	If we read this paragraph and the next one correctly, the stated assessed Equilibrium Climate Sensitivity (ECS) range of 2.5C to 4C on lines 28-29 is based on multiple lines of evidence (as explained on line 33). If so, we recommend the phrase "based on multiple lines of evidence" be added to line 29 after the phrase "with an assessed likely range of 2.5C to 4C, based on multiple lines of evidence." Otherwise, we were unclear at first whether the para beginning on line 33 was introducing a new assessed value for ECS or referring to that in the previous paragraph. [Government of Canada, Environment and Climate Change Canada]

Comment ID	From Page	From Line	To Page	To Line	Comment
8941	8	27	8	37	Recommend to switch the order of H.S.4.4 and H.S.4.5 and combine their contents into a single headline statement. With these revisions, the statement opens with the most important context for policymakers to understand the AR6 ECS assessment given widely publicized increases from some climate models (namely, it is not just based on the models). It then summarizes the most salient advance since AR5 qualitatively (a narrowing of uncertainty), and it finally closes with the most important takeaway for policymakers (i.e., the ECS assessment itself in quantitative terms). Omitting the remainder of H.S.4.5 avoids unnecessary commentary on the assessment process. A focus on the process at this highest level risks drawing attention and confidence away from the key results, especially when delivered on an equal footing and after those results are provided. The new combined H.S would thus be: "H.S.4.4: The assessed range of equilibrium climate sensitivity and future warming from multiple lines of evidence are narrower and have lower mean values than the ensemble of the latest generation of climate models. Improved knowledge of climate feedbacks, past climate states, and the observed energy gain independent of the CMIP ensembles have led to a reduction in uncertainty in equilibrium climate sensitivity^13. The AR6 assessed likely range of equilibrium climate sensitivity is 2.5 to 4°C (compared to the AR5 likely range of 1.5 to 4.5°C), the very likely range is 2 to 5°C, and the best estimate is 3°C. {7.1, 7.2, 7.3, 7.4, 7.5, Box 7.1, Box 7.2} [TS.3.2]" [Government of United States of America, U.S. Department of State]
6659	8	28	8	28	The footnote should not simply repeat the scientific definition of ECS as per the glossary, but provide a more contextual explanation for non-experts of why it is important. In particular, the reference to doubling of concentration is not helpful in a communications product. Non-expert readers are often confused by this, imagining that doubling is part of plausible 'BAU' scenario projection. Possible alternative footnote language "ECS is one of the most of important relationships in climate science since it informs us how temperatures respond to CO2 emissions". [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
4909	8	28	8	28	Rather than using the term 'reduction in uncertainty...', please consider using 'improved confidence in...'. Although the two strictly say the same thing, they do carry different associations. The former can be construed as that we are very uncertain in a way that is not justified. [Government of Norway, Norwegian Environment Agency]
7809	8	28	8	28	note 13: The equilibrium (steady state) change in the surface temperature following a doubling of the atmospheric CO2 concentration from pre-industrial conditions. - it should be indicated specifically before which year: 1750 or 1850 [Government of Poland, Ministry of Environment, Department of Air Protection and Climate]
55	8	30	8	30	Suggest to reflect the figure from Sherwood et al., 2020, which had reported a very likely (5-95%) range of 2.3-4.7 K. [Government of Singapore, Ministry of Environment and Natural Resources]
2989	8	30	8	30	Clarify "central estimate" is "mean" or "median" [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
4061	8	30	8	30	In TS or Chapter 7, the word "best estimate of ECS" is used instead of "central estimate of ECS" that is used in SPM. To avoid confusion, it seems better to use the same term throughout the report. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
2567	8	33	8	33	Concerning the term "narrower" we suggest to change it to "much narrower" while also, if possible, show previous and actual assessment to illustrate the progress [Government of France, Ministère de la Transition écologique et solidaire]
4067	8	33	8	33	To emphasize the difference in the way of quantify ECS between AR5 and AR6, it will be desirable to describe "multiple lines of evidence" in a little more detail, by adding "process-understanding, the instrumental record of warming, paleoclimate evidence, and emergence constraints" as mentioned in Chapter 7. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]

Comment ID	From Page	From Line	To Page	To Line	Comment
455	8	33	8	34	"The assessed range of equilibrium climate sensitivity from multiple lines of evidence is narrower and has a lower mean value than that of the latest generation of climate models." This sentence suggests that the CMIP6 model may be more climate sensitive, but in H.S.5.3, it is stated that the historical warming simulated by the CMIP6 model is higher than that of the CMIP5 and reached the threshold of 1.5 degrees earlier. Therefore, it is suggested to add an explanation as to why the CMIP6 model is more sensitive. [Government of China, China Meteorological Administration]
4063	8	33	8	34	This statement indicates that the latest generation climate models tend to overestimate the climate sensitivity and, consequently, also the actual warming. Then a natural question would be why simulation result in Figure SPM1b shown in brown agrees well with the observed time series. Explanation on this point would be desirable. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
6661	8	33	8	35	Check the underlying report. They should expand on this. Not just say that the multi-evidence is narrower than the models. Explain why this is so &/or why it is correct to use the multi-evidence range rather than the model range. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
4651	8	33	8	35	This sentence in isolation might lead the reader to wonder why we should trust these projections given that some of the models fail to replicate past warming. This in turn could undermine confidence in many of the conclusions of the SPM. Could a description be added to flesh out why this would not be the correct inference to draw? Additionally, for some aspects of the projections at least, one of the possible reasons why there is a mismatch between the models and historical warming (high ECS) is accounted for - i.e. they are constrained by observations (e.g. Tokarska et al - 4.3.4). It would be helpful if this could also be explained, to avoid further confusion. And additionally, if it could be explained which projections are constrained in this way and which are not (e.g. presumably the straight CMIP6 versions of the SSPs), this would be very useful. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
7517	8	33	8	35	Confusing text: better focus on ranges, rather than average values: "The assessed range of equilibrium climate sensitivity from multiple lines of evidence is narrower than that of the latest generation of climate models. This leads to an assessed range of future warming that is narrower than the spread of model projections." [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
6663	8	33	8	37	HS.4.5 assumes a lot of prior knowledge- e.g. reports that latest generation of climate models compute larger sensitivity, and that this was perceived as an additional risk. HS4.5 does not explain well why that tail risk is not taken into account, and which other information was considered stronger than the model results. While the 'consistent' projections is probably a good thing, the policy maker needs to know to what extent tail risks are still in the scenario and at what probability. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
3345	8	33	8	37	There is no confidence statement. [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
8491	8	33	8	37	Suggest rephrasing, as this section appears contradictory. It says the assessment of ECS, and thus of projected warming, has a narrower range and lower mean value than derived from models. Then it states this report presents projections "fully consistent" with the assessment of climate sensitivity. Readers may wonder if the projections are based on something other than those models. Suggest an introductory sentence or two such as "Equilibrium climate sensitivity assessed from multiple lines of evidence, provides the basis for an assessed range of future warming. Individual climate models also have intrinsic equilibrium sensitivity which, for the collection of latest generation of climate models has a higher mean value and larger spread than the latest assessment based on models as well as other lines of evidence. This leads to an assessed..." [Government of Australia, Department of Industry, Science, Energy and Resources]

Comment ID	From Page	From Line	To Page	To Line	Comment
4659	8	33	8	37	It would be useful to reorder this sentence to start with the key point, which is that the uncertainty in ECS has been reduced and then explain that the reasons for that, something along the lines of: "The uncertainty in ECS has been reduced to improved knowledge of climate feedbacks.... The assess likely range is ..." [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
1667	8	33	8	37	Narrowing equilibrium climate sensitivity is an exellent acheivement! Would it be user-friendly to add references to SPM figures which are affected by the new estimate of equilibrium climate sensitivity? [Government of Finland, Finnish Meteorological Institute (FMI)]
7063	8	33	8	37	what about the back casting of models for projections of surface warming, ocean warming and sea level rise in previoius ceturies and paleoclimate? [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]
4065	8	33	8	37	We understand that the assessed range of future warming is not only narrower but also lowered than the spread of model projections. This warming level difference is worth mentioned. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
8183	8	33	8	37	Can the SPM confirm that three separate lines of evidence were used to determine ECS as was the case for the AR5? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
4519	8	33	9	21	This part appears unnecessarily convoluted. On p. 8 it would seem to be alluded that climate models are not used for the projections in the report (as they have a wider ECS). On p. 9, it is stated that models are better than in AR5. Later in the report projections based on models are shown but it is not clearly stated how these were produced, what and when results might be adjusted for ECS. It should be explained somewhere that models are used to provide information about the global warming levels and their other uses in the report. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
2345	8	34	8	34	We suggest to add some information about the latest generation of climate models. It could be said that low-cloud feedbacks remain the primary source of spread in climate sensitivity among these models, and the latest models have a higher mean value largely because of a stronger positive low-cloud feedback. [Government of France, Ministère de la Transition écologique et
6097	8	34	8	34	For consistency reasons please clarify whether the terms "mean value" (used here), "central estimate" (e.g. used in line 30), "best estimate" (e.g. Ch 7, Section 7.5.5., page 7-111, line 44) and "central value" (e.g. Ch 7, Table 7.13) are meant interchangeably resp. synonymously. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
4355	8	35	8	37	The "A key advance… sensitivity." is not very useful here. The point to be made remains elusive as it relates more to the projections than climate sensitivity. Suggest moving it into the headline statement above, or consider as a candidate for deletion. Alternatively, it could perhaps be presented in conjunction with the projections (Box SPM.1, HS.5). [Government of Sweden, Swedish Meteorological and Hydrological Institute]
6665	8	35	8	37	As it is presented as a "key advance" it would seem useful to explain what is meant by "fully consistent" and and why it matters. Were earlier projections inconsistent with earlier assessments of ECS? [Philippe Tulkens, European Union (EU) - DG Research & Innovation]

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2347	8	35	8	37	We recommand to clarify the sentence starting with "A key advance in this report is ..." Most readers won't be aware that previous IPCC reports were not fully consistent. What could be clarified is : 1) which range of ECS is taken into account to assess the projections? (likely? very likely?) 2) is the assessment of climate sensitivity taken into account in every number, figure, table, informing on warming and SLR projections in the SPM? If yes, it should be made very clear in the caption of every paragraph/table/figure showing projections (because it is new compared to earlier assessments and, as it is said here, a key advance of this report). It would also help if it is clearly stated when it is not taken into account (for instance in the assessment of the projections of extreme events?), saying that these projections are estimated from CMIP6 models only. The SPM should be extremely clear about this, as it has important implications for risk assessments. [Government of France, Ministère de la Transition écologique et solidaire]
8493	8	35	8	37	Please clarify the basis of the assessment of climate sensitivity (eg add "… from observations") [Government of Australia, Department of Industry, Science, Energy and Resources]
4661	8	35	8	37	Here it is stated that the projections are made to be fully consistent with the assessed range of equilibrium climate sensitivity. Therefore, if we have high confidence in the lower bound of equilibrium climate sensitivity, but only medium confidence in upper bound (as per the discussion of ECS in the TS), then it follows that we only have medium confidence in the upper bound of our projections too. If this is so, it is an important point and should be stated here. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
6099	8	35	8	37	Please explain: How can the projections of physical properties (pure CMIP results) be consistent with an "assessed" range of ECS (i.e. constrained by other lines of evidence) when the mean ECS from CMIP6 is actually higher than the "assessed" one? [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
8185	8	35	8	37	How is this important? What is the confidence level? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
4663	8	37	8	37	"the assessment of climate sensitivity" is a bit ambiguous in this context. It is not necessarily immediately clear whether the report is referring to the model range of sensitivity or the formally assessed range, which excludes models. Please could this be clarified. This is particularly important as the reader is likely to be unsure whether, for example, projections of surface warming are impacted by the higher ECS in CMIP6. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
33	8	47	8	47	The footnote 11 is not clear. It is not clear when we say changes in climate drivers is an agent or process climate system that influences a component of human or natural system. [Government of United Republic of Tanzania, Tanzania Meteorological Authority (TMA)]
8943	8	47	8	47	Some words are missing from Footnote 11. Do authors mean "an agent or process OF THE climate system"? [Government of United States of America, U.S. Department of State]
57	8	48	8	48	Footnote '#11' missing the words 'of the' between 'process' and 'climate system' [Government of Singapore, Ministry of Environment and Natural Resources]
8495	8	70	8	70	Suggest additional information is added to note 13: For those not familiar with the assumptions of doubling CO2 emissions, can the estimated pre-industrial level be specified? [Government of Australia, Department of Industry, Science, Energy and Resources]
6339	9	0	10	0	Could scenario names be more descriptive? Current SSP followed by different combinations of numbers is not easily accessible for policymakers. [Government of Estonia, Estonian Meteorological & Hydrological Institute]

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7623	9	1	9	1	Replace "Our Possible Climate Futures" with the title "Some Potential Climate Scenarios". Explanation: The term "Our" is misplaced as it is the output of a few select scientists and it should have an objective label reflecting this and not a subjective one. The word "possible" will also create confusion since it suggests that all of the scenarios are within the realm of possibility which they are not, especially SSP5 and SSP3. Similarly futures is a stronger suggestion of what may really happen, rather than a modelling product which is what they are, and hence Scenarios is more appropriate. In fact this is the term used in the text immediately below. In the technical summary in section TS.1.3.1 it is stated clearly "These scenarios do not intend to match how events actually unfold in the future" [Government of India, Ministry of Environment, Forests and Climate Change]
8945	9	1	9	1	"Our" can be deleted. [Government of United States of America, U.S. Department of State]
8187	9	1	9	7	Possible futures should also include information on atmospheric concentrations being projected which impact on both climate and human health. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
2949	9	1	15	43	TS, underlying chapters and Annex IV have dedicated to explain and assess changes in important modes of variability. However, there is no mention regarding changes in important modes of variability in SPM. Inclusion of assessment of changes in modes of variability (especially ENSO) is highly recommended. [Government of Republic of Korea, Korea Meteorological Administration
7625	9	3	9	3	Replace "A core set of five new emissions scenarios" by " A non-comprehensive, non-exhaustive, non-representative list of five emissions scenarios, developed by separate teams of authors". Explanation: The replacement is more accurate and correct description of the scenarios. [Government of India, Ministry of Environment, Forests and Climate Change]
6101	9	3	9	3	"across this report": In how far were the "new emission scenarios" used in the WG-II report and referred to in the WG-III report? If this could be mentioned here, it would highlight the overall coherence in IPCC-AR6. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
2353	9	3	9	4	Concerning the term "emissions scenarios" we strongly suggest to remove the term emissions as these scenarios also contain information about land use and use broader information than just emissions. Maybe the sentence can be revisited to illustrate that these are scenarios and they take into account : the broader range of greenhouse gas and air pollutant emissions as well as land use changes [Government of France, Ministère de la Transition écologique et solidaire]
4069	9	3	9	4	I understand that the number of main scenarios has been an even number (i.e., 4) up to AR5 to avoid the interpretation that the middle scenario is the most plausible projection. Since AR6 has not changed this standpoint (that there is no "most plausible scenario"), as indicated in lines 29-30 of page 9, this standpoint should also be stressed in the preamble (lines 3-7 of page 9). [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
2351	9	3	9	7	We suggest to move into this chapeau the important message given on this page line 30 telling that the presentation of the scenarios here does not take into account their feasability or probability that will be assessed by WG3. It is a critical information to be provided before describing the scenarios. We would also suggest to add a sentence about the progress of models in this paragraph. [Government of France, Ministère de la Transition écologique et solidaire]
8947	9	5	9	5	An important element missing here is that 'scenarios' are also linked to socio-economic pathways that place climate change in a broader picture, including vulnerability. [Government of United States of America, U.S. Department of State]
8949	9	6	9	7	Because solar activity is not really known in the future, rephrase to: "These projections also account for POSSIBLE CHANGES IN solar activity and forcing from volcanoes." The "long-term background" makes no sense here; solar is also long term. [Government of United States of America, U.S. Department of State]
8951	9	6	9	7	It might be worth noting that simple climate models are parametric and do not resolve the processes or spatial details. [Government of United States of America, U.S. Department of State]

Comment ID	From Page	From Line	To Page	To Line	Comment
7627	9	7	9	7	After the end of current sentence on line 7 add the following: "These projections are neither necessary nor sufficient, but illustrative of possible scenarios. While illustrating potential connections between socioeconomic factors and emissions, the same emission trajectories in the aggregate maybe produced by potentially several other combinations of socioeconomic factors. The Shared Socio Economic Pathways used in the report are modelled pathways which describe how socio-economic factors including population, economic growth, education, urbanization and the related technological development may change in the future and the impact of these changes on climate variables. The inclusion of these factors in driving warming introduces significant uncertainties. This report uses only the marker scenarios to assess the implications of the radiative forcing corresponding to each modelled emissions pathway. It does not evaluate, validate, or use the underlying social and economic assumptions of the SSPs". [Government of India, Ministry of Environment, Forests and Climate Change]
7243	9	10	9	12	[Chapter 9] "the majority regional sea-level rise within ±20% of the projected global mean sea level increase" Based on Figure 9.28, it should be further emphasized in this sentence that not only mean sea level rise and variability, but also rises of several orders of magnitude relative to the mean may occur in some coastal areas. And the "majority" should be defined somewhere so that it chould be expressed as a percentage of ocean area, or the number "20" should be further specified based on the siginificance level 95% or 99% [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
8195	9	10	50	28	Are the SSPs are optimised to achieve specific temperature outcomes? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8197	9	10	50	28	How do the GCMs include SSPs to provide outcomes consistent with temperature outcomes? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8199	9	10	50	28	How do the GCMs include SSPs to provide outcomes that are consistent with temperature outcomes? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8201	9	10	50	28	Are the plausible emissions trajectory based on a set of narratives? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
59	9	11	9	11	There is currently not enough information on how AR6 projections compare to AR5 projections. As this is one of the first questions asked by policymakers, it needs to be addressed more adequately in the SPM. [Government of Singapore, Ministry of Environment and Natural Resources]
6667	9	11	9	31	It appears that the emission scenarios do not consider the possibility of passing 'tipping points', some of which may be reached within the next 10 years. The scenario section should clarify that high-impact, low-probability events are not included. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6669	9	11	9	50	Providing combined RCP-SSP scenarios (as opposed to a matrix system), and clarifying the respective roles of WG1 & WG3 is very welcome. However, it is cumbersome for communication purposes. Please replace with a simpler nomenclature for the SPMs (like the P1-P4 system of SR1.5). Will the pairings be carried across the 3 Working Group reports and SYR? (e.g. SSP1 paired with RCP 1.9, SSP3 paired with RCP7.0 etc). If so, the case for adopting a P1-P4-type formulation is even stronger. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]

Comment ID	From Page	From Line	To Page	To Line	Comment
4911	9	11	9	50	Regarding the names of the SSPs and uncertainty of temperature increase: Consulting with some of our policy makers, they intuitively relate the concept of the SSPs and their numbers (e.g. SSP1-1.9. SSP1-2.6) to temperature (e.g., for SSP1-1.9 the numbers are interpretted to indicate that in this scenario, temepratures will be between 1-1.9 degrees higher than pre-industrial levels). It would be more useful to rename scenarios so that numbers are either not used or cannot be mistaken for temperature levels. [Government of Norway, Norwegian Environment Agency]
4913	9	11	9	50	Please consider explaining SSP term and what the numbers mean, not only in a footnote. For example it could show "SSP X-Y" and explain what X and Y refer to. It should also explicitly state that X and Y do not refer to the temperature increase associated with that scenario [Government of Norway, Norwegian Environment Agency]
333	9	11	9	50	We would recommend refraining from using the names of the emissions pathways (SSP1-1.9, SSP1-2.6, SSP2-4.5, SSP3-7.0, SSP5-8.5) in the SPM. First, while we recognize the development and the usefulness for the SSP scenarios, they have no impact on the projections done by WGI, hence they lead the reader of the SPM into the false believe the SSPs have been considered by the present report. Second referring to the scenarios as very low, low, medium and high emissions scenarios makes the messages much more accessible for policymakers. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
335	9	11	9	50	Box SPM.1: We think that box SPM.1 would be the right place to include references to how the scenarios are used in WGII and how they related to the scenarios of WGIII. In this case, the reader has the possibility to related the findings of all WGs with each other and it will be easier to compile the findings for the synthesis report. The same box could then be introduced in each of the WG contributions to the AR6. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
4521	9	11	9	50	The description does not inform on how model results have been adjusted for ECR (cf. H.S.4.5), which would be useful to capture here, or the information clearly provided in some other way. What applies for other variables than temperature? [Government of Sweden, Swedish Meteorological and Hydrological Institute]
7861	9	11	9	50	Sould the term "SSP" not be defined in this box? [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
6103	9	11	9	50	Please reconsider the naming of the scenarios. Using "SSP" can cause the wrong conclusion that socio-economic conditions are considered in WG I. In addition, some readers might confuse the numbers with ranges of warming levels. We strongly suggest using names that are self-explanatory, e.g. very low, low, medium emissions or something along these lines. In this regard we would like to suggest to include the infographic TS.1 (or at least its first page on TS-5-53) in the SPM. It contains the main information on the used-emission pathways and the corresponding temperature levels in two easily accessible graphics. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
8953	9	11	9	50	It's not clear if 'global climate models' are emulators or fully coupled general circulation models. Specify the type of model that is described here. [Government of United States of America, U.S. Department of State]
2355	9	13	9	13	We would like to draw attention to the term "coordinated by" as CMIP coordinates model simulation but not the model developments [Government of France, Ministère de la Transition écologique et solidaire]
8955	9	13	9	20	It's not clear how the warming projections are constructed. The box should be standalone in explaining the approach. Do these estimates adjust CMIP6 model projections based on the lower range of assessed climate sensitivity? [Government of United States of America, U.S. Department of State]

Comment ID	From Page	From Line	To Page	To Line	Comment
6105	9	15	9	18	The statement of "better representation of … processes" is contrasted with the statement that individual models are not able to reproduce the observed warming, a key property of climate models. We suggest to clarify and reformulate the paragraph. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
2357	9	16	9	16	To provide a fair assessment of the performance of current climate models and of its implication for climate projections, this Box should include 3 additional (and crucial) points: 1) although the climate models improve for most large-scale indicators, some persistent biases or weaknesses persist (e.g. in the simulation of regional precipitation patterns and in the intensity of extreme precipitation events). 2) despite this general improvement, the CMIP6 models exhibit a larger spread of climate sensitivity estimates than the previous generations of climate models, with models exhibiting climate sensitivities larger than the upper bound of the assessed range, primarily due to a strong positive low-cloud feedback [note that currently the word 'cloud' is not used once in the SPM - a first in IPCC history] 3) the models that predict a climate sensitivity outside the assessed range have not been considered for the projections of surface warming, ocean warming and sea level rise discussed in this report (HS4.4) [this is a key piece of information for a Box such as this one] [Government of France, Ministère de la Transition écologique et solidaire]
8957	9	16	9	16	Rewrite sentence, or clarify what is meant by "mean state of most large-scale indicators of climate change". [Government of United States of America, U.S. Department of State]
4357	9	16	9	17	Is a confidence statement needed here? Isn't this a statement of fact? [Government of Sweden, Swedish Meteorological and Hydrological Institute]
8959	9	16	9	17	Why are the underlying chapters cited since most of Figure SPM.4 is a direct lift from the Technical Summary? The panels for CO2 and CH4 are replicated from Figure TS.4 but, for NOx and SO2, the trends are different than what is seen in the underlying text. If there is a reason for this difference, provide it.There is no traceability for N2O in the underlying text. [Government of United States of America, U.S. Department of State]
2359	9	17	9	18	We suggest to reformulate this sentence as it seems to be a contradiction. If this is the idea, perhaps rephrase as : "Past warming is generally well simulated by the new generation of models, with a few exceptions which simulate a past surface warming that is either below or above that observed." We would also advise to change the term "past warming" as it could look like we are only looking at warming. We suggest to put in the part that talks about the progress of science concerning models to refer to "past human influence on the climate" [Government of France, Ministère de la Transition écologique et solidaire]
8497	9	17	9	19	Suggest including data to improve the usefulness of this sentence is not useful. Perhaps include a quantitative statement of the agreement and variance. [Government of Australia, Department of Industry, Science, Energy and Resources]
6671	9	18	9	18	"either below or above", do you mean systematically and significantly? And what is done with the information from such models? [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
2361	9	18	9	18	Concerning the term "past surface warming" we suggest to add the period of evaluation [Government of France, Ministère de la Transition écologique et solidaire]
8961	9	20	9	20	"assess" or "constrain"? [Government of United States of America, U.S. Department of State]
7219	9	20	9	20	[Chapter 6] except CH4 and many HCFCs and HFCs => except CH4, many HCFCs and HFCs [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
2363	9	20	9	20	This sentence could read as models projections have been weighted according to how well models simulate the past. If this is indeed the case we recommend to say it clearly and say for which projections this is the case. Furthermore, highlighting that those assessments lead to an improved estimates of global warming would be a plus (it is mentionned in the chapters) [Government of France, Ministère de la Transition écologique et solidaire]

Comment ID	From Page	From Line	To Page	To Line	Comment
8963	9	23	9	23	Revise the sentence as follows: "The core set of five scenarios used in this report explore the range of possible changes to amplitude and patterns of aerosol and greenhouse gas emissions, and land use." [Government of United States of America, U.S. Department of State]
7499	9	23	9	23	It is unclear to what extent the updated climate sensitivity as mentioned in statement HS.4.4 is incorporated in CMIP6 (statement HS.4.5 suggests it is not) and the 'core set' of five scenarios as introduced in Box SPM.1. Please, be more clear on this crucial issue. [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
7629	9	23	9	23	Replace "A core set of five new emissions scenarios" by " A non-comprehensive, non-exhaustive, non-representative list of five emissions scenarios, developed by separate teams of authors". Explanation: The replacement is more accurate and correct description of the scenarios. [Government of India, Ministry of Environment, Forests and Climate Change]
8193	9	23	9	28	What are the constraints on non CO2 GHG and other species? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8189	9	23	9	28	How these are linked to the scearios used in the 1,5C specail report should be clear [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8191	9	23	9	28	The 1.5C report indicated Net-zero CO2 ahead of 2050 the text suggest after can this be explained? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
3693	9	23	9	31	Probably many readers will be not enough familiarized with new SSPx-y scenarios. Some additional explanation (footnote?) may be needed [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
8965	9	24	9	24	Remove the '_' from "broader_range". [Government of United States of America, U.S. Department of State]
8967	9	24	9	24	What is meant by pollutant? Is there a glossary term that could be added here? [Government of United States of America, U.S. Department of State]
5211	9	24	9	24	Please, check the use of the underscore "_" in "broader_range". [Government of Argentina, Ministry of Environment and Sustainable development of Argentina]
7811	9	24	9	24	"a broader_range of" - it should be "a broader range of" [Government of Poland, Ministry of Environment, Department of Air Protection and Climate]
7631	9	24	9	24	Replace "these scenarios" with "these modelled scenarios" [Government of India, Ministry of Environment, Forests and Climate Change]
8969	9	24	9	25	Revise "greenhouse gas and air pollutant futures" to "greenhouse gas and air pollutant forecasts/predictions". [Government of United States of America, U.S. Department of State]

Comment ID	From Page	From Line	To Page	To Line	Comment
4517	9	24	9	31	It would be useful if this text is more explicit about the very strong differences between the scenarios. This is illustrated in the figure but the text does not reflect this. For example, the "without any climate change mitigation" could be expanded by something like "continued strong increase in emissions of GHGs". The "intermediate RCP4.5 scenario" could be further described using "continued high emissions over the next 50 years". The "decline" associated with RCP1.9 and 2.6 could be labelled "rapid strong decline starting well before 2030, leading to net zero around or after 2050, followed by...". [Government of Sweden, Swedish Meteorological and Hydrological Institute]
8499	9	25	9	25	Suggest providing an example of what 'y' means (eg 'y' is a radiative forcing of 1.9 in W m2). Suggest also cross reference to the part of the report that further explains the SSP pathways. [Government of Australia, Department of Industry, Science, Energy and Resources]
2369	9	25	9	25	Concerning the footnote 14 : this information could be put in evidence a bit more in the text. We would also recommend to add the reference to the TS where it is explained in details [Government of France, Ministère de la Transition écologique et solidaire]
7785	9	25	9	25	Explanation in the footnote: It would be helpful to have the difference between SSP's and the RCP's (previously used) explained [Government of Poland, Ministry of Environment, Department of Air Protection and Climate]
7635	9	25	9	25	Omit SSP5-8.5 in this line and henceforth. Explanation: Contradictory rationale have been provided for its inclusion . In TS 1.3.1 it has been argued that they are actually needed to represent potential carbon cycle feedback in lower emissions trajectories, whereas in cross chapter box 1.4 it is clear that is a legacy of RCP 8.5 and indeed SSP 8.5 produces even higher radiative forcing. [Government of India, Ministry of Environment, Forests and Climate Change]
5109	9	25	9	25	Footnote 14 is not sufficiently clear for non-expert readers. Please explain the link between SSPs and WGI scenarios in a clearer way, so as to avoid the perception that these scenarios are about socio-economic aspects (e.g. explain that a new small set of radiative forcing / emission scenarios is used by the WGI to explore the full range of forcing levels; these were taken from a wider ensemble of scenarios from the litterature which combine a shared socio-economic pathway and hypotheses about mitigation, resulting in scenarios names such as SSPx-y referring to a socio-economic pathway (SSPx) and the forcing level achieved in 2100 (y). [Government of Belgium, Belgian Science Policy Office - Belspo]
6673	9	25	9	26	Move the parentheses (SSP3…SSP5-8.5) to after "without any climate change mitigation". [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6675	9	25	9	26	Do you mean without any *additional* climate mitigation ? Surely even SSP3.7 and SSP8.5 do not revert the past mitigation achievements? [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
4915	9	25	9	28	We have noticed that there might be a potential to be more consistent troughout the SPM when it comes to specific wording for emission scenarios. Currently, at least the terms "core scenarios", "scenarios", "emission scenarios", "emission pathways", "CO2-emission pathways" and "emission trajectories" are used in a manner that might give an impression of coincidence. We beleive that for a policymaker this shifting between terms might create some confusion, and encorage you to be consistent troughtout the SPM. [Government of Norway, Norwegian Environment Agency]
4917	9	25	9	28	We appreciate the current grouping into high, intemediate and low emission pathways, and think there is a potential to increase usage of these annotations, rather than the technical abbreviation (SSPx-y), later in the SPM. It seems that the current draft is sort of using both grouping and the abbreviation, and we have a preference for the less technical approach. Perhaps this grouping could also be visualized in Figure SPM.4 in e.g. a legend box, and that this could open up for using less technical wording later in the SPM text itself? [Government of Norway, Norwegian Environment Agency]
4919	9	25	9	28	We have a concern regarding writing "CO2-emission pathways". In our view, this creates some confusion regarding which forcers that actually are included in the emission pathways themselves. It could be interpretted as if only CO2 are included, while when looking at Figure SPM.4 and reading the next sentence it is obvious that other forcers are also included. Please consider deleting "CO2" when writing about the emission pathways here and throughtout the SPM. [Government of Norway, Norwegian Environment Agency]

Comment ID	From Page	From Line	To Page	To Line	Comment
2367	9	27	9	27	We suggest to replace "around or after" with "decline to net zero around 2055 (SSP1-1.9) or around 2080 (SSP1-2.6), followed (...). [Government of France, Ministère de la Transition écologique et solidaire]
6107	9	27	9	27	Only providing net negative emissions gives the false impression that negative emission is only occurring in the two most ambitious scenarios. Please modify and indicate that negative emissions are included in all scenarios to a certain degree. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
6677	9	27	9	28	"followed by varying levels of net negative emissions": Does it mean a non-zero level in ALL cases? If so, does it imply that all of these would overshoot? [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
2365	9	27	9	28	We suggest to put the definition page 20 line 28-29 for "negative-emissions" before as it is first used here. Furthermore, maybe an additional statement like the one used in SR15 about the scenario might be usefull here : to clearly inform that no scenarios assessed in this report assess the deployement of SRM in the portfolio of solution to limit global warming [Government of France, Ministère de la Transition écologique et solidaire]
7633	9	28	9	28	Remove SSP-1.9 here and henceforth . Explanation: SSP1-1.9 is a non marker scenario. [Government of India, Ministry of Environment, Forests and Climate Change]
8971	9	29	9	29	I was expecting more than just "controls" but governance, policies (other than AQ policies) and economic development. At a minimum, controls should be plural. [Government of United States of America, U.S. Department of State]
6679	9	29	9	30	"This Report focuses on the climate response to this set of scenarios, whereas the feasibility or likelihood of individual scenarios is not part of the assessment." Whilst this separation is reasonable, can it be fully maintained? Mitigation actions have varying degrees of direct influence on the climate system. For example, scenarios implying large-scale land-based mitigation to achieve net negative outcomes are likely affect the climate response differently than those that achieve similar concentrations through other means. It is unclear to what extent the "response" can be separated from the scenarios. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
7637	9	29	9	31	Reframe sentence, currently it appears contradictory. [Government of India, Ministry of Environment, Forests and Climate Change]
8973	9	30	9	30	The word "whereas" is not used appropriately. Replace it with the word "and". [Government of United States of America, U.S. Department of State]
6681	9	30	9	30	of the WG1 assessment, or in general the AR6 assessment? Clarify. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
4665	9	30	9	30	While it is true to say that there is no feasibility assessment of the scenarios in this report, to avoid misinterpretation of what the results corresponding to these scenarios actually mean, it would be useful to include a statement clarifying whether or not these emissions scenarios spread the full possible range of future emissions, or whether higher or lower emissions are possible. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial
8501	9	31	9	31	Suggest further explanation is needed: ie include the level of emissions at the starting point. That is, in chart SPM.4 the starting point is 40 Gt CO2/yr (and other levels for other GHGs). Also explain this value is the level of emissions which was estimated/measured in 2015. [Government of Australia, Department of Industry, Science, Energy and Resources]
8975	9	34	9	34	Add estimated GHG emissions for 2015-2019. [Government of United States of America, U.S. Department of State]
7557	9	34	9	34	Figure SPM.4: Consistency labelling: should be SSP5-8.5 (left graph) [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
8503	9	34	9	50	Suggest clarification: The figure shows projected time series of climate drivers including greenhouse gases (CO2, CH4 and N2), and SO2. In the bottom bar graphs, the 'negative' warming is given as 'anthropogenic aerosols.' Is the figure using sulphur dioxide as a proxy for aerosols? If so the caption should state that clearly. [Government of Australia, Department of Industry, Science, Energy and Resources]

Comment ID	From Page	From Line	To Page	To Line	Comment
8977	9	36	9	36	Replace "Future" with "Projected". [Government of United States of America, U.S. Department of State]
8979	9	36	9	48	While this figure is very helpful for understanding the overall drivers of climate change, it is not as useful as needed for planning international actions for the period out to 2050 and to 2100. The diagram that is really needed for policy planning is the warming effect of future emissions, as these are the ones that policymakers can potentially control. So, it would be incredibly helpful to have the additional warming influences being caused by emissions (by type, and including specifically also HFCs) from 2020 to 2050 (or now, perhaps 2022 to 2050) and then also the contributions to temperature change for emissions from 2050 to 2100. These results could be presented in the existing future by subdividing each column into the years of emissions contributing to the warming influence, so say emissions from 1850 to 2020, 2020 to 2050, and 2050 to 2100. Or, perhaps more helpful, by dividing this figure into multiple panels. What policymakers need is an understanding of the relative importance of controlling future emissions for each type. In doing this, the role of HFCs should all be separated out. This is of particular importance because present inventories account for only about half of the emissions that must be occurring given the changes in atmospheric composition that are being observed, and the warming contribution of these "rogue" emissions could be comparable to reductions in warming influence that are expected to be achieved by the reductions in CO2 emissions. So, it is essential to provide information on the specific influences of future emissions, not just the overall analysis. [Government of United States of America, U.S. Department of State]
4071	9	36	9	48	It would be helpful to have a brief explanation of how the temperature response was assessed in Figure SPM.4. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
7981	9	36	9	50	The inclusion of SO2 in Figure SPM.4 - Panel a. is confusing as there is no mention of its role as a driver in that section, and Panel b. represents the role of anthropogenic aerosols in general. It would be important to specify the relationship. [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
4359	9	44	9	44	The "range" should not be typeset in italics. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
8981	9	52	9	52	It would be helpful if Footnote 14 defined the meaning of the x in SSPx. Also state that the radiative forcing is relative to pre-industrial levels (if true) and globally averaged. [Government of United States of America, U.S. Department of State]
2895	9	53	9	53	indicate the reference period: 1850-1900 [Government of Chile, Ministry of Environment]
7639	10	0	10	0	Table SPM 1-Drop SSP 1.9 and SSP-8.5 as already indicated. [Government of India, Ministry of Environment, Forests and Climate Change]
8203	10	1	10	2	As these are models "Are projected" should be used rather than "will" [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
3347	10	1	10	4	There is no confidence statement. [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
8983	10	1	10	4	This paragraph is written using statements of fact (no confidence qualifiers). Is it really the case that every realization of every climate model assessed in AR6 produced a GSAT that is warmer than "today"? If not, it would be more accurate to report that "the GSAT is projected to be warmer than the 1995-2014 interval using multiple and converging lines of evidence" (or something that defines what today is, and recognizes that there is a lot of variability in individual models and individual years, and 2050 is only 30 years from today). [Government of United States of America, U.S. Department of State]

Comment ID	From Page	From Line	To Page	To Line	Comment
7065	10	1	10	4	How the natural effects has been considered in this projection? [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]
7865	10	1	10	4	HS.5: Make it more compelling. The first sentence of HS.5 is not conveying much policy-relevant information, and can hence be omitted. Instead, the high-end scenarios should be mentioned in this HS with the warming of up to 5°C, with significantly enhanced warming over land and in the high latitudes. Note: a top HS on sea level rise is missing! [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
6109	10	1	10	4	This statement is not only a result of the WG I projections reflecting increased process understanding but also follows from the emission scenarios that drove the models. It should please be reformulated indicating this fact, e.g. "Projections using the emission scenarios lead to … ". Similarly, the statement that 2 of the 5 scenarios used exceed the temperature limits of the Paris Agreement is not useful since it depends on the input from the emission scenarios but might give the wrong impression that WG I can make a statement on the feasibility of reaching the Paris goals. Please modify. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
8505	10	1	10	5	Suggest rephrasing to use conditional and probabilistic language: "Global surface temperature around 2050 will be higher than today under all emission scenarios considered in this Report" eg: "Global surface temperature around 2050 *would* [or are extremely likely to] be higher than today under *any* emission scenarios considered in this Report." [*all* the emissions scenario considered in this report will not occur, and it is not which if any will occur] [Government of Australia, Department of Industry, Science, Energy and Resources]
8985	10	1	10	6	Revise HS.5 to state: "All Global surface temperature metrics around 2050 will be higher than today under all emission scenarios considered in this report. Global warming levels of 1.5 and 2°C above pre- industrial levels will be very likely exceeded by the end of the 21st century in SSP2-4.5, SSP3-7.0, and SSP5-8.5. In the lowest CO2 emission scenario (SSP1-1.9) it is more likely than not that the warming will stay below the 1.5°C level. (Figure SPM.4, SPM.8, Table SPM.1) {2.3, Cross-Chapter Box 2.3, Cross-Chapter Box 2.4, 4.3, 4.4, 4.5}" In doing so, the authors add clarity to avoid ambiguity about which GST metrics are being discussed (it doesn't matter). Be specific about the scenarios being referenced and add probabilistic language in line with the results in Table SPM-1. With respect to SSP1-1.9, the language needs correcting to reflect that the 'very likely' range exceeds 1.5°C. [Government of United States of America, U.S. Department of State]
457	10	1	10	6	The first citation of Figure SPM-8 in the text appears before Figure SPM5-7. It is suggested to adjust the order of the figures to place Figure SPM-8 before Figure SPM-5. [Government of China, China Meteorological Administration]
4073	10	1	11	16	HS.5 messages based on scientific findings are issued in an appropriate and understandable manner. It would certainly help policymakers' appropriate understanding. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
7271	10	1			For reasons outlined above, it is problematic to combine observed and projected assessments into a single temperature estimate relative to pre-industrial levels that any reader would directly relate to political targets. Assessments of scenario projections in the SPM and throughout the report should be presented only in relation to the recent reference period 1995-2014 as it was done in the IPCC AR5. Also, the selection of scenarios presented is by no means comprehensive. So a statement about exceedance of warming targets in a finite ensemble of chance has little signficance. [Government of Saint Kitts and Nevis, Department of Environment - Ministry of Agriculture, Marine Resources, Cooperatives, Environment and Human Settlements]
2371	10	2	10	2	Concerning the choice of the global warming levels detailled here, we understand the link with the Paris Agreement and we think it is a very important point to put it in evidence. However, it would also be good to add other global warming levels in order to assess other possibilities, while keeping 1.5°C and 2°C in evidence [Government of France, Ministère de la Transition écologique et solidaire]

Comment ID	From Page	From Line	To Page	To Line	Comment
2373	10	2	10	2	From table SPM.1, only SSP1-1.9 is below 1.5 and 2°C. SSP1-2.6 very likely range includes warming above 2°C (2.4°C). So that sentence is only true for the central estimates, not for the very likely range. This could be clarified as follow: Global warming levels of 2°C above pre- industrial levels will be exceeded by the end of the 21st century under all but the two lowest CO2 emission scenarios (central estimate). Limiting global warming levels below 1.5°C above pre-industrial levels will only be achieved under the lowest CO2 emission scenarios (central estimate). [Government of France, Ministère de la Transition écologique et solidaire]
7787	10	2	10	2	„global warming levels of 1.5C and 2C (…) will be exceeded by the end of 21st century" - unless the time of exceeding the 1.5C level is given, what is the reason for giving both the two levels? [Government of Poland, Ministry of Environment, Department of Air Protection and Climate]
7519	10	2	10	4	This statement is not correct: only one scenario meets both the 2 and 1.5 degree threshold; change into: "Global warming levels of 2°C and 1,5°C above industrial levels will be exceeded by the end of the 21st century under all but respectively the two lowest and the lowest CO2 emission scenarios" [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
2675	10	2	10	5	HS.5. The statement that global warming of 1.5C and 2C will be exceeded by the end of the century in all but the two lowest scenarios cannot be verified with the data in table SPM.1 or that in Figure SPM.8. Therefore, we suggest adding a column to Table SPM.1 to show the end of century warming under each scenario. [Government of Canada, Environment and Climate Change Canada]
4921	10	2	10	6	According to Table SPM.1, the second lowest CO2 emission scenario (SSP1-2.6) will exceed global warming levels of 1.5 deg C above pre-industrial levels by the end of the 21st century. Please consider rephrasing the sentence to capture this cruicial difference between 1.5 and 2.0 and SSP1-1.9 and SSP1-2.6. [Government of Norway, Norwegian Environment Agency]
8507	10	2			Suggest rephrasing for clarity: The sentence starting with "Global warming levels of 1.5oC and 2oC.." gives the impression the two lowest CO2 emissions scenarios can keep warming under 1.5 deg. In fact, only one scenario keeps warming at around 1.5 deg and the two lowest scenarios keep warming to 2 degrees. Suggest two separate sentences. [Government of Australia, Department of Industry, Science, Energy and Resources]
2805	10	2			Please be more clear that you are only referring to the five SSP-RCPs assessed in AR6 by saying "under all but the two lowest emission scenarios assessed." [Government of Jamaica, Meteorological Service Division]
4361	10	3	10	3	In some of the scenarios, these warming levels are reached before the end of the 21st Century. Could this be expressed by "…exceed before…"?, or some suchlike expression. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
2375	10	3	10	4	Box SPM.1 indicates that the 2 lowest CO2 emission scenarios (SSP1-1.9 and SSP1-2.6) are net-negative after 2050. We therefore suggest to use this characteristic to refer to these scenarios as it would be more salient [Government of France, Ministère de la Transition écologique et solidaire]
7521	10	4	10	4	Add to Headline Statement 5: "In even the lowest scenarios, the central estimate of crossing the 1.5°C global warming level lies in the early 2030s. This is about ten years earlier than the midpoint of the likely range (2030–2052) assessed in the SR1.5" [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
7641	10	4	10	4	Add the following to HS.5 : "That global warming of 1.5 degree C will be crossed in the early 2030's is the central estimate of most models including those with mitigation policies" ! This statement from H.S.5.3 is of such significance that it must appear in the lead headline statement. [Government of India, Ministry of Environment, Forests and Climate Change]
7177	10	5	10	5	Cross-Chapter Box 2.3, Figure 1: From the vertical axis caption the plot is showing surface temperature anomalies from 1850-1900, however the values from 1850 to 1900 are seemingly very well below the normal. [Government of Madagascar, National Meteorological Service]

Comment ID	From Page	From Line	To Page	To Line	Comment
8509	10	8	10	8	Suggest reviewing the text for accuracy: The footnote for 'Compared to 1850-1900 …' states this as 'The multi-century period prior to the onset of large-scale industrial activity around 1750.' [Government of Australia, Department of Industry, Science, Energy and Resources]
8511	10	8	10	8	Suggest rephrasing: The first sentence of footnote 15 describes the preindustrial, but is footnoted to "1850-1900". This could be addressed by swapping the order of the two sentences in the footnote and rewording slightly. [Government of Australia, Department of Industry, Science, Energy and Resources]
2377	10	8	10	8	If this is possible, the long-term estimate should be centered on 2100 and not on 2090. We are missing 0.3C in the estimates of warming for the end of the century. Given we are already in 2021, this decade matters. [Government of France, Ministère de la Transition écologique et solidaire]
109	10	8	10	8	Since the model estimates of future temperature are discussed, it is expedient to add 'projected' before 'global surface temperature averaged over 2081–2100' [Government of Russian Federation, Institute of Global Climate and Ecology]
7863	10	8	10	8	For the reference period at the end of the century IPCC uses a 20 year average (2081-2100). This is in contrast to the reference period for the current climate (2011-2020), where a 10 year average is used and in contrast to the WMO reference periods where 30 year averages are used. Why are the periods used by the IPCC not consistent with other set of reference periods? [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
201	10	8	10	8	The statement " Compared to 1850–190015, global surface temperature averaged over 2081–2100 is very likely to be 9 higher by 1.0°C–1.8°C under the lowest CO2 emission scenario" Include all GHG gases scenarios [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
4075	10	8	10	8	For clear understanding, it would be better to rephrase the footnote 15 as "The reference period 1850-1900 is used to approximate pre-industrial global surface temperature. The pre-industrial period is the multi-century period prior to the onset of large-scale industrial activity around 1750". In addition, the term "1850-1900" appears for the first time in H1.2, so it would be better to move the footnote there. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
459	10	8	10	10	The future temperature change from 2081-2100 is projected in the body text H.S.5.1, while Figure SPM.4b gives the change in 2100. It is suggested to further confirm the correctness of the figure and its caption to ensure the graphical and textual consistency. [Government of China, China Meteorological Administration]
4077	10	8	10	10	These estimates of warming are likely to rely heavily on climate model projections. The aforementioned (lines 33-34 on page 8) tendency for the latest climate models to overestimate the climate sensitivity needs to be addressed. It is desirable to state whether or not a correction has been made. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
8205	10	8	10	12	Footnote 15 mentioned multi century period. What does this imply for the analysis provided? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8987	10	8	10	13	Revise H.S.5.1 to state: "Compared to 1850–1900 , global surface temperature averaged over 2081–2100 is very likely to be higher by 1.0–1.8°C under the lowest CO2 emission scenario considered in this report (SSP1-1.9) and by 3.3–5.7°C under the highest CO2 emission scenario (SSP5-8.5). The last time sustained global warming levels of more than 2.5°C higher than 1850–1900 occurred was over 3 million years ago. {2.3, Cross-Chapter Box 2.4, 4.3, 4.5} [Figure TS.1, Box TS.2, Box TS.4, Cross-Section Box TS.1, Cross-Section Box TS.1] (Table SPM.1)" Strike the "when major elements ..." clause. The second sentence needs a rewrite for basic comprehension. Removal of the trailing clause is needed since many differences were part of the climate response to higher CO2. If authors wanted to say something more specific about the drivers of Pliocene climate (including continental configurations, tectonic activity, ice sheet loss, or GHG levels), they should do so explicitly. [Government of United States of America, U.S. Department of State]

Comment ID	From Page	From Line	To Page	To Line	Comment
4923	10	8	10	13	Suggested rephrasing: 'Global surface temperature averaged over 2081–2100 is very likely to be higher than 1850–1900 by 1.4°C under the lowest...'. As suggetsed here we would prefer to have the central estimate in the text and move the temperature intervals to the tables to make it easier to read. [Government of Norway, Norwegian Environment Agency]
7015	10	8			Table SPM.1: While the temperature changes are given relative to 1850-1900, the equivalent table in AR5 SPM (Table SPM.2) presented the changes relative to 1986-2005. It would be advisable for the AR6 WGI SPM to take a corresponding approach and present changes relative to the most recent reference period, meaning 1995-2014. With that, a distinction would be made between the observational record and projections. This approach would allow for comparability between the AR5 and AR6 temperature assessments and ensure that AR6 has a line of sight to AR5 and the Paris Agreement temperature goals which it informed. [Government of Fiji, Fiji Meteorological Services]
7273	10	8			Table SPM.1: We trust that the authors fully understand and embrace the need to establish a clear line of sight to the AR5 assessment, not only in the underyling chapters but also in the SPM. In AR5, the equivalent table was provided relative to the CMIP5 reference period 1986-2005, the forward looking impact assessment was derived based on the projections relative to this reference period and was hence unaffected from the assessment of historical temperature change. The AR5 authors allowed for a merged pre-industrial estimate by providing the historical temperature assessment as part of the table. We would strongly advise for the authors to replicate this approach for Table SPM.1. Like this, it will be much easier to explain and lay out the changes in the AR6 temperature assessment compared to AR5. Both, the new AR6 assessment of historical temperature change plus the corresponding estimate based on the AR5 methodology should be shown for the 1995-2014 period, with the projections then provided relative to this more recent reference period. Like this, a clear distinction can be made between the observational record (which has changed in addition to years of warming since AR5) and projections (which are more or less equally sensitive to anthropogenic forcing when compared to AR5). [Government of Saint Kitts and Nevis, Department of Environment - Ministry of Agriculture, Marine Resources, Cooperatives, Environment and Human Settlements]
7149	10	8			Table SPM.1: There is an difference in logic between this table and the predecessor table in AR5 AGI SPM Table SPM.2, which used a recent reference period (1986-2005). In AR5, the assessment of future impacts was a result of projections relative to 1986-2005, thus unaffected by the assessment of historical temperature change. Table SPM.2 should take the same approach as AR5, so that comparability between AR5 and AR6 is achieved. Both the new assessment of historical temperature change and the corresponding estimate based on AR5 methodology should be introduced relative to the most recent AR6 reference period 1995-2014 in table footnotes, allowing to derive pre-industrial estimates while being fully tranparent. [Government of Samoa, Ministry of Foreign Affairs and Trade]
2807	10	8			We have already outlined why we feel that the AR6 temperature assessment should be separated for historical and projected change. It is unfortunate that the clarity of providing pre-industrial estimates would have to be sacrificed in this context, but the authors should be aware of the policy implications of providing combined estimates and opt for a transparent assessment that allows for comparison to AR5. [Government of Jamaica, Meteorological Service Division]
6391	10	8			As stated previously, assessments of observed and projected warming should be considered as separate components and not combined into one finding presented relative to pre-industrial levels. The SPM should present its assessments of scenario based projections only relative to a recent reference period, as was done in AR5. [Government of Saint Lucia, Department of Sustainable Development - Ministry of Education, Innovation, Gender Relations and Sustainable Developement]
2379	10	10	10	10	We recommand to define "sustained" as it is not defined in the glossary. Does it mean there is a minimum time length? [Government of France, Ministère de la Transition écologique et solidaire]
7501	10	10	10	11	A likelihood should be added (and could be added based on the underlying literature) to this sentence. It probably is 'very likely'. [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]

Comment ID	From Page	From Line	To Page	To Line	Comment
461	10	10	10	11	It is suggested to add a confidence expression to this sentence. [Government of China, China Meteorological Administration]
3349	10	10	10	12	There is no confidence statement. [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
7559	10	10	10	12	Shortly specify what major elements these are. [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
6111	10	10	10	13	Major elements of the climate system sound very theoretical. For policymakers it would be useful to find a more self-explaining expression. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
6683	10	10			Replace "warming" with "temperature" to read "sustained temperature levels...". [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
1669	10	11	10	11	The paragraph would benefit from some insight into what are these major elements of the climate system, and how they were different? [Government of Finland, Finnish Meteorological Institute (FMI)]
6685	10	11	10	12	Consider redrafting from 'since over 3 million years ago' to ' in the last 3 million years'. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
8989	10	18	10	18	Revise "Changes in global surface temperature" to "Changes in the two-decade running average of the surface temperature" and then add a footnote that states: "The annual variability around the two-decade running average is likely to be several tenths of a degree C and particular monthly variations even greater." [Government of United States of America, U.S. Department of State]
6687	10	18	10	18	A simple but very useful table. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
2381	10	18	10	18	We suggest to clarify if these estimates exclude the model projections from the models that have an ECS outside of the assessed range. If so, it is highly important (cf HS4.5). We also recommend to change "for selected time periods" with "for their averages over selected time periods" in the caption. It would resolve a potential ambiguity on the meaning of the very likely range values. Are there likely ranges for the central estimate of the average (our interpretation) or a very likely range for the temperatures over the individual years of the different periods? [Government of France, Ministère de la Transition écologique et solidaire]
111	10	18	10	18	Since the model estimates of future temperature are discussed, it is expedient to add 'Projected' before 'Changes in global surface temperature' [Government of Russian Federation, Institute of Global Climate and Ecology]
7599	10	18	10	19	Is it global surface temperature or global MEAN surface temperature? [Government of South Africa, Senior Policy Adviser International Climate Change Cooperation Department of Environmental Affairs]
8991	10	18	10	20	Add '4.4' to the line-of-sight references. [Government of United States of America, U.S. Department of State]
2677	10	18	10	20	Table SPM.1: Strongly recommend that the caption include the information that the values in this table are not simply derived from cimate model output but are assessed values based on multiple lines of evidence. As per Cross-section Box TS.1, this approach is new to the AR6 WGI report and therefore should be stated clearly in the SPM since this is different than how global temperature for future time periods was presented in previous IPCC WGI reports. [Government of Canada, Environment and Climate Change Canada]
5111	10	18	10	21	Table SPM.1: For consistency with the text, the ranges provided in Table SPM-1 should be provided in square brackets (because they relate to "very likely" ranges). [Government of Belgium, Belgian Science Policy Office - Belspo]

Comment ID	From Page	From Line	To Page	To Line	Comment
4305	10	18	10	22	We suggest to transform Table SPM1 in a figure [Government of Italy, CMCC - Centro Euro-Mediterraneo per i Cambiamenti Climatici Instituto Nazionale di Geofisica e Vulcanologia (INGV)]
337	10	18	10	23	Table SPM.1: In order to make the numbers more easily comparable to previous IPCC reports please also provide the likely ranges additional to the very likely ranges. Our comment on global surface temperature metric and it's relation to the temperature goal of the Paris Agreement also applies here. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
6113	10	18	10	23	_Quantifying future warming: We thank the authors for this useful table SPM.1 We request to consider the following points and clarify the questions, as these values are very policy relevant. - Please assure that this table provides values that are relevant for the implementation of the Paris Agreement. We suggest to provide the figures relative to the recent past. As in AR5, a constant number could be provided to calculate the difference to preindustrial (0.61° in the AR5). This might help avoiding confusion around changing the temperature scale between AR5 and AR6. - What are the reasons of the increased values and what are their contributions: 1) Increase due to the improved assessment of the historical warming; 2) increase due to accelerated warming in recent years, 3) use of a new set of emission scenarios with stronger near-term warming? - When comparing these values to the current GST change (period 2011-2020 of 1.09°C), the near- term central estimate for all scenarios implies that there will be warming rates of up to 0.4°C per decade. Is that correct? If so, we request the authors to spell out this important finding of much stronger near-term warming somewhere prominent in the SPM. - How do "changes in global surface temperature" relate to "global warming"? [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
6115	10	18	10	23	Table SPM.1: Previous IPCC reports provided that likely range (66-100%) while this report provides the very-likely range (90-100%). Please provide also the likely range for comparison with previous reports. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
4667	10	18	11	7	Different confidence intervals are discussed in H.S.5.2 and Table 1 and this may be confusing. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
2809	10	18			With Table SPM.1, the authors have the opportunity to establish a very clear line of sight to the previous IPCC assessment and provide less confusing estimates for projected temperature change in the context of the Paris Agreement Long-Term Temperature Goal (LTTG) by using the 1995-2014 reference period. The provision of projections relative to the more recent reference period ensures that they are understood to be unaffected from the assessment of historical temperature change. Like in AR5, authors can facilitate the derivation of a merged pre-industrial estimate by providing the historical temperature assessment in footnotes of the table. The new AR6 assessment of historical temperature change plus the corresponding estimate based on the AR5 methodology should be provided for the 1995-2014 period. For the reader, it would then be straightforward to identify the changes in the AR6 temperature assessment compared to AR5. Using a more recent reference period would also avoid any misconception around estimates resulting from stylised emission pathways for a period where observations exist. [Government of Jamaica, Meteorological Service Division]

Comment ID	From Page	From Line	To Page	To Line	Comment
6393	10	18			Table SPM.1: In order to allow comparability of AR6 with AR5, we would strongly suggest designing this table after its equivalent in AR5. The SPM table in AR5 employed the reference period 1986-2005, with projections relative to this period, and therefore separated the forward looking component from the historical assessment. The historical assessment was presented in a table footnote to enable the readership to combine warming components to provide projections relative to pre-industrial. Using this same approach for AR6 Table SPM.1 would allow the temperature assessment to be clear and transparent with regard to changes in the historical assessment. In the table footnotes, the reference period 1995-2014 should be used for the projections and both the new AR6 assessment of historical temperature change and the corresponding estimate based on the AR5 methodology. [Government of Saint Lucia, Department of Sustainable Development - Ministry of Education, Innovation, Gender Relations and Sustainable Developement]
8993	10	20	10	20	Add Table 4.5 as a reference since these values are pulled from there. [Government of United States of America, U.S. Department of State]
2383	10	20	10	20	Concerning the line 2 of Table SPM 1, one sentence could be added in the legend to explain the numbers provided as in the Technical Summary Box TS.1 Table.1 where one can read: "The entries give both the central estimate and, in parentheses, the very likely (5–95%) range" Here the range is not in parentheses, but it could be worth adding the explanation [Government of France, Ministère de la Transition écologique et solidaire]
2385	10	20	10	20	Concerning the 1st column of table SPM 1 : the names of the scenarios given in this column will be abstract for the wide public. Characterizing each scenario by a word or two (as done in the box SPM-1) would make the list less cryptic and would avoid going to the Table to understand what it means. [Government of France, Ministère de la Transition écologique et solidaire]
6117	10	21	10	21	Table SPM.1: Interesting data; the table may be improved by accentuating the temperature level higher than 2 degree by a different colouring. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
8995	10	21	10	22	Is there an intended gap (of 20 years) in the end of "Mid-term" range (2060) and the beginning of the "Long term" (2081)? Or is it more of a typo (either in 2060 or in 2081)? [Government of United States of America, U.S. Department of State]
4079	10	21	10	22	Please clarify the meaning of “central estimate”. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
8997	10	22	10	22	Explain in the text or a table footnote why Table SPM.1 shows a higher central estimate for the mid-term and lower central estimate over the long-term. [Government of United States of America, U.S. Department of State]
8999	10	25	10	25	The first sentence of Footnote 15 is not complete. Also it is hard to see how it could be the definition of "1850-1900" -- i.e., placement of the callout is odd. [Government of United States of America, U.S. Department of State]
2897	10	26	10	26	explein better why a multi-century period prior to large-scale industrial activity is approximated by the period 1850-1900 [Government of Chile, Ministry of Environment]
6689	10		10		Footnote 15 is confusing. The text says 1850-1900, then the footnote refers to a "multi-century period". Please clarify [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
7117	10		10		There is still the perception among water resources policymakers that Scenario RCP8.5 will show the greatest amount of precipitation decrease and the greatest amount of temperature increase. This issue should be well explained(DOI 10.1007/s10584-008-9438-5 and https://doi.org/10.1007/s11269-020-02486-8) [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]
9001	11	1	11	1	According to the underlying text in Section 4.3, the extremely likely confidence is only associated with SSP2.4.5. The underlying text suggests that under SSP5-8.5 and SSP3-7.0 that the warming level will be crossed: "During the entire 21st century, a warming level of 2°C in GSAT, relative to the period 1850-1900, will be crossed under SSP5-8.5 and SSP3-7.0, will extremely likely be crossed under SSP2-4.5, will unlikely be crossed under SSP1-2.6, and will extremely unlikely be crossed under SSP1-1.9." [Government of United States of America, U.S. Department of State]

Comment ID	From Page	From Line	To Page	To Line	Comment
8207	11	1	11	3	What are the uncertainty ranges around the historic analysis provided? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
9003	11	1	11	7	It would help the reader to appreciate the projected warming of 2021-40 if also shown relative to the most recently updated WMO 1991-2020 climatology. This could be done in another table like Table SPM.1 , or simply in the text to provide some more modern-day relevant context for the projections of temperature. [Government of United States of America, U.S. Department of State]
4669	11	1	11	7	In HS5.2, the probabilities of scenarios crossing thresholds is well described, sticking to probabilistic interpretations instead of only looking at the central estimate. We would suggest that an assessment for SSP1-2.6 is also included, so that the full range of scenarios is described. We would also suggest that SSP1-1.9 assessment mentions the decline in temperature after its peak to below 1.5C, as this is highly policy relevant information. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
2679	11	1	11	7	The information in this paragraph about likelihood of exceeding different global temperature thresholds does not seem to be traceable to Table SPM.1. Therefore, directing readers to that reference is confusing. The key supporting evidence is in Cross section Box TS.1 and Table 1 within that Box. [Government of Canada, Environment and Climate Change Canada]
8209	11	1	11	16	What are the uncertainty ranges around temperature record for the 1850-1900 period? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8211	11	1	11	16	How is global warming of 2C and 1.5C defined here? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
6119	11	1	11	16	It is very important to explain the reasons for stronger warming: Is it due to the updated assessment of historical warming (methodologic or physical causes)? Does the new scenario set produce the stronger near-term warming compared to AR5 or is it the change in the ECS and TCRE? Please clarify. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
6121	11	1	11	16	Please clarify the difference in "global warming" in H.S.5.2 and the "central estimate of the global warming level" in H.S.5.3, including the time period used for averaging, and relate the statement to Table SPM.2 and to the Paris Agreement's temperature goals. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
7275	11	1			As highlighted before, projections should be presented only relative to the recent reference period. Also, it should be noted that the 'larger near-term warming' might be partly due to the stylised nature of scenario forcing over the past 7 years and not accounting for observed changes in aerosols and the COVID effects on emissions. [Government of Saint Kitts and Nevis, Department of Environment - Ministry of Agriculture, Marine Resources, Cooperatives, Environment and Human Settlements]
2811	11	1			Please clarify if the 'larger near-term warming' results from the stylised nature of scenario forcing over the recent past and if these estimates are consistent with the observed rate of change! [Government of Jamaica, Meteorological Service Division]
6395	11	1			Given concerns already expressed, we suggest that projections are presented only in relation to the recent reference period. [Government of Saint Lucia, Department of Sustainable Development - Ministry of Education, Innovation, Gender Relations and Sustainable Developement]

Comment ID	From Page	From Line	To Page	To Line	Comment
9005	11	2	11	2	Eliminate double negative. Change "that do not decline greenhouse gas emissions before mid-century" to "with greenhouses gas emissions continuing to increase through mid-century". [Government of United States of America, U.S. Department of State]
9007	11	2	11	2	Change "not decline" to "not substantially decline". There needs to be an indication of how much decline is needed. [Government of United States of America, U.S. Department of State]
9009	11	2	11	2	"greenhouse gas emissions" is correct here, but needs to have been defined earlier as it is in Figure SPM.2. This is a very clean accurate statement and makes one realize how inaccurate the headline bullet HS.5 is. [Government of United States of America, U.S. Department of State]
8513	11	2	11	2	Suggest "peak" would read better than "decline" in this sentence. [Government of Australia, Department of Industry, Science, Energy and Resources]
8215	11	2	11	7	The basis for the reference to a temporary overshoot should be clear. This is a model run? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8213	11	2	11	16	How are uncertainties in the historic reference period addressed in the analysis of global warming increments? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
6691	11	2			It is important to point out that the two scenarios that do not exceed the 2° target not only start early, but also both have net CO2 emission below zero. Text suggestion: " …under the three scenarios that (i) do not decline GHG emissions before mid-century, and (ii) do not have carbon dioxide removal strategies in place..." [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
9011	11	3	11	3	Typo: replace "SSP-8.5" with "SSP5-8.5" [Government of United States of America, U.S. Department of State]
2991	11	3	11	3	SSP-8.5 -> SSP5-8.5 [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
7869	11	3	11	3	"SSP5-8.5" instead of "SSP-8.5" [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
4081	11	3	11	3	"SSP-8.5" should be "SSP5-8.5" [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
245	11	3	11	3	In the following text “4.5, SSP3-7.0, SSP-8.5). Under the lowest assessed CO2 emission…” the SSP scenario is SSP5-8.5 as opposed to SSP-8.5. The authors should correct this error. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
6693	11	3	11	7	The sentence as phrased is confusing and potentially misleading. The last clause ("implying a potential temporary overshoot of no more than 0.1°C above 1.5°C global warming") should be deleted or clarified. It can be understood to refer either to the lowest assessed scenario (and its impacts), or only to the value of 1.6°C. If it refers to the former, then it is misleading, as the scenario does not imply that the overshoot would be "no more than 0,1°C". That outcome would only have an approximately 50% chance. If, on the other hand, the clause refers to the 1.6°C figure as such, then "no more than" should be deleted, as 1.6°C is exactly 0,1°C above 1,5°C. Moreover, "potential temporary overshoot" appears to be a biased formulation, as the likelihood ("potential") is not quantified and the overshoot may also be permanent. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]

Comment ID	From Page	From Line	To Page	To Line	Comment
9013	11	3	11	7	This is a very long, complex sentence. It includes information about the scenario itself, the probability of staying under 2°C in this scenario, then a discussion of 1.5°C in this scenario. This sentence should be broken into at least two and possibly three sentences to more clearly get all of these concepts across. Could also consider breaking H.S.5.2 into two separate statements -- one about the scenarios that lead to >2°C warming, and one about the scenario that stays < 2°C warming. [Government of United States of America, U.S. Department of State]
9015	11	3	11	7	This statement is only plausible if it is made clear that the global warming referenced is the running two-decade average global warming; this statement is simply not plausible if referring to one-year exceedances and this needs to be made very clear so that the impacts community is not misled. Thus, on line 5, change "global warming" to "the two-decade running average of global warming". Giving a likelihood of "extremely likely" also seems overstated given that the pace of observed warming is well above the stated average of global warming given in the SPM because of the two-decade period of averaging. There have now been individual years at roughly 1.3°C warming and it is not at all clear if this is due to variability or due to an acceleration of the pace of warming as sea ice cover melts (generally faster than the models project), permafrost thaws, snow cover retreats, and so on. To be appropriately cautious in coming to scientific findings, "extremely likely" should be changed to "very likely" and "with a more than 50% likelihood" changed to "with the possibility of". That greater caution should be used in the statement on lines 3-7 (and elsewhere) is made clear in the text on lines 10-13 on this page. [Government of United States of America, U.S. Department of State]
2387	11	3	11	7	It would be extremely useful to have a similar sentence for the SSP1-2.6. [Government of France, Ministère de la Transition écologique et solidaire]
2689	11	3	11	7	The probability of a temporary overshoot is very significant for a range of impacts and so clear communication of the duration and size of overshoot of 1.5C is important. Here, we are told that projected warming with SSP1-1.9 is extremely likely to remain below 2C during the 21st century, with a more than 50% chance of staying below 1.6C implying a temporary overshoot of no more than 0.1C. The reasoning for a temporary overshoot of no more than 0.1C is unclear given that the first part of the sentence just says it is extremely like warming will remain below 2C. Please clarify the duration and potential magnitude of overshoots larger than 0.1C for this scenario this century. [Government of Canada, Environment and Climate Change Canada]
9017	11	4	11	4	"Under the lowest assessed CO2 emission scenario (SSP1-1.9) -- with declining global greenhouse gas emissions from the 2020s onwards and reaching net zero CO2 emissions in the 2050s -- global warming during the 21st century is extremely likely to remain below 2°C." It is important to note that this scenario also requires substantial use of negative emission technologies. [Government of United States of America, U.S. Department of State]
2389	11	4	11	4	Both the SSP1-1.9 and SSP1-2.6 assume strong negative emissions after 2050, not just net zero. We recommend to make this explicit here [Government of France, Ministère de la Transition écologique et solidaire]
4303	11	4	11	4	In AR5 and SR1.5 glossaries there was a definition of climate neutrality which has not been included in this report. It would be beneficial to include such definition. [Government of Italy, CMCC - Centro Euro-Mediterraneo per i Cambiamenti Climatici Instituto Nazionale di Geofisica e Vulcanologia (INGV)]
9019	11	5	11	5	Rather than using the term 50% likelihood, use the language in the Chapter 4 underlying text (page 37, line 17): more likely than not. [Government of United States of America, U.S. Department of State]
249	11	5	11	7	In the text it is stated that "extremely likely to remain below 2°C, with a more than 50% likelihood of staying below 1.6°C" with regards to scenario SSP1-1.9, however this quote is contradicted in the referenced chapter (4.3) as it is stated that "Under SSP1-1.9, 55% and 36% of the model simulations rise above 1.5°C and 2.0°C, respectively" thereby the text should be altered to 1.5 with a percentage of remaining below the aforementioned temperature of 45%, as there is no direct quotation in regards to 1.6°C. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]

Comment ID	From Page	From Line	To Page	To Line	Comment
2391	11	6	11	6	Concerning the overshoot, we suggest either to precise that this bit applies to the "50% likelihood" part of the sentence, not the whole sentence (the overshoot can be larger than 0.1°C) or to delete this part, as it is redondant with "below 1,6" [Government of France, Ministère de la Transition écologique et solidaire]
7477	11	6	11	7	the statement in "implying … warming" suggests high accuracy. We prefer to mention the likely range of overshoot for the SSP1-1.9. [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
9021	11	6	11	7	It needs to be made explicit that this 0.1°C value for exceedance is based on the running two-decade or so change in the global average temperature. Due to variability, there will be individual years where the exceedance is as much as several tenths of a °C greater than this -- and since the degree of many types of impacts is dependent on one year or even shorter length exceedances, this statement seriously underplays the types of impacts that would result from this emissions scenario. [Government of United States of America, U.S. Department of State]
6695	11	7	11	7	Useful to give also the probability of staying below 1.5 C. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6405	11	7	11	23	SIDS are among the most vulnerable regions and every increment of warming matters, the regional assessments of changes under 1.5°C (H.S. 11.1/2) and 2°C (H.S.11.3) should be more balanced and provide changes for the most vulnerable regions as well. [Government of Saint Lucia, Department of Sustainable Development - Ministry of Education, Innovation, Gender Relations and Sustainable Developement]
4363	11	9	11	9	Here, it is left as unclear what applies for the SSP5-8.5. (The text in the TS is also unclear about this (cf. TS-9, lines 29-35), whereas the Cross-Section Box TS.1, Table 1 would seem to suggest that the central estimate of crossing occurs already earlier in SSP5-8.5.) [Government of Sweden, Swedish Meteorological and Hydrological Institute]
6697	11	9	11	9	HS.5.3 is arguably the most important HS statement of the report. And what about SSP5-8.5? The HS statement could also mention which trajectory the current emissions are following and whether this is similar to one of the SSPs. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
9023	11	9	11	9	A phrase needs to be included after the comma explaining the situation for SSP5-8.5, saying "for which an even earlier crossing is expected". [Government of United States of America, U.S. Department of State]
8515	11	9	11	9	Please clarify: In which direction does the estimate for SSP5-8.5 differ from the others? [Government of Australia, Department of Industry, Science, Energy and Resources]
9025	11	9	11	10	This statement is presumably, as with other statements in the SPM, referring to the date when the two-decade running average (or perhaps even the running average of the preceding two-decades ... the text is not clear on this) exceeds 1.5°C. Due to variability, the first year that has a warming of 1.5°C is likely to be considerably sooner and this needs to be stated by changing "the central esimate" to "the central estimate for the average warming over the preceding two decades" or adjusted for whatever the averaging period being presented is. While climate scientists may like to use the changing average over the previous decade or two, the media and the public are focused on the hottest present year, and the SPM statement needs to recognize this and indicate that individual year events could well (indeed essentially must) occur before the time-averaged warming does cross this threshold value. [Government of United States of America, U.S. Department of State]
339	11	9	11	10	This sentence, while reflecting correctly the underlying assessment, could be understood in a way that the lower limit of the Paris Agreement Temperature goal of 1.5°C is out of reach. Considering that the overshoot is very limited (0.1°C) for SSP1-1.9 (Table SPM.1) and considering that the Paris Agreement is based on the temperature range of AR5, which is 0.08°C cooler than the range assessed here, this is not the case. We thus propose to replace the word "crossing" by "reaching". [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]

Comment ID	From Page	From Line	To Page	To Line	Comment
6123	11	9	11	10	_1.5°C Scenario: Although from a scientific perspective the statement that all scenarios exceed 1.5 °C global warming is correct, since they do so at least for a certain period of time, it might send the wrong message to non-experts that limiting global warming to 1.5°C is out of reach. To avoid such a misunderstanding, we strongly urge the authors to replace "crossing" with "reaching" and by explaining that SSP1-1.9 is a low overshoot scenario (less than 0.1 °C). [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
61	11	9	11	11	Suggest to point out the central estimate of crossing 1.5C mark for SSP5-8.5, from evidences in the technical summary figure TS.1. [Government of Singapore, Ministry of Environment and Natural Resources]
7181	11	9	11	16	At this stage, we are still concerned as it relates to the treatment of the global mean temperature change that has led to new warming levels in AR6 for the same period compared to AR5. We remain confused as to the reason for the new warming level up from 0.61 to 0.69, an increase by 0.8oC in global surface temperature in AR6 relative to the direct equivalent estimates for the same period in AR5. We are concerned about the lack of clarity in terms of line of sight back to AR5. This raises major confusion for us and elevates uncertainty in communicating the results to decision-makers in the absence cogent reasoning. Moreover, it places a different lens on the Paris Agreement and therefore it would also be helpful for the authors to bring further clarity on how the temperature change already accepted and used to inform critical decisions in AR 5 compares with what now obtain in AR6 and what this now means for 1.5oC and 2.0oC targets. For instance what does the means for Carbon Budgets? This is important because it now places an additional rush on the PA targets which may appear more costly and less motivated. Therefore we have a serious concern with increase in warming. Can the authors provide greater clarity. [Government of Trinidad and Tobago, Ministry of Planning and Development]
297	11	9	11	16	The statement in the underlying chapter 2. P. 41 L. 28 P. 41 L. 30 “The assessment of global warming to date now being larger than previously assessed has no consequence on the assessment of past climate impacts, nor does it generally imply that projected climate impacts are now expected to occur earlier”, is in conflict with the finding H.S.5.3 in the SPM: “the central estimate of crossing the 1.5°C global warming level lies in the early 2030s. This is about ten years earlier than the midpoint of the likely range (2030 –2052) assessed in the SR1.5”. These conflicting findings should be clarified in the SPM and justification should be provided for decision makers. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
6699	11	9	11	16	This paragraph needs greater attention given the high policy relevance of its findings. Suggested improvements: [most important] 1) state the findings from Cross-chapter Box 2.3 on "implications for assessment of impacts and adaptation", namely that 1.5°C warming under the new understanding is equivalent to 1.42°C in SR1.5. If possible, state the time when warming would be expected to cross the threshold had the historical warming not been updated. [nice to have] 2) state what are the methodological improvements that led to reassessment of historical warming (if this is possible in 1-2 sentences). 3) mention what are the main drivers of the larger near-term future warming trend (appears to be the introduction of a projection derived from multiple lines of evidence rather than extrapolation of past trends). Ideally explain why this method is better (given that complicated models are not always best at short-term predictions). [Philippe Tulkens, European Union (EU) - DG Research & Innovation]

Comment ID	From Page	From Line	To Page	To Line	Comment
4671	11	9	11	16	By focusing only on the central estimate, instead of a range, the wording of this sentence gives the misleading impression that 1.5C will always be crossed, which is not consistent with the underlying evidence. This level of precision is , combined with the changes of methodology/data, will lead to confusion as to what actual changes the world is undergoing physically and what is possible. Instead of looking only at a central estimate for crossing 1.5C, we would suggest discussing the chances of exceeding 1.5C over time for each scenario. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
4673	11	9	11	16	The comparison between this report and SR1.5 on the central estimates of crossing 1.5°C is likely to confuse readers, given that it is comparing dates derived from different methodological approaches and starts from different baselines, and is therefore not a like-for-like comparison. We suggest removing the text in HS.5.3. that reads: "This is about ten years earlier than the midpoint... than the recent trends extrapolated in SR1.5". It also currently difficult to separate 'real' changes from methodological ones and we would welcome if these methodological changes and the resulting increases in projections could be clearly articulated and separated out as much as possible. Taken out of context, this paragraph could be understood as saying the world is in a much worse situation than it was in 2018. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
4675	11	9	11	16	Comparing HS5.3 on the timing of crossing 1.5C in the early 2030s with HS1.2 on the level of current warming would imply a warming rate over the next decade of approximately 0.4C, which is double SR1.5's 0.2C/decade. Could you please clarify if this is in fact the rate of warming you are expecting? If so, could you please clarify what this higher rate would be due to? If not, then this statement should be modified to give a realistic estimate of future warming. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
9027	11	9	11	16	It's not clear from H.S.5.3 if the earlier crossings of the 1.5°C global warming level came from the underlying assessed literature or assessment done by the authors of this report. [Government of United States of America, U.S. Department of State]
4679	11	9	11	16	We are grateful that in HS5.2, the authors communicate a probabilistic interpretation of staying below 1.5°C or 2°C as opposed to focussing solely on central estimates, which may give rise to an unjustified binary interpretation of whether or not each pathway stays within these limits. We are concerned that the first sentence of HS5.3 may give rise to unjustified confidence that we will cross 1.5°C in the 2030s 'in all scenarios'. We would therefore encourage the use of a more probabilistic framing here, such as the phrase "In all scenarios considered in this report, it is more likely than not that the 1.5°C global warming level would be crossed by the early 2030s." This should then be put into context with a statement comparing the scenarios to show the extent to which rapid mitigation delays near- and mid-term warming, as well as a statement explaining the likelihood of SSP1-1.9 returning below 1.5°C by the end of the century. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
7017	11	9	11	16	The efforts made to clarify the timing issue of crossing 1.5°C are welcome. There are however several issues present: First, the timing issue should be assessed based on most recent observations combined with scenarios that are exactly capturing the recent past. As it appears that SSP-RCPs were used to assess recent warming as opposed to observations, information on the modelled vs. observed decadal warming rates would be desirable. Also, it is important to keep in mind that readers will instantly associate 1.5°C warming with the Paris Agreement informed by AR5, and that AR6 must establish a line of sight to this previous asssement. With the political sensitivity of 1.5°C, the presented assessment needs to be absolutely robust. Currently this is not the case, and the 1.5°C of warming presented would silently correspond to 1.42°C if Paris Agreement consistent methods were applied. [Government of Fiji, Fiji Meteorological Services]

Comment ID	From Page	From Line	To Page	To Line	Comment
7277	11	9	11	16	While we appreciate the efforts by the authors to elaborate on the 1.5°C timing issue based on the revised AR6 temperature assessment, there are several issues with the presented assessment that cannot stand. Given the proximity to the 1.5°C warming limit, it is important to assess the timing question based on most recent observations combined with most up-to-date scenarios. In addition, it has to be kept in mind that highlighting of the 1.5°C warming level will always be associated with the Paris Agreement long-term temperature goal infomed by IPCC AR5. As previously stated, it is important to clearly point to the warming assessment in AR5 and definitions that formed the basis of the Paris Agreement. In addition, the SSPs were designed to start in 2015. Which means that potentially outdated projections are used as "observations". How do modelled decadal warming rates compare to the available observations for the most recent past? Given the political sensitivities around 1.5°C, it is crucial that WGI only presents an assessment that is most robust with regards to science and transparent with regards to the Paris Agreement long-term temperature goal. [Government of Saint Kitts and Nevis, Department of Environment - Ministry of Agriculture, Marine Resources, Cooperatives, Environment and Human Settlements]
2691	11	9	11	16	This information about crossing a level of global warming 1.5C above pre-industrial is of course very significant given the Paris Agreement long term temperature goal. If “crossing time” is defined over climatologically relevant time periods, that should be made clear in the main text, rather than in a footnote. Does the conclusion of lines 9-10 mean that over the 20 year period centred on the early 2030s, the average global temperature over that period is 1.5C? If so, this long term averaged warming of 1.5C is important to communicate. [Government of Canada, Environment and Climate Change Canada]
205	11	9	11	16	Only 1.5 global warming level is considered here. All scenarios need to be presented in order to have a complete comparison, further global warming levels (such as 2 C) must also be regarded. Include findings of crossings for more global warming levels. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
463	11	9	11	16	It is stated here that AR6 estimates the global temperature reach 1.5℃ ten years earlier than SR1.5. This conclusion is not sufficiently justified and not convincing enough, and it is suggested to delete this paragraph. The climate sensitivity (ECS) of the CMIP6 model used in the AR6 report is different from that of the CMIP5 model used in the SR1.5 report, so is the methodology used. So it is not possible to makethis comparison and it is difficult to draw the above conclusion. [Government of China, China Meteorological Administration]
7151	11	9	11	16	The 1.5°C timing issue is explained, yet there are concerns here: It is critical that the timing issue is addressed based on most recent observations combined with most up-to-date scenarios (especially given the proximity to reaching 1.5°C). Readers will always relate 1.5°C warming to the Paris Agreement Long-Term Temperature Goal (LTTG) which was informed by AR5. AR6 must clearly link to that. Also, it is concerning that SSPs, designed to start in 2015 and thus only stylised projections, are apparently used as “observations” for the recent past. It would be important to provide information on how the modelled decadal warming rates compare to observations. It is important that the AR6 WGI assessment is particularly robust and transparent with regards to the Paris Agreement’s 1.5°C goal, given the political sensitivities. [Government of Samoa, Ministry of Foreign Affairs and Trade]
2813	11	9	11	16	We are approaching the 1.5°C warming limit rapidly, so it is absolutely key to investigate the timing question using most recent observations as well as most up-to-date scenarios. When talking about 1.5°C warming, it has to be clear that the readership will always associate this direclty with the Paris Agreement long-term temperature goal. It is therefore crucial to estabish a line of sight to the warming assessment in AR5 because it informed the Paris Agreement. Given that SSP-RCPs appear to be used for the assessment of recent warming, i.e. modelled change as opposed to observed change, it would be very helpful to know how recent observed decadal warming rates compare to the modelled rates. 1.5°C is politically sensitive, so the AR6 WGI assessment has to be very careful in not communicating timing issues based on inadvertantly shifted goalposts, as 1.5°C in AR6 corresponds to 1.42°C in AR5. [Government of Jamaica, Meteorological Service Division]

Comment ID	From Page	From Line	To Page	To Line	Comment
6397	11	9	11	16	We welcome the clarification on the 1.5°C timing issue based on the revised AR6 temperature assessment but there are several outstanding issues. As we are close to reaching 1.5°C, the question of timing needs to be based on most recent observations together with most recent scenarios. A clear link to the AR5 temperature assessment and the Paris Agreement is important, as well, seeing that the 1.5°C warming level is always associated with the Paris Agreement's long-term temperature goal. Also, it is important to reflect that the SSPs were designed to start in 2015, potentially outdated projections are hence used as 'observations'. WGI should only present a robust and transparent scientific assessment that relates to the Paris Agreement goal. [Government of Saint Lucia, Department of Sustainable Development - Ministry of Education, Innovation, Gender Relations and Sustainable Developement]
2393	11	10	11	10	Concerning "the early 2030s" we recommend to provide the likely range [Government of France, Ministère de la Transition écologique et solidaire]
2681	11	10	11	10	Footnote 16. This topic of crossing time is important and therefore it is critical to ensure the definition of this term is clearly stated. Is it correct that it is defined such that the global temperature averaged over the 20 year period surpasses a given threshold? If so, we suggest rewording the footntote to read "the crossing time is defined as the midpoint of the first 20 year period during which global temperature, averaged over the 20 year period, exceeds the global warming level." [Government of Canada, Environment and Climate Change Canada]
6701	11	11	11	11	Spell out SR1.5 report name. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
9029	11	11	11	11	Replace "because, owing to" with "due to" [Government of United States of America, U.S. Department of State]
7503	11	11	11	12	It should be better explained why AR6 assesses larger historical and future warming than SR1.5. "progress in methods" is not really an explanantion. It might be linked to the fact that lower climate sensitivity values are less likely and mentioned in prior statements? [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
2951	11	11	11	12	It would be better to explain more details about earlier emergence of 1.5C warming level, expecially for first reason, "larger historical warming" in AR6 owing to progress in methods". Cross-Section Box TS.1 provides qualitative description very short about AR6's assessments for historical warming rate compared to SR1.5. If some numbers for warming rate in AR6 and SR1.5 is provided, it would be helpful. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
4553	11	11	11	12	The "because, owning to" could be replaced by "from". [Government of Sweden, Swedish Meteorological and Hydrological Institute]
6127	11	11	11	12	We were surprised to read that AR6 assesses larger historical warming than SR1.5 for the first time in the section of "our possible climate futures". We strongly request the authors to discuss this information earlier in the SPM within the statement of the new temperature levels including a new temperature metric (HS.1.2). Please add a sub paragraph in section H.S.1 where warming is first mentioned. We also found it confusing that only the progress in methods leading to the change in historical warming (0.08°C – c.f. CCB 2.3) and the higher near-term warming are the reasons behind the 10-years-earlier timing. What about the contribution of the recent warm years (2015-2020) that lead to a much higher current global surface temperature? Please revise the statement. Furthermore, this timing in the early 2030s implies that the current rate of global warming is 0.3 to 0.4°C per decade (from 1.1 to 1.5 in about 12-15 years), which is much more than the SR1.5 reported (cf. SR1.5 SPM A.1.1) and higher than the recent decade implies (comparison of 2003-2012 GST change of 0.9°C vs. 2011-2020 GST change of 1.09°C). Is this number correct? If so, we urge the authors to spell out this very important message of drastically higher near-term warming. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]

Comment ID	From Page	From Line	To Page	To Line	Comment
341	11	11	11	13	While it is important that the SPM includes this para to explain that global warming of 1.5°C may be reached 10 years earlier than in the SR1.5, the explanations given need to be explained more clearly. On the one hand, Cross-section Box TS.1 explains that current global warming is assessed 0.08°C higher than in SR1.5 and AR5 due to a different temperature metric. How much does this change contribute to the 10 years? On the other hand, near-term projections are raising faster than in the SR1.5. Please make this change also more specific and explain why this assessment has changed and why it seems to be faster than recent changes imply. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
6125	11	11	11	13	The explanation of the 10-year difference needs to be improved please so that they are accessible for lay people. 1) Cross-Section Box TS.1 explains the updated assessment of historical warming (TS-28:22-23) due to changes in observational understanding and the availability of more data. Is this the only contribution for half of the ten-year difference or are there other reasons? Please clarify and quantify other potential contributions. 2) What are the reasons for assessing larger near-term future warming? Is this due to the use of a new set of emission scenarios? Or are there other contributions? 3) How do "changes in global surface temperature" relate to "global warming" or "global warming level"? [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
8217	11	11	11	14	This is an important update and arises because both the assessed level and rate of human-induced warming are revised from SR1.5. Yet it is difficult to follow, because directly comparable figures for the current level of human-induced warming are not given, and the current rate of human-induced warming is not clear. Can this be clarified? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
9031	11	11	11	14	This section is highly relevant for policymakers and should be extremely clear. Is the change because of improvements in model representation of physics, the GMAT dataset, or something else? This sentence could be revised to: "Roughly half of this ten-year difference arises because AR6 assesses larger historical warming than SR1.5; the other half arises because AR6 also assesses larger near-term future warming (medium confidence)." [Government of United States of America, U.S. Department of State]
4299	11	11	11	15	The differences with SR1.5 should be further clarified [Government of Italy, CMCC - Centro Euro-Mediterraneo per i Cambiamenti Climatici Instituto Nazionale di Geofisica e Vulcanologia (INGV)]
8221	11	12	10	13	When does this historical warming emerge from the records and over what period? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
9033	11	12	11	12	Some elaboration of change in the methods is needed here since the projection has changed significantly. [Government of United States of America, U.S. Department of State]
8219	11	12	11	13	Can progress in methods be explained? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]

Comment ID	From Page	From Line	To Page	To Line	Comment
4681	11	12	11	13	With respect to "assesses larger near term future warming…" - it would be helpful to have this expanded upon. There is a widespread perception that CMIP6 models are "running hot" because of their high ECS and this sentence, as currently ambiguously written, may lead many readers to conclude that this larger near term future warming is the result of the high ECS models. My understanding is that it is not because of this (the CMIP6 models are constrained by obs for this exercise, as per 4.3.4) and rather because of the switch from using current trends in SR1.5 to SSPs. It would be very helpful to have what is driving this larger warming more clearly explained. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
4083	11	12	11	13	Is the "larger near-term future warming" something derived from the latest generation climate model estimates? If so, influence from the aforementioned (lines 33-34 on page 8) overestimate of the climate sensitivity should be addressed. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
2395	11	13	11	13	We strongly suggest to revise this sentence to assess more clearly the progress that have been made in models. The method could be explained a bit more, explaining why the other half assesses a larger historical warming, is it due to a larger ECS. The formulation could also be simplified especially the part that talks about "recent trends extrapolated " [Government of France, Ministère de la Transition écologique et solidaire]
4217	11	13	11	13	The timing of crossing 1.5 degrees is undoubtedly a sensitive and impactful topic for policy makers. As such, it is our view that the most balanced and sufficient scientific statements need to be provided on this topic in the SPM. While the current draft of the SPM only contains relatively simple statements on this topic, we acknowledge that extremely important scientific findings are described in P41 Line 28 to 32 and P41 Line 54 to P42 Line 1 of Chapter 2. These findings state that: (a) “The implications are mainly that the level of warming associated with a particular impact has been revised”. It is also stated that “Most of the previously projected impacts and risks associated with global warming of 1.5°C have therefore not changed and are still associated with the same level of future warming (0.89°C) relative to 1986-2005.” Upon all the statements mentioned above, it is concluded that: (b) “There is therefore high confidence that assessment of the magnitude and timing of impacts-related climate quantities at 1.5°C is not substantially affected by the revised estimate of historical global warming.” Given these explanations, 1) It is not sufficiently clear if and how the statements (a) and (b) as quoted above are consistent with each other, thus require further clarifications. The former explains that the level of warming associated with a particular impact has been revised, while the latter explains that impacts-related climate quantities at 1.5°C is not substantially affected by the revised estimate of historical global warming, even though it is explained that the previously assessed consequence of 1.5°C is now associated to 1.58°C. 2) The findings currently contained in Chapter 2, including the statement (a) and (b), should be reflected in the SPM. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
6341	11	13	11	14	… AR6 also assesses larger near-term future warming …' What is the cause of that? Just methodology or also the recent hottest decade? [Government of Estonia, Estonian Meteorological & Hydrological Institute]
9035	11	14	11	15	A statement is needed to indicate what could result in particular years. This type of statement is needed throughout the SPM, being explicit in each of the many findings about when statements are based on extended period running averages and how different conditions could be in an individual year. [Government of United States of America, U.S. Department of State]

Comment ID	From Page	From Line	To Page	To Line	Comment
8223	11	14	11	16	We are aware of variability how is this information to be used to inform policy? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
6703	11	14	11	16	The sentence should be clarified, in particular regarding the the period concerned and "any individual year". Does "by 2030" mean that "any year before 2030" could exceed 1.5°C with the given probablility, or that by 2030 we would reach the situation that any individual year [thereafter] could exceed it with that likelihood? If it is the latter, then the end of the applicable period should also be provided (e.g., 2030-2040), as the likelihood would increase depending on the scenario. Whichever period is concerned, it is not clear whether the given likelihood applies to every year individually (i.e., that each year could exceed 1.5°C with such likelihood, which would make it virtually certain that, over a decade, at least one year would exceed 1.5°), or it is cumulative for the period (i.e., there would be 40-50% chance that there would be one year exceeding that temperature). [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
4677	11	14	11	16	In relation to the statement beginning 'Global surface temperature in any individual year…', it will be vital to accurately communicate the relationship between 1.5°C in a single year and climatic global warming as commonly understood in the meteorological community (and hence the temperature goal of the Paris Agreement), i.e. the difference between an annual and multi-decadal average. We would suggest changing this sentence to read "Global surface temperature in any individual year is subject to significant variability and may reach 1.5°C before the multi-decadal average used to measure global warming. By 2030, annual temperatures may exceed 1.5°C relative to 1850–1900 with a likelihood between 40% and 60%, across the scenarios considered here." [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
2683	11	14	11	16	This likelihood of individual years exceeding 1.5C is for years after 2030? Or up to 2030? If the former, then suggest changing 'by 2030' to 'beyond 2030' (or after 2030). [Government of Canada, Environment and Climate Change Canada]
4085	11	14	11	16	It should be clarified whether or not the exceeding threshold of 1.5 °C considers natural variability. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
6505	11	15	11	15	"…,with a likelihood between 40% and 60%, …" It should be about as likely as not (33–66%) ? [Government of Chile, Ministry of Environment]
207	11	15	11	15	The likelihood mentioned for global surface temperatures to exceed 1.5 C relative to 1850-1900 by 2030 between 40% and 60% is not supported by any reference. There is no mention in the referenced sections of the underlying report of this likelihood. Please omit this finding from the SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
2953	11	16	11	16	It doesn't seem that Figure SPM.8 supports H.S.5.3 sentenses enough. This should be considered whether to remain. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
4685	11	19	11	19	It would be helpful across the SPM to also refer to the consequences/impacts from changes, e.g. at the end of HS6 could add 'with increasing risks to people and nature/biodiversity' [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
2397	11	19	11	19	Could this sentence be clarified, does "heat waves over ocean" refer to marine heat waves or to atmospheric heat waves over the oceans ? [Government of France, Ministère de la Transition écologique et solidaire]

Comment ID	From Page	From Line	To Page	To Line	Comment
7183	11	19	11	21	Trinidad and Tobago is recommending that the text “tropical cyclones” be added after drought in HS 6 text, lines 19-21. Changes in tropical cyclone in HS 6.4 page SPM 12, line 3-5, carry the same high confidence level as all the other extremes in the statement and warrants elevation to the headline statement. Tropical cyclones are one of the most destructive extremes for the Caribbean and is the most destructive and therefore important climate hazard for Caribbean Small Islands and other tropical and mid-latitude regions. Including it will also balance the statement. [Government of Trinidad and Tobago, Ministry of Planning and Development]
3351	11	19	11	21	There is no confidence statement. [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
6705	11	19	11	21	Some of the phenomena listed (notably heat waves, heavy precipitation or droughts) do not constitute "changes" in and by themselves. The sentence should refer to changes in the magnitude and/or frequency of these. Please rephrase. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6707	11	19	11	21	Suggest replacing "increasing global warming" with "increasing global temperatures". The phenomena would become more severe with increasing temperature, whether or not [the rate of] warming increases. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
4683	11	19	11	21	While seemingly obvious, this is an important message to emphasise: that impacts increase as warming increases. It could be further strengthened and clarified by using wording similar to the start of HS.6.2 "every additional half a degree of global warming..." - this was a critical message from the SR1.5 and it is worth emphasising again. Its important that policymakers understand that keeping warming as low as possible avoids worsening impacts and that, even should the 1.5C threshold be crossed, there is enormous value in continuing to limit warming as much as possible, instead changing the focus to 2C or higher. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial
343	11	19	11	21	This statement is very general and would profit that some more quantification as done in the paras that are supporting it. Furthermore, we suggest to reword "become lager with increasing global warming" to "increase in intensity and frequency with increasing global warming". [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
7523	11	19	11	21	Add after droughts: "intense tropical cyclones and peak wind speeds" [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
7067	11	19	11	21	HS.6: Is there any evidence that these phenomena have been repeated in ancient geological times due to the natural warming of the earth? [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]
7579	11	19	11	21	HS.6 is quite an open door. At least it would be helpful if the authors could indicate whether new insights in the rate of change as a function of temperature increase have evolved since AR5. [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
7867	11	19	11	21	HS.6: Here the logical flow from large-scale indicators to more regional indicators is broken. HS.7 should come before HS.6. Futhermore, HS.6 mixes different changes into one statement and remains vague ("become larger") . The specific changes get somewhat lost, e.g., a HS on cryosphere (sea ice, glaciers etc) would be useful. Overall, HS.6 is not compelling. [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
6129	11	19	11	21	This statement is so vague (many changes become larger with increasing warming) that it becomes trivial. Please try to be more specific to provide a more powerful message. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]

Comment ID	From Page	From Line	To Page	To Line	Comment
8225	11	19	11	23	The text is unclear, what is meant scientifically by become larger? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
6709	11	19	11	23	This is a no-brainer. The question is how much larger? Linearly with T, non-linear? [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
9037	11	19	11	23	Changing "larger" to "greater" or "more substantial". [Government of United States of America, U.S. Department of State]
9039	11	19	11	23	All events listed in the statement already exist. What characteristics have changed (e.g., as loss of Arctic sea ice)? [Government of United States of America, U.S. Department of State]
4927	11	19	11	29	Please consider replacing 'larger' with 'more severe'? 'Large' can refer to intensity or area, but frequency can be higher. The duration of the events is also an aspect that ought to be included here, but it's not natural to describe longer lasting ones as 'larger'. [Government of Norway, Norwegian Environment Agency]
6131	11	19	12	14	We miss statements about the very policy-relevant topic of permafrost thawing and strongly request the authors to add more information from Ch 5 and Box 5.1 and subCh 9.5.2. In particular we miss the following information, which we think would fit in HS.6 quiet well. - Quantification: Please add information quantifying the potential role of permafrost: "Thawing terrestrial permafrost will lead to carbon release (high confidence), but there is low confidence in the timing, magnitude and the relative roles of CO2 versus CH4 as feedback processes. CO2 release from permafrost is projected to be 3–41 PgC per 1°C of global warming by 2100, based on an ensemble of models." (5-8:28-31) Although it is a wide range, it is crucial for policymakers to understand the potential role of permafrost. - Add information on the increasing role of fire and thermokarst: "[...] high confidence that Permafrost degradation through fire (Jones et al., 2015; Gibson et al., 2018b) is currently occurring faster in some well-studied regions than during the first half of the 20th century, and medium confidence that thermokarst formation, to which about 20% of the northern permafrost region is vulnerable (Olefeldt et al., 2016), can lead to faster large-scale permafrost degradation in response to climate change." (9-87:38-43), "Increased fire frequency and severity (Hu et al., 2010) also contributes to abrupt emissions and the removal of the insulating cover which leads to an acceleration of permafrost thaw (Genet et al., 2013)" (5-66:9-11) - Please include information on the role of abrupt thaw: "Abrupt thaw processes can contribute up to half of the total net greenhouse gas release from permafrost loss, the rest attributed to gradual thaw (Schneider von Deimling et al., 2015; Turetsky et al., 2020)" (5-66:7-9). [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
4925	11	19			H.S.6: Please consider specifying by including information about what is new in AR6. For example, "AR6 establishes with improved confidence that changes in the climate system, such as… become larger with increased global warming", if relevant. [Government of Norway, Norwegian Environment Agency]
9041	11	20	11	20	Key issue - Drought: "Droughts" here must be rephrased to "droughts in some regions" or "regional droughts" or similar, consistent with the more detailed statement at line 33. Otherwise, the false impression is given that global warming systematically increases drought worldwide. [Government of United States of America, U.S. Department of State]
2399	11	23	11	23	12.4 is quoted twice, and it seems that 3.4, 4.3 and 7.4 are missing (referenced in HS.6.5) [Government of France, Ministère de la Transition écologique et solidaire]
4929	11	25	11	25	Please consider claryfying what "mean climate" refers to. This is also the only time it appears. E.g. consider replacing with a term that is easier to understand such as "climate mean values". [Government of Norway, Norwegian Environment Agency]
7505	11	25	11	25	What is new here? Again, a very high level statement without much information. [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]

Comment ID	From Page	From Line	To Page	To Line	Comment
9043	11	25	11	25	Replace "climate" with "temperatures and precipitation". [Government of United States of America, U.S. Department of State]
3353	11	25	11	26	There is no confidence statement. [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
3355	11	25	11	26	It would be useful to include duration in addition to frequency and intensity of extremes [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
6711	11	25	11	26	Please consider using another term instead of "large" for describing frequencies. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
9045	11	25	11	26	Revise "Changes in mean climate, the intensity and frequency of extremes and other climatic impact drivers become larger with additional global warming" to "Changes in mean climate, the intensity and frequency of most extremes, and other climatic impact drivers become larger with additional global warming." It is highly questionable that the instensity of cold extremes will become larger. [Government of United States of America, U.S. Department of State]
9047	11	25	11	28	Change "larger" to "greater" or "more substantial". [Government of United States of America, U.S. Department of State]
7707	11	25	11	29	mention the quantified changes in ocean and land surface temperatures [Government of India, Ministry of Environment, Forests and Climate Change]
8227	11	25	11	29	As these are models of the future "projected" should be used rather than "will" [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
6713	11	25	11	29	How much larger intensity and frequency, and how does it depend on global T. How much warmer is land compared to ocean. HS61 is to qualitative to be useful. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
9049	11	25	11	29	In H.S.6.1, "changes is mean climate" needs to be rephrased into a statement with appropriate metrics for policymakers. The message claims it's virtually certain but has no quantitative measures or specific regional examples to support the claim. [Government of United States of America, U.S. Department of State]
9051	11	25	11	29	H.S.6.1 is a mix of two thoughts: extremem events and spatially different warming. Putting them together implies they are causally tied, but it does not mean (as implied) that extreme events will become 'larger' in the Arctic because it experiences more warming. Is there evidence for that? [Government of United States of America, U.S. Department of State]
4289	11	25	11	29	We suggest to include a reference to Antarctic sea ice or at least ice sheet [Government of Italy, CMCC - Centro Euro-Mediterraneo per i Cambiamenti Climatici Instituto Nazionale di Geofisica e Vulcanologia (INGV)]
7581	11	25	12	14	The substatements of HS.6 would be more policy relevant if it could be indicated whether new insights have been found in climate research since AR5. For example heavy prcipitation events increase faster/slower with each degree of global warming than we thought in AR5. If new research only confirms the findings of AR5 that would also be valuable to mention. [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
9053	11	26	11	26	Delete "It is virtually certain that". There are no indications of any alternative except perhaps in the event of severe volcanic eruptions. [Government of United States of America, U.S. Department of State]
9055	11	26	11	26	"larger" seems inadequate. Find a better word. [Government of United States of America, U.S. Department of State]

Comment ID	From Page	From Line	To Page	To Line	Comment
2401	11	26	11	28	We would like to draw attention to the fact that the section H.S.6 focuses on extremes. Maybe introduce the fact that this will be about large scale pattern. Futhermore, according to Figure SPM.5 and TS.2.6, exceeding the global average warming is true not only for the Arctic but also for the global land surface. This is a very relevant finding for decision-makers. Thus, we recommend to mention it and to add that the Arctic will even exceed the global land average warming. [Government of France, Ministère de la Transition écologique et solidaire]
8363	11	26	11	28	From the first part of the sentence it is clear that land will warm more than the ocean, but the second with the focus on the Arctic is not very clear is the Arctic here only ocean or includes land area? [Government of Ukraine, Director Ukrainian Hydrometeorological Institute]
4365	11	31	11	31	The "statistically significant" could be deleted, as it is clear from the context (it would seem that when the report speaks of changes, these indeed refer to statistically significant changes). Mentioning it here may confuse. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
9057	11	31	11	31	Should state "Every additional half a degree CELSIUS of global warming …" to ensure readers don't assume Farenheit. [Government of United States of America, U.S. Department of State]
8517	11	31	11	32	Suggest including a short explanatory text to indicate what 'statistically significant' refers to, in: ‘Every additional half a degree of global warming causes statistically significant increases in temperature extremes'. The underlying chapter also does not make this clear. 'Statistically significant' in, or relative to, historical data? [Government of Australia, Department of Industry, Science, Energy and Resources]
9059	11	31	11	32	Is this really true for cold extremes? Change "Every additional half a degree of global warming causes statistically significant increases in temperature extremes (likely)" to "Every additional half a degree of global warming causes statistically significant increases in hot temperature extremes (likely)". [Government of United States of America, U.S. Department of State]
239	11	31	11	32	The text line depicts a different confidence level that is not consistent with the referenced text {11.2, 11.3, 11.4, 11.6, Cross-36 Chapter Box 11.1} [TS.2.6] (Figure SPM.6). The SPM text line states "Every additional half a degree of global warming causes statistically significant increases in temperature extremes (likely)", whereas Ch. 11, pg. 6, Line 28-29 indicates "In particular, this is the case for temperature extremes (very likely)." In order to ensure consistency, the text should reflect the same confidence levels. Replace (likely) with (very likely) in th SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7479	11	31	11	33	Why is the term likely used for temperature extremes, whereas a confidence level is used for other variabels? [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
6715	11	31	11	33	Please clarify what "half a degree" relates to. Add "celcius/kelvin". It's not fahrenheit or lat/lon degrees. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6717	11	31	11	33	Please explain what is considered "statistically significant" here. Is it linked to some probability testing? [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6719	11	31	11	33	What is meant by "increases in temperature extremes"? Does it apply to low extremes as well as high ones? Are the "extremes" interpreted against the current distribution (so more events currently considered extreme) of extreme under the future climate (increased global mean), implying higher variability? [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
8519	11	31	11	33	Suggest clarifying that these changes are expected from simulations or projections (also in the rest of the H.S.6 statements). [Government of Australia, Department of Industry, Science, Energy and Resources]
345	11	31	11	33	As written now this sentence give the impression that the increases go stepwise, from one half of a degree to the next. We suggest rather using a wording of "With every increment of global warming" as is done in Figure SPM.6. Additionally we are surprise by the confidence statement of "likely". As indicated in ES of Chapter 11 we would rather expect a "very likely" in this sentence. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
7019	11	31	11	33	Specifically for vulnerable regions such as the Pacific, every increment of a degree of warming matters. Therefore, the statement should make that clear (instead of only emphasising every half of a degree). [Government of Fiji, Fiji Meteorological Services]

Comment ID	From Page	From Line	To Page	To Line	Comment
7279	11	31	11	33	We fear that the statement "Every half of a degree causes significant increase in temperature extremes" is too coarse and does not reflect the actual science assessed in AR6 WGI. Please revise statement to clarify that also much smaller increments in °C matters (public statement of Co-Chair on SR1.5). Every increment of avoided warming matters. [Government of Saint Kitts and Nevis, Department of Environment - Ministry of Agriculture, Marine Resources, Cooperatives, Environment and Human Settlements]
2955	11	31	11	33	Specifying affected regions by increases of temperature extremes and heavy precipitation intensity (most of the land areas for both?) would be useful to be compared with droughts that have "in some regions". [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
7153	11	31	11	33	It would be important to make clear here that, in fact, it is not only every half of a degree that matters but every increment of a degree – especially for vulnerable regions such as the Pacific. [Government of Samoa, Ministry of Foreign Affairs and Trade]
6133	11	31	11	33	"every additional half a degree of global warming causes…" could be misunderstood as nothing happens if warming increases by less than half a degree. However, "even relatively small incremental increases in global warming" (Ch 11, ES, page 11-6, lines 26-28). Please avoid this misunderstanding by writing "every increment" as in figures SPM 5 and 6. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
6135	11	31	11	33	Please specify whether the terms "increases" and "severity" reflect changes in "frequency" and/or "intensity", e.g.: does an increase in temperature extremes mean an increase in temperature or of the frequency? Are changes of heavy precipitation only related to the intensity or also to the frequency of these events? This may ensure consistency with the subsequent description in H.S.6.3 and H.S.6.4., but also in H.S.3 (e.g. H.S.3.2). [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
2815	11	31	11	33	Please reword this paragraph to make sure that it is understood that also smaller increments than 0.5°C lead to dicernible climate impact differences. [Government of Jamaica, Meteorological Service Division]
6399	11	31	11	33	We strongly suggest amending the statement to reflect that in fact, every bit of warming matters, not only of half a degree but also of more incremental changes. [Government of Saint Lucia, Department of Sustainable Development - Ministry of Education, Innovation, Gender Relations and Sustainable Developement]
465	11	31	11	34	"statistically significant increases" in the sentence "Every additional half a degree of global warming causes statistically significant increases in … and the severity of droughts in some regions (high confidence)" is not made sure for the change in drought for each 0.5 degree increase. It is suggested to verify whether the corresponding conclusions are available in the underlying report, and to correctly indicate the reference. [Government of China, China Meteorological Administration]
6429	11	31	11	36	Although the definitiion of extreme is explained in Chapter 11, the inclusion here to indicate that in present day extreme events are rare should be revisited. Extreme events are no longer considered rare in the Caribbean region particularly as it relates to tropical cyclones. So maybe including that in most cases are still rare or some other addition. [Government of Saint Lucia, Department of Sustainable Development - Ministry of Education, Innovation, Gender Relations and Sustainable Developement]
63	11	31	11	36	Suggest to incorporate chapter 11.5 findings on floods where appropriate/ feasible. [Government of Singapore, Ministry of Environment and Natural Resources]
6721	11	31	11	36	Cummulative impacts should be noted. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
4931	11	31	11	36	Perhaps leave the 'statistical significant' out here as it is covered in the main report? Also, it is slightly complex since the concept already involves likelihood, which then is merged with another likelihood consept - 'likely'. Furthermore, the expression of 'statistically significant' is fairly meaningless unless the level is explicitly stated - Presumably it's on the 5%-level. But again, please consider dropping it in the SPM as it presumably are more extensively covered in the main report. [Government of Norway, Norwegian Environment Agency]

Comment ID	From Page	From Line	To Page	To Line	Comment
6723	11	31	11	36	This paragraph could be deleted since its findings are rather general and its points are covered in the paragraphs that follow. Its main finding seems to be that changes at +0.5°C warming are statistically significant. But surely readers are entitled to assume statistical significance when reading about these same phenomena in the rest of the H.S.6 statements. If there is an important, non-duplicative point being made in this parapaph, it needs to be stated much more clearly. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
9061	11	31	11	36	Referring to "statistically significant increases in temperature extremes" is meaningless. With a large enough sample, even a miniscule change can be "statistically significant". And since this is a modeled result, a large sample can be created on a whim. The point that should be made here is that a half degree of global warming would lead to changes in extremes that are detectable in observations over a period of years. To make that claim, authors would have to state what time period is being considered, but that should be easy enough to do. [Government of United States of America, U.S. Department of State]
9063	11	31	11	36	"some regions" doesn't convey the importance of this summary finding. Will wetter areas become more wet and drier areas more dry? [Government of United States of America, U.S. Department of State]
9065	11	31	11	36	The first sentence of H.S.6.2 is too complicated and not region-specific. Consider deleting it. "Every additional half a degree of global warming causes statistically significant increases ..." [Government of United States of America, U.S. Department of State]
2403	11	32	11	32	On this line, there is a mixture of likelihood assessment with “likely” and confidence assessment with “high confidence”. It could seem that they are on the same level, which is not the case, so maybe restructuring the sentence would avoid this effect. [Government of France, Ministère de la Transition écologique et solidaire]
9067	11	32	11	32	The line-of-sight for the statement on changes in temperature extremes is noted as very likely in Chapter 11 (page 6, line 29). [Government of United States of America, U.S. Department of State]
2993	11	32	11	32	"temperature extremes" can be confused as including "cold extremes". [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
4087	11	32	11	32	The term of likelihood of an extreme temperature increase due to additional half a degree of global warming (likely) seems to be inconsistent with the underlying chapter (very likely) (page 11-6, lines 28-29). [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
6137	11	32	11	32	Please substitute 'likely' regarded to significant increases in temperature-extremes by 'very likely' as it is written in the ES of Ch 11 [p:11-6;l:28-29] [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
9069	11	32	11	33	Need more specificity in the phrase "the severity of droughts in some regions (high confidence)." Where are areas of low confidence about severity of droughts? Is there a highly confident detection of a pattern to where droughts are more severe? [Government of United States of America, U.S. Department of State]
9071	11	33	11	33	"in some regions" is vague. Specify the regions. [Government of United States of America, U.S. Department of State]
9073	11	33	11	33	"The occurrence of SOME extreme events ... will increase." A qualifier is needed here. [Government of United States of America, U.S. Department of State]
4255	11	33	11	33	It is stated that “the occurrence of extreme events that are rare in present-day”. Is that a correct statement? As based on our experience that extreme events have become a regular event and more frequent in this present day. [Government of Indonesia, Ministry of Environment and Forestry Indonesia]
7093	11	33	11	33	Prolonged drought and rising temperatures in mid-latitudes and arid and semi-arid regions with no choice have adapted to the new climate conditions and coped with these emerging climate patterns. Therefore, changing types and patterns of the environment in the world are included. (it should be added?) [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]

Comment ID	From Page	From Line	To Page	To Line	Comment
3357	11	33	11	34	It would be useful to give examples of the "extreme events that are rare today" [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
6725	11	34	11	35	Does it refer to all such events? E.g., late/early frosts, ice storms? [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
9075	11	34	11	35	The last sentence is a very important point, but it is phrased in a way that might confuse the reader. Suggest revising to: "Compared to the change in common events, there will be a greater increase in frequency of rarer extreme events." [Government of United States of America, U.S. Department of State]
9077	11	34	11	35	Aside from the sentence not explicitly indicating what is being compared, what would really be helpful is to provide an example of the very large shifts in extremes that are occurring. As one possibility that would be instructive, the text could present the Hansen et al. result that what were once normalized three-sigma summertime, land-surface, warm events in the mid-20th century (so roughly a 1-in-1000 likelihood) are now occurring with a likelihood of over 1-in-10, so a frequency increase of 100 in conditions for which building structures built back then were not designed to handle. Another type of example that could be mentioned would be intense precipitation events. Whatever is chosen, an example would greatly help in making this key point. [Government of United States of America, U.S. Department of State]
2957	11	34	11	35	Adding a link to Box TS.3 here would be relevant for "rarer extreme events". [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
2865	11	36	11	36	Figure SPM5 should be called also here. [Government of Chile, Ministry of Environment]
6727	11	38	11	38	It maybe useful to provide a footnote explaining what is meant with intensity of heatwaves and tempeture extremes. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
467	11	38	11	38	It is suggested that the SPM provide additional information on the differences between the terms "heat extreme", "heat wave" and "temperature extreme". [Government of China, China Meteorological Administration]
3359	11	38	11	39	It would be useful to give information on the three characteristics (frequency, intensity and duration) for both hot extremes and heat waves. [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
8231	11	38	11	39	How far into the future are these increases projected to continue? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
4933	11	38	11	39	Please consider adding a part to the sentence about why the intensity and duration of heat waves will increase even with stabilizing temperatures at 1.5C. Is it compared to todays situation? [Government of Norway, Norwegian Environment Agency]
8523	11	38	11	39	Suggest clarification. It is unclear whether the increase described is over present levels, or after warming has stabilised at 1.5°C. [Government of Australia, Department of Industry, Science, Energy and Resources]
9079	11	38	11	39	The meaning of the sentence is difficult to understand, and needs clarification. Is the intent to state that the magnitude of extreme heat waves would rise more than the magnitude of global warming? Or, as it now appears, is the intention to state that, even if global mean temperature rise stabilizes at 1.5°C, the intensity of regional heat waves will continue to rise? [Government of United States of America, U.S. Department of State]
9081	11	38	11	39	Is this statement discussing the change from the present or after 1.5°C is reached? [Government of United States of America, U.S. Department of State]
8229	11	38	11	46	As these are models of the future "projected" should be used rather than "will" [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]

Comment ID	From Page	From Line	To Page	To Line	Comment
347	11	38	11	46	Please specify if the changes in extreme expressed in this paragraph are with respect to which period? Is it present day, or pre-industrial? [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
9083	11	38	11	46	Authors have already established that land has warmed at a rate 1.5 times that of the global mean. It is hardly remarkable that the temperature of the hottest days increases by "1.5 to 2 times the rate of global warming." It is unclear how this "extreme" is related to the unnamed extremes that rise at 2-3 times the rate of global temperature. In sum, is it appropriate to scale the land extremes with mean land temperature? At a minimum, state the type of extreme that rises 2-3 times the rate of global warming, and also restate the relative land and global warming rates. [Government of United States of America, U.S. Department of State]
469	11	38	11	46	"Changes in the intensity of temperature extremes will very likely be proportional to changes in global warming" addresses the relationship between the intensity of extreme temperature events and climate warming. It is suggested to give the relationship between the change in the frequency of extreme temperature events and climate warming as well. [Government of China, China Meteorological Administration]
8521	11	38	22	37	Suggest rephrasing for accuracy: In a number of places in the text it is stated something *will* happen. This usage is also in some of the underlying chapters (11). This should be minimised, and replaced as much as possible with conditional and probabilistic language such as "is projected to" or "is likely to" or "is virtually certain to" in the SPM and in the accompanying chapters. The projected changes presented in WG1 are mainly scenario-dependent and need to be distinguished from forecasts or predictions - which are not the main focus of the WG1 report. [Government of Australia, Department of Industry, Science, Energy and Resources]
271	11	38		39	In the finding starting with "The frequency and intensity of hot extremes and the intensity and duration of heat waves will increase even if global warming is stabilised at 1.5°C." there is no mention of the level of confidence of the finding wherase findings in which are mentioned in the SPM should have the level of confidence of the finding. Hence, the level of confidence should be added. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
2405	11	39	11	39	We recommend to precise the definition of the hot extremes to understand the difference between the hot extremes and heat waves. Hot extremes = temperature extremes ? [Government of France, Ministère de la Transition écologique et solidaire]
2995	11	39	11	39	It is difficult to accept 'intensity' and 'temperature increase' in the same concept. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
6139	11	39	11	39	To quantify the intensity of expected hot extremes relative to present- day conditions, please insert: "…1.5°C. Relative to present-day conditions, changes in the intensity of extremes would be at least double at 2°C, and quadruple at 3°C of global warming compared to changes at 1.5°C of global warming.", as it is mentioned in the ES of Ch 11 [p:11-7;l:17-18]. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
4687	11	40	11	40	We would suggest removing the phrase 'and in some regions up to 2-3 times larger' from this paragraph, as this information is implied in the following sentences, but creates confusion when trying to understand how it related with the 1.5x and 3x stats quoted. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial
2901	11	40	11	40	how does this translate into ºC? please make the computation explicit [Government of Chile, Ministry of Environment]
7789	11	40	11	40	„up to 2-3 larger” - unclear: larger than what? Larger than in other areas? Larger than average? [Government of Poland, Ministry of Environment, Department of Air Protection and Climate]
9085	11	40	11	40	What does "2-3 times larger" mean? Does this mean greater change in temperature, longer duration, more likely, etc. If "more likely", the Hansen et al. results suggest "2-3 times" is too small unless the comparison is over only a short period (i.e., a decade or two). The text needs to be clarified. [Government of United States of America, U.S. Department of State]

Comment ID	From Page	From Line	To Page	To Line	Comment
7823	11	40	11	40	In paragraph H.S.6.3 it is recommended to change the wording in the statement "temperature extremes will be proportional to changes in global warming" (no precise definition for temperature extremes, no function to define "proportion" in the mathematical sense) [Government of Poland, Ministry of Environment, Department of Air Protection and Climate]
7095	11	40	11	40	Please add this sentence : "Rising temperatures in arid and semi-arid regions have lengthened the warm seasons and shortened the cold seasons." to the end of the sentence: "…..and in some regions up to 2–3 times larger" [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]
2685	11	41	11	43	Suggest replacing "temperature of the hottest days" with "temperature on the hottest day of the year". And similarly for the coldest. [Government of Canada, Environment and Climate Change Canada]
6729	11	42	11	43	"The highest increase in temperature of the coldest days" suggests a reduction in the frequency and/or intensity of cold extremes. That seems to contradict the first sentence of the previous paragraph, which postulates a general increase of extreme temperatures. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
9087	11	42	11	43	In Alaska, for example, for some dates of the year circulation changes are causing warming that is tens of °C above normal; in Siberia also, some of the hot days are much more than 2-3 times the increase in global average warming. This sentence needs to be clarified to match what is being observed (and, for reasons not clear, what is being observed is greater than being found in models, which do not seem to be altering the global jet-stream circulation in the Northern Hemisphere as much as is being observed). [Government of United States of America, U.S. Department of State]
4545	11	43	11	43	Why is “Arctic regions” in plural and not expressed as “the Arctic region”. The latter would be the more common geographical reference in English. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
3361	11	44	11	45	It would be useful to provide information on intensity and duration in addition to frequency for marine heat waves. [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
2407	11	44	11	45	We suggest to provide a number here, as done for the other extremes just before and add information about duration of marine heatwaves (important to assess massive mortality risks) [Government of France, Ministère de la Transition écologique et solidaire]
2959	11	44	11	45	It would be useful to indicate where and how much changes are expected for "frequncy of marine heatwaves". [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
2687	11	45	11	45	With this paragraph discussing temperature extremes, not all of the cited Ch. 11 sections seem relevant. [Government of Canada, Environment and Climate Change Canada]
2899	11	48	11	48	“In the footnote, do the 20-year periods correspond to running windows? Please clarify.” [Government of Chile, Ministry of Environment]
7119	11		11		In the case of arid and water-scarce areas of the world where there are many problems with water resources (especially the Middle East), more attention should be paid to the report.(DOI 10.1007/s10584-008-9438-5) [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]
6141	12	1	12	1	Is "heavy precipitation" in the text defined in the same way as "extreme precipitation" in Figure SPM.6 ? Please clarify. If the definition is the same, a reference to the figure caption would be enough. (please also check for "extreme temperature" and "drought" in the text blocks following HS.6.). [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
351	12	1	12	2	Add the uncertainty statement "virtually certain" here as is the case in the executive summary of chapter 11 [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
119	12	1	12	2	In fact, there are quite some regions where heavy precipitation events become less intense and frequent. Therefore it would be more accurate to write 'Heavy precipitation events IN MANY REGIONS will intensify…'. [Government of Russian Federation, Institute of Global Climate and Ecology]

Comment ID	From Page	From Line	To Page	To Line	Comment
139	12	1	12	2	The confidence level of the statement is missing "Heavy precipitation events will intensify and become more frequent with additional global warming". Include likelihood/confidence levels. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
141	12	1	12	2	Percipitation events should not be generalized to global level without description of underlying regional models. They should be dicsused on regional level. Additionally, as stated in chapter 8, page 12 line 37, "intensification of heavy precipitation events over land regions where sufficient data networks exist (medium confidence)", this statement has medium confidence and this should be stated in this paragraph in the SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
6731	12	1	12	3	"as warmer atmosphere holds more moisture"- this needs a bit more explanation why that would lead to more heavy precipiation- beyond linear scaling of rain with evaporation. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
8525	12	1	12	7	Suggest rephrasing for accuracy. Several parts of this text say extremes 'will' intensify or 'will' increase. Please express as 'will likely' or ' is projected to' or 'is likely to' etc. The accompanying figure SPM6, uses 'will likely occur' placing the extremes in probabilistic context. [Government of Australia, Department of Industry, Science, Energy and Resources]
349	12	1	12	7	This para uses the terminology "heavy precipitation" whereas the associated Figured SPM.6 uses the wording "extreme precipitation". Please clarify if they are the same. If it not the case, it would be better to align the text and the Figure so that they show the same. If they do show the same, use the same wording. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
9089	12	1	12	7	Using confidence statements seems much more useful than using the "likelihood" vocabulary (particularly in statements that start "It is virtually certain that"). It would be helpful to use the confidence statement approach more often, even on a consistent basis, in the SPM. [Government of United States of America, U.S. Department of State]
8233	12	1	12	14	As these are models of the future "projected" should be used rather than "will" [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
9091	12	1	12	56	This section needs to clearly define what is meant by "heavy precipitation" and "extreme precipitation" based on the definitions used in the underlying report. Particularly with the specificity used for some of the projected changes (increase by 7% per each degree of warming), these qualitative descriptions must be based on a quantitive threshold. The temporal and spatial scales and characteristics used to define " heavy" and "extreme" in this context need to be stated, at least in footnotes. [Government of United States of America, U.S. Department of State]
4689	12	2	12	2	I had been under the impression that whilst, experimentally and under theoretically ideal conditions, a 7% increase in water content of the atmosphere accompanies a degree of warming, in reality something between 4 and 5% increase is seen in reality - e.g. https://www.nature.com/articles/srep38752 Skliris et al paper. Assuming that this paper is still considered valid, have the authors considered this finding? [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
2409	12	2	12	2	We suggest to clarify this sentence to make it clear that it is the intensity of the precipitation (amount of falling water) that will grow by 7% by degree of global warming or the frequency of such events [Government of France, Ministère de la Transition écologique et solidaire]
2411	12	2	12	2	We suggest to add the term "celsius" after "degree" [Government of France, Ministère de la Transition écologique et solidaire]
6143	12	2	12	2	Please insert 'virtually certain' to express the likelihood of more frequent and more intense heavy precipitation events under additional global warming (as stated in the ES of Ch 11 [p.11-8;l:2] [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]

Comment ID	From Page	From Line	To Page	To Line	Comment
121	12	2	12	3	The statement «At the global scale,… » needs to be reformulated. Heavy convective precipitation over land (in the majority of regions) decrease with warming temperatures exceeding certain threshold (see, e.g., Hardwick Jones et al 2010, Drobinski et al 2016, Wang et al 2018, Berg et al 2009, Drobinski et al 2016, Martinkova and Kyselý 2020, Hardwick Jones et al 2010, Bao et al 2017, Wang et al 2018, Huang et al 2019). Additional check by the authors is required. [Government of Russian Federation, Institute of Global Climate and Ecology]
9093	12	2	12	3	Suggest changing "about" to "at least" as there are numerous studies suggesting super Clausius-Clapeyron scaling in certain types of storms, including tropical cyclones, atmospheric rivers, and mesoscale convective systems. Otherwise, this statement is overly conservative. [Government of United States of America, U.S. Department of State]
4523	12	2	12	3	This assessment appears to be made based on GCMs and is valid for daily precipitation (cf. Ch 11). The same chapter mentions also sub-daily precipitation extremes and convection-permitting models for which there are a number of studies (as cited in Ch 11 and elsewhere in the report, e. g. in the Atlas). These indicate potentially stronger (at least regionally) increases than the CC-scaling indicated here. It would be good if this were made clear here - either simply add "daily", or add a sentence about super-CC-scaling. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
6507	12	3	12	3	" as a warmer atmosphere is able to hold more moisture." Here I suggest change atmosphere by troposphere to be consistent with H.S.1.3 where says "Since the 1950s, the troposphere has warmed and it is virtually certain that the stratosphere has cooled." [Government of Chile, Ministry of Environment]
9095	12	3	12	3	This sentence might need elaboration as radiative and dynamical changes contribute to this response. [Government of United States of America, U.S. Department of State]
9097	12	3	12	3	Replace "as a warmer atmosphere is able to hold more moisture" with "in line with likely increases in specific humidity" since the current phrasing doesn't actually explain what will happen. [Government of United States of America, U.S. Department of State]
7591	12	3	12	3	Instead "as a warmer atmosphere is able to hold more moisture" should be "as in a warmer atmosphere, evaporation and atmospheric moisture content can increase" [Government of Croatia, Meteorological and Hydrological Service]
2817	12	3	12	5	This statement on projected changes in tropical cyclones is crucial for Small Island nations like ours. The combination of being assessed as a high confidence finding together with the fact that these changes will have huge implications on climate damages should lead to the inclusion in HS.6. [Government of Jamaica, Meteorological Service Division]
6401	12	3	12	5	Considering the adverse impacts of tropical cyclones on many regions and especially on SIDS, the significant projected changes, and the high confidence in this information, we would like to see this important finding elevated to HS.6. [Government of Saint Lucia, Department of Sustainable Development - Ministry of Education, Innovation, Gender Relations and Sustainable Developement]
2413	12	3	12	5	Adding if the areas will be affected by tropical cyclone change with the higher moisture would be a plus [Government of France, Ministère de la Transition écologique et solidaire]
7021	12	3	12	5	Tropical cyclones already have devastating effects on many regions of the globe, including the Pacific. To take this into account, elevating this finding and including it in H.S.6 should be considered. [Government of Fiji, Fiji Meteorological Services]
7281	12	3	12	5	Tropical cyclones have already been causing destruction with increasing frequency and intensity. Therefore, this statement on projected changes is of utmost importance to many most vulnerable regions around the globe, SIDS in particular. Given the significance of the projected changes for future impacts in most vulnerable regions and the high confidence in the findings, please elevate this finding further to be included in HS.6 [Government of Saint Kitts and Nevis, Department of Environment - Ministry of Agriculture, Marine Resources, Cooperatives, Environment and Human Settlements]
9099	12	3	12	5	The confidence in this statement on future tropical cyclones (TCs) is linked to the confidence in the detection statement for proportion of intense TCs (page SPM-7, lines 15-16). High confidence in the projection here would be justified if there were medium or higher confidence in the detection of an observed change in the metric. Despite what is claimed on page SPM-7, line 15-16), this statement only warrants medium/high confidence. [Government of United States of America, U.S. Department of State]

Comment ID	From Page	From Line	To Page	To Line	Comment
7155	12	3	12	5	We welcome the information on tropical cyclones and their projected changes due to their adverse effect on regions like the Pacific, and would therefore argue for this important finding (with high confidence) to be elevated and included in H.S.6. [Government of Samoa, Ministry of Foreign Affairs and Trade]
2961	12	5	12	5	Same as the 5th comment. Specifyinig regions for droughts would be useful. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
9101	12	5	12	6	Here, and elsewhere in the SPM, there is confusion about drought (an event of variability relative to a reference climatology) and overall drying (an aridification). The difference is important, but muddled in the text throughout. [Government of United States of America, U.S. Department of State]
9103	12	5	12	6	Key issue - Drought: This statement is presumably derived from the AGR ECOL rows of Tables 11.6, 11.9, 11.12, 11.15, 11.18, and 11.21, which show more and more regions affected by agricultural/ecological drought as the global warming level increases. However, as discussed in the Whole Document comments on Drought, this finding is likely dependent on the controversial linkage of temperature-dependent proxy metrics to agricultural/ecological drought effects rather than on the total-column soil moisture in the assessments in those table rows. With (uncontroversial) total-column soil moisture as the drought metric, one would expect equal areas of increasing and decreasing drought severity/frequency (as shown on Figures 8.19(c,f,i) and SPM.5(d)). The statement should be changed to reflect this -- e.g., "The land area affected by increasing drought frequency and severity, and the land area affected by decreasing drought frequency and severity, will both expand with increasing global warming." [Government of United States of America, U.S. Department of State]
6733	12	5	12	7	How much will be the expansion? [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
2867	12	7	12	7	Figures SPM5 and SPM7 should be called also here. [Government of Chile, Ministry of Environment]
2963	12	7	12	7	Adding a link to TS.6 would be useful for this paragraph. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
6437	12	9	12	9	Add clarity by inserting „more“ after „will lead to“ [Government of Austria, Federal Ministry of Agriculture, Forestry]
2415	12	9	12	9	In order to reinforce this important finding and better reflect the report, we recommend to add "additional" after "lead to" [Government of France, Ministère de la Transition écologique et solidaire]
9105	12	9	12	9	"Additional warming" relative to what? Current climate or current projections of warming? [Government of United States of America, U.S. Department of State]
9107	12	9	12	9	Change "will lead to" to "will lead to further". It needs to be made clear that all of these impacts are happening now. [Government of United States of America, U.S. Department of State]
3363	12	9	12	10	It would be useful to clarify the expresion "additional warming", in particular with respect to which baseline. [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
7977	12	9	12	10	In the statement "Additional warming will lead to permafrost thawing,..." it would be clearer to say "Additional warming will lead to larger…", as in the HS.6. [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
2693	12	9	12	10	The statement implies that additional warming is required for these changes to the cryosphere to occur. However, these changes are already occurring and for permafrost, glaciers and ice sheets, these impacts will lag behind the change in climate. Rewording is required to reflect that these changes are ongoing and will be exacerbated with further warming. Suggest to add the word "additional" before permafrost thawing. That is, "Additional warming will lead to ADDITIONAL permafrost thawing, loss of seasonal snow cover etc." [Government of Canada, Environment and Climate Change Canada]

Comment ID	From Page	From Line	To Page	To Line	Comment
5113	12	9	12	10	A statement with no time frame or level of warming remains quite vague - it only states the principle that with warming there will be less ice. Could you provide more specific statements, with a clear context? The reasons for not mentioning Antarctic ice sheet should be provided, if it is not included here. Statements about the link between human activities and Antarctic ice sheet mass loss need to be provided, possibly in a separate sentence due to the different processes and limited confidence in attribution (e.g. based on TS page 44). [Government of Belgium, Belgian Science Policy Office - Belspo]
9109	12	9	12	12	This statement about the time of sea ice-free summers in the Arctic seems weaker than statements in previous reports. Rephrase to provide more details about the influence of different scenarios and the potential timing of Arctic sea ice-free summers. Previous reports indicate the strong possibility of an Arctic sea ice-free summer occuring before 2050. [Government of United States of America, U.S. Department of State]
7441	12	9	12	13	The text from chapter 9, P.47, L. 47-49 states, "providing high confidence that the Arctic Ocean will likely become practically sea-ice free in the September mean for the first time for future CO2 emissions of less than 1000 Gt and before the year 2050 in all SSP scenarios." Additionally, the Executive Summary (pg. 6, Line 35-35) mimicks this text, "The Arctic Ocean will likely become practically sea ice–free during the seasonal sea ice minimum for the first time before 2050 in all considered SSP scenarios. There is no tipping point for this loss of Arctic summer sea ice (high confidence)." However, the SPM (pg. 12, Line 9-13) is not consistent with this text. Instead, the SPM states "....under all but the lowest two CO2 emissions scenerios (high confidence)." It is not clear what is meant by "..under all but lowest two CO2 emissions scenerios" as there is no text within the chapter that supports or reflects this POV. Remove "under all but the lowest two CO2 scenerios", and replace with "all considered SSP scenarios." [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
2417	12	9	12	13	We suggest to add in this section dealing about the cryosphere, a statement about the future of the Antarctic ice-sheet, the largest ice mass on Earth. Elements are provided in TS p44 l12-16 [Government of France, Ministère de la Transition écologique et
4367	12	9	12	14	A finding also on the Antarctic ice sheet(s) would be useful here. Please amend, as appropriate. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
6735	12	10	12	10	Here a statement aboout the Antarctic ice sheet is missing. It is rapidly losing mass, accelerating since 2002. Reference to Antarctic sea ice further down OK. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
9111	12	10	12	10	With more and more melting adding freshwater to the surrounding ocean, it is not surprising that there are uncertainties about trends and timing of changes in seasonal sea ice. However, there are changes occurring, and so this statement would benefit from a bit of amplification, to something like: "While there is low confidence in the timing of the projected long-term decrease in seasonal Antarctic sea ice cover that will result from global warming, ocean waters are generally warming and tending to thin and weaken ice shelves that are holding back the ice streams that drain the Antarctic ice sheet." [Government of United States of America, U.S. Department of State]
7439	12	10	12	11	The text from chapter 9, page 47-48, line 47-2, indicates CMIP 6 model simulations to be "providing high confidence that the Arctic Ocean will likely become practically sea-ice free...SSP scenarios." The confidence level, (likely), is omitted from the SPM (pg. 12 Line 10-11) in the sentence, "the Artic Ocean will become practically..." Omitting (likely) from this sentence demonstrates high certainty, however, that is not the case. Add "likely" after "will" and before "become" to ensure consistency with the referenced chapters. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]

Comment ID	From Page	From Line	To Page	To Line	Comment
2701	12	10	12	12	The language used to describe projected sea ice-free conditions in the Arctic is unclear. Does the phrase "The Arctic Ocean will become practically sea-ice free in later summer by the end of the century…." mean such a state will become the norm by the end of the century? This is the phrasing used on page TS-43. Alternatively, the phrase "practically sea-ice free may be a reference to the threshold of sea ice area below which the ocean is considered 'ice free'. Unclear as written which meaning is intended. Also, adding information for the likelihood of ice-free conditions under lower warming scenarios would also be informative. SR1.5 expressed conclusions about the likelihood of late summer sea ice free conditions in the Arctic in terms of the frequency of Sept ice free conditions at 1.5 vs 2C, and SROCC expressed it in terms of an annual probability at different GW levels. [Government of Canada, Environment and Climate Change Canada]
9113	12	10	12	12	This statement seems to be well behind what is being observed, at least as phrased. Much attention on observations focuses on the particular day with the very lowest amount whereas this statement appears to focus on the condition existing for a season. One must also state what "sea ice-free" actually means (what that minimum is). It would be useful if the statement here could be more reconciling of observations and model projections. For example, perhaps say: "The unprecedented retreat and thinning of Arctic sea ice cover observed over recent decades will continue leading to lower and lower amounts over longer and longer periods, thus allowing greater and longer ice-free access to the region (high confidence)." It just does not seem worthwhile getting into nuances of exactly what "ice-free" means and what "late summer" means, etc. [Government of United States of America, U.S. Department of State]
2695	12	11	12	11	Replace "by the end of the century" with "in the second half of the century". Figure SPM.8 panel b seems to show the practically sea ice free threshold being crossed (in the multi-model mean) in the third quarter of the century for the 3 highest emission scenarios. We note that in TS2.5 (page TS-43 lines 3-4), the reference to become practically sea ice free in late summer by the end of the century is for the high CO2 emission scenarios only (so not including SSP2-4.5). [Government of Canada, Environment and Climate Change Canada]
9115	12	11	12	12	The underlying Chapter 9 (page 6) notes a likely confidence for all emission scenarios: "The Arctic Ocean will likely become practically sea ice-free during the seasonal sea ice minimum for the first time before 2050 in all considered SSP scenarios. There is no tipping point for this loss of Arctic summer sea ice (high confidence)." [Government of United States of America, U.S. Department of State]
9117	12	12	12	12	Why is there low confidence for the projected decrease of Antarctic sea ice and high confidence for the decrease in Arctic sea ice? Is the reason for low confidence for Antarctic sea ice declines due to regional model simulations? If so, state that. [Government of United States of America, U.S. Department of State]
6145	12	12	12	13	The message includes only projected decrease of Antarctic sea ice, but may also refer to dislocation or thickness of sea ice, or in addition incorporate projections on shelf ice disintegration and increase in ice bergs. [link to H.S.9.3.2 - mass loss of Antarctic Ice Sheets] [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
273	12	12			The finding "There is low confidence in the projected decrease of Antarctic sea ice." is "Low confidence" finding and it may impact the confidence of any findings based on it. Hence, this finding should be omitted. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
8527	12	19	12	25	Suggest clarification to include the intent of Figure SPM.5 Panel a): It is not clear why the observed data and the simulated data are put together. The first sentence of the caption should clarify the intent: for example could read 'Comparison of actual and simulated data for global temperature annual mean change'. Verb is missing from second sentence -> 'Observed temperature data is from Berkeley…' [Government of Australia, Department of Industry, Science, Energy and Resources]
4089	12	19	12	25	Panel a): It is unclear what message the SPM is trying to convey by comparing observed and simulated changes. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]

Comment ID	From Page	From Line	To Page	To Line	Comment
2819	12	19			The introduction of Global Warming Levels (GWL) is very much appreciated since it allows to clearly relate regional changes to the global signal. This not only true for Figure SPM.5 but also for the rest of the SPM. However, due to the issues of combining historical and projected temperature changes, authors should include a clear pointer in a footnote that this assessment is based on the AR6 historical temperature assessment which is 0.08°C higher than in AR5. [Government of Jamaica, Meteorological Service Division]
7283	12	19			Figure SPM.5: The useage of Global Warming Levels (GWL) is very powerful here and throughout the report, and it provides a very clear picture of projected climate system changes, also on regional scales. Given the concerns raised regarding the combination of the historical and projected temperature change assessment, please make sure that information is incuded in the caption or in a footnote on which historical temperature assessment is used for the presented GWL changes. This approach should be taken whenever GWLs are presented. [Government of Saint Kitts and Nevis, Department of Environment - Ministry of Agriculture, Marine Resources, Cooperatives, Environment and Human Settlements]
9119	12	20	12	22	Change "data from" on line 20 to "data are from" to make this a sentence. On line 22, change "is available" to "are available". [Government of United States of America, U.S. Department of State]
4369	12	21	12	21	A mention on other global temperature data sets (which have been and are used extensively) should made. Ideally, these would be displayed in the figure as well, given their use in previous IPCC reports. Is the analysis uncertainty comparable to the other data sets? [Government of Sweden, Swedish Meteorological and Hydrological Institute]
8529	12	21	12	21	Consider reword for accuracy: As this is a surface temperature dataset, "horizontal" is redundant. Consider "spatial" instead. [Government of Australia, Department of Industry, Science, Energy and Resources]
4371	12	23	12	24	Is 100 years too short to calculate a reliable linear regression? How long should a period be for this? Also, "trend" would be a simpler term than "reliable linear regression", and could be used here. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
4091	12	24	12	25	The word "change" seems to be missing after "The right map shows simulated annual mean temperature". [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
9121	12	26	12	27	In Figure SPM.5, what soil moisture metric is shown (e.g., top level or accumulated over whole column)? [Government of United States of America, U.S. Department of State]
9123	12	26	12	27	It would be more helpful to have the soil moisture results be for the growing season or similar relevant period rather than the whole year. If one is a farmer, what matters is the growing season, not all year. [Government of United States of America, U.S. Department of State]
9125	12	26	12	32	The plots are quite interesting, but percentage change can be misleading in some presently dry areas. For example, the figure shows a very large percentage increase over the Sahara Desert and some other regions nearby. This needs to be explained or noted so a misimpression is not given that the deserts will now be covered in green plants. Somehow that there is a large percentage change on a miniscule base needs to be indicated or explained. And then, over India, for example, this is presumably an intensification in the monsoon, and so much more precipitation that flooding problems may result. Perhaps what to also show is the change in absolute amount. [Government of United States of America, U.S. Department of State]
7749	12	26	12	33	On Figure SPM.5. Panel b: In case of 4°C global warming, it is not clear that the temperature of the last category is between 5.0°C and 5.5°C, or above 5°C. (According to the legend, every colour means 0.5°C, which indicates the former answer, but regarding the size of the brown area suggests the latter option.) [Government of Hungary, Ministry of Innovation and Technology - Climate Policy Department]
7751	12	26	12	33	On Figure SPM.5. Panel c: In case of 4°C global warming, it is not clear that the precipitation change of the last category is between 40% and 50%, or above 40%. (According to the legend, every colour means 10% change in precipitation, which indicates the former answer, but regarding the size of the dark blue area suggests the latter option.) [Government of Hungary, Ministry of Innovation and Technology - Climate Policy Department]

Comment ID	From Page	From Line	To Page	To Line	Comment
8531	12	27	12	27	Suggest provide an example on how to interpret the standard deviation change in Figure SPM.5 Panel d). While degrees, precipitation change in percentage terms is easier to understand, what does the standard deviation change mean for people on the ground? Maybe give an example: at +1.0 SD what type of soil moisture change can people be expected to observe? [Government of Australia, Department of Industry, Science, Energy and Resources]
7753	12	38	13	4	Please add "daily" to the extreme precipitation. Maybe the explanation is not needed 4 or 3 times for what a 10-year event mean. [Government of Hungary, Ministry of Innovation and Technology - Climate Policy Department]
6737	12	38	13	4	The caption of SPM 6 should not equate "extreme temperatures" with extreme highs only. It would be good to show changes in extreme cold conditions, but even if they are not presented, their existence should be recognised. They are also a very important impact driver (e.g., the reduction in cold extremes has impacts on species distributions, including of pests and diseases and their vectors). [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
7983	12	40	12	40	Figure SPM.6 frequency reflects modifications in the return period of extremes. It would be interesting to reflect also the calculation of the new return period for the Present and Future warming levels. [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
65	12	51	12	54	To clarify that "these regions" refer only to the regions where there is at least medium confidence in a projected increase in agriculture/ecological drought. This does not include extreme temperature and precipitation where results are shown for the global land. Currently it is not sure if the sentence applies to droughts only, or all three extreme events. [Government of Singapore, Ministry of Environment and Natural Resources]
67	12	51	12	54	Suggest to specifically explain why regions such as SEA are excluded, e.g. there are no findings of medium confidence. [Government of Singapore, Ministry of Environment and Natural Resources]
2697	12	54	12	56	Fgure SPM.6 caption: The caption says the dots and bars show the medians and their respective very likely range. This is straightforward to understand for the bars in the change in intensity graphs. It is not so clear how to apply this to the bold dots in the change in frequency graphs, especially as the text in the figure itself says the bold dots are the likely change in frequency. Some further clarification of this in the caption would be helpful. [Government of Canada, Environment and Climate Change Canada]
2699	12	57	13	1	Fgure SPM.6 caption: Can some plain language be added here to explain what “Fractions of standard deviation of annual soil moisture” means, so that the graph for changes in 10-year drought events can be properly interpreted and communicated to others? This unit is a barrier to understanding although the main message of increaseing intensity of drought at higher levels of global warming is nonetheless clear. [Government of Canada, Environment and Climate Change Canada]
7755	13	4	13	7	SPM.8 is placed a bit far behind. It could be considered to include Figure SPM.8 after Figure SPM.6 because H.S.6.5 already refers to that figure. [Government of Hungary, Ministry of Innovation and Technology - Climate Policy Department]
177	13	6	13	10	The text lacks the holistic coveregae when discussing the future weakening of ocean sinks. According to Ch. 5 P7 Line1, the effects of these changes is not yet reflected in a weakening trend of the contemporary (1960–2019) ocean sink (high confidence). This should be added giving the whole picture. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
2421	13	7	13	7	There is no subsection on potential changes in ENSO frequency and/or intensity. Given the large impacts of ENSO in southern countries, especially in the agricultural sector, we strongly recommend to add in a subsection, the current state of knowldege concerning future ENSO. [Government of France, Ministère de la Transition écologique et solidaire]
9129	13	7	13	7	HS.7 and its sub-messages have very little information about regions. [Government of United States of America, U.S. Department of State]
3365	13	7	13	8	There is no confidence statement. [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]

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2419	13	7	13	8	In order to clarify the idea of scale in this section, we suggest to clarify the difference between the different global warming levels mentionned [Government of France, Ministère de la Transition écologique et solidaire]
7069	13	7	13	8	HS.7: It suggests to add the phrase "from natural and human made (anthropogenic) activities" at the end of this sentence: "Further global warming will … wet and dry events from natural and human made (anthropogenic) activities." [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]
7871	13	7	13	8	HS.7: Some quantification and link to scenarios would make this HS more compelling. [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
8235	13	7	13	9	As these are models of the future "projected" should be used rather than "will" [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8237	13	7	13	9	Can intensification of year to year variability be determined? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
9127	13	7	13	27	In this segment, but also elsewhere where projection results are discussed, it would greatly help the reader (who may very well be aware of prior IPCC assessments) as to how the new projections differ from the prior. So, is there anything new emerging here regarding change in the hydrologic cycle vs. AR5? It was helpful to have that contrast in prior projections when discussing the equilibrium temperature response. Do the same for the hydrologic cycle. [Government of United States of America, U.S. Department of State]
2965	13	7	13	37	Large-scale atmospheric circulation including Hadley circulation, Walker circulation, jets and extratropical cyclones are also important part of water cycle. However, changes of those aspects are not included except for the Southern Hemisphere jet and storm tracks under HS.7. More inclusion of large-scale circulation change in the SPM is highly recommended. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
5115	13	7	14	13	Could drought be considered in this section? [Government of Belgium, Belgian Science Policy Office - Belspo]
9131	13	8	13	8	The idea of a "wet and dry event" is interesting but not defined. No example of use thus far or in previous assessments. There are "heavy precipitation" and "drought" events. [Government of United States of America, U.S. Department of State]
6739	13	11	13	12	Better just to mention which SSPs this considers- as the scenarios are not only about CO2. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6439	13	12	13	12	The following language is suggested: "Further increase of the global surface temperature will result in further increase of the average annual global land precipitation." [Government of Austria, Federal Ministry of Agriculture, Forestry]
4093	13	12	13	12	It should not be limited to the surface temperature, but should be expressed as the warmer climate progresses. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
143	13	12	13	13	As indicated in Chapter 8, page 6, lines 15-23, the estimated rate of presiciptation and evaporation increase with global warming is model-depenent with a very likely range of 1-3% per 1 degree celsius. This is because not all models are wetting and some are drying. This is represented as 'high confidence that global mean precipitation and evaporation increase with global warming'. High confidence can not be concluded in model-dependent very likely range. The confidence level not acceptable and should reflect the fact that model-dependent estimation is used. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]

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7825	13	12	13	13	The first sentence is misleading in the context of the rest of H.S.7.1. [Government of Poland, Ministry of Environment, Department of Air Protection and Climate]
7949	13	12	13	17	There is no mention of changes in annual precipitation over Sahel/Sahara in almost all global warming levels and East Africa region under 4.0 warming level as seen in Figure SPM.5(c). [Government of Kenya, Kenya Meteorological Service]
8239	13	12	13	37	As these are models of the future "projected" should be used rather than "will" [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
7757	13	12	13	37	The H.S.7.1 and 7.2 paragraphs are very similar to H.S.6.4, and H.S.7.2 is more like a repetition. H.S.7.5 is also a repetition and not detailed enough to have its own paragraph. [Government of Hungary, Ministry of Innovation and Technology - Climate Policy Department]
6741	13	13	13	13	How much is the projected antartic see ice decline, and why is the confidence low? [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
9133	13	13	13	13	Define high latitudes, and does this sentence pertain to both the Northern and Southern hemispheres? [Government of United States of America, U.S. Department of State]
6509	13	13	13	14	"Precipitation will very likely increase over high latitudes and the tropical ocean, but likely decrease over large parts of the subtropics". I suggest add here one sentence that indicate that the deacrase in precipitation in the subtropics is intensified in the eastern boundaries of the oceans in the Southern Hemisphere, which is evident in Figure SMP.5 [Government of Chile, Ministry of Environment]
69	13	14	13	14	Useful to indicate which areas of the subtropics (over land/ocean) will experience decrease, in reference to Fig. SPM5. [Government of Singapore, Ministry of Environment and Natural Resources]
6743	13	14	13	14	The text indicates that the Sahel region will experience a decrease in precipitation, but Fig. SPM-5 (c) shows exactly the opposite. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
7091	13	14	13	14	Please add the sentence "changing precipitation patterns from normal to torrential precipitation in unconventional seasons" as well to the end of paragraph. [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]
2703	13	14	13	16	It is of interest to know whether precipitation variability will increase or not since this is something that often gets said and for which the evidence is sometimes unclear. So we support including a statement on this in the SPM. We wonder whether the text on these lines about the increased year-to-year variability (in seasonal mean precipitation) should include the information from Box TS.6 (page TS-52 lines 22-23) that this is year-round for the tropics and in the summer season elsewhere (medium confidence). Also, space allowing, we find the information in Box TS.6 page TS-52 lines 24-26 about projected increases in sub-seasonal precipitation variability also relevant for inclusion in the SPM. "Sub-seaonsal precipitation variability is also projected to increase with fewer rainy days but increased daily mean precipitation intensity over many land regions (high confidence). [Government of Canada, Environment and Climate Change Canada]
9135	13	14	13	16	Statistical significance does not guarantee practical significance. Authors don't mention whether this is a statistical result across models, or speak to the practical detectability of such a change in the future observational record. [Government of United States of America, U.S. Department of State]
9137	13	14	13	16	How can the land area of increase and decrease in mean precipitation both expand? The total land area is fixed, an expansion of the dry area must be at the cost of the expansion of the wet area. [Government of United States of America, U.S. Department of
9139	13	14	13	16	The land may "experience" a decrease or increase, but "statistical significance" is something attached to projections or certainty. Odd usage. [Government of United States of America, U.S. Department of State]

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5117	13	14	13	16	This sentence is long. Please clarify what "increased year-to-year variability" applies to, and consider splitting the sentence. [Government of Belgium, Belgian Science Policy Office - Belspo]
9141	13	15	13	16	"... mean precipitation will expand (medium confidence), with increased year-to-year variability" is not supported by what's shown in Figure SPM.5. This is because Figure SPM.5d mainly displays the SD changes of annual mean soil moisture instead of precipitation, although the two do have some relationship. So, it may be better to replace the soil moisture figure with the SD changes of annual precipitation if still keeping the same statement. But, if the authors still choose to keep the soil moisture figure, clarify if it is the soil moisture at surface layers or at all the soil layers. [Government of United States of America, U.S. Department of State]
7873	13	19	13	19	It might be helpful to replace "severity" by "intensity" here (this sentence does primarily refer to the events themselves and not to the imopacts?). [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
4691	13	19	13	20	Can you say what kind of "extreme weather events" are meant? As the section is about the water cycle, presumably they are precipitation events so could "weather" be replaced with "precipitation"? [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
2423	13	19	13	20	Though HS.7 focuses on water cycle, it is not clear whether the authors mean "precipitation-related extreme weather events" or "any kind of extreme weather events". The current wording is ambiguous and should be clarified. [Government of France, Ministère de la Transition écologique et solidaire]
113	13	19	13	21	The statement 'A warmer climate will increase the severity of very wet or very dry seasons and extreme weather events (high confidence). The severity of these extremes will increase in the 21st century, but their location and frequency will depend on projected changes of the large-scale circulation.' looks too strong. It is known that the cold season in Arctic is getting milder due to warming. Some refinement is needed. [Government of Russian Federation, Institute of Global Climate and Ecology]
3367	13	20	13	21	It would be useful to explain or elaborate on "the projected changes of the large scale circulation". [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
4693	13	20	13	21	I suggest amending "The severity of these extremes will increase in the 21st century, but their location and frequency will depend on projected changes of the large-scale circulation." to "The severity of these extremes will increase in the 21st century, but their location and frequency will depend on future changes of the large-scale circulation." as the sentence currently implies that the projected changes in models will drive real world impacts. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
8533	13	20	13	21	Suggest rephrase for accuracy: The severity will not depend on the projected changes, but rather on the actual changes in large-scale circulation (presumably from among a range of projections). [Government of Australia, Department of Industry, Science, Energy and Resources]
7827	13	20	13	21	H.S.7.2 - the statement too general ("location and frequency will depend on projected changes of the large-scale circulation"). Should be followed with some examples [Government of Poland, Ministry of Environment, Department of Air Protection and Climate]
4373	13	21	13	21	The projected changes in location/frequency may well depend on projected changes of the large-scale circulation. But the dependence of changes in location/frequency is (surely) on changes of the large-scale circulation (phenomenon), not projections (study method). Please clarify as appropriate. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
4935	13	21	13	21	We believe that many readers are not familiar with the term "large-scale circulation". Please consider explaining "projected changes of the large-scale circulation" better. [Government of Norway, Norwegian Environment Agency]

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6745	13	21	13	21	Why "projected"? It will depend on actual changes - not model-projected, although a correlation is likely. Suggest deleting "projected". [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
2425	13	21	13	21	please change 'large-scale circulation" to "large-scale atmospheric circulation" (cf. Box TS.6) [Government of France, Ministère de la Transition écologique et solidaire]
2967	13	21	13	21	"large-scale circulation patterns" would be recommended to deliver correct information. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
9143	13	21	13	21	Delete "projected". For an SPM audience, suggest explaining large-scale circulation ... of what? [Government of United States of America, U.S. Department of State]
3005	13	21	13	21	SPM is targeted for policy makers. Please It would be better to specify or suggest some exaples on large-scale circulations. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
9145	13	24	13	24	The likelihood statement for global monsoon precipitation applies to the Northern Hemisphere (Chapter 6, page 4). The line-of-sight for sahel is Chapter 8 (page 8). [Government of United States of America, U.S. Department of State]
6147	13	24	13	25	The statement regarding monsoon-projections in the SPM [p:SPM-13; l:24-25] differs substantially from the statement with regard to monsoon-projections given in the ES of Ch 8 [p:8-8;l:13-14]. Please correct. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
7791	13	24	13	25	high confidence is assigned to the projected increase while in H.S. 3.3 medium confidence is assigned to the observed increase or to its reasons. This seems inconsistent. [Government of Poland, Ministry of Environment, Department of Air Protection and Climate]
4937	13	24	13	27	Please consider a slight rephrasing to change the emphasis: 'The global land monsoon precipitation is projected to increase in response to global warming during the 21st century' [Government of Norway, Norwegian Environment Agency]
6747	13	24	13	27	increase by how much? [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
2969	13	24	13	27	According to underlying chapters, natural variability and response to aerosol forcing would play an important role in uncertainty of change in monsoon precipitation, especially in near-term period. I think this information on large variability of precipitation is important for policy makers who are interested in air quality control, for example, so it should be considered to add more information. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
251	13	24	13	27	In the following text "During the 21st century, global land monsoon precipitation is projected to increase in response to global warming (high confidence)". The text should include that the referenced chapter cited the likeliness of such an event taking place as likely which equates to (66-100%) as there is no direct confidence level linked to such an event taking place. It is also quoted that "Monsoon precipitation responses depend on region and emission scenario (high confidence)." [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
9147	13	25	13	25	Add definition of "monsoon precipitation". [Government of United States of America, U.S. Department of State]
9149	13	25	13	26	This text is partially repetitive and contradictory with text in H.S.3.3. [Government of United States of America, U.S. Department of State]
6749	13	26	13	26	Maybe add more info on Sahel, if it really gets wetter it would be a positive effect of climate change. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
9151	13	26	13	26	Given the totality of projections of the North American monsoon, there is only low confidence that the monsoon precipitation will decrease. [Government of United States of America, U.S. Department of State]
4939	13	29	13	29	As policy makers are not familiar with the term, please define "Storm tracks". [Government of Norway, Norwegian Environment Agency]

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4941	13	29	13	31	Please consider rephrasing for clarity: 'It is likely that the summer extratropical jet, storm tracks and associated precipitation will intensify and shift poleward in the Southern Hemisphere under high CO2 emission scenarios in the long term (2081–2100)...' [Government of Norway, Norwegian Environment Agency]
115	13	29	13	31	Why just CO2 is discussed? All greenhouse gases and aerosols are important in this regard. [Government of Russian Federation, Institute of Global Climate and Ecology]
9153	13	29	13	31	Th reader will be curious to know what the projections are for change in the NH jet/storm tracks, not only the SH jet/storm tracks. Include a statement, even if the projections are indeterminant for the NH. [Government of United States of America, U.S. Department of State]
471	13	29	13	31	It is only the historical and future changes of circulation systems and their influence on precipitation in the Southern Hemisphere that are addressed in H.S.7.4 and H.S.1.4. It is suggested to add relevant conclusions for the Northern Hemisphere. [Government of China, China Meteorological Administration]
7481	13	29	13	33	Can a statement be added on the extratropical jet in the Northern Hemisphere? [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
6751	13	29	13	33	Is this paragraph important enough for hte SPM? It could be deleted but, if retained, its relevance to the water cycle (HS..7) should be highlighted. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
2427	13	29	13	33	The current phrasing is ambiguous and it is not clear whether some phenomena developped in H.S.7.4 apply to both hemispheres or if H.S.7.4 concerns the SH only. Refering to TS.2.3, only SH is concerned, therefore we suggest to start the sentence as following :" In the long term (2081–2100) and in the Southern Hemlisphere, it is likely ..." and to delete the reference to SH in line 30. However, we also strongly suggest to add similar information about the Northern Hemisphere [Government of France, Ministère de la Transition écologique et solidaire]
2705	13	29	13	33	As per our comment on the conclusions on observed changes in storm tracks and the role of human influence (on page 4 of the SPM), there seems to be a gap by only mentioning changes in Southern Hemisphere storm tracks. TS.2.3 page TS-38 lines 1-2 conclude that while extratropical storm tracks have likely shifted poleward since the 1980s, there is low confidence in projected poleward shifts of the Northern Hemisphere mid-latitude jet and storm tracks due to large internal variabilty and structural uncertainty in model simulations. It would be helpful to include this conclusion in the SPM (perhaps, given the space constraints, without the details on the reasons for the low confidence). Sometimes, low confidence conclusions are important to include in an SPM to be clear that a topic was assessed, but there is only low confidence in the conclusion. [Government of Canada, Environment and Climate Change Canada]
8365	13	29	13	33	This H.S.7.4 is devoted to the Southern Hemisphere, but any specific H.S. is about the Northen Hemisphere. Could the first sentence with "shift poleward" be applied to both hemispheres? The second sentence is not clear at all. Please, rephrase this H.S. more clear [Government of Ukraine, Director Ukrainian Hydrometeorological Institute]
7829	13	30	13	33	H.S.7.4 - the nature of the opposing effects to the human influence on the jet due to "increased of other greenhouse gases" unclear. [Government of Poland, Ministry of Environment, Department of Air Protection and Climate]
6753	13	31	13	31	Should there also be info on the northern jet? [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
9155	13	31	13	31	Southern Annular Mode is the term used in the underlying text (Chapter 4, page 6). Be consistent. [Government of United States of America, U.S. Department of State]
4375	13	31	13	32	The "influence... likely to be reduced" is a bit complex way of saying this. Perhaps "In the near term (...) the effect of stratospheric ozone recovery counteracts the climate change impact…" [Government of Sweden, Swedish Meteorological and Hydrological Institute]

Comment ID	From Page	From Line	To Page	To Line	Comment
4095	13	31	13	32	1) After reading the Chapter 4, I understand that this assessment is for the Southern Hemisphere. It would be better to add “in the Southern Hemisphere” after “the human influence on the jet” in order to avoid confusion with change in jet stream in the Northern Hemisphere. 2) Assessment for the Northern Hemisphere jet is also interesting, even if its confidence level is low (TS p. 38). Differences in confidence levels are informative. In Chapter 4, pages 4 – 6, it is explained as follows: In the near term, the forced change in Southern Annular Mode in austral summer is likely to be weaker than observed during the late 20th century under all five SSPs assessed. This is because of the opposing influence in the near- to mid-term from stratospheric ozone recovery and increases in other greenhouse gases on the Southern Hemisphere summertime mid-latitude circulation (high confidence). In TS page 38, it is explained as follows: There is low confidence in projected poleward shifts of the Northern Hemisphere mid-latitude jet and storm tracks due to large internal variability and structural uncertainty in model simulations. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
257	13	31	13	33	The following text "However, in the near term (2021–2040), the human influence on the jet is likely to be reduced under all scenarios assessed, because of opposing effects of stratospheric ozone recovery and increases in other greenhouse gases (high confidence)." contains conflicting level of confidence/likeliness, the authors must unify the confidence criteria. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
6755	13	31	13	33	This paragraph is only understandable to experts. It could be made readable to a general audience by identifying the weather/climate phenomena that these changes will bring (e.g. where in the Southern hemisphere would the intense precipitation shift from/to?). Also, TS2.3 mentions many regional phenomena. What is the rationale for highlighting this one? [Philippe Tulkens, European Union
9157	13	31	13	33	"However, in the near term (2021-2040), the human influence on the jet is likely to be reduced under all scenarios assessed, because of opposing effects of stratospheric ozone recovery and increases in other greenhouse gases." Does this apply to the Southern Hemisphere only, or does this apply globally? [Government of United States of America, U.S. Department of State]
6441	13	32	13	33	The current language lacks clarity. Building on the TS the following wording is suggested: .. and increases in net emissions of other greenhouse gases. [Government of Austria, Federal Ministry of Agriculture, Forestry]
4097	13	33	13	33	"other greenhouse gases": Other than ozone? Or, other than CO2? It should be clarified. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
8535	13	35	13	35	Suggest clarification: ‘abrupt and irreversible' - state on what time scales changes would be 'abrupt' and/or 'irreversible'. Note HS9 (p. 14, line 40) uses 'irreversible' but appropriately states the time scale on which change would be 'irreversible'. [Government of Australia, Department of Industry, Science, Energy and Resources]
6757	13	35	13	35	HS7.5. It quite unclear what is meant with 'can not be excluded'. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
9159	13	35	13	35	On what timescale are the regional changes in the water cycle irreversible? Decadal, centennial to millennial, or geologic (millions of years). [Government of United States of America, U.S. Department of State]
4943	13	35	13	36	Please consider adding information about which scenarios the statement refers to, if applicable. As is, the para does not provide much additional information from what is said above and could be cut. [Government of Norway, Norwegian Environment Agency]
4099	13	35	13	37	We would like to confirm that this paragraph is suitable for the water cycle section. Irreversible changes and abrupt changes are described in HS.9 and in HS.12, respectively. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
4377	13	35	13	37	This paragraph is quite vague ((i) "21st C and beyond" could refer to any period under any scenario, (ii) "cannot be excluded" - would be true to many things, (iii) "medium confidence" on what?) and thus not a very informative one. Also, the nature of such changes is left unclear. Suggest deletion of H.S.7.5. [Government of Sweden, Swedish Meteorological and Hydrological Institute]

Comment ID	From Page	From Line	To Page	To Line	Comment
3369	13	35	13	37	It would be interesting to elaborate under what circumstances or scenarios "the abrupt and irreversible regional changes" may occur. [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
4945	13	35	13	37	Please consider this suggestion: 'We cannot exclude abrupt and irreversible regional changes in the water cycle over the 21st century and beyond, including changes in seasonal precipitation, streamflow and aridity, ...' [Government of Norway, Norwegian Environment Agency]
6759	13	35	13	37	Please give an example of one of the possible changes. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
2429	13	35	13	37	Could the authors specify which of these climate features might be irreversible and why? We found no clear supporting evidence in the cited chapters. For example, the amazone deforestation could be cited. Regions where these changes have high confidence could also be presented. Finally, it would make the statement clearer to specify for which scenarios these changes will occur, maybe section H.S.9 would be more appropiate to talk about irreversability [Government of France, Ministère de la Transition écologique et solidaire]
145	13	35	13	37	This statement "Over the 21st century and beyond, abrupt and irreversible regional changes in the water cycle, including changes in seasonal precipitation, streamflow and aridity, cannot be excluded (medium confidence)" is conflicting with the discussion in Chapter 8, page 9, Lines 11- 15. Abrupt human-caused changes to the water cycle cannot be excluded. There is evidence of abrupt change in some high-emission scenarios, but there is no overall consistency regarding the magnitude and timing of such changes. In fact, Positive land-surface feedbacks, including vegetation and dust, can contribute to abrupt changes in aridity, but there is only low confidence that such changes will occur during the 21st century. The statement in the SPM should be replaced with an accurate statement from the chapter. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
8367	13	35	13	37	Please, give examples of irreversible changes in seasonal precipitation, streamflow and aridity [Government of Ukraine, Director Ukrainian Hydrometeorological Institute]
9161	13	35	13	37	Delete H.S.7.5. Many things cannot be excluded (including asteroid impacts, massive volcanism, economic collapse, nuclear war, etc.), and one might imagine that they would have abrupt impacts on the water cycle too. Thus the specific aspects called out here are partial but self-evident. The item adds very little to the SPM. [Government of United States of America, U.S. Department of State]
209	13	35	13	37	Here the phrase "Cannot be excluded" is being refered to "abrupt and irreversible regional changes". The sentence refers to the same meaning of its referenced finding in Chapter 8: "Human-caused changes to the water cycle cannot be excluded." Refrain from using "Cannot be excluded" as it is not in the IPCC calibrated language. In addition, there is confilicting findings in this case. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7417	13	35	13	37	There is no mention in H.S.7.5 in the SPM of the following phrase in the underlying chapter 8, page 9, lines 12-13 "There is no overall consistency regarding the magnitude and timing of such changes". Reflect this sentence under H.S.7.5 of the SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
4101	13	36	13	37	The expression "cannot be excluded" itself contains some probabilistic connotation. Adding a "medium confidence" to this sentence makes its meaning very difficult to grasp. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
6761	13	40	13	40	"Under high CO2 emission scenarios": This seems to be the case for all scenarios. At least some measure of reduction of the sink is mentioned for all. In any event, it could be useful to clarify what is meant by "effectiveness". [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6763	13	40	13	40	High CO2 emission scenarios is not correct terminology, as also other emissions are high. Scenarios associated with high CO2 emissions? [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
7643	13	40	13	40	In HS.8 before the current text add the following, "In the lower CO2 emission scenarios, atmospheric CO2 concentrations are dominated by emissions rather than feedbacks." This statement from HS8.3 is highly motivating for policy makers to take urgent action and deserves prominence in HS.8 [Government of India, Ministry of Environment, Forests and Climate Change]

Comment ID	From Page	From Line	To Page	To Line	Comment
4947	13	40	13	41	H.S.8: Please consider rephrasing to increase understandability, we suggest: "The ocean and land carbon sinks are projected to become less effective at slowing the growth rate of atmospheric CO2 under high CO2 scenarios (high confidence)". Similar phrasings could also be used for some of the sub-sections. [Government of Norway, Norwegian Environment Agency]
4695	13	40	13	41	Is this not slightly misleading because H.S.8.2 also confirms that this loss of effectiveness also occurs under lower emission scenarios? Could this be clarified please. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
7563	13	40	13	41	Specify what high CO2 emission scenarios are [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
9163	13	40	13	41	This phrasing implies this will happen in the future, and yet it is already happening to a very significant degree. The Arctic, for example, has already become a growing source of CO2 and the Amazon is absorbing less carbon. This finding needs to be rewritten, making clear that this has already started and thus applies, with high confidence, to all emissions scenarios. [Government of United States of America, U.S. Department of State]
6149	13	40	13	42	H.S.8.: Is it really only "Under high CO2 emission scenarios"? In H.S.8.2 it is described that the removal of CO2 will also change under the lowest CO2 emission scenarios. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
8241	13	40	13	42	this is important for policy, could a clearer transition statement be included? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8243	13	40	13	42	The term "in combination" should be used here and the relative percentages for oceans and land included. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8245	13	40	13	42	Avoid use of relative time periods, state start and end of period under analysis. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
7483	13	40	13	42	Unclear statement. Please rephrase into: Under … effective, implying a larger fraction of the emitted CO2 remains in the atmosphere. [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
353	13	40	13	42	This high-level statement does not seem to reflect completely the underlying paras. In the summary text, it only referred to high emissions scenarios, whereas H.S.8.2 also talks about low emissions scenarios. Please reflect those two in the summary statement. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
6765	13	40	13	42	"Under high CO2 emission scenarios, the ocean and land carbon sinks are projected to become less effective at slowing the growth rate of atmospheric CO2 (high confidence)." Could you clarify how this weakening of sinks is considered in the scenarios, carbon budgets and pathways aiming for carbon neutrality? [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
7875	13	40	13	42	HS.8: There is no HS statement on ocean acidification. The impact on coastal systems is huge with consequences for marine food production (WGII), and hence WGI should set the stage for acidification by addressing it at the SPM top HS level. [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]

Comment ID	From Page	From Line	To Page	To Line	Comment
6767	13	40	14	13	It should be clarified whether or how land management effects associated with the scenarios (in particular land-based CDR) is taken into account in the findings presenteed. Whilst it appears that emissions/removals associated with land-use change are considered within anthropogenic emissions/removals (therefore not under the "land carbon sink" discussed in HS.8, which seems to be limited to the "natural response"), there clearly ought to be a significant interaction between the two. If the "land sink" is assumed to take place only on unmanaged land (or land not undergoing LUC), then the difference in the area of such land among scenarios should have an impact. If the "land sink" is considered to operate on all land (including land also counted for anthropogenic emissions/removals), then the emissions/removals on the same land areas must be partitioned among the two categories (anthropogenic vs the natural sink) and again the differences among scenarios could be expected to have an impact on this partitioning. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6343	13	40	14	13	HS8 says that sinks become less effective under high emission scenarios but does not specify what causes that. Please add a short explanation. Will there be GHG release from these sinks. What is the role of forests here? How are forests sinks affected? [Government of Estonia, Estonian Meteorological & Hydrological Institute]
9165	13	40	14	13	The statements regarding the likely response of the future land sink are particularly important (HS.8). They show that future increases in the land sink are likely under high emissions scenarios, yet a smaller proportion of emissions as emissions increase. They also show that the land sink could become a source if negative emissions are successful, which is a serious risk to abatement. Low confidence is associated with the likely evolution of the land sink under negative emissions though, which reinforces the urgent need to better understand the relationship between the land sink and atmospheric CO2 concentrations. [Government of United States of America, U.S. Department of State]
4103	13	40	14	35	It is confusing whether the land sink is natural processes only or involves anthropogenic processes of land-use and land-cover changes. In Figure SPM.7, changes in land carbon storage and the share of anthropogenic CO2 emissions taken up by land are treated as the sum of net biome productivity and anthropogenic land-related emissions from IIASA database. In H.S.8, the land sink seems natural processes only. If so, referring to Figure SPM.7 in this section gives inconsistent information. In anyway, the land sink should be defined explicitly. In addition, it should be clarified whether or not projections by Earth system models are combined with observational constraints and assessed ranges of climate sensitivity indicators including TCRE. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
275	13	40		41	The finding "Under high CO2 emission scenarios, the ocean and land carbon sinks are projected to become less effective at slowing the growth rate of atmospheric CO2 (high confidence)." only highlights the outcome of some of the scenarios without providing the outcome of the other scenarios. The findings from the all scenarios should be highlighted to provide clarity to the overall outcome and not to highlight only some findings from some scnarios. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
277	13	40		41	The finding "Under high CO2 emission scenarios, the ocean and land carbon sinks are projected to become less effective at slowing the growth rate of atmospheric CO2 (high confidence)." does not identify the specific scenarios that are refrenced. The refrenced scearios in the findings should be identified clearly in order to avoid any misunderstanding [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
9167	13	41	13	41	Add "concentration" after "CO2", to read: "growth rate of atmospheric CO2 concentration". [Government of United States of America, U.S. Department of State]
9169	13	41	13	41	Do authors want to say slowing the growth rate or removing CO2? Subsequent statements seem to address the latter. [Government of United States of America, U.S. Department of State]
4379	13	44	13	44	What does "on average" mean? Per year? Seen over the whole period (with different rates during different sub-periods?)? [Government of Sweden, Swedish Meteorological and Hydrological Institute]

Comment ID	From Page	From Line	To Page	To Line	Comment
9171	13	44	13	44	This finding could be linked with the TCRE concept. The importance/relevance of reduced fraction of CO2 removed from atmosphere by land and ocean under higher cumulative emissions is not clear, but it's the reason why cumulative emissions and change in air temperature is linear. [Government of United States of America, U.S. Department of State]
6151	13	44	13	45	Here some short examples of major land and ocean sinks could increase accessibility of the SPM, as readers would not have to consult Ch 5 to understand how land and ocean function as sinks, which is not explained in the SPM. Please revise and add examples accordingly. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
8537	13	44	13	45	Suggest clarification: Over what variable(s) is this figure averaged? [Government of Australia, Department of Industry, Science, Energy and Resources]
8539	13	44	13	45	Suggest clarification: Why is the value reported here for the last six decades, and not consistent with what's presented in Figure SPM.7? [Government of Australia, Department of Industry, Science, Energy and Resources]
6769	13	44	13	45	Can the 56% (as a central value) be given "high onfidence"? It would seem preferable to provide a range. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6771	13	44	13	45	It is somewhat confusing that the text gives 56% as the historic rate, whilst Fig. SPM7 uses 58%. They do not contradice as they apply to different periods, but it would be preferable in the SPM to use the same value in both the figure and the text. Also, it is quite likely that their confidence intervals overlap considerably. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
9173	13	44	13	47	Since authors give the 56% number, also give corresponding percentages in line 47 instead of describing as "decrease". [Government of United States of America, U.S. Department of State]
6153	13	44	13	48	It is stated that the land and ocean CO2 sinks will change in efficiency under different scenarios; unfortunately, it is not only the efficiency which is changing but the occurrence of ecosystems which act as "carbon stores", see e.g. Ch 5. Please add this information to the SPM. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
4697	13	44	13	48	HS8.1 talks about 56% over the past six decades, however, Figure 7 notes 58% between 1850-2019, could these be made consistent? [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
2431	13	44	13	48	We strongly suggest to harmonize this paragraph with the data showed on figure SPM.7. This means either to give the percentage over the 1850-2019 (as presented in Figure SPM.7(b)), i.e. say : "Land and ocean CO2 sinks have removed on average 58% of all anthropogenic CO2 emissions over the 1850-2019 period"; while also giving the respective shares of land and ocean. or present a chart of the past six decades period in the bottom left of Figure SSPM.7(b) rather than one for the 1850-2019 period [Government of France, Ministère de la Transition écologique et solidaire]
2433	13	44	13	48	This paragraph is formulated in a way which could cause confusion. The first statement is about fraction (56%) The second is about the absolute quantity. The third sentence is again about fraction. May be replace the last sentence by something closer to the headline: However, under high CO2 emission scenarios,sinks will become less effective at slowing the growth rate of CO2 because of climate change, [Government of France, Ministère de la Transition écologique et solidaire]
181	13	44	13	48	Ch.5 P59 Line16-18 mentioned that new syntheses since AR5 corroborate that the effect of elevated CO2 on plant growth and ecosystem carbon storage is generally positive (high confidence). This should be reflected in the SPM giving the whole picture for policymakers. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
183	13	44	13	48	The text should include as well the uncertainitiy of the magnitude of both the direct CO2 effect on land carbon uptake, and its limitation by nutrients as indicated in Ch.5 P60 Line29 [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
9175	13	44	13	48	What's the driver of the decreased C removal? [Government of United States of America, U.S. Department of State]

Comment ID	From Page	From Line	To Page	To Line	Comment
4383	13	44	14	6	The H.S.8.1 and H.S.8.2 would be useful to combine, as they both relate to sink strengths in the future. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
7583	13	44	14	13	Again, would it possible to indicate progression made since AR5? [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
6155	13	45	13	45	Please insert 'absolute' to clarify: "…take up a larger absolute amount of CO2…". [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
4381	13	45	13	46	The "Projections show… However, the" risks becoming confusing. While this is true, the key point here is that the sinks handle a smaller fraction of the emissions. The sentence "fraction of emissions… in the atmosphere." would as such seem to state with clarity the essential point (including that the sinks continue to function as sinks). [Government of Sweden, Swedish Meteorological and Hydrological Institute]
9177	13	45	13	46	This seems to imply that all existing natural sinks will remain so and this is already demonstrably not the case. The Arctic, for example, was recently found to be emitting on order of 6% of global CO2 emissions, so a source instead of a sink. [Government of United States of America, U.S. Department of State]
6157	13	46	13	48	Please indicate the consequences of this shift of proportion, in particular concerning feedbacks and the ECS. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
8247	13	46	13	48	Can projected atmospheric concentrations levels be included for this as well as timing if certain pathways are followed? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
4949	13	46	13	48	To clarify that the sentence refers to share of emitted CO2 remaining in the atmosphere, please consider rephrasing "proportion of remaining CO2 in the atmosphere" with "proportion of CO2 emissions remaining in the atmosphere". [Government of Norway, Norwegian Environment Agency]
179	13	46	13	48	The text does not cover the other factors influence the strorage of anthropogenic CO. In addition to atmospheric CO2 concentration, physical ocean processes and physico-chemical carbonate chemistry also influence the the storage of anthropogenic CO2. As indicated in Ch.5 P23 Line53-55. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
9179	13	46	13	48	Question whether this merits "high confidence" given the uncertainty in the biological response, especially in the ocean, and the potential size of the deep ocean carbon reservoir. [Government of United States of America, U.S. Department of State]
279	13	46		48	In the finding stating" However, the fraction of emissions removed from the atmosphere by land and oceans will decrease with higher cumulative CO2 emissions, resulting in a higher proportion of remaining CO2 in the atmosphere" wherase in Chapter 5, Page 6, line 46-48 stat "Over the past six decades, the average fraction of anthropogenic CO2 emissions that has accumulated in the atmosphere (referred to as the airborne fraction) has remained nearly constant at approximately 44%." this may provide conflicting findings regarding the fraction of CO2 emissions in the atmosphere. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
6773	13	48	13	48	mention how much the relative sink can go down. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
9181	13	48	13	48	Figure SPM.7 shows 58% and not 56% (as in line 44) for land and ocean carbon sink. [Government of United States of America, U.S. Department of State]
9183	13	48	13	48	Should read "with a higher proportion of emitted CO2 remaining in the atmosphere" [Government of United States of America, U.S. Department of State]

Comment ID	From Page	From Line	To Page	To Line	Comment
2971	14	1	14	1	It would be better to change expression for SSP2-4.5 to "intermediate CO2-emission pathway" (phrase of Box SPM 1) instead of "scenario that stabilize atmospheric CO2 concentration", for reader's easy understanding. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
8541	14	1	14	3	Suggest clarification: The sentence uses scenarios (plural) but only one example is given. Please clarify if this is the only one of the core scenarios with this behaviour. [Government of Australia, Department of Industry, Science, Energy and Resources]
6775	14	1	14	3	Please clarify whether in "the growth rates of CO2 removed by the land and oceans are expected to decrease" the "CO2 removed" refers to rates of removals (fluxes) or cumulative quantities removed. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6777	14	1	14	3	"The land sink eventually turns into a source under SSP1-1.9": Could you elaborate on the mechanism behind this? It seems counterintuitive, as that scenario would stress land ecosystems the least and "ougassing" is not an issue for land sinks. Does the reason have to do with the significant land take for the for CDR (which would make the affected land unavailable for "natural" carbon uptake)? [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
1671	14	1	14	5	We appreciate policy-relevant information given in this HS. Especially, research-based assessment on high-end sea level rise estimate including poorly understood ice-sheet destabilization processes is exteremely policy-relevant for the development of adaptation strategies and their implementation. [Government of Finland, Finnish Meteorological Institute (FMI)]
8249	14	1	14	6	Very important but unclear, some outline of the process that drive the reduced uptake and emissions from land is needed. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
4951	14	1	14	6	In H.S.8.2 it is not mentioned how we can achieve higher CO2 uptake from land and ocean. It seems like all emission scenarios will decrease the uptake, and even turn them into sources. Please explain how the uptake can remain at least at the current level. [Government of Norway, Norwegian Environment Agency]
4953	14	1	14	6	It might seem confusing to the reader that the land and ocean will take up less CO2 in low emission scenarios, since the previous para refers to the effectiveness (per emission) being lowest in high emission scenarios. Therefore, please consider to include a short explanation of this distinction in the beginning of this para, eg. moving some of the text in line 4-5 "take up less carbon in response to declining atmospheric CO2 concentrations" and, if suitable, refer to relevant climate inertia reactions/ interactions. Furtermore, it is not clear what "growth rates of CO2 removed" means. Please consider rewriting to make it more understandable e.g., "the rates of CO2 removal … decrease". [Government of Norway, Norwegian Environment Agency]
4699	14	1	14	6	In HS8.2, SSP2-4.5 is described as stabilising atmospheric CO2 concentrations this century. However, it is clear from Figure SPM4 that under this scenario, there are still substantial emissions of CO2 (around 10Gt per year) in 2100, which would make this statement incorrect. It would therefore be more accurate to start this statement with 'Under intermediate Co2 emission pathways' to be consistent with the description in Box SPM1. When describing SSP1-1.9 and SSP1-2.6, the reason atmospheric concentrations decrease is because emissions turn net negative which is not currently highlighted, so it would be useful to rephrase this section as 'Under the two emission scenarios that cross into net negative global emissions within this century...' [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
4701	14	1	14	6	The headline statement H.S.8 makes a general comment about reduced uptake in high emission scenarios, but this is not then referred to again. In this paragraph, there is a focus on moderate and low emission scenarios. Would recommend making this paragraph more comprehensive and providing information on all scenarios, from low to high, and their implications for CO2 uptake. Moreover, it would be more helpful if this we quantified in some way. In its current, qualitative, format, it is difficult to compare and contrast between scenarios. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]

Comment ID	From Page	From Line	To Page	To Line	Comment
355	14	1	14	6	This paragraph might be moved or linked to HS.13 as it is relevant to the discussion of CDR. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
185	14	1	14	6	The text indicates that land sink eventually turns into a source under SSP1-1.9 without mentioning how the ocean will response. This will not give the whole picture for policy makers for the assessment of impact of CO2 removal by land and ocean. It should be clearly mentioned that the ocean is expected to remain a sink (high confidence) as indicated repeatedly in Ch5 P81 Line49, and P104, Line1 [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
187	14	1	14	6	In relation to the slowing the growth of the ocean sink after 2050, there is low confidence in how changes in the biological pump will influence the magnitude and direction of the ocean carbon feedback as indicated in Ch.5 P8 Line13-14. Therfore, this should be clearly added to the SPM [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
9185	14	1	14	6	Elevating H.S.8.2 to the SPM could encourage an incorrect assessment of meaning. One reading of this is that one shouldn't reduce atmospheric CO2 too much because then the land becomes a source. Consider replacing this with another finding or adding a clarifying statement. Additionally, stating if this change in land sink could be altered through mitigation approaches (e.g., planting trees, etc.) would add value. [Government of United States of America, U.S. Department of State]
9187	14	1	14	6	The Technical Summary (page 47, line 21) describes the relationship between growth rate and carbon emissions: "This means that the more CO2 that is emitted, the less efficient the ocean and land sinks become (high confidence), an effect which compensates for the logarithmic relationship between CO2 and its radiative forcing, which means that for each unit increase in additional atmospheric CO2 the effect on global temperature decreases." This is a clearer statement for policymakers. The current statement should also describe when the land becomes a source for all of the SSP because the TS suggests that it isn't until 2300 that the lower emission scenarios project the land changes from a sink to a source (page 47, line 45): "Under three SSP scenarios with long-term extensions until 2300 (SSP5-8.5, SSP5-3.4-OS, SSP1-2.6), ESMs project a change of the land from a sink to a source (medium confidence)." The line-of-sight references TS.3.3.2 Carbon Dioxide Removal. Remove the cite or add additional information on the impacts that deliberate carbon removal will have on the land/ocean source and sink. [Government of United States of America, U.S. Department of State]
4105	14	2	14	2	“CO2 removed by the land and oceans” seems to be used as an accumulated amount of CO2 in the land and ocean sinks, but can be taken as a flux (CO2 amount per unit time). To avoid this ambiguity, using words such as “accumulated” may be an option. Another solution may be to replace “the growth rates of CO2 removed by ... decrease” by “annual CO2 removal by ... decrease”. In TS (e.g. Box TS.5), “(ocean and land) sink(s)” are often used to represent an amount of CO2 accumulated at the oceans and land, which should be consistent with PS. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
4385	14	2	14	2	The "growth rates" risks being unclear (growth rate of the size of the fraction going into sinks? Growth rate of the annual amount of CO2?) [Government of Sweden, Swedish Meteorological and Hydrological Institute]
8543	14	2	14	2	Suggest rewording the following: 'the growth rates of CO2 removed by the land and oceans are expected to decrease' to 'the rates of CO2 removal by the land and oceans are expected to decrease'. [Government of Australia, Department of Industry, Science, Energy and Resources]
2435	14	2	14	2	Saying "the growth rate is expected to decrease" is not trivial to understand. Does it really mean second derivative?. From Chapter 5, figure 5.25, it could be written: "Under CO2 emissions ... (SSP2-4.5), the land and ocean sinks are expected to decrease in the second half of the century. [Government of France, Ministère de la Transition écologique et solidaire]

Comment ID	From Page	From Line	To Page	To Line	Comment
473	14	2	14	2	The statement of "the growth rates of CO2 removed by the land and oceans" is not clear with regard to whether it means the growth rate of land-ocean carbon sinks. In order to make it accurate, it is suggested to verify and modify it. [Government of China, China Meteorological Administration]
9189	14	2	14	2	These changes are already occurring. The phrase "are expected" seems a decade out of date. [Government of United States of America, U.S. Department of State]
9191	14	3	14	3	Should read "THIS century", not "the century". [Government of United States of America, U.S. Department of State]
2437	14	3	14	5	SSP2-4.5 shows the same dynamics: land and ocean also taking less CO2. Also, as mentioned in chapter 5, it seems better to also acknowledge that the airborne fraction is increasing : "Scenarios that assume CO2 stabilisation in the 21st century (such as SSP1–2.6 or SSP2–4.5), have smaller absolute sinks but these sinks take-up an increasing fraction of the implied emissions." [Government of France, Ministère de la Transition écologique et solidaire]
4955	14	3	14	6	Please consider to either explain why the land sink turns into a source under SSP1-1.9, or delete the sentence. [Government of Norway, Norwegian Environment Agency]
4387	14	4	14	4	Does the "less" refer to the fraction going into sinks, or annual amount? [Government of Sweden, Swedish Meteorological and Hydrological Institute]
6779	14	5	14	5	to what time does "eventually" refer? [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
2441	14	5	14	5	We suggest to add after atmospheric CO2 concentration : "and warmer temperatures for the ocean waters" [Government of France, Ministère de la Transition écologique et solidaire]
6159	14	5	14	6	Please mention that the ocean might also become a CO2 source in scenarios with very large negative emissions und quickly dropping concentration (as in SSP5-3.4) as mentioned in TS-65-15. In addition, the paragraph might be more useful to move this paragraph to H.S.13 when CDR is discussed. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
7719	14	5	14	6	is it due to less green cover/reduced rate of photosynthesis? [Government of India, Ministry of Environment, Forests and Climate Change]
4703	14	5	14	6	Referencing the land sink as turning into a source for the lowest emission scenarios but for higher ones simply saying that uptake is reduced may seem counterintuitive. Could this be explained? Is the land sink only turning into a source in SSP1.9? If so, why exactly is that? Also, could a timescale be added as this is very relevant to policy - the TS says it could be over decades or centuries (the difference is obviously significant). [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
7285	14	5	14	6	The finding that land sinks become carbon sources under SSP1-19 is critical information that would require further details on reasons and implications. Please add! [Government of Saint Kitts and Nevis, Department of Environment - Ministry of Agriculture, Marine Resources, Cooperatives, Environment and Human Settlements]
6781	14	5	14	6	How about the ocean sink? [Philippe Tulkens, European Union (EU) - DG Research & Innovation]

Comment ID	From Page	From Line	To Page	To Line	Comment
2439	14	5	14	6	Could it be clarified if there is an apparent contradiction with SPM.7 where for SSP1-1.9 and SSP1-2.6 the share of anthropgenic CO2 by land and ocean is larger than for historical and the other scenarios? Also, we could not find this statement in the TS or chapters. In Box T.S.5, one can read "Under high CO2 emissions scenarios, it is very likely that the land carbon sink will grow more slowly due to warming and drying from the mid 21st century, but it is very unlikely that it will switch from being a sink to a source before 2100" and then further: "Under three SSP scenarios with long-term extensions until 2300 (SSP5-8.5, SSP5-3.4-OS, SSP1-2.6), ESMs project a change of the land from a sink to a source". Finally, please consider adding "transient" before "source" to keep it consistent with chapter 5 as well as precising the time when it will become a source (2100?) [Government of France, Ministère de la Transition écologique et solidaire]
475	14	5	14	6	This sentence means that the land will eventually change from a carbon sink to a carbon source under the SSP1-1.9 scenario, but key information of time frame is missing here, e.g., when will the change occur? It is suggested to give supplementary description. [Government of China, China Meteorological Administration]
7157	14	5	14	6	The information on land sinks turning into carbon sources under SSP1-1.9 is very important; more information on this here would be desirable. [Government of Samoa, Ministry of Foreign Affairs and Trade]
8545	14	6	14	6	Suggest mentioning in what decade it is more likely for the land sink to turn into a sink for each scenario. Or mention in text when that happens for the most optimistic scenario. In this way, the reader would get the idea that any other scenario means land sinks become sources even sooner. [Government of Australia, Department of Industry, Science, Energy and Resources]
9193	14	8	14	8	Authors are projecting how much CO2 will be in the atmosphere by 2100; however, the use of the word "uncertainty" here obscures what they are trying to say. The point is that the most important factor influencing CO2 concentration in 2100 is the amount of anthropogenic CO2 emissions (i.e., the scenario). The use of the word "uncertainty" detracts from that high confidence statement. Reword to indicate the choice of scenario is the most important factor determining atmospheric CO2 concentration in 2100. [Government of United States of America, U.S. Department of State]
6783	14	8	14	9	choice of emission scenarios'. It is not clear how a 'choice' can determine uncertaincies. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
4705	14	8	14	13	Could the authors consider adding the range of rates of permafrost loss projected under different RCPs? I also can't quite see how the final statement in this paragraph only gets 'medium confidence' as emissions from wetlands and permafrost thaw would surely contribute to further warming? [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
4707	14	8	14	13	Given the broad policy and societal interest in feedbacks, it would be helpful if this paragraph could be made less general. Currently it is an extremely high level overview, with no specifics. There is a lot of material to draw on in 5.4 and I appreciate that this makes it challenging to summarise, but perhaps some specific examples could be drawn out. Permafrost recieves a lot of attention and the findings of Box 5.1 could be highlighted. Or perhaps the basic summary from Chapter 5, Page 8, Line 43 - "Models project that over the 21st century the combined feedback of 0.02–0.09 W m-2 °C-1 is comparable to the effect of a CO2 release of 5-18 PgCeq °C-1 (low confidence)." [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
9195	14	8	14	13	Figure TS.17 shows that climate-carbon feedbacks add 0.33 W/m2/C. This is about 10% of the best estimate of climate sensitivity. Could this be used in this key finding? Here, and later when discussing air quality, being told that "human choices dominate climate effects" leaves unanswered the question of "for a given human scenario choice, what are the climate effects?" which is still a relevant question. So here, while CO2 concentrations are dominated by the difference between scenarios, it is still relevant that (a) climate-carbon feedbacks add about 10% to warming on average; (b) the uncertainty in that feedback ranges from 0 to 20%; and (c) for high CO2 emission scenarios the feedbacks could add as much as XX%. [Government of United States of America, U.S. Department of State]
9197	14	9	14	9	Replace "feedbacks" with "feedback effects". [Government of United States of America, U.S. Department of State]

Comment ID	From Page	From Line	To Page	To Line	Comment
2443	14	10	14	10	Could the part on feedback be clarified. Is this statement related to the fact that the lead to reduced fraction stored in land and ocean? [Government of France, Ministère de la Transition écologique et solidaire]
9199	14	10	14	10	Change "but these feedbacks" to "but these feedbacks, which could lead to massive natural emissions of greenhouse gases (e.g., as a result of permafrost thawing)". Also, change "uncertain" to "likely" as that is the direction of the likely influence. [Government of United States of America, U.S. Department of State]
4257	14	10	14	11	It is stated that : these feedbacks become more important and more uncertain in high CO2 emission scenarios. Additional ecosystem responses to warming" How to account for this and use this statement to develop a scenatio of climate change mitigations ? [Government of Indonesia, Ministry of Environment and Forestry Indonesia]
8251	14	10	14	13	When are these consequences of high emission scenarios projected to kick in and at what CO2 concentraion levels? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
2445	14	11	14	11	Concerning the "additional ecosystem response" when reading this sentence it suggests that previous estimates didn't include all feedbacks. Maybe the different statements should identify more clearly where the different estimates come from? in particular if these ecosystems were not considered, what is the implication for figure SPM.7? [Government of France, Ministère de la Transition écologique et solidaire]
4389	14	11	14	12	Could something be said here about how significant (for the overall increase of GHG in the atmosphere) these responses are projected to be at different levels of emissions/warming? For example, are such responses significant for the lower levels of warming? Some idea of magnitude would be useful here, such as fraction of respective carbon budget. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
8547	14	11	14	12	Suggest clarification: It is unclear whether the further amplification of warming is the net (overall) effect of all studied ecosystem responses, or just of some selected ones individually. [Government of Australia, Department of Industry, Science, Energy and Resources]
6785	14	11	14	12	in the para it reads: … Additional ecosystem responses to warming, including those associated with emissions from wetlands and permafrost thaw, further amplify warming (medium confidence). QUESTION why 'medium confidence'? [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
3041	14	11	14	12	Is it for Co2 or greenhouse gases? [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
6787	14	11	14	13	Other ecosystem responses should also be mentioned, especially the potential destabilisation of forests, for example in the Amazon basin. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
9201	14	11	14	13	The statement on ecosystem responses seems out of place as written. Expanding to say that these ecosystem responses will have a larger impact on warming and atmopsheric CO2 concentration in the higher emissions scenario would provide more context and increase the utility of this statement. [Government of United States of America, U.S. Department of State]
2447	14	12	14	12	Does "further amplify warming" applies only to high emissions scenarios ? If this is the case, could you please precise it. Furthermore, is this amplified warming beyond the climate projections presented here? please clarify the extent to which emissions from permafrost thawing are included in the projections provided. [Government of France, Ministère de la Transition écologique et solidaire]
7759	14	16	14	37	SPM.7: Above panel a) and b) the text is too long and basically a repetition, could be shortened Panel a) has no reference period mentioned and the historical share in H.S.8.1 was 56%, it is a bit confusing; Thus, 58% could be included in the text instead (with the respective timeframe 1950-2019) because that is the information understandable from Panel b).Please explain in the figure note what does "reference period: 1850-2100" mean.; Description lines 10-12: It is a bit complex description on fossil-fuel emisisons. [Government of Hungary, Ministry of Innovation and Technology - Climate Policy Department]

Comment ID	From Page	From Line	To Page	To Line	Comment
6789	14	18	14	18	"Carbon storage" is ambiguous. It is not defined in the glossary. "Cumulative change" suggests that it corresponds to carbon stock changes since 1850 (less any losses due to LUC). However, it is unclear whether the land fraction of the projected "storage" would translate into a corresponding increase of terrestrial carbon stocks. Also, the text in panel a) of figure SPM.7 says that "carbon storage" would increase throughout the 21st century for all scenarios, while the curve for SSP1-1.9 appears to decline at the end of the period. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
2707	14	18	14	24	Figure SPM.7 caption: We are unsure if there is simply an editorial error or we are misunderstanding something. The text above the figure in panel (a) showing change in land and ocean carbon with the five core scenarios says the results are shown from 1950-2100 but the caption says 1850-2100. And yet the grey line in the panel seems to be at zero in 1950. What was the uptake from 1850-1950? If this is not an editorial error, we can recommend the caption provide further clarification so this Figure is more easily, correctly interpreted. [Government of Canada, Environment and Climate Change Canada]
9203	14	18	14	35	Regarding ocean uptake, a plot needs to be added, perhaps as a panel c, showing the resulting change in ocean pH for the various scenarios. If the oceans take up as much CO2 as indicated in the high emissions scenarios, ocean acidification will be much worse. This aspect needs to be illustrated or otherwise made very clear regarding the risk being taken of the marine biosphere and food chain. [Government of United States of America, U.S. Department of State]
7051	14	22	14	23	(Chapter6: Short- lived climate forcers): According to the energy balance sheet of the electricity industry in Iran, the contribution of thermal power plants for SO2 emissions has been 29.94% in 2017.(IRAN energy balance sheet ,MOE,2018-2019) [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]
4391	14	23	14	24	The first part of the "historical period" until 1950 does not come well across in the figure (the grey interval below 0-line?) This would need further explanation (alternatively revision of the figure, e.g. extension of the x-axis to 1850). [Government of Sweden, Swedish Meteorological and Hydrological Institute]
4957	14	27	14	27	In line 9 of the figure caption of SPM.7, please consider replacing "budgets" by e.g. "carbon stores", as budgets might be confused with carbon budgets. [Government of Norway, Norwegian Environment Agency]
3371	14	40	14	41	There is no confidence statement. [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
7525	14	40	14	41	Add: "Sea level will continue to rise for centuries to millennia due to continuing deep ocean heat uptake and mass loss from ice sheets, and will remain elevated for thousands of years (high confidence)." [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
8549	14	40	14	41	Suggest adding glaciers to this phrase, to read: "…the ocean, ice sheets, glaciers and …" [Government of Australia, Department of Industry, Science, Energy and Resources]
2449	14	40	14	41	This headline gives the false impression that climate change itself (not its consequences) is not irreversible. Most elements of climate change are irreversible (except may be in SSP1-1.9). In fact it is probably worth reporting that under very high mitigation scenarios with large negative emissions (as is SSP1-1.9), climate change is reversible: global temperature slowly declines, Arctic sea-ice grows back, as does ocean ph (referring to figure SPM.8) [Government of France, Ministère de la Transition écologique et solidaire]
7071	14	40	14	41	HS.9: With what stable and solid evidence? Has such phenomena occurred in paleoclimate times? [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]

Comment ID	From Page	From Line	To Page	To Line	Comment
7877	14	40	14	41	HS.9: "Many consequences" is rather unspecific. You could spell out melting of ice sheets, sea level rise, acidification, possible crossing of thersholds at regional (e.g. monsoon) and global scale (e.g. AMOC), and make this HS more compelling. [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
9205	14	40	14	41	Slight rewording for clarity: "Many consequences of ongoing climate change are irreversible, especially for changes in ocean chemistry, ice sheet extents, and global sea level." [Government of United States of America, U.S. Department of State]
8253	14	40	14	43	The AR5 WGI SPM referred to the long term commitment to warming due to accumulated emissions of CO2 why is this not included here? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
6161	14	40	15	23	As mentioned in our overarching comment about tipping points, the framing of irreversible changes in the climate system is very helpful and understandable for policymakers. We urge the authors to include the term “tipping point" in this section HS.9 to strengthen its accessibility to non-experts. Also, please include some statements from Box TS.9 as they will add more perspective to the topic of tipping points and abrupt changes, for instance: - "It is virtually certain that irreversible, committed change is already underway for the slow-to-respond processes as they come into adjustment for past and present emissions." (TS-71:7-9) - "At sustained warming levels between 3°C and 5°C near-complete loss of the Greenland Ice sheet and complete loss of the West Antarctic Ice Sheet is projected to occur irreversibly over multiple millennia (medium confidence)" (TS-71:39-42) - "The response of biogeochemical cycles to anthropogenic perturbations can be abrupt at regional scales and irreversible on decadal to century time scales (high confidence)" (TS-72:8-9) - "At the regional scale, abrupt responses, tipping points and even reversals in the direction of change cannot be excluded (high confidence). Some regional abrupt changes and tipping points could have severe local impacts, such as unprecedented weather, extreme temperatures and increased frequency of droughts and forest fires." (TS-71:15-18) [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
357	14	40	15	23	We consider HS.9 and the supporting paras to be very policy relevant and putting into perspective the actions needed to limit climate change in agreement with the temperature goal of the Paris Agreement. In order to increase the policy relevance, we suggest including the term "tipping point" in the headline statement. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
2573	14	40	15	45	Concerning section HS.9, we recommend to clearly describe the irreversibility of climate components due to past emissions, instead of describing future changes in the context of future SSPs scenarios as currently done in HS.9.1 and HS.9.3. The SSPs related changes should be covered in previous sections (HS.5 to HS.8). [Government of France, Ministère de la Transition écologique et
6791	14	45	14	45	Maybe "past anthropogenic emissions commit us to" or similar, considering that the term "committed" is used later as well. At least "past emissions will lead to…" [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
9207	14	45	14	45	Replace "Past emissions have led to unavoidable future changes" with "Past emissions are expected to lead to unavoidable future changes". [Government of United States of America, U.S. Department of State]
8551	14	45	14	46	Suggest rephrase for accuracy, to include ice mass loss: ie "… from ocean thermal expansion and ice mass loss, which …" [Government of Australia, Department of Industry, Science, Energy and Resources]
6511	14	45	14	46	"… and sea level rise from ocean thermal expansion, …." I suggest add here the efect of the glacier mass loss in the sea level rise to be consistent with H.S.4.3 where says that "glacier mass loss accounts for about 41% of the observed sea level rise". [Government of Chile, Ministry of Environment]

Comment ID	From Page	From Line	To Page	To Line	Comment
2973	14	45	14	46	"from ocean thermal expansion" can be deleted. Because "sea level rise from ocean thermal expansion, which are irreversible" is right but this sentence excludes the sea level rise from glacier melting which is also irreversible. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
2575	14	45	14	50	"Past emissions have led to unavoidable future changes in ocean temperature". This does not seem to be true for the ocean surface. It might be best to refer to the global ocean or ocean interior or deep ocean. [Government of France, Ministère de la Transition écologique et solidaire]
8255	14	45	14	50	Past emissions of CO2? The main GHG linked to centennial to millennial timescales is CO2, is there a reason not to be clear on this? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
4709	14	45	14	50	Given that H9.1 purports to describe the range of ocean warming ranges over the 21st century, SSP1-1.9 should also be included. If that information is not possible, it should note this. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
4711	14	45	14	50	at a rate depending on the future scenario' is a really important 'caveat' - whilst we understand that WGII and III will explore the role of SSPs in much more detail, given their role in projecting future warming and changes in impact drivers, it would be helpful if more emphasis could be placed on the choices/possible futures represented by different scenarios. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
9209	14	47	14	48	This is confusing or misleading: the 2000-2100 "warming" ranges from 2 to 4-8 times that observed during 1971-2018. That is 100 years versus 48 years. Do authors mean the annual rate of warming? [Government of United States of America, U.S. Department of State]
4959	14	48	14	49	Are the readers of this report supposed to be able to read this independently of the main report and the technical report? If yes, is "Ocean stratification, acidification and deoxygenation" widely known? Please consider using less technical language. [Government of Norway, Norwegian Environment Agency]
2709	14	48	14	50	If possible, it would be helpful to include here a statement on whether these ocean changes (especially acidification and deoxygenation) are also irreversible on centennial to millennial time scales. [Government of Canada, Environment and Climate Change Canada]
9211	14	49	14	45	"a rate" should be "rates" [Government of United States of America, U.S. Department of State]
253	14	49	14	49	In the text it is stated that the level of confidence in increasing ocean deoxygenation is of high confidence however in chapter 4 table 4.10 it is stated that the "Projected 21st century change under continued warming" is of "Medium confidence in deoxygenation rates and increased hypoxia". The authors must alter the confidence level for this particular item. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
4283	14	49	14	50	The significant increase in oxygen loss under future conditions in the last generation of ESM simulations is of significant concern, particularly for oxygen reaching unprecedented levels. E.g. chapter 5, page 5-54, lines 9-12 quantitatively and 12-13 qualitatively. [Government of Italy, CMCC - Centro Euro-Mediterraneo per i Cambiamenti Climatici Instituto Nazionale di Geofisica e Vulcanologia (INGV)]
9213	14	49	14	50	Should read "… at a rate DEPENDENT on the future emission scenario." [Government of United States of America, U.S. Department of State]
9217	14	50	14	50	Do the confidence levels depend on the scenario? [Government of United States of America, U.S. Department of State]
4961	14	50	14	50	Please consider replacing "the future emission scenario" with "future emissions". [Government of Norway, Norwegian Environment Agency]
9215	14	50	14	50	Add Table 4.10 to line-of-sight references because it is a cross-chapter assessment of irreversibility of various earth system components. [Government of United States of America, U.S. Department of State]

Comment ID	From Page	From Line	To Page	To Line	Comment
9219	15	1	15	1	Change "Glaciers" to "Mountain glaciers" or "High-mountain glaciers". [Government of United States of America, U.S. Department of State]
2451	15	1	15	1	Given the impact of glacier mass loss on freshwater resources in some regions, elements on the potential timing on water shortages due to glaciers shrinking or disappearance would be useful (cf SROCC). [Government of France, Ministère de la Transition écologique et solidaire]
2841	15	1	15	2	H.S.9.2: I would add a sentence on glaciers as a hydrological resource after the first sentence, to make clear why it's important. Something like "There is high confidence that glacier contribution to river streamflow will decrease in the second half of the century and beyond {8.4, 9.5}." [Government of Chile, Ministry of Environment]
8257	15	1	15	3	For the future "projected" is preferred to "will" [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
9221	15	1	15	5	H.S.9.2 states with very high confidence that glaciers will lose mass. Explain why: extrapolation of observations, simple models, expert judgement? Most CMIP6 models include interactive ice sheets; they prescribe and keep glacier mask constant. They tend to lose snow on glaciers. [Government of United States of America, U.S. Department of State]
6163	15	1	15	5	To express the extent of the expected trends, it is suggested to address more components of the cryosphere, and to aligne confidence statements with the underlying report. Please substitute the first two sentences of H.S.9.2 by: "The Arctic Ocean is projected to become practically sea ice-free in late summer under high CO2 emission scenarios by the end of the 21st century (high confidence). It is virtually certain that further warming will lead to further reductions of the Northern Hemisphere snow cover, and there is high confidence that this is also the case for near-surface permafrost volume. Glaciers will continue to lose mass at least for several decades even if global temperature is stabilized (very high confidence), and mass loss over the 21st century is virtually certain for the Greenland Ice Sheet and likely for the Antarctic Ice Sheet." as it is expressed in the TS [p:TS-43;l: 2-8]. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
7761	15	1	15	5	Arctic sea ice extent is missing form the paragraph, and please link Figure SPM.8 for it as well. [Government of Hungary, Ministry of Innovation and Technology - Climate Policy Department]
359	15	1	15	5	Please add the high confidence statement from the TS here that near-surface permafrost volume is also projected to decrease. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
4713	15	1	15	5	The complement our comment on Fig SPM8, we believe that the low confidence elements of Fig SPM8d and SPM8e should be removed and paragraph H.S.9.2 should be expanded to highlight the potential hazard (i.e. SLR of 2m by 2100 is possible) but not quantifying the probability more than the evidence base warrants (e.g. we would prefer a “this cannot be ruled out” type statement rather than a likely/very likely or 83rd percentile type quantification). [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
4505	15	1	15	5	Reference should probably be made also to section 9.6 (including table 9.8). This paragraph would furthermore benefit from being more specific than "one additional meter". It would be especially prudent to be clear about which scenarios the "one additional meter" applies to. Table 9.8 (SSP5-8.5; 2100; MICI) would seem to suggest that this applies for the high-end scenarios, but not the other ones. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
9223	15	2	15	2	Reconsider the high confidences for Greenland and Ice Sheet mass loss. In Chapter 9, page 7, it is stated that "Both the Greenland Ice Sheet (virtually certain) and the Antarctic Ice Sheet (likely) will continue to lose mass throughout this century under all considered SSP scenarios." [Government of United States of America, U.S. Department of State]

Comment ID	From Page	From Line	To Page	To Line	Comment
8553	15	2	15	2	Suggest clarification: It is surprising that projected ice sheet mass loss is only “high confidence” given current observed trends. Suggest this should be "Very high confidence" [Government of Australia, Department of Industry, Science, Energy and Resources]
6165	15	2	15	3	Please add the fact that both ice sheets will lose mass at "an increasing rate" as stated by the SROCC SPM B.1 and reconfirmed by the assessment done in Ch 9 (c.f. 9-53:4-19) [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
361	15	2	15	3	Both the SROCC and chapter 9 of the present report assessed that the loss of mass of ice sheets is increasing. Please include this in the SPM. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
255	15	2	15	3	In the following text "There is high confidence that both Greenland and Antarctic Ice Sheets will continue to lose mass throughout this century..." However the certainty level of greenland ice sheet "Projected 21st century change under continued warming" is stated as "Virtually certain mass loss under all scenarios" and for the West Antarctic Ice Sheet and Shelves the confidence level under the same category is stated as "Likely mass loss under all scenarios; Deep uncertainty in projections for above 3°C" in Table 4.10 [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
6169	15	3	15	3	Poorly understood ice-sheet destabilization processes... may be easier to read if the sentence is divided like this: "Ice-sheet destabilization processes which are yet poorly understood…" [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
4393	15	3	15	3	The "poorly understood" would seem to be rather relaxed expression. Suggest referring to "deep uncertainty" instead, as it also is used elsewhere, and has been used in previous reports. [Government of Sweden, Swedish Meteorological and Hydrological
6793	15	3	15	4	Is there evidence for a likelyhood metric for this statement? [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
2453	15	3	15	4	Firstly, this sentences stands out from the rest of the document which uses IPCC calibrated language. Some quantitative qualifier could be added. Secondly, it would be of importance to mention that both ice sheets have a threshold at ca 1.5-2 degree above preindustrial as discussed in Chapter 9, section 9.4.2.6. This might not fit here as HS9 is related to the consequences of ongoing climate change and might be better in HS12. Finally, the (low confidence) CI brings confusion. There is just one statement of confidence (low confidence), but there are two statements in the sentence: destabilization of ice sheets could have large impacts on sea level (do we only have low confidence on this?), yet the mechanisms remain poorly understood and it is difficult to determine precisely in which scenarios it may happen (low confidence). The risks are such that it is important to formulate this clearly. [Government of France, Ministère de la Transition écologique et solidaire]
4107	15	3	15	5	This sentence may be suitable to the next paragraph H.S.9.3 where the likely sea level rise is first described. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
525	15	3	15	5	Even though this is a low-confidence-statement, we consider this statement to be very important and of very high policy-relevance [Government of Denmark, Danish Meteorological Institute]
4109	15	3	15	5	It needs to be noted that this is not a general case, but an assessment under special conditions. Therefore, it would be better to add “in a low-likelihood, high-impact storyline and a high CO2 emissions scenario” to the end of the sentence in accordance with BOX TS4. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
7443	15	3	15	5	There is low agreement on global mean sea level (GMSL) projections for 2100 as stated in the text from chaper 9, P.107, L31-33 "...particularly for higher 32 emissions scenarios, as well as a higher degree of sensitivity to the choice of emissions scenario." Meanwhile, the SPM (pg. 15, Line 3-5) mentions these projections, despite it being of low confidence. Statements or texts of low confidence should not be included in the text. Omit this from the SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]

Comment ID	From Page	From Line	To Page	To Line	Comment
6167	15	3	15	5	Please add some perspective here beyond 2100 as found in the Ch 9: "Under high-emission scenarios, poorly understood processes related to Marine Ice Sheet Instability and Marine Ice Cliff Instability, characterized by deep uncertainty, have the potential to strongly increase Antarctic mass loss on century to multi-century time scales." (9-7:39-41) For policymakers information about long-term changes and dependence on the emission pathways are very important. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
4395	15	3	15	5	In TS, this finding is affixed to "In a low-likelihood, high-impact storyline and a high CO2 emissions scenario". If this indeed refers or mainly refers to high CO2 emission scenarios, this should be very clearly indicated here in the SPM as well. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
8259	15	3	15	5	While this is very important inclusion of low confidence statements should be avoided. Can it be restructured? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
4715	15	3	15	5	Do these poorly understood destablisation processes apply to both Greenland and Antarctica? [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
8555	15	3	15	5	Suggest rephrasing for accuracy: "Poorly understood ice sheet destabilization processes" don't contribute to sea level. Suggest change to "Ice sheet destabilization processes could lead to the ice sheets contributing more than …", and delete "poorly understood," as the confidence is already attributed as "likely" and it already says "could". An additional sentence could be added saying "Uncertainties in projections of future ice sheet mass change are large due to poorly understood ice sheet destabilization processes." [Government of Australia, Department of Industry, Science, Energy and Resources]
6795	15	3	15	5	The one meter added sea level rise from marine ice sheet instability is highly speculative, and cannot be quantified in this way. This applies especially to the "exactly" plotted extra curve in Fig. SPM-8. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
2711	15	3	15	5	This information about additional SLR due to potential ice sheet destablization processes is very important to keep in the SPM. This is a case where low confidence results have high policy-relevance. That said, as written we are uncertain if the statement that such processes could contribute an additional one metre of SLR by 2100 is irrespective of emission scenario or not. Figure SPM.8 seems to indicate it is, whereas the text on TS-45 line 15 (Box TS-4) provides this conclusion in association with the low likelihood, high-impact, high CO2 emission storyline. Clarity on the sensitivity of this additional SLR to different emission scenarios or global warming levels would be very helpful. It is important to understand the extent to which this additional risk can be avoided if global warming is limited to lower levels. [Government of Canada, Environment and Climate Change Canada]
5119	15	3	15	5	Replace 'Poorly understood' by 'Potential', so that this becomes: 'Potential ice-sheet destabilization processes …'. In the TS this processes are referred to as 'large or deep uncertainty', not specifically poorly understood. [Government of Belgium, Belgian Science Policy Office - Belspo]
281	15	3		5	The finding starting with "Poorly understood ice-sheet destabilization processes could contribute more than one additional meter of sea level increase by 2100 in addition to the likely projected global mean sea level rise " is Low confidence finding and should not be added in the SPM. This finding should be omitted. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
9225	15	4	15	4	Recommend to better clarify when global mean sea level is being discussed (to distinguish it more clearly from local sea level rise). Change "one additional meter of sea level increase" to "one additional meter of global mean sea level increase". [Government of United States of America, U.S. Department of State]
6797	15	4	15	4	What Is meant with 'likely projected sea level rise'? Is something like median meant? Although there is a low confidence, the impact may be high and this should be mentioned. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]

Comment ID	From Page	From Line	To Page	To Line	Comment
8557	15	4			Suggest clarification: it is difficult to reconcile the 'more than one additional meter of sea level increase' with the dotted line in Figure SPM.8 labelled 'Adding low confidence processes'. The line does not appear to be more than 1 m above the SSO5-8.5 curve or range. [Government of Australia, Department of Industry, Science, Energy and Resources]
9227	15	7	15	9	Suggest adding "even without the contribution from the low-confident processes for sea level rise" to the end of the sentence. [Government of United States of America, U.S. Department of State]
7763	15	7	15	9	Even though it is about models, the H.S.9.1 had another reference period of the observed sea level rise. It might be confusing. [Government of Hungary, Ministry of Innovation and Technology - Climate Policy Department]
477	15	7	15	9	It is noted that 1995-2014 and 1986-2005 are adopted as the baseline period for global mean sea level rise projection in AR6 and AR5 respectively. To facilitate policymakers to compare sea level rise projections given by AR6 and AR5, it is suggested to provide global mean sea level change between the periods of 1986-2005 and 1995-2014 in a footnote. Furthermore, it is suggested to clearly state the projection year or projection period of the projections "0.28-0.55 m" and "0.63-1.02 m". [Government of China, China Meteorological Administration]
9229	15	7	15	15	There is no mention of possibly higher sea level rise amounts this century due to processes not directly captured in ice sheet models. At least mentioning uncertainties and rise amounts as stated in the chapter itself is critical. Also, some mention of rise to 2150 under both directly modeled as as well uncertainties not captured in the models is important to reinforce the 'when not if' approach to adaptation. [Government of United States of America, U.S. Department of State]
9231	15	7	15	15	Why has the base period for SLR changed relative to SROCC? The different baseline makes it difficult to ascertain whether the SLR estimates are different based on evolving science or have just shifted along with the baseline. [Government of United States of America, U.S. Department of State]
4717	15	7	15	15	Given HS1.7 gives observed sea level rise from 1901 up to 2018, using 1995-2014 as a baseline for projected sea level rise is unhelpful, as without knowing the difference between 1995-2014 and 2018 levels, it is not possible to calculate where sea levels will be at any given point in the future. We suggest that these baselines are aligned, with HS9.3 giving projected rise from a 2018 baseline. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
6403	15	7	15	23	H.S.9.3 and H.S.9.4.: We welcome the information on post-2100 SLR in Figure SPM.8 as it is highly impact-relevant for SIDS in particular. As such, the two associated H.S. could be strengthened even further. Details on SLR commitments as included in the TS, Box TS.4 Figure 1 should also be reflected in the SPM (especially panel c), as this information is highly relevant. [Government of Saint Lucia, Department of Sustainable Development - Ministry of Education, Innovation, Gender Relations and Sustainable Developement]
2821	15	7	15	23	The 2300 SLR information provided in Figure SPM.8 is highly appreciated as it clearly points to the long-term risks of not pursuing the most stringent emission reductions possible. We would like to highlight information on SLR commitments provided in the TS, Box TS.4 Figure 1, in particular, and ask the authors to consider this highly illustrative information also to be reflected here in the SPM. [Government of Jamaica, Meteorological Service Division]
7023	15	7	15	23	For the Pacific region, information on sea level rise beyond 2100 is critical and very welcome. It is therefore suggested that H.S.9.3 and 9.4 reflect this information, which is already very well featured in Figure SPM.8 and in the TS (and should not only be presented in the TS but also the SPM). [Government of Fiji, Fiji Meteorological Services]
7287	15	7	15	23	We would like to thank the authors for providing post-2100 SLR information in Figure SPM.8. This is highly impact relevant information for Small Island Developing States and most vulnerable coastal regions alike. We would like to encourage the authors to further strengthen H.S.9.3 and H.S.9.4 on multi-centennial SLR in line with the information provided in the figure and move beyond paleo-climatological references. We very much feel that information on SLR commitments provided in the TS, Box TS.4 Figure 1, in particular, is so crucial that it should be further elevated to the SPM. The rationale on SLR timings or milestones (in a bad sense) provided in panel c of Box TS.4 Figure 1 is incredibly useful and should reach a wider audience. [Government of Saint Kitts and Nevis, Department of Environment - Ministry of Agriculture, Marine Resources, Cooperatives, Environment and Human

Comment ID	From Page	From Line	To Page	To Line	Comment
7159	15	7	15	23	Due to the relevance of post-2100 sea level rise for SIDS and coastal regions, it is suggested that further details are included in H.S.9.3 and H.S.9.4 (see also Figure SPM.8 and the TS, particulary Box TS.4 Figure 1, which feature this information well). [Government of Samoa, Ministry of Foreign Affairs and Trade]
9233	15	7	15	43	For H.S.9.3 and Figure SPM.8, more emphasis to irreversible or unstoppable sea level rise due to changes in Greenland and Antarctica's ice sheets or glaciers should be given. [Government of United States of America, U.S. Department of State]
2905	15	8	15	8	indicate time horizon [Government of Chile, Ministry of Environment]
2455	15	8	15	8	It is proposed to add "at 2100" in this sentence : "It is virtually certain that global mean sea level will continue to rise over the 21st century, with a likely rise, at 2100, of 0.28-0.55 m under SSP1-1.9 and 0.63-1.02 m under SSP5-8.5 relative to the 1995–2014 average (medium confidence)." We also strongly advise to change the result of SSP1-1,9 to SSP1-2,6 for the continuity with SR1.5 and SROCC [Government of France, Ministère de la Transition écologique et solidaire]
7879	15	8	15	8	It might be helpful to specify that these ranges are valid until the end of the XXIth century. [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
2457	15	9	15	10	it is proposed to replace « Over the 21st century, the majority of coastal locations have a median projected regional sea-level rise within ±20% of the projected global mean sea level increase (medium confidence) » by « Over the 21st century, the majority of coastal locations will experience a median projected regional sea level rise within ±20% of the median projected GMSL change (medium confidence) ». We also suggest to replace "coastal locations" with "coastal regions" [Government of France, Ministère de la Transition écologique et solidaire]
2975	15	9	15	10	"the majority regional sea-level rise within ±20% of the projected global mean sea level increase" Based on Figure 9.28, it should be further emphasized in this sentence that not only mean sea level rise and variability, but also rises of several orders of magnitude relative to the mean may occur in some coastal areas. And the "majority" should be defined somewhere so that it chould be expressed as a percentage of ocean area, or the number "20" should be further specified based on the siginificance level 95% or 99% [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
6799	15	9	15	11	This reads somewhat wrong with +/-20% . A statement is needed that the coastal changes relative to global average is changing as consequence of changes in crustal loading, rheology and gravitational changes, which can make large deviations in local sea level relative to global (close to the ice sheets sea level will drop and further away be unchanged, e.g. in northern Europe relative to Greenland melt effect). [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
9235	15	10	15	10	Recommend to better clarify for policymakers the contribution of geologic land uplift to local sea level rise predictions. Change "Over the 21st century, the majority of coastal locations..." to "Over the 21st century, after accounting for local geologic land uplift or subsidence rates, the majority of coastal locations..." [Government of United States of America, U.S. Department of State]
3013	15	10	15	10	"sea level" is more appropriate than "sea-level" unless there is a clear reason. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
9237	15	11	15	11	The date for the "once-per-century" analysis needs to be stated. Is that referring to now, to the 20th century, to what? Also change "extreme" to "extreme high". [Government of United States of America, U.S. Department of State]
6443	15	11	15	11	The current language is misleading. The following wording is suggested: The current frequency of extreme sea level events will increase in the 21st century, so that once-per-century extreme .. [Government of Austria, Federal Ministry of Agriculture, Forestry]
71	15	11	15	12	Wording describing 1-in-100 yr event should be "once-per-century extreme sea level events on average" to be consistent with language used in Fig. SPM 5. [Government of Singapore, Ministry of Environment and Natural Resources]
2907	15	11	15	12	hard to follow. indicate the time period used for the calculation of the once-per-century event.how to interpret this result? [Government of Chile, Ministry of Environment]

Comment ID	From Page	From Line	To Page	To Line	Comment
8559	15	11	15	12	Suggest rephrasing for accuracy: the sentence states '…extreme sea level events *will* occur annually .." but then states two different percentages for two different SSPs. *Both* SSPs will not happen. The text should read: '…extreme sea level events *are projected to* occur annually .." [Government of Australia, Department of Industry, Science, Energy and Resources]
8563	15	11	15	12	Sea level rise information expressed in this way is useful. Suggest qualifying "about 60%", and replacing "or" with "and" – as we are not facing a choice between these two scenarios, but rather considering the range between them. [Government of Australia, Department of Industry, Science, Energy and Resources]
6801	15	11	15	12	"so that once-per-century…". Does this mean "so that current once-per-century …"? [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
2459	15	11	15	12	We recommend to specify the baseline for the "once-in-century". Also, we recommend to write "current once-per-century" otherwise it reads like : once-per-century events occur every year. [Government of France, Ministère de la Transition écologique et
8561	15	11	15	13	Suggest rephrasing for clarity: The use of 'once per century' could be confusing here without context. Suggest could be replaced with 'Rare events that have occurred on once per century frequencies, will become annual by 2100…' [Government of Australia, Department of Industry, Science, Energy and Resources]
6803	15	11			The "once per century" events are high-tide events only, is this correct? [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
9239	15	12	15	12	Need the reference period for the definition of 1/100 years. [Government of United States of America, U.S. Department of State]
7527	15	13	15	15	Suggested to add some SLR range for 2200 or 2300. [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
8565	15	14	15	14	Suggest "… ice sheet mass loss …" or "… mass loss from the ice sheets …". [Government of Australia, Department of Industry, Science, Energy and Resources]
2461	15	14	15	14	In order to be consistent with the entire summary, we suggest to use here "ocean warming" instead of " "ocean heat uptake" [Government of France, Ministère de la Transition écologique et solidaire]
9241	15	17	15	17	Recommend to better clarify when global mean sea level is being discussed (to distinguish it more clearly from local sea level rise). Change "multi-millennial sea level rise" to "multi-millennial global mean sea level rise". [Government of United States of America, U.S. Department of State]
9243	15	17	15	17	Is not the finding underlying "multi-millennial" based mainly on model simulations considering only changes in the surface energy balance of the ice sheets and not including movement of the ice sheets? From 20,000 to 8,000 years ago, sea level rose on average a meter per century as the global average temperature increased, on average, 1°C per 2000 years (20 centuries). With the global average temperature going to be up a few degrees over preindustrial through much of the 21st century and beyond, what is it that suggests it could take multi-millennial periods to get to a new equilibrium? To avoid consideration of whether the period involved will be several centuries instead of several millennia, perhaps just strike "multi-millennial" as it is really not clear how such a long period can be justified given that temperatures rise as ice sheet thickness declines, and ice shelf resistance to flow goes way down as ocean temperatures and sea level rise. [Government of United States of America, U.S. Department of State]
8567	15	17	15	17	Please clarify the source of these estimates. [Government of Australia, Department of Industry, Science, Energy and Resources]
6805	15	17	15	17	Explain "committed" (its a too climate-technical term). [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
3373	15	17	15	18	There is no confidence statement. [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]

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6171	15	17	15	20	In H.S.1.2 it is stated that "global surface temperature was 1.09 [0.95 to 1.20] °C higher in 2011–2020 than 1850–1900". Here (H.S.9.4) it is stated that a sea level of +5 to +10 m in a world that is 0.5 to 1.5 warmer than 1850–1900 would be a "consistent" estimate of future sea level rise. Please explain why a higher sea level can be "consistent" with a world that is just as warm as at present (due to committed long-term melting etc.). [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
4111	15	17	15	23	H.S.9.4 describes about paleoclimate sea level rise. It is not natural located in H.S.9.4 in the section of "Possible Climate Future" as well as located after the future projection of SLR. It is also not clear the relation to H.S.9.3, the results of future changes in SLR, in front of paleoclimate. In SPM Fig. 8, the projected SLRs at the end of 21st century by SSP1-2.6, which corresponds to 0.5-1.5 degrees, is about 0.5-3 m, and by SSP5-8.5, which corresponds to 2.5-4 degrees, is about 2-7 m, respectively. These paleoclimate SLR values shown in this paragraph are quite different from the values in H.S.9.3. In order to make the sentence more natural, we suggest replacing the first sentence (Estimates of ... climate states.) with the statement on TS page14 L25-28 (Although past and future ...GMSL response to global warming. For example,). [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
9245	15	17	15	23	It is hard to reconcile the statements here with the estimates of sea level shown in Figure SPM.8. Paleoclimatic analsyses suggest that the equilibrium sensitivity of global sea level to change in global average temperature could be as much as 15-20 meters per °C, and yet for the SSP5-8.5 scenario that reaches over 5°C warming the projection of sea level rise by 2300 is only 8-16 meters. It might be useful to give an indication of committed sea level rise for various amounts of warming given paleoclimatic analogs, which would suggest that the commitment at that level of warming could well be several tens of meters. The slow 5-6°C warming over 12,000 years starting at the Last Glacial Maximum led to loss of about 2/3 of the existing ice mass. The high emissions scenario suggests about the same amount of further warming over just a century or two and it is hard to understand how that could not lead to much greater sea level rise as much of the last third of the land ice melts (the Eemian warming was quite rapid and caused a quite large loss of mass of the ice sheets). The WGI AR6 has improved since the second-order draft, but seems to still fail to express the full implications of the projected warming and potential rise in sea level. [Government of United States of America, U.S. Department of State]
4963	15	17	15	23	This paragraph is difficult to read and it is hard to grasp what is the main message. Please consider the language and look at how the key points can be best formulated. Also, in the first sentence it might not be clear what "committed" and "sustained global warming levels" mean. Please consider explaining or rephrasing this sentence. It is currently also an example of when the calibrated language somehow might blur the picture for new or non-expert readers: [Government of Norway, Norwegian Environment Agency]
4719	15	17	15	23	We would suggest removing the assessment in HS9.4 from the SPM as this could be confusing and lead people to try and interpret projected sea level rise from these numbers, instead of from HS9.3, which are informed by multiple lines of evidence. Instead, a sentence could be added to the end of HS9.3 saying 'These estimates are consistent with evidence from past warm climate states'. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial
6807	15	17	15	23	Some more guidance on the applicability of past SL and temperature pairs as an analogy to present climate change would be needed. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
4507	15	17	15	23	The “Estimates of future committed multi-millennial sea level rise for sustained global warming levels are consistent with evidence from past warm climate states” is perhaps a bit too strong. It gives an impression of committed sea level rise to be better constrained than what it really is, given the very large ranges given on the past climates' sea and temperature levels. Additional nuancing would be useful, such as "are roughly consistent", or similar. Alternatively, the paragraph could also be modified, such as to start with "Evidence from past warm climate states supports the magnitude of the future committed multi-millennial..." [Government of Sweden, Swedish Meteorological and Hydrological Institute]

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9247	15	18	15	18	Put some range/limits on "past warm climate". What time range? [Government of United States of America, U.S. Department of State]
6445	15	18	15	18	The current language is misleading. The following wording is suggested: from past warm climate periods .. [Government of Austria, Federal Ministry of Agriculture, Forestry]
4113	15	18	15	22	The reference period for sea level 125,000 years ago and 3 million years ago is not clear. We suggest that it be clarified, for example adding text "…years ago than XXX". [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
7881	15	19	15	19	"5-10 m" -> Is this really the correct number (seems rather high given a similar temperature level than today). [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
3015	15	19	15	20	Clarify that sea level is higher than which period (ex. 1995-2014, 1901, etc). [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
8569	15	20	15	21	Suggest clarification: '...3 million years ago, when atmospheric CO2 levels were at levels comparable to today'. Should read '3 million years ago, when atmospheric CO2 levels are inferred to have been at levels comparable to today'. We do not have direct measurements of atmospheric CO2 from 3 million years ago and must infer from proxies such as boron isotopes in marine carbonates. [Government of Australia, Department of Industry, Science, Energy and Resources]
4115	15	20	15	22	It would be helpful to have a footnote about the temperature range seems higher than that estimated from the assessed ECS range and atmospheric CO2 levels today. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
6173	15	20	15	22	This sentence links very good paleoclimate evidence with sea level rise. However, in the TS there is information to further specify the long-term effects at temperature levels that are very policy relevant (TS-14:31-34): "[…], indicate a committed long-term GMSL rise over 10,000 years, reaching about 8-13 m for sustained peak global warming of 2°C and to 28-37 for 5°C, [...]" Please add information at least on the committed long-term GMSL rise for global warming of 2°C. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
9249	15	20	15	22	Ocean basin (and continent) geometry was totally different 30 million years ago compared to today, so it is not clear at all why it makes sense to compare sea level estimates from back then with those from today. [Government of United States of America, U.S. Department of State]
8571	15	26	15	45	Suggest clarification for SPM 8d: There is a sea-level rise trajectory labelled 'Adding low confidence processes'. Caption should indicate which SSP these are added to (is it SSP5-8.5?). [Government of Australia, Department of Industry, Science, Energy and Resources]
7985	15	28	15	33	Figure SPM.8. Panel a): the assessed changes have been calculated using a methodology that apparently differs from that used in the rest of the document. 0.85°C has been added as the increase of temperature for 1995-2014, while in the rest of the paper data for 2019-2020 are used (e.g. Figure SPM.1, SPM.2,...) [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
1673	15	28	15	43	Figure SPM.8 Caption: Bolding also the first sentence after the "Panel x):" would help the reader to capture the panel's main data at a a glance. [Government of Finland, Finnish Meteorological Institute (FMI)]
6809	15	28	15	43	For some panels the source of the data is given (CMIP6), for others not. Maybe it would make sense to harmonize. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
4117	15	29	15	32	"The assessed changes were... and transient climate response": Does this mean that the latest generation model results are corrected to remove influences of the high equilibrium climate sensitivity? If so, are the corrected values used for other portions in SPM mentioning future projection? It should be stated in the main text rather than in a figure caption. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]

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4397	15	35	15	36	"from 1950-2100" should perhaps read "in 1950-2100" or suchlike. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
4399	15	38	15	39	Is the significance of such upper limit equally relevant for all scenarios (high and low CO2)? [Government of Sweden, Swedish Meteorological and Hydrological Institute]
2713	15	38	15	39	Figure SPM.8 caption: does this potential additional SLR really respresent an assessed likely upper limit? This is based on low confidence processes related to ice sheet instablities. The text on page SPM-15 lines 3-5 expresses this information differently, saying this additional SLR from low confidence processes is additional to the assessed scenario-dependent likely ranges. Similar phrasing is used in Box TS.4. [Government of Canada, Environment and Climate Change Canada]
4401	15	40	15	40	The "limited modelling" is quite imprecise and it could refer to few scenarios or low capability of models to model the longer-term. Suggest using something like "as other scenarios have not been extended beyond 2100." [Government of Sweden, Swedish Meteorological and Hydrological Institute]
2715	15	41	15	42	Figure SPM.8 caption: it seems the shading is provided only for 2 scenarios - SSP1-2.6 and SSP5-8.5. Please add this information to the caption. [Government of Canada, Environment and Climate Change Canada]
35	16	1	16	1	Wny national and Local scale are not included considering that adaptation is locally specific [Government of United Republic of Tanzania, Tanzania Meteorological Authority (TMA)]
7645	16	1	16	1	Change title to "Climate Information Relevant to Adaptation" . Explanation: Risk is not a purely natural scientific concept. There is an extensive literature from climate change and disaster management that speaks to the sociological , anthropological, psychological and political dimensions of risk. Hence as in past assessment reports risk assessment as a leading concept may be relegated to Working Group II. Further, the introduction of risk appears to be mainly to justify introducing and providing prominence to low confidence and high warming scenarios. These low confidence and high warming scenarios are significantly skewing the policy message in an unbalanced way. [Government of India, Ministry of Environment, Forests and Climate Change]
8261	16	1	16	10	While WGI is vital for the work of WGII, it should not cross its boundaries, perhaps reduce material that is best addressed in the WGII report. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
7073	16	1	16	44	HS.10: In risk assessment and regional adaptation, the effect of natural climate variables has been considered but according to this chapter the effects of natural climate variables have not been anlayzed carefully, suggestion is to mention this matter as an effective and important studies on the global level parameters. [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]
4965	16	1	19	19	The term "climate change information" can underplay the importance of this section. Please consider using "scientific knowledge base", "scientific input to" or another term to better catch the reader's attention. [Government of Norway, Norwegian Environment Agency]
481	16	1			The section "Climate Information for Risk Assessment and Regional Adaptation" in the WG1 Summary for Policymakers, which is valuable for decision support, devotes too little discussion to the climate service. One key conclusion from Chapter 12 -- 12.6 Climate change information in climate services -- is not cited either (Box TS.11: Climate Services is included in the Technical Summary). It is suggested that the SPM should also include relevant conclusions to highlight the importance of climate information/climate services for risk assessment and adaptation planning. [Government of China, China Meteorological Administration]
2463	16	3	16	3	Even though it is a fact that climate has natural and anthropogenic sources of variation, this head-comment for a chapter may sound as mitigating the number of previous comments where "human influence" is put forward. Because many policy makers will read only the head key messages, reformulating this sentence, seems appropriate [Government of France, Ministère de la Transition écologique et solidaire]

Comment ID	From Page	From Line	To Page	To Line	Comment
9251	16	3	17	10	In reviewing the key points throughout the section entitled "Climate Information for Risk Assessment and Regional Adaptation" it was not clear as to what the motiviation was for elevating many of these key points to the SPM. On the whole, the key points align only weakly with the title of the section and provide marginal utility for risk assessment. Recommend that authors include additional text in the opening paragraph to describe the motivation for selecting key points that are most important for Climate Information for Risk Assessment. Text that specifically states the reason that low likelihood, high impact events are important for climate risk assessment would provide clarity. [Government of United States of America, U.S. Department of State]
4403	16	6	16	6	It is not evident that the footnote is needed here or that this provides necessary information on the SPM-level. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
7765	16	6	16	6	Footnote 17 could be placed in the first paragraph, marked with italics. [Government of Hungary, Ministry of Innovation and Technology - Climate Policy Department]
7647	16	6	16	6	Delete Footnote 17 .Explanation: Sentence garbled conveying no significant information. After dropping risk from the title, the footnote may be omitted. [Government of India, Ministry of Environment, Forests and Climate Change]
7793	16	7	16	7	„internal climate variability" may be unclear for the readers. Adding a footnote with explanation is suggested. [Government of Poland, Ministry of Environment, Department of Air Protection and Climate]
7813	16	7	16	7	"responses to internal variability..." - it is worth expanding what this term means [Government of Poland, Ministry of Environment, Department of Air Protection and Climate]
4967	16	7	16	39	Please concider explaining the difference between "human-caused forcings" and "anthropogenic aerosol forcings", and if possible, use one term only. See also page 7, lines 8 and 9, where it says "anthropogenic aerosols", and page 22, line 8, where it says "human-caused aerosols". [Government of Norway, Norwegian Environment Agency]
7651	16	8	16	10	Delete sentence and replace by the following, "This report contributes to the IPCC risk framing in the reports of WG II and III through the assessment of relevant climate information. Explanation: We have already noted the need to drop risk from WG I Report. [Government of India, Ministry of Environment, Forests and Climate Change]
6175	16	9	16	9	While we appreciate the IPCC's risk framing, referring to it without explaining the concept could lead to the conclusion that the IPCC report is not neutral and objective, but overemphasizes risks of climate change. To avoid this impression, we suggest rephrasing the sentence as follows: "This Report assesses relevant climate information, including climatic impact-drivers and low-likelihood, high impact outcomes, thus providing information on climate risks in a manner that is relevant for decision making", or a similar formulation. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
6177	16	10	16	10	For consistency reasons please revise the term "low-likelihood, high impact outcomes". In the glossary, the corresponding entry refers to "low-likelihood, high impact events", whereas the definition in footnote 20 (page SPM-19) includes "outcomes or events". Furthermore, "impacts" may be referred to as "consequences or outcomes" according to the corresponding glossary entry. It may be therefore helpful to also distinguish between these two terms in the definition of "low-likelihood, high-impact outcomes" which includes "outcomes or events [...] whose potential impacts on society and ecosystems [...]", according to footnote 20. Please revise choice of language in order to avoid circularity. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
4405	16	13	16	13	The same is true for the long(er)-term, albeit with a changing relative weight. It would be useful to somehow also include the longer term as the overal section heading does not refer only to near-term, and as the subsequent headline statements do not explicitly highlight the long-term for which forcing is decisive. [Government of Sweden, Swedish Meteorological and Hydrological Institute]

Comment ID	From Page	From Line	To Page	To Line	Comment
2467	16	13	16	13	we suggest to precise what "near-term' means here, as done in HS.11 and H.S.11.1 [Government of France, Ministère de la Transition écologique et solidaire]
3375	16	13	16	14	There is no confidence statement. [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
2465	16	13	16	14	This HS does not convey a clear and strong message. Building on findings developed in the H.S.10.i, we suggest a HS.10 message such as "Climate variability will affect the human influence on near-term climate on global to regional scales, limiting the reliability of near-term projections of changes in precipitation and extreme events. A large volcanic eruption might even reduce global surface temperature and land precipitation for several years." [Government of France, Ministère de la Transition écologique et solidaire]
7883	16	13	16	14	HS.10: Taken alone this HS suggests a balance between anthropogenic and natural changes, that is inconsistent with the projections. This would be a misleading message from the WGI SPM. Clearly, anthropogenic influences dominate, particularly for all non-Paris Agreement compatible scenarios. [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
37	16	13	16	16	Does it mean that Human Influence does not affect near-term climate?. We need to reflect National and local scales [Government of United Republic of Tanzania, Tanzania Meteorological Authority (TMA)]
8263	16	13	16	16	What is near terms here? Is this not always going to be the case? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
2977	16	13	16	43	Sequence of El Nino events such as 2014-2016 El Nino contributed to the record breaking warming (Cross-Chapter Box 3.1) and those kind of events could happen and contribute further warming. Inclusion of those aspect under HS.10 is highly recommended. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
6811	16	18	16	18	The off-set is fairly small, and it would be better to mention how much it was. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
9253	16	18	16	20	The language here is unclear. Recommend revising and indicating why the 1998-2012 timeframe is referenced. Proposed text: "Internal variability, solar variations, and volcanic forcing partly offset the human-caused global surface temperature trend slowdown over the 1998–2012 period, with pronounced regional and seasonal signatures (high confidence)." [Government of United States of America, U.S. Department of State]
2717	16	18	16	20	To understand why this time period is being singled out, readers have to have the prior knowledge that 1998-2012 is the period of a slow down (hiatus) in global warming. Without this knowledge, the focus on this time period in the SPM is puzzling. Recommend adding text to clarify that the 1998-2012 period refers to the recent hiatus in observed global warming (or language to that effect). [Government of Canada, Environment and Climate Change Canada]
2469	16	18	16	20	The importance of climate trends occurring on top of natural decadal variability should be the focus here, rather than this specific episode. This sentence on the hiatus could be in the TS only. It seems superfluous to come back to this specific hiatus, giving it more importance than it has. [Government of France, Ministère de la Transition écologique et solidaire]
4723	16	18	16	21	Please could you slightly clarify this paragraph, e.g. when discussing ‘trends’, please could you indicate the direction of the trend (1st sentence)? Also the second sentence implies that during ’98-’12, warming stopped. However, the 1st sentence notes the ‘the trend was PARTLY offset’. Also, according to the Technical Summary, warming didn’t stop and recent evidence suggests that the slowdown was in fact less significant than previously thought. This could also be noted. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]

Comment ID	From Page	From Line	To Page	To Line	Comment
4119	16	18	16	24	"However, such internal or volcanically forced decadal variations in GSAT trend have little affect on the centennial warming" which is the critical sentence on Cross-Chapter Box 3.1 would be added at the end of H.S.10.1. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
4721	16	18	16	24	The sentence "One to two decades of both reduced and increased trends in global surface temperature, relative to human-caused warming, will continue to occur through the 21st century" is unclear. Could the authors find a clearer way of describing "reduced trend" and "increased trend"? We would also suggest linking this more explicitly to the internal variability, which is not currently done, as well as specifying that this is separate from the long-term trend, and not a long-term natural contribution to climate change. Perhaps something like: "Periods of one to two decades during which global surface temperature falls or rises as a consequence of natural variability, relative to human-caused warming, will continue to occur throughout the 21st century". [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
8369	16	18	16	24	It is not clear why in the H.S.10 on near-term climate the first H.S.10.1 starts with very disputable statement on past trend for 1998-2012. We suggest to delete the first sentence and rephrase the whole H.S.10.1 [Government of Ukraine, Director Ukrainian Hydrometeorological Institute]
2471	16	20	16	20	"ocean heat content" is used and adds complexity for a non-scientific reader compared to the use of "ocean warming" that seems to have been chosen in the first half of the SPM. [Government of France, Ministère de la Transition écologique et solidaire]
9255	16	21	16	21	Remove the word "entire". [Government of United States of America, U.S. Department of State]
6179	16	21	16	23	In this paragraph, variable trends in global surface temperature are limited to "one to two decades" whereas Cross-Ch Box 3.1 (Ch 3, page 3-29, lines 17-19) only states "reduced and increased GMST and GSAT trends at decadal timescales"; Cross-Section Box TS.1 (page TS-30, lines 43-44) mentions "Events of reduced and increased global surface temperature trends at decadal timescales". The underlying assessment limiting such decadal variations in trend to two to decades could not be found within the Report. And why is this limited to the 21st century, isn't this variability a natural phenomenon that can occur at any time? Please clarify. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
363	16	21	16	23	While we find this sentence Important to mention in the SPM, the way it is written makes is rather obscure. We would propose to find another way to indicate that natural variability can increase of decrease trends of warming in particular on smaller time scales. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
8573	16	21	16	23	Please clarify whether this intends to mean one or two actual decades, or periods of one to two decades. [Government of Australia, Department of Industry, Science, Energy and Resources]
2473	16	21	16	23	It is difficult to identify which message is conveyed by this sentence. One wonders whether it means that there will be successively a decade with reduced trend and another one with increased trend or whether it means that we can see different shorter than decadal trends with opposite signs. Please change to "periods of both reduced and increased trends at decadal time scales", or to "decadal periods of both reduced and increased trends" (cf. cross-section box TS.1); the wording "one to two decades of..." is confusing. [Government of France, Ministère de la Transition écologique et solidaire]
9257	16	21	16	24	The language here is confusing. Recommend revising to read: "One to two decades of stronger and weaker global surface temperature trends, relative to human-caused warming, will continue to occur through the 21st century (very high confidence). " [Government of United States of America, U.S. Department of State]

Comment ID	From Page	From Line	To Page	To Line	Comment
4121	16	26	16	26	Likelihood of large eruptions in this century mentioned here is just from implication of past record (including proxy record) and it is quite different from climate future projections. Furthermore, according to Cross-Chapter Box 4.1, volcanic forcing is prescribed as a constant background loading in CMIP6 models which means that the effects of potential large volcanic eruptions are largely absent from model projections, and few studies have addressed the potential implications on 21st century warming. Taking into account the description in Cross-Chapter Box 4.1, this paragraph seems to overweight likelihood and potential impacts of large eruption in the context of future climate change. In this regard, the first sentence of H.S.10.2 could be rewritten as: “Proxy records show that large volcanic eruptions with effective radiative forcing (ERF) more negative than -1 W/m2 occurred on average twice a century throughout the last 2500 years, the most recent being Pinatubo in 1991” (quoted from Cross-Chapter Box 4.1). This revision also helps to clarify the definition of the “large volcanic eruption”. Another option is to amend the paragraph as below: “Proxy records on past volcanic eruption imply that it is likely that at least one large volcanic eruption could occur during the 21st century. Such an eruption would reduce global surface temperature and land precipitation for several years, alter the monsoon circulation, modify extreme precipitation and change the profile of many climatic impact-drivers (medium confidence).” [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
7715	16	26	16	26	what is meant by a large volcanic eruption? The scale should be mentioned since eruptions continually occur [Government of India, Ministry of Environment, Forests and Climate Change]
6813	16	26	16	26	This is a loose statement. At least define what a "large eruption" is relative to climate change transient effects [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
4259	16	26	16	27	It is stated that: It is likely that at least one large volcanic eruption will occur during the 21st century. This statement contains very uncertain data and is merely based on the prediction including prediction of location, magnitude, type of eruption, and timing of volcano eruption. Consider to rewrite or to delete this statament. [Government of Indonesia, Ministry of Environment and Forestry Indonesia]
9259	16	26	16	30	Lead with the most important point and simplify language, recommend revising to read: "The emergence of human influence on some regional changes can be delayed if a major volcanic eruption or a series of eruptions occurred during the 21st century. A major volcanic eruption with a large stratospheric input of SO2 is expected to reduce global surface temperature and precipitation over land for several years, alter monsoon circulations, modify extreme precipitation, and change the profile of many climatic impact-drivers (medium confidence)." [Government of United States of America, U.S. Department of State]
4407	16	26	16	30	It is doubtful whether the inclusion of this is useful in the SPM. It is speculative, not the only possible external event that could be of importance, and furthermore not reduce the need to adapt to climate change as the long-term warming will still be in the system. That some signals of climate change might get delayed would seem to lack greater relevance. Suggest deletion. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
4725	16	26	16	30	Could this be swapped with 10.3 or 10.4? It relates to a very specific scenario that feels like it should follow on from the other two. Also, what is meant by ‘several years’ - could this be made more specific? [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
6815	16	26	16	30	Whilst the paragraph is valid, it is also somewhat speculative. It could be left out of the SPM. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6817	16	26	16	30	This paragraph in my opinion is not necessary as the impacts volcanic activity are already addressed in the previous paragraph. It focuses on the consequences of a single event outside of human control: citing uncontrollable events, although likely, that could "naturally" slow down the climate warming will risk to dilute the overall message of the SPM. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]

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7611	16	26	16	30	Where will this eruption take place? Which regions will be mostly affected [Government of South Africa, Senior Policy Adviser International Climate Change Cooperation Department of Environmental Affairs]
8575	16	27	16	27	Suggest clarification: Why use the term 'land precipitation'? Does it mean that Ocean precipitation will not be affected? [Government of Australia, Department of Industry, Science, Energy and Resources]
2475	16	27	16	27	Please clarify the order of magnitude of the duration of the impact of a volcanic eruption on temperature and precipitation. "several years" can be understood as 5 years or 20 years. [Government of France, Ministère de la Transition écologique et solidaire]
1675	16	28	16	28	It is not clear what the word "profile" refers to in "change the PROFILE of many climatic impact-drivers". [Government of Finland, Finnish Meteorological Institute (FMI)]
2477	16	28	16	28	We suggest to replace "profile" with "evolution" or "trend". [Government of France, Ministère de la Transition écologique et solidaire]
9261	16	29	16	29	Define "emergence" in a footnote. [Government of United States of America, U.S. Department of State]
2479	16	29	16	29	Please clarify where this level comes from. there is no mention of it in the referred sections. [Government of France, Ministère de la Transition écologique et solidaire]
7689	16	29	16	30	Add clear confidence statement with the sentence "If it occurs in the near term, this could delay the emergence of human influence on some regional changes" .Explanation: Lack of confidence statement makes it confusing and it can give wrong signal that there is no need for near term climate response actions. [Government of India, Ministry of Environment, Forests and Climate Change]
3377	16	29	16	30	There is no confidence statement. [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
73	16	29	16	30	"If it occurs in the near term, this could delay the emergence of human influence on some regional changes." Here "delay the emergence of human influence" may be replaced with "temporally mask human influences". [Government of Singapore, Ministry of Environment and Natural Resources]
6819	16	32	16	32	Here and later, specify what is meant by 'near term'. Next 5 years. 10 years? [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
4123	16	32	16	33	It would be helpful to add specific examples for the local feedbacks. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
4525	16	32	16	33	The "intensify or obscure" will apply also on longer time scales. I.e., it is not relevant only for the nearest decades, although the effect becomes less pronounced as forced changes increase. [Government of Sweden, Swedish Meteorological and Hydrological
6181	16	32	16	36	We welcome this important paragraph. Some suggestions for further improvement: Please replace “obscure“ by ”mask“. Does "at the regional scale" in line 33 refer to all three changes or only to the last one? Please specify "surface" - do you mean "a few regions"? The word "fully" might not be needed. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
9263	16	32	16	36	Rewrite to more clearly communicate key points: "Regional scale human-caused changes in mean and extreme climate conditions will continue to be obscured by internal variability and local feedbacks in the near-teram. Surface temperatures at regional scales can therefore show cooling in the near-term. Near-term cooling at any given location is consistent with human-caused global surface temperature increase (high confidence)." [Government of United States of America, U.S. Department of State]

Comment ID	From Page	From Line	To Page	To Line	Comment
4969	16	32	16	36	H.S.10.3: This is an important statement to keep in the SPM, and it is quite well written. Just one minor editorial or consistency issue. Currently there is human-induced, human-caused, human influence, human-driven, human activity, human drivers etc. in addition to anthropogenic. It would be good if you as far as possible manage to be consise when it comes to these perspectives. [Government of Norway, Norwegian Environment Agency]
2719	16	32	16	36	The second sentence is difficult to understand and would benefit from a rephrasing. Suggestion: "Near-term cooling at any small, particular location is still fully consistent with the global surface temperature increase due to human influence." [Government of Canada, Environment and Climate Change Canada]
2481	16	32	16	36	The degree of generality here might seem to contradict the very high confidence in the evidence of global warming displayed elsewhere. Perhaps replacing "any" by "some" would avoid this ambiguity. [Government of France, Ministère de la Transition écologique et solidaire]
8371	16	32	16	36	It is not clear what means under "cooling"? If it is about some colder than the climate norm years (seasons, months) then it is better to state more precisely [Government of Ukraine, Director Ukrainian Hydrometeorological Institute]
4409	16	33	16	33	Perhaps "mean climate and climate extremes" rather than "mean and extreme climate"? [Government of Sweden, Swedish Meteorological and Hydrological Institute]
4261	16	33	16	33	Plase clarify the term " A small fraction of the surface". Is it possible to pointing out the indicative locations?. [Government of Indonesia, Ministry of Environment and Forestry Indonesia]
4411	16	33	16	35	The second sentence of H.S.10.3 could be omitted. Its underlying idea is already contained in the first sentence. Also, "cooling" is unclear (compared to what? Over how long a period?) Also, a stronger warming than what would be "consistent" is also a possible and to be expected in some locations, at some points of time. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
479	16	33	16	36	Here it is stated that the cooling of some regions is "consistent with" the global warming. It is suggested to replace "consistent with" with "not conflict with", which seems more logical. [Government of China, China Meteorological Administration]
6447	16	34	16	34	It is suggested to delete „fully" – this qualifier should not be used to describe issues related to uncertainty [Government of Austria, Federal Ministry of Agriculture, Forestry]
4547	16	34	16	34	Here, an expression such as "which means", or something similar, could be a clearer expression, rather than the present "so". [Government of Sweden, Swedish Meteorological and Hydrological Institute]
6183	16	38	16	38	H.S.10.4: Please insert: "…at regional scales are uncertain, mainly because they largely depend…", to express the uncertainty of near-term projections of precipitation changes as given in the ES of Ch 4 [p:4-5;l:51-53] [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
7649	16	38	16	40	Delete first sentence of H.S.10.4. Explanation: This sentence misrepresents the assessment from line 44 to line 46 on page TS-50 (Box TS.6). [Government of India, Ministry of Environment, Forests and Climate Change]
9265	16	38	16	43	Revise to more clearly communicate message: "Near-term projected regional precipitation changes largely depend on internal variability, uncertainty related to model physics, and regional patterns of short-lived natural and anthropogenic forcings (medium confidence). These could accelerate or delay emergence of human-caused changes due to well-mixed greenhouse gases in many land regions (high confidence). However, some aspects of water cycle changes that are already discernible from internal variability will become more pronounced in the near term (high confidence)." [Government of United States of America, U.S. Department of State]
9267	16	38	16	43	Revise to quantitatively define the time period referred to as "near-term". [Government of United States of America, U.S. Department of State]
4413	16	39	16	40	This is rather complicated, and seem to speak of drivers, modelling, projections and observations... What is it that contributes? Internal variability can both enhance and suppress signals, and would not the same be true for forcing uncertainties and model errors? [Government of Sweden, Swedish Meteorological and Hydrological Institute]

Comment ID	From Page	From Line	To Page	To Line	Comment
2843	16	40	16	40	H.S.10.4: In my opinion, the second phrase could be misunderstood to mean that human-caused change may be delayed in the real world. I think the addition of the word "simulated" would make this sentence clearer: "These contribute to the delayed or reduced simulated signal of human-caused changes in many land regions (high confidence)." [Government of Chile, Ministry of Environment]
7653	16	40	16	40	This sentence maybe be modified suitably in view of the deletion of the first sentence suggested above. [Government of India, Ministry of Environment, Forests and Climate Change]
2483	16	40	16	41	We recommend to add a non-exhaustive list of aspects of water cycle changes. Also, this point is confusing. It starts on projected changes. One source of variations for these is 'uncertainty related to model physics'. Then it moves (it seems) to observations of these changes, indicating that part of the reasons are the same. This is confusing: uncertainty in our models' physics can not explain recent trends or observations. [Government of France, Ministère de la Transition écologique et solidaire]
4727	16	41	16	41	Some aspects of the water cycle’ - is it possible to give examples? [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
4549	16	41	16	41	Could some examples be given here of aspects of water cycle changes that already are discernible? [Government of Sweden, Swedish Meteorological and Hydrological Institute]
9269	16	41	16	42	What water cycle changes are discernible from natural variability? The reader shouldn't have to track them down in the relevant chapters. Revise by adding a list of specific physical climate changes that are discernible from natural variability. [Government of United States of America, U.S. Department of State]
147	16	41	16	42	"However, some aspects of water cycle changes that are already discernible from internal variability will become more pronounced in the near term (high confidence)." The statement does not specify what aspects of water cycle changes will beome more pronounced in the near term wihg high confidence level. Without specifying these aspects the statement is not useful and cannot be verified. The statement should be omitted. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
6185	16	41	16	43	This sentence implies that water cycle changes will become more pronounced depending on mitigation action - is this correct? In addition, please add the highly policy relevant finding from Box TS.6): "Over the 21st century and beyond, abrupt human-caused changes to the water cycle cannot be excluded (medium confidence)." [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
365	16	41	16	43	Are these statements true for any level of global warming? It would be good to include and quantify that mitigation action can avoid some of the changes in the water cycle if this is the case. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
7447	16		19		The following text from chapter 10, P7, L.21-22, should be included in the SPM: "The performance of global and regional climate models and their fitness for future projections depend on their representation of relevant processes, forcings, and drivers and on the specific context." The context of this text reflects the importance of improving global model performance for regional scales to increase their use in regional informational sources. Include this statement in 'Climate Information for Risk Assessment and Regional Adaptation' of the SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7449	16		19		The following text from chapter 10, P. 16, L.25-30, should be included in the SPM: "Other elements that play a role are the inconsistency between the global and regional models in dynamical downscaling or the observational and methodological uncertainty In bias-adjustment methods." The context of this text describes the affects of uncertainty on the overall confidece of regional climate information. Therefore, this should be brought to attention in the SPM. Include this statement in pg. 16 of the SPM under, 'Climate Information for Risk Assessment and Regional Adaptation.' [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]

Comment ID	From Page	From Line	To Page	To Line	Comment
4125	17	0	17	0	A quotation mark is missed after the word “Regions” in the footnote 18. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
9271	17	1	17	2	"increasingly" is unclear; also it's important to clarify that authors are speaking of the "physical drivers of climate impacts". Propose revising to read: "Every region is expected to experience some mix of concurrent changes in multiple physical drivers of climate impacts during the next 30 years." [Government of United States of America, U.S. Department of State]
4729	17	1	17	3	The first sentence in HS.11 is unclear as, given the second sentence, it could be assumed that the first sentence is referring to differences in the 1.5oC and 2.0oC pathways to 2100 in the 2050s rather than any scenario in the next 30 years. The second sentence should also be clarified by stating that it is referring to 1.5oC and 2.0oC of warming regardless of timing and not referring to those pathways in the 2050s. We propose: *In every scenario examined here,* every region will increasingly experience concurrent changes in multiple climatic impact drivers during the next 30 years. A wider set of changes would occur at 2°C compared to 1.5°C *(regardless of timing)* in the majority of regions. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
2485	17	1	17	3	The time horizons spanned by HS.11 and H.S.11.i are not clear. It seems that near to mid term is targeted though some findings refer to the whole century. We suggest to try improving the consistency of the time horizons addressed in HS.11. We also fnd that it is difficult to see the differences between the different global warming levels, the narrative around those important decision-related temperature could be improved. [Government of France, Ministère de la Transition écologique et solidaire]
7885	17	1	17	3	HS.11: Perhaps change "concurrent" with "compound" to make the statement stronger. "climatic impact-drivers" is an akward notion. Is this understood? The second sentence could be simplified: "Changes that occur at 2°C warming are stronger and affect more regions than those that occur at 1.5°C." [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
7677	17	1	17	3	Rewrite the sentence to incorporate the disagreements that exists for Climate Impact Drivers in terms of attribution and detection of human influence over natural climate variability. Studies quoted in chapter 11 indicate the presence of several disagreements, low confidence, and limited evidence to suggest significantly different impacts between 1.5 deg C and 2 deg C. These studies indicate an incremental change between 1.5C and 2C in terms of intensity of impacts, but no distinct change in terms of likelihood and frequency, of events. [Government of India, Ministry of Environment, Forests and Climate Change]
8265	17	1	17	4	For the future "projected" is preferred to "will" [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
4971	17	1	17	5	Please consider rephrasing to: 'The consequences of climate change associated with a 2°C global warming will be more severe than those compared to 1.5°C in the majority of regions (high confidence), and every region will experience increasing concurrent changes in multiple climatic impact-drivers over the next 30 years.' [Government of Norway, Norwegian Environment Agency]
6821	17	1	17	14	It is slightly confusing that both HS11 and HS11.1 mix time scales, namely 30 years and a 1.5/2 world, which refers implicitly to 2100. It may be useful to separate the short and medium outlook, which seems robust across different SSPs and target levels, from the 1.5/2 insights. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]

Comment ID	From Page	From Line	To Page	To Line	Comment
5121	17	1	18	12	This section largely focuses on 1.5 and 2°C. We welcome the update on the 1.5°C report, this is important but it should not obscure information on consequences of warming beyond 2°C. Please consider providing information on higher levels of warming. [Government of Belgium, Belgian Science Policy Office - Belspo]
6187	17	1	18	12	Please work out the differences between different levels of warming more clearly, e.g. by describing particularly significant differences or by providing quantitative information. The current formulation does not convey as prominently as the SR1.5 why half a degree difference (or much better "every increment" as in Fig. SPM 5 and 5) in global warming matters. Please assure that these statements on 1.5 / 2 C can be reconciled with the AR5 assessment (and the temperature goals of the Paris agreement). [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate
6823	17	1	18	36	HS11 addresses global warming 1.5°C and 2°C. Considering that current pledges under the Paris Agreement we are on track to 3°C warming, it would be useful to also address also this possibility. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6189	17	2	17	2	Does the statement "concurrent changes" refer to a period of time (next 30 years) or a warming level (+2 or +1.5 degrees)? If it is intended to say that a warming of +1.5 to +2 degrees is expected within the next 30 years, this should be clarified; e.g. "A wider set of changes..." --> "At that time, a wider set of changes..." [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
367	17	2	17	2	The message convened by this high-level statement is not clear. Does the second part of the sentence only applies if 2°C or 1.5°C thresholds are crossed within the next 30 years? We think that the second sentence refers to long-term stabilization at these levels, but this should be clarified. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
9273	17	2	17	3	Does the data support a stronger statement on the differences between 1.5 and 2°C warming? If climate impacts worsen linearly from 1.5 to 2°C, this statement is less meaningful. As justified by the underlying report, recommend editing to: "A disproportionately wider set of physical climate changes would occur at 2°C compared to 1.5°C in the majority of regions. (high confidence) ". [Government of United States of America, U.S. Department of State]
8373	17	2	17	3	From the sentence not clear that 2C and 1.5C are both global warming over pre-industrial levels and not local or regional warming. [Government of Ukraine, Director Ukrainian Hydrometeorological Institute]
75	17	7	8	0	It would be useful to include which regions face the highest risks of the region-specific changes. [Government of Singapore, Ministry of Environment and Natural Resources]
7445	17	7	17	8	In Chapter 9, Pg. 49, Line 20-22 states, "there was no significant trend in annual mean Antarctic sea-ice area over the period of reliable satellite retrievals starting in 1979 (high confidence)" and this should be added to the SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
8267	17	7	17	8	For the future "projected" is preferred to "will" [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
4731	17	7	17	8	Could the authors clarify if the impacts experienced depend on when a temperature level is reached? The first sentence of H.S.11.1 should note that this applies to any scenario and the second and third sentences need to comment on the timing of 1.5oC and 2.0oC (even if that is "regardless of timing") to avoid any misunderstanding and inferences made regarding consecutive sentences. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial

Comment ID	From Page	From Line	To Page	To Line	Comment
7769	17	7	17	11	In addition to the statement that “All regions will experience further climate changes in the near to mid term (next 30 years) (high confidence). For 1.5°C of global warming, regional changes include: … decreased cold extremes (e.g., cold spells, frosts) (high confidence)” it could also be emphasised in the SPM that the frequency and intensity of cold extremes on the northern hemisphere seem to be on the rise due to the warming-induced trend-like weakening of the polar vortex. This possibility was raised already in AR5 Chapter 14.8.6 Page 1266), but since then a large number of observational evidence have emerged which are partly referenced in Chapter 10 Page 20-21 in AR6 (“Mechanism for a potential influence in winter”) and several extreme cold spells hit the northern continents with severe consequences. It is now high time including this possibility in the SPM as well. It should also be shown in Figure SPM.9 panel a) on Page 36. [Government of Hungary, Ministry of Innovation and Technology - Climate Policy Department]
6191	17	7	17	13	The difference or added information compared to the previous paragraphs (esp. HS.6) does not become clear. Please provide insights on the fact that these changes are to be seen EVERYWHERE without re-phrasing previous statements, or move regional statements from HS.6 to this section. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
7097	17	7	17	13	Early start of summer and its prolongation should be mentioned here. [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]
4973	17	7	17	14	To shorten, please consider rephrasing "in the near to mid term (next 30 years)" to "over the next 30 years". [Government of Norway, Norwegian Environment Agency]
8577	17	7	17	14	Suggest rephrase for accuracy: The paragraph is confusing given inclusion of Antarctica for "All regions" in terms of 1) agriculture and health and 2) confidence attributed to change. We do not agree that this level of confidence is appropriate for Antarctica. Suggest Antarctica is mentioned in separate sentence. [Government of Australia, Department of Industry, Science, Energy and
6825	17	7	17	14	The changes mentioned for 1.5 C are already observed now, so clarify what is new about this? Surpassing tresholds is probably non-linear with temperature, but also sensitive to arguably formulation/choice of these thresholds. HS11.1 could give more policy relevant information on this. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
2823	17	7	17	23	We would like to ask the authors to provide more information here on the most vulnerable regions around the globe, including SIDS. These are the hardest hit regions in need of this extremely important information. [Government of Jamaica, Meteorological Service Division]
7025	17	7	17	23	The regional assessment should be more balanced regarding information on most vulnerable regions including SIDS, for which in particular not only half a degree but every increment of a degree matters. [Government of Fiji, Fiji Meteorological Services]
7289	17	7	17	23	Please make sure that the regional assessment on 1.5°C specific changes in H.S.11.1/2 and 2°C in H.S.11.3 is more balanced in terms of information on most vulnerable regions, including SIDS. It is these regions that will feel every increment of global warming the most. [Government of Saint Kitts and Nevis, Department of Environment - Ministry of Agriculture, Marine Resources, Cooperatives, Environment and Human Settlements]
7161	17	7	17	23	Regions such as SIDS are affected by every increment of warming and therefore the regional information provided in H.S.11.1/2 and H.S.11.3 should account for this. [Government of Samoa, Ministry of Foreign Affairs and Trade]
4127	17	7	17	36	It seems onerous to get the information of H.S11.1 – 11.3 straight, because the changes in climatic impact-drivers (CID) at 1.5 and 2 degree of global warming are interspersed in these paragraphs. We recommend dividing them into two paragraphs which mention the CIDs at 1.5 degree of global warming and at 2 degree of global warming. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]

Comment ID	From Page	From Line	To Page	To Line	Comment
7679	17	7	17	36	The section should justify why the difference between 1.5C and 2C scenario are being highlighted only for selective climate impact drivers. The SPM presents only incremental change in the intensity of impacts from 1.5C to 2C. There is no distinct difference discussed between the two scenarios in terms of the event frequency and absolute value of impacts. Further, there are disagreements within the literature on confidence levels and uncertainty. [Government of India, Ministry of Environment, Forests and Climate Change]
8269	17	7	18	12	For the future "projected" is preferred to "will" [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
9275	17	8	17	8	Change "annual surface temperature" to "annual mean surface temperature". [Government of United States of America, U.S. Department of State]
6827	17	8	17	11	It is unclear why the impacts associated with 2°C are also linked to a date (2050), whilst those related to 1.5°C are not. If the impacts are time-sensitive, it may be useful to provide more detail. [Philippe Tulkens, European Union (EU) - DG Research &
6193	17	11	17	11	Please delete „by 2050“ because it is the level of global warming level not its timing that matters. For the same reason, please delete "by mid-century" in SPM-17-28. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
9277	17	11	17	11	Throughout the SPM, use "greater warming" rather than "higher warming". [Government of United States of America, U.S. Department of State]
4263	17	11	17	11	Plase consider consistency on citing the degree of global warming (is it on 2 C and 1.5 C?) [Government of Indonesia, Ministry of Environment and Forestry Indonesia]
2729	17	11	17	12	This example is not clear enough. These thresholds are more frequently exceeded compared to what? Is there significance to the year 2050 here? Compared to 1.5 C or lower warming, the absolute thresholds would be exceeded more at 2C regardless of when that level is reached. [Government of Canada, Environment and Climate Change Canada]
4129	17	11	17	13	It is valuable to add the value of extreme heat thresholds, such as 41 degree at Chapter 12, page 7, line 42. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
2487	17	12	17	12	concerning the "other sectors" including irreversible large-scale impacts on marine ecosystem services [Government of France, Ministère de la Transition écologique et solidaire]
6481	17	13	17	13	Why are glaciers not included? [Government of Austria, Federal Ministry of Agriculture, Forestry]
8579	17	13	17	13	Suggest clarification: ‘further decreases of what?’ Suggest this reads ‘decreases in ice’; or ‘decreases in each of these Climatic Impact Drivers. [Government of Australia, Department of Industry, Science, Energy and Resources]
2845	17	13	17	14	H.S.11.1: As this sentence stands, it is unclear what "decreases" refers to. I suggest to change the sentence to "In regions outside of Antarctica, further decreases in permafrost, snow, lake and sea ice are projected (medium/high confidence)." [Government of Chile, Ministry of Environment]
6449	17	13	17	14	The following sentence lacks clarity: „In regions outside of Antarctica with permafrost, snow, lake and sea ice, further decreases are projected.“ The following wording is suggested: For all regions worldwide except Antarctica further decreases of permafrost, snow, lake and sea ice are projected. [Government of Austria, Federal Ministry of Agriculture, Forestry]
3379	17	13	17	14	Please specify to what refers "further decreases" [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]

Comment ID	From Page	From Line	To Page	To Line	Comment
6195	17	13	17	14	Please mention that near-surface permafrost is also projected to decrease with high confidence, see e.g., TS-43-6. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
6197	17	13	17	14	The message of the sentence remains unclear. Which factor will further decrease? And how is Antarctica affected? Which regions are meant by "outside of Antarctica"? Please clarify. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
9279	17	13	17	14	Suggest rewording to: "Outside of Antarctica, further decreases are projected in permafrost, snow, and lake and sea ice." [Government of United States of America, U.S. Department of State]
369	17	13	17	14	Please add to this sentence that near-surface permafrost is also projected to decrease as noted in TS-43-6. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
2721	17	13	17	14	Could some clarification be added to explain what the situation is with Antarctica. It isn't clear from the statement whether these changes are not occuring in Antarctica OR whether there are no projections OR we have low confidence in what the changes will be. (with warming presumably similar changes could occur in Antarctica so some further information could be useful). [Government of Canada, Environment and Climate Change Canada]
2489	17	13	17	14	Please clarify the "further decreases". Does it refer to their amount of ice or to their areas? [Government of France, Ministère de la Transition écologique et solidaire]
7887	17	13	17	14	This sentence is very hard to understand. [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
483	17	13	17	14	As for the sentence "In regions outside of Antarctica with permafrost, snow, lake and sea ice, further decreases are projected", it is suggested to state more clearly what elementsare expected to further decrease. [Government of China, China Meteorological Administration]
6829	17	13			Consider rewording "In regions outside of Antarctica with permafrost" to "In regions with permafrost outside of Antarctica". [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
2847	17	14	17	14	H.S.11.1: No point between "projected" and "(medium/high confidence)" in the last sentence [Government of Chile, Ministry of Environment]
4415	17	14	17	14	Combining confidence levels (medium/high) risks becoming unclear and difficult to understand. Suggest using the more appropriate of the levels. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
487	17	14	17	36	Some of the findings on this page use two confidence expressions (high/medium confidence, medium/high confidence), which can be confusing for decision makers. It is suggested to make a revision. [Government of China, China Meteorological Administration]
9281	17	16	17	16	Be mindful of the audience. Add definition of "pluvial flooding" in a footnote or consider changing "pluvial" to "subsequent" since "precipitation" is already in the sentence. [Government of United States of America, U.S. Department of State]
4975	17	16	17	16	As policy makers are not familiar with the term, please define "pluvial flooding". [Government of Norway, Norwegian Environment Agency]
4733	17	16	17	16	The word "pluvial" will be unfamiliar to some readers. Please replace with more familiar language eg "flooding caused by rainfall" or add "pluvial" to the glossary. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]

Comment ID	From Page	From Line	To Page	To Line	Comment
4735	17	16	17	16	Should this say 'the frequency and intensity of heavy precipitation events'? [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
6831	17	16	17	16	Explain "pluvial flooding". Not well-known. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
7681	17	16	17	17	The section should adequately specify the observations on precipitation being significantly different between 1.5C and 2C. It needs to add the role of natural climate variability and human influence, and add the differences, and disagreements in the studies cited in chapter 11. HS11.2 states that at "1.5°C of global warming, heavy precipitation and pluvial flooding are projected to increase with respect to the last 20 –40 years in most regions in Africa, Asia (high confidence)". In Table 11.8 page 153 of chapter 11 in terms of detection and attribution there exists limited evidence and even disagreement amongst studies that human influenced variability is greater than natural climate variability. This is particularly true for significant intensification of heavy precipitation in the case of East Asia, East Central Asia, and South Asia, Arabian Peninsula, West Asia, Russian Far East. [Government of India, Ministry of Environment, Forests and Climate Change]
485	17	16	17	18	In the sentence "heavy precipitation and pluvial flooding are projected to increase", it is not clear whether the increase here refers to the intensity or frequency of storm and flood events, or both. It is suggested to add clarification. [Government of China, China Meteorological Administration]
7951	17	16	17	20	The confidence level for the projected warming, heavy precipitation and pluvial flooding under 1.5 warming is not stated for Africa. [Government of Kenya, Kenya Meteorological Service]
7195	17	16	17	26	While Trinidad and Tobago agrees with the authors that distilling regional climate information from multiple lines of evidence can vary substantially from one case to another, we remain concerned with HS 11.2 at page 17, lines 11-26 and the associated figure SPM 9, page 36, which excludes increases in heavy rainfall from among projected specific combination of changes the Caribbean region would experience and limiting this to just hotter and drier, when the literature already captures the heavy rainfall have increased across the region. Trinidad and Tobago is requesting that the authors revisit literature for the Caribbean region. [Government of Trinidad and Tobago, Ministry of Planning and Development]
7197	17	16	17	26	In particular, Stephenson et al; 2014 that provides evidence of changes in heavy precipitation for the entire region. Specifically, the study found "The most significant change is found in the heavy rainfall events (R95p), which are generally rising. A significant R95p increase of 2.93, 4.93 and 2.07% per decade is observed in regions 1, 2 and 5, whereas a significant increase of 2.05% per decade is found in the regional average series for the entire Caribbean region during the past 25 years". Also, the study found that "these results are in agreement with results presented in Peterson et al. (2008); Aguilar et al. (2005) and Peterson et al. (2002)." These along with Dookie et al., 2019 should provide further clarity [Government of Trinidad and Tobago, Ministry of Planning and Development]
4133	17	16	17	26	An enormous amount of information in Table 11.4 - 11.21 is summarized only in one paragraph, H.S.11.2, and this causes some inconsistent information, such as "more frequent droughts and projected increase of precipitation in a same region". Since Figure SPM.9 refers to the details of the changes of climatic impact-drivers (CIDs) for each region, we suggest that H.S.11.2 mentions only introduction of Figure SPM.9, not bringing up the details of the CIDs changes. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
7795	17	16	17	26	This paragraph is difficult to read. Perhaps, separating 1.5C and 2C consequences could help. [Government of Poland, Ministry of Environment, Department of Air Protection and Climate]
6833	17	16	17	26	At 2°C confidence is higher for which regions? How much are the increases for the regions mentioned? Quantitative estimates would be useful for this statement [Philippe Tulkens, European Union (EU) - DG Research & Innovation]

Comment ID	From Page	From Line	To Page	To Line	Comment
4131	17	16	17	36	The term of "pluvial flooding" is used to describe inland flooding caused by rainfall, while "river flooding" is used to describe flooding from rivers. In general, the pairing terms is pluvial-fluvial or rain-river. It is better to use appropriate pair of words. References: Bates, Paul D., Niall Quinn, Christopher Sampson, Andrew Smith, Oliver Wing, Jeison Sosa, James Savage et al. "Combined modeling of US fluvial, pluvial, and coastal flood hazard under current and future climates." Water Resources Research 57, no. 2 (2021): e2020WR028673. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
9283	17	17	17	17	With regard to changes in Africa, because it is presenting percentage changes, Figure SPM.5c gives the impression that most of the changes in precipitation will be over the Sahara Desert. The text here about pluvial changes indicates most of the change is over tropical Africa. Some clarification is needed to avoid misconceptions (e.g., absolute amounts of precipitation change). [Government of United States of America, U.S. Department of State]
2979	17	17	17	17	It is unclear if high confidence is given to Asia only or both Africa and Asia. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
4537	17	17	17	17	The "last 20–40 years" appears vague. Which period is used exactly? [Government of Sweden, Swedish Meteorological and Hydrological Institute]
2491	17	17	17	17	For clarity please consider adding (high confidence) after Africa too [Government of France, Ministère de la Transition écologique et solidaire]
4417	17	18	17	18	Combining confidence levels (medium/high) risks becoming unclear and difficult to understand. Suggest using the more appropriate one of the two levels mentioned. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
4419	17	18	17	18	The "confidence is higher" is difficult to decipher. Higher than high, but still not very high? [Government of Sweden, Swedish Meteorological and Hydrological Institute]
8581	17	18	17	18	Suggest clarification: should this read "At 2 C…"? [Government of Australia, Department of Industry, Science, Energy and Resources]
7185	17	18	17	19	Trinidad and Tobago remains concern with the treatment of the Caribbean and the subsequent suppression of key findings that are not adequately reflected in the SPM due to the choice of referring to the grouping of the 3-sub-regions South America, Central America and the Caribbean as Central and South America. The grouping of the 3-sub-regions as Central America, South America and the Caribbean in the underlying report has been referred to as Central America and South America when articulating on the entire region. [Government of Trinidad and Tobago, Ministry of Planning and Development]
7187	17	18	17	19	This has led to suppression of key findings for the Caribbean. A reader would have to have prior information that the group Central and South America contains the Caribbean. As a result of the Caribbean being embedded, the text "confidence is higher changes in extreme precipitation at 2oC warming" at lines 18-19, which is an important message to convey for the Caribbean appears as though this finding is only for Central and South America. Trinidad and Tobago is therefore requesting that the authors consider retaining Central America, South America and the Caribbean as whole, to read "All Central America, South America and the Caribbean" to ensure the correct message is conveyed. [Government of Trinidad and Tobago, Ministry of Planning and Development]
6451	17	19	17	19	It is suggested to substitute „seen" by „expected" – because it is only seen by the model – but not in reality by now. [Government of Austria, Federal Ministry of Agriculture, Forestry]

Comment ID	From Page	From Line	To Page	To Line	Comment
7683	17	20	17	22	"Rewrite the statement ""At 1.5°C of global warming, more frequent and/or severe agricultural and ecological droughts are projected in a few regions in all continents except Asia compared to 1850–1900 (medium confidence) and in more regions at 2°C, some with high confidence"". The medium and high confidence in the statement is inconsistent with observations made in table 11.6 in chapter 11 (pg 136 onwards). In terms of AGHYD and MET droughts, most studies (particularly Touma et al., 2015; Cook et al., 2020 for Africa and Naumann et al., 2018; Gu et al., 2020 for Asia) indicate slightly reduced drying with low confidence, inconsistent trend signals at these warming levels." [Government of India, Ministry of Environment, Forests and Climate Change]
9285	17	20	17	22	Key issue - Drought: As discussed in the Whole Document comment, this statement omits any mention of those regions where agricultural/(ecological) drought is expected to decrease with climate change. Presumably this is because it's based on the assessment in Figure SPM.9b (and ultimately on the Chapter 11 tables), rather than on the GCM total-column soil moisture projections alone. This statement should rely only on the total-column soil moisture projections (and not on the other lower-confidence metrics in the Chapter 11 tables), and should report both increases and decreases in drought thus defined. [Government of United States of America, U.S. Department of State]
7099	17	20	17	22	Based on the available evidences, climate change in Asia and all mid-latitudes (arid and semi-arid regions) has been much greater than other continents and latitudes. Thus, climate change in these regions in Asia leads to frequent and prolonged droughts, changing rainfall patterns, torrential rains in hot seasons when the land is dry and without water leading to environmental and severe economic damages in a large part of the continent. It suggoests to add here in this paragraph. [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]
489	17	20	17	22	The conclusion of this sentence should be a reference to the executive summary of Chapter 11, not a reference to 12.4. It is suggested to make a check and revision. [Government of China, China Meteorological Administration]
3381	17	22	17	22	Please specify which regions are referred to in "Few regions…" [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
2723	17	22	17	24	Awkward phrasing. Suggest rephrasing to read "Few regions are projected to experience significant changes in mean precipitation at 1.5C, whereas at 2C of global warming, mean precipitation is projected to increase....". [Government of Canada, Environment and Climate Change Canada]
2493	17	22	17	24	This sentence would read clearer if it was divided in two. One about 1.5°C and one about 2°C [Government of France, Ministère de la Transition écologique et solidaire]
2495	17	23	17	23	Regarding the increase at the end of the line, one could assume, by default, that in regions where an increase is not found, precipitation remains unchanged. But this is contradicted in point 11.3 below that mentions reduction in precipitation. [Government of France, Ministère de la Transition écologique et solidaire]
4539	17	24	17	24	The "last 20–40 years" appears vague. Which period is used exactly? [Government of Sweden, Swedish Meteorological and Hydrological Institute]
2731	17	25	17	25	This citation includes all of the Ch 11 regional tables, but others here cite only section 11.9. This should be consistent across all of the key findings. [Government of Canada, Environment and Climate Change Canada]
7201	17	26	17	28	Sane as the 5th comment. Specifying affected regions would be useful. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
6453	17	28	17	28	It is suggested to delete „by mid-century" because the critical parameter is a global warming level of 2oC – independent by when this level is reached. [Government of Austria, Federal Ministry of Agriculture, Forestry]
4421	17	28	17	28	Why is the reference to "by mid-century"? Would not the changes be the same/similar also for a later period, if and when 2oC would be reached beyond 2050? [Government of Sweden, Swedish Meteorological and Hydrological Institute]
8583	17	28	17	29	Please clarify what it means for these changes to "accumulate". [Government of Australia, Department of Industry, Science, Energy and Resources]

Comment ID	From Page	From Line	To Page	To Line	Comment
2725	17	28	17	30	It is unclear how the phrase "that will accumulate in each region" adds new information that is not already captured by the phrase "Most regions will experience additional changes in climate-impact-drivers". We think the intent is to point towards the risk of cumulative impacts from changes in multiple climate impact-drivers, but this sentence and the WGI report is not about impacts. Perhaps it is sufficient here to say "most regions will experience additional changes in multiple climate impact-drivers (i.e. add the word "multiple"). [Government of Canada, Environment and Climate Change Canada]
3383	17	28	17	33	It is stated that with 2ºC global warming ", "region specific changes could include…..reductions in mean precipitation and aridity". Nonetheless in the precedent H.S.11.2 it is stated that "mean precipitation is projected to increase with respect to the last 20-40 years in polar regions, regions of northern Eurasia and North America, and two regions of South America with high confidence at 2°C of global warming". It seems that both statements are not fully consistent. [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
9289	17	28	17	36	The statement uses both "high/medium confidence" and "medium/high confidence". Is there a difference between these levels of confidence? [Government of United States of America, U.S. Department of State]
4423	17	29	17	29	Do changes in climate impact-drivers "accumulate"? The formulation is a bit unclear. Deletion of "that will accumulate" might be a useful simplification. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
9287	17	29	17	29	Delete "that will accumulate". It is not needed, and drivers do not 'accumulate'. [Government of United States of America, U.S. Department of State]
4737	17	29	17	29	Could you clarify what is meant by impacts ‘accumulating’ in each region? Does this refer to compound/cascade events? [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
2499	17	29	17	29	Climate impacts on air pollution are lacking from the list and Fig SPM.9. In the earlier version of Chap 12 (AR6 SOD Table 12.7), it was clearly stated that in Europe there was "High confidence of hazard increase for ozone air pollution , and low confidence in hazard decrease for aerosol pollution". In Chap 12 of this FGD, the distinction between aerosol and ozone pollution disappeared, so that overall climate impacts on air pollution are presented as uncertain. This choice is debatable because the impact on ozone is well established. Nevertheless the present comment is not meant to argue about the choice made for the FGD version of Chap 12, but it points towards an inconsistency in the overall FGD report, where it is still clearly stated in Chap 6 (P58L45) that there is medium to high confidence that "climate change will introduce a surface O3 penalty increasing with increasing warming levels" [Government of France, Ministère de la Transition écologique et solidaire]
2497	17	29	17	30	For the regions specific changes, will the affected area change or will they stay the same ? If new regions are to be affected by natural hazards, they may not be well prepared or even not prepared at all to face large fires, floods or hurricanes. [Government of France, Ministère de la Transition écologique et solidaire]

Comment ID	From Page	From Line	To Page	To Line	Comment
9291	17	29	17	33	To simplify sentences, better articulate concurrent nature of changes, and provide more balanced view of change in drought, suggest revising to read: "Region-specific changes could include increases in tropical cyclone intensity or extratropical storms in some regions (medium confidence). Reductions in mean precipitation and increases in aridity are projected in some drying regions (high/medium confidence), along with increases in fire weather (medium/high confidence) and increasing hydrological droughts (high/medium confidence), and with decreases in river flood risk in a few regions. Conversely, in other wetting regions, increases in precipitation and decreases in aridity and hydrologic droughts are expected (high/medium confidence), along with increases in flood risk (high/medium confidence)." [Government of United States of America, U.S. Department of State]
4977	17	29	17	33	Please clarify whether the increase in extratropical storms refers to intensity or frequency. [Government of Norway, Norwegian Environment Agency]
2849	17	30	17	30	H.S.11.3: In the second sentence it is unclear what will increase for extratropical storms. According to the information in 11.7.2.4, I suggest to change this sentence to "Region-specific changes could include increases in tropical cyclone intensity, changes in the location of extratropical storm tracks (medium confidence),…" [Government of Chile, Ministry of Environment]
2727	17	30	17	30	As written, it is unclear if this sentence means tropical cyclone intensity could increase, as could the frequency of extra-tropical storms, or whether it means the intensity of both tropical cyclones and extratropical storms could increase. If the latter, then suggest rephrasing as "Region-specific changes could include increases in intensity of tropical cyclones and extra-tropical storms, etc. [Government of Canada, Environment and Climate Change Canada]
2501	17	30	17	30	Regarding "extratropical storms" this is not found in the Technical Summary TS.4.3.2 where changes are mentioned mainly for tropical cyclones, but not for extratropical storms [Government of France, Ministère de la Transition écologique et solidaire]
4425	17	31	17	33	Combining confidence levels (medium/high) risks becoming unclear and difficult to understand. This is further compounded by the use of both "high/medium" and "medium/high". Suggest using the more appropriate of the two levels in each case - either "high" or "medium", as appropriate. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
9293	17	33	17	33	Key issue - Drought: As discussed in the Whole Document comment, this makes no mention of areas where runoff would increase due to climate change (e.g., in Box TS.6 Figure 1d), and thus presumably hydrological drought risk would decrease. It is unclear why the hydrological drought bar in Figure SPM.9b does not show these wetting regions. To fix this, "increasing hydrological droughts" could be changed to "regional increases and decreases in hydrological droughts" or similar. [Government of United States of America, U.S. Department of State]
9295	17	33	17	35	To better articulate confidence level for these changes, revise to: "Future regional risk can also be substantially influenced by other changes (e.g., hail, ice storms, severe storms, dust storms, heavy snowfall, and avalanches) but confidence in projections of these phenomena remains low." [Government of United States of America, U.S. Department of State]
77	17	34	17	35	It would be useful to elaborate further on how the other changes stated could influence regional risks and which regions are most relevant. [Government of Singapore, Ministry of Environment and Natural Resources]
4427	17	35	15	35	Above, many findings with less than "high" confidence are quoted. It would seem odd that a finding is not provided here, because of lack of "high" confidence. Is the meaning here rather that such projections are not possible on reasonable levels of confidence? If so, please amend. Alternatively delete lines 33-35, if no finding with a reasonable level of confidence can be extracted. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
9297	17	38	17	38	Recommend to better clarify for policymakers the contribution of geologic land uplift to local sea level rise predictions. Change "Except in a few regions with substantial land uplift ..." to "Except in a few regions with substantial geologic land uplift rates ..." [Government of United States of America, U.S. Department of State]
6835	17	38	17	38	Why is the qualification very likely to virtually certain needed? If this is not clear, very likely seems appropriate. Note that there was also a qualifier extremely likely defined in the text. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]

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6431	17	38	17	39	Sentence incomplete, it ends with "and" line 40 and seems like something else should be added in this section [Government of Saint Lucia, Department of Sustainable Development - Ministry of Education, Innovation, Gender Relations and Sustainable Developement]
6201	17	38	17	39	Is HS.11 focussing on the next 30 years or not? H.S.11.2 and H.S.11.6 focus on warming levels. Statement H.S.11.4 extends over the whole 21st century. For the following statements the time period is unclear. Suggest to clarify the scope and messages of HS.11 and its sub paragraphs. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
371	17	38	17	39	The message convened by this high-level statement is not clear. Does the second part of the sentence only applies if 2°C or 1.5°C thresholds are crossed within the next 30 years? We think that the second sentence refers to long-term stabilization at these levels, but this should be clarified. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
217	17	38	17	39	Here there is a use of range of likeliness (very likely to virtually certain). Use a single term of likeliness bearing in mind that very likely ranges from (90%-100%) [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7953	17	38	17	40	The sentence seems to be incomplete, it ends with "and" followed by level of confidence in parenthesis. [Government of Kenya, Kenya Meteorological Service]
4135	17	38	17	40	The sentence does not finish properly. Referring Chapter 12 (page 12-7 line 13), this "and" seems unnecessary. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
4137	17	38	17	40	It is a bit hard to understand that this sentence indicate a series of the difference in case of 2°C increase. Also, it would be helpful if it is described of the difference comparing to the case at 1.5°C of global warming. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
6199	17	38	17	40	H.S.11.4 Something seems to be missing here at the end, the sentence is incomplete. In addition, the sentence is too long, please revise. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
7771	17	38	17	40	“…contributing to increases in the frequency and severity of coastal flooding in low-lying areas and to coastal erosion along most sandy coasts and (high confidence).” end of sentence is missing, or delete "and" [Government of Hungary, Ministry of Innovation and Technology - Climate Policy Department]
4979	17	38	17	40	It would be really helpful with a short indication of which regions the exception to sea level rise are, or an indication of where on the globe these regions are. Perhaps in a footnote? [Government of Norway, Norwegian Environment Agency]
8585	17	38	17	40	Please clarify whether this is over all the core scenario projections. [Government of Australia, Department of Industry, Science, Energy and Resources]
8587	17	38	17	40	Suggest review the need for this statement, which seems to largely repeat H.S.9.3. [Government of Australia, Department of Industry, Science, Energy and Resources]
149	17	38	17	40	"..... sandy coasts and (high confidence)." Incomplete statement. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7699	17	38	17	41	Relative sea level rise will not only cause coastal erosion along most sandy coasts but also cause erosion on the shores of small islands which leads into submergence; Example: Islands in Gulf of Mannar, Tamil Nadu [Government of India, Ministry of Environment, Forests and Climate Change]

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6203	17	38	17	41	We learned in the SROCC that global sea level is rising at an increasing rate (SROCC SPM B.3) and found similar statements in the executive summary of Ch 9 (c.f. 9-8:34). Therefore, the relative sea level should also rise in most regions at increasing rate. We kindly request the to revise this statement and add information about the rate of relative sea level rise. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
9299	17	38	17	41	This statement is not very different than the previous ones on global sea level rise. Recommend deleting or focusing more clearly on coastal flooding and erosion and including specific rates of regional sea level rise, which are more relevant for risk framing. [Government of United States of America, U.S. Department of State]
373	17	38	17	41	This statement should include an indication that the level of sea level is not only rising but also accelerating. This statement was made in the SROCC and in chapter 9 of the present report. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
4981	17	38	17	41	Please consider rephrasing to: 'Locally, relative sea level is very likely to virtually certain continuing to rise throughout the 21st century and beyond, except in a few regions with substantial land uplift. Rising sea levels will contribute to increased frequency and severity of coastal flooding in low-lying areas and to coastal erosion along most sandy coasts (high confidence). [Government of Norway, Norwegian Environment Agency]
7613	17	38	17	41	It will be important for policymakers to have an idea of whether or not their specific region is likely to be impacted by increased frequency and severity of coastal flooding or not (except in a few regions), for this reason it is important to highlight those regions in this sub-headline statement. [Government of South Africa, Senior Policy Adviser International Climate Change Cooperation Department of Environmental Affairs]
2503	17	38	17	41	We recommend to reformulate this sentence : "Episodic coastal flooding is caused by Extreme Total Water Levels (ETWL), which is the combination of RSL, tides, storm surge and high wave setup at the shoreline" because sea level rise is not the only parameter. See for reference 12.3.5.2 We would also suggest to change "sandy coast" to "coastal erosion and notably along most sandy coast" as in 13.3.5.3. Finally, it seems that the sentence is not finished. [Government of France, Ministère de la Transition écologique et solidaire]
4739	17	39	17	39	Can we mention SLR beyond the 21st century here? E.g. ‘throughout the 21st century and beyond’ [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
2851	17	40	17	40	H.S.11.4: Incomplete last sentence [Government of Chile, Ministry of Environment]
3385	17	40	17	40	The sentence seems incomplete since it ends with "and" [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
79	17	40	17	40	Missing word after "and" in "most sandy coasts and (high confidence)." [Government of Singapore, Ministry of Environment and Natural Resources]
6483	17	40	17	40	This sentence seems to be incomplete or the last "and" needs to be deleted. [Government of Austria, Federal Ministry of Agriculture, Forestry]
7797	17	40	17	40	A part of the sentence is missing after „and”. [Government of Poland, Ministry of Environment, Department of Air Protection and Climate]
4983	17	40	17	40	Content seem to be missing at the end of the sentence since it currently ends with an "and". [Government of Norway, Norwegian Environment Agency]
1677	17	40	17	40	The last sentence ends abruptly. There might be word(s) missing? [Government of Finland, Finnish Meteorological Institute (FMI)]
7565	17	40	17	40	Remove 'and' at the end of the sentence. [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]

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8589	17	40	17	40	Please review, the sentence is incomplete 'most sandy coasts and..?' [Government of Australia, Department of Industry, Science, Energy and Resources]
2733	17	40	17	40	Delete "and" before "(high confidence)" [Government of Canada, Environment and Climate Change Canada]
6837	17	40	17	40	Word(s) missing at end of sentence (deltas?) [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
3019	17	40	17	40	"to coastal erosion along most sandy coasts and" seems a typo. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
491	17	40	17	41	It is inappropriate to end this sentence with an "and". It is suggested to make a check and revision. [Government of China, China Meteorological Administration]
7121	17		17		The relationship between climate change and the occurrence of floods should be shown more favorably in the report(http://dx.doi.org/10.1080/02626667.2013.857411 and http://dx.doi.org/10.1080/02508060708692215) [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]
2911	18	0	18	0	Fig. 9, panel a: (e.g. SSA) green color groups both fire weather and more precipitation; please clarify whether both extremes are expected to occur in the same or different sub-regions [Government of Chile, Ministry of Environment]
4139	18	1	18	1	As for the urban-specific effects caused by climate change, it seems that they are as described in the original draft and do not need to be modified. However, it would be better to explain that, for example, the effect of urbanization is excluded as much as possible in the derivation of the global mean temperature increase based on observed data (i.e., temperature data for urban areas are not used), and that the effect of urbanization is not taken into account in the future projection of climate change by the coupled atmosphere-ocean models. In other words, it would be better to explain that "climate change → urban impact" is as stated in the original draft, but "urbanization → global climate change" is not assessed, just in case. Otherwise, it is concerned that some people may mistakenly think that the IPCC as a whole is evaluating the interaction between urbanization and global climate change. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
6205	18	1	18	1	H.S.11.5: Please check the confidence statement, it is not consistent with Ch11 [p: 11-39;l:53-54]. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
7831	18	1	18	2	Paragraph H.S.11.5 refers to the urban scale which is not covered by the global climate models simulations. The first statement is not always true as it depends on the city characteristics, season, and geographical location [Government of Poland, Ministry of Environment, Department of Air Protection and Climate]
4429	18	1	18	3	This would seem to be rather basic information and it is not clear that it would be a new key finding and/relevance for the presentation of key findings in the SPM? Deletion, or combining some of this with the next sentence, might be an option. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
9301	18	1	18	3	Rework these sentences to more clearly communicate the major point about the impacts of urbanization: "Urbanization alters temperatures and the water cycle by generating increased precipitation over and downwind of cities (medium confidence) and increasing runoff intensity (high confidence)." [Government of United States of America, U.S. Department of State]
5123	18	1	18	7	This paragraph is vague because there is no reference to specific levels of warming. Please provide more specific statements. [Government of Belgium, Belgian Science Policy Office - Belspo]
4985	18	1	18	7	Please consider rephrasint the first sentence to: 'Urban areas are generally warmer than their surroundings, albeit predominantly at night-time (very high confidence)...'. In the second sentence perhaps say 'local water cycle and hydrology', which better reflects the exapmles provided? [Government of Norway, Norwegian Environment Agency]
8591	18	1	18	7	Suggest clarification: which parts of this statement represent advances since AR5? [Government of Australia, Department of Industry, Science, Energy and Resources]

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6839	18	1	18	7	It is pertinent to highlight the likely interactions between urbanisation and climate change. However, arguably more significant interactions between land use and climate change are not addressed at all, although those also have interactions with emissions themselves. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6355	18	1	38	12	In this context, it is suggested to review the following text: https://www1.undp.org/content/undp/es/home/news-centre/news/2019/Vulnerable_developing_countries_lead_world_on_climate_ambition_UN_report.html [Government of Mexico, Directora General del Instituto Nacional de Ecologia y Cambio Climatico]
7693	18	2	18	2	increased precipitation over cities'. The experience over inland cities in regions where the prognostication is of precipitation decline shows that there is a decline in urban rainfall perhaps due to urban heat island effect, concretization and reduction [Government of India, Ministry of Environment, Forests and Climate Change]
4141	18	2	18	2	Use "increased extreme rainfall events" instead of "increased precipitation" following Chapter 8, page 14, line 6~7. On the whole, SPM distinguishes "increase extreme rainfall events" and "increase precipitation" depending on the situations. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
151	18	2	18	3	The source statement in the chapter (Chapter 8, Page 7 Line 17-19 provides additional context relevant to water cycle. The original statemet reads "Urbanization has increased local precipitation (medium confidence) and runoff intensity (high confidence). Increased precipitation intensities have enhanced groundwater recharge, most notably in tropical regions (medium confidence)." The complete statement should be included in the SPM as well. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7421	18	3	18	3	Chapter 8, page 29, line 48 states "There is medium confidence that urbanisation can increase local precipation and runoff intensity" and this has a different confidence level in the SPM H.S.11.5 where it is stated that "Urbanization alters the water cycle.... increasing runoff intensity (high confidence). Align the confidence level in the SPM to medium confidence as in the underlying chapter. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7655	18	3	18	4	Delete the sentence starting "large implications.." Replace with, "Large implications are expected from the more frequent occurrence of extreme climate events in urban areas" (very high confidence). [Government of India, Ministry of Environment, Forests and Climate Change]
9303	18	3	18	7	What does "large implications" mean? Recommend rewording to read: "Cumulative and detrimental impacts are expected from the combination of future urban development and the more frequent occurence of extreme climatic events, such as heatwaves." [Government of United States of America, U.S. Department of State]
7697	18	5	18	5	Add after "extreme sea level".. "intense cyclone" [Government of India, Ministry of Environment, Forests and Climate Change]
2735	18	5	18	5	By "extreme sea level" is reference being made to storm surges for which the impact will be exacerbated with the projected ongoing rise in relative sea level? Perhaps the statement could be revised to be clearer. [Government of Canada, Environment and Climate Change Canada]
6841	18	5	18	5	Extreme sea levels as a result of storm surges or SLR? Likely both, but please elaborate. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6207	18	9	18	9	H.S.11.6: Please insert the word 'likely' in ….regions will likely experience an increase…., as it is given in the ES of Ch 11 [p:11-9;l:52-53]. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
9305	18	9	18	10	Clarify what "compound events" are, for example: "Many regions will experience an increase in the probability of compound extreme weather and climate events with greater global warming." [Government of United States of America, U.S. Department of
6843	18	9	18	12	Please provide examples of some of the most typical or serious compound events to be expected, and their frequency / intensity. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]

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7615	18	9	18	12	It is important for policymakers to know whether or not their region will be impacted and those regions affected need to be highighted. For instance, research conducted nationally shows that South Africa will warm at twice the rate of the GMST, therefore climate change related impacts could also be more frequent and more severe as compared to other regions/countries. It is therefore, important for policymakers to understand this. Most developing countries might have large data gaps regarding this, so this SPM could help them assess it further in terms of policy development. [Government of South Africa, Senior Policy Adviser International Climate Change Cooperation Department of Environmental Affairs]
4431	18	10	18	10	Does this apply also for 2oC and upwards? What would apply for 1.5oC? Also, what does more frequent refer to (1850-1900, or lower levels of warming, something else)? [Government of Sweden, Swedish Meteorological and Hydrological Institute]
9307	18	10	18	10	Use "greater" rather than "higher". [Government of United States of America, U.S. Department of State]
2505	18	10	18	12	It could be worth giving more precision, or at least an example: which type of silmutaneous or sequential extremes?. Also, we suggest to move the parenthesis at the end of the sentence [Government of France, Ministère de la Transition écologique et
2909	18	11	18	11	critical "regions" or critical "sectors"? [Government of Chile, Ministry of Environment]
6421	18	15	18	35	Noting that the Caribbean Region is expected to experience more intense hurricanes and extreme precipitation, would number 2 better apply here? [Government of Saint Lucia, Department of Sustainable Development - Ministry of Education, Innovation, Gender Relations and Sustainable Developement]
7767	18	15	18	37	SPM.9: The most complex figure with a lot of details, both panel a) and b). Panel a): At what likelihood range results are shown? Are drought and fire weather are linked? Is it worth separating these two as one is possible without the other? Also, are the pluvial floods are basically the indices for wetter extremes? The naming is misleading.; In the headline, the reference period is not shownd while GWL is not explained and "OR" is used while in the figure description "IF".; Panel b): The definition of CIDs with illustration could be removed from the figure.; The maximum number of regions is 50 here, while 44 are on the hexagon figure and 44+3xPAC on panel a)?; Coastal and oceanic and oceanic regions are hard to be separated. Some CIDs are even the same with different results; Why CIDs in the others are needed? Air pollution weather, radiation at surface are not clear and atmospheric CO2 is not needed here as it is not an impact. [Government of Hungary, Ministry of Innovation and Technology - Climate Policy Department]
7987	18	17	18	31	Figure SPM.9. Panel a) For clarity, the name of the clusters should match between the map legend and the combinations below. In addition, the names in the legend highlight certain general/regional drivers in a non-homogeneous way for all clusters. It would be clearer if the same criteria for naming the clusters were used in all cases, or if detailed names were avoided. [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
7291	18	17			Figure SPM.9: Please put the CID definition provided as part of panel b more prominently below the figure headline statement [Government of Saint Kitts and Nevis, Department of Environment - Ministry of Agriculture, Marine Resources, Cooperatives, Environment and Human Settlements]
4435	18	27	18	28	A candidate for shortening could be to delete: "The five groups are chosen to provide a reasonable level of region-specific detail whilst not overwhelming the map with" [Government of Sweden, Swedish Meteorological and Hydrological Institute]
4433	18	31	18	33	The number of regions would not seem to provide key information, compared to the nature of changes and their geography displayed in panel (a). Suggest omitting panel (b) for brevity and focus. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
4143	18	35	18	35	Not TS.24, but TS.22. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]

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4237	18	38	18	38	As a tropical country located directly on the equator and an archipelago (with more than 17,000 islands) with the 5th largest population in the world (approximately 260 million people, the majority of whom live below the poverty line), the phenomenon of "sea level rise" will almost certainly have a significant impact on the country's physical as well as socio-economic conditions. It is recommended that impact assessment be carried out and anticipatory measures be prepared. It is hoped that this assessment can be completed with funding support from international funds. Furthermore, more than 60% of Indonesia's largest cities are located in coastal areas, which at current moment has a 'rob' at various times, with the shoreline having receded tens of meters in comparison to many decades ago. Land subsidence happened in various locations because of the phenomena of groundwater subsidence caused by groundwater being sucked up for industrial and residential reasons, compounding the situation. During a socio-economic survey in the north coast of Jakarta (Cengkareng and Penjaringan sub-districts) in 2017, which was funded by the UNEP-CTCN, the author learned that the current location of his house is approximately 3 meters above the location of his grandfather's house, which he had lived in since he was a child. It is necessary to perform assessment to determine the actual situation in large coastal cities in order to develop policy recommendation and concrete initiatives to address them. Greater international support is needed for highly vulnerable developing countries like Indonesia to adapt to climate change [Government of Indonesia, Ministry of Environment and Forestry Indonesia]
6209	18	40	18	40	Changing "outcomes leading to" --> "outcomes associated with" seems clearer to us (non-native speakers). Please check. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
6845	18	40	18	40	This section is very helpful. However, the 'low-likelihood' labelling, while accurate, could give a false sense of security. They are low likelihood given current knowledge, but current knowledge is evolving. Suggestion: the section should provide some commentary on whether the likelihood (or plausibility) of these outcomes has increased in recent years due to the reality of a changing climate and/or improvements in science. Also consider to include the word 'tipping point', and develop this in HS12.4 [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
3387	18	40	18	42	There is no confidence statement. [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
7529	18	40	18	42	Add to HS: "The chance of low-likelihood, high impact outcomes increases with higher global warming levels." [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
4541	18	40	18	42	The "and complement climate information for risk assessment." could be omitted. It is not really discussed in the text that follows, and in any case the fact as such is rather given. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
2507	18	40	18	42	This sentence is not very clear and efficient in reflecting the details of the messages below for an SPM audience : a revised wording could be proposed to better explicit what larger global or regional changes one is to expect and how higher warming impacts this expectation. No statement is given about the likelihood of permafrost thawing and associated enhance warming.This is often a question arising and that may need some information in HS.12. [Government of France, Ministère de la Transition écologique et solidaire]

Comment ID	From Page	From Line	To Page	To Line	Comment
7893	18	40	18	42	HS.12: "Low likelihood outcomes" is technical and not compelling. This could be replaced by "Surprises in the climate system, such as crossing thresholds, regime shifts, or irreversible changes, could lead to substantially larger ...". The closure of the HS could be improved: is it not that they are currently a gap in risk assessment? [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
493	18	40	18	42	The statement is not aligned with "The Concept of Risk in the Sixth Assessment of Report: A Summary of Cross-Working Group Discussions", where risk is considered as "the potential of adverse consequences". Low-likely outcomes should be a part of risk assessment. Technically speaking, all possible events, no matter how rare they are, should be considered in the risk assessment. Without it, the risk assessment is incomplete. It should not be considered as "complement information". [Government of China, China Meteorological Administration]
4145	18	40	18	44	The phrase of "low-likelihood outcome cannot be ruled out and complement" seems to be subjective. What constitutes "substantively larger changes" depends on the judgment of the policy makers. It would be better to describe as "Low-likelihood outcome leading to substantially larger global or regional changes than assessed for the very likely range of projections should discussed climate information for risk assessment considering current uncertainty of the projection together" [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
9309	18	40	18	44	Rewrite to more clearly articulate the major point about the occurrence of low-likelihood, high-impact events and the need to consider them in climate risk assessments: "Low-likelihood outcomes leading to substantially larger global or regional changes than assessed for the very likely range of projections have and can occur, and should be included as part of climate risk assessment." [Government of United States of America, U.S. Department of State]
8271	18	40	18	45	A clearer statement cannot "cannot be ruled out" would be useful as well as a confidence statement on specific high impact topics. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
6847	18	40	19	10	The headline sentence and 1st paragraph largely repeat each other and add little value compared to a basic common sense understanding of climate change (surprisingly high warming would lead to larger impacts). Proposed editing: * make the current paragraph H.S.12.3 the headline statement. It is a more powerful message (the fact that warming itself increases the chance of low-likelihood events) and makes sense as a standalone statement. * delete paragraph HS.12.1. and replace it with the current headline H.S.12 (which says the same thing more concisely, and mentions risk assessment). [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6463	18	40	19	19	This approach is very important and must not be deleted but definitely be kept! The reason being that in the past criticism has been raised that the IPCC is too conservative and does not inform about the full spectrum of climate change risks but limits is messages to the most likely impacts. Although this approach had is merits in the past it is now the right point in time to broaden the message on possible impacts to the full picture – because a lower probability of occurrence does not mean that there is no probability at all! The IPCC has to avoid to have a bias in its information – otherwise it might be blamed not to have warned the broader public on all the risks related to climate change. [Government of Austria, Federal Ministry of Agriculture, Forestry]

Comment ID	From Page	From Line	To Page	To Line	Comment
6211	18	40	19	19	We appreciate the innovative approach to address low-likelihood high impact outcomes since these are particularly important for risk management. However, the current text is not yet presenting this purpose clearly enough. Most statements following HS.12 (except H.S.12.4) convey rather obvious aspects most of which were already touched before (e.g. on page 16). In addition, some trivial statements may give a wrong impression. E.g. HS.12.2 seems to give trivial examples for low-likelihood, high-impact outcomes (LL-HI-O) and thus to act as an introduction to the subsequent H.S. Are LL-HI-O not possible for global warming outside the "very likely" range? It seems trivial that LL-HI-O are possible anytime, even under current conditions. It might also be worth considering that emphasis on scientifically correct, but trivial facts could trigger a fatalistic attitude with the reader. Please see our comments on the individual statements and strengthen these paragraphs avoiding duplications or misunderstanding and provide clearer messages. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
4987	18	40	19	19	Strong support for including low-likehood outcomes where these are linked to very high impacts. Taking decisions under uncertainty is important for policy-makers and these scenarios may constitute significant risks that policy-makers need to be aware of. [Government of Norway, Norwegian Environment Agency]
6849	18	40	19	19	HS.12 Should include at least one paragraph specific to high-impact events involving ecosystems, such as the rapid deterioration of forest regions (like "collapse of the Amazon") or some marine systems. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
7657	18	40	19	19	Delete completely. Explanation: Specific low confidence outcomes and relevance of high warming scenarios (excluding SSP-8.5) are registered in the appropriate section in the text. A separate section drawing specific attention in an unbalanced way to these in largely generalities is unbridled alarmism, unproductive and detrimental in messages to policy-makers. [Government of India, Ministry of Environment, Forests and Climate Change]
2869	18	40	19	44	The footnote #20 (explaining how low-likelihood events are defined) should be provided at the begging of the section (i.e., page 18). In the current version of SPM it is delivered in the page 19. [Government of Chile, Ministry of Environment]
4741	18	46	18	46	Is it possible to give brief examples of why warming might exceed the very likely range for a given scenario? [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
6455	18	46	18	47	It is suggested to delete the following wording: „including low CO2 emission scenarios and near-term projections“ because this insertion does not change the main message but makes it more difficult to get the key message [Government of Austria, Federal Ministry of Agriculture, Forestry]
4437	18	46	18	49	This would seem to be trivial, i.e. that consequences will be larger for larger warming. If reference is to tipping points and suchlike, please clarify. It is not presently clear what the text intends to convey. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
2509	18	46	18	50	Suggestion to reformulate this sentence into maybe 2 sentences in order to make it more understandable. Also is here"high-warming" needed? indeed, if low CO2 emission scenarios are included, the reference to high-warming is then inconsistent [Government of France, Ministère de la Transition écologique et solidaire]
4147	18	46	18	51	We suggest adding the details or values of "very likely range" to enhance this paragraph. We feel that the information provided in current H.S.12.1, such as "climatic impact-drivers would be larger if global warming exceeds the assessed very likely range" is obvious and may not be of much valuable to most readers. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
7485	18	46	18	51	open door [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
6213	18	46	18	51	H.S.12.1: Do you want to express that changes outside the "very likely range" could have larger (or lower?) impacts than the changes inside this range? Isn't this obvious? [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]

Comment ID	From Page	From Line	To Page	To Line	Comment
4989	18	46	18	51	Initially we find the language in these sentences to be somewhat challenging to understand. At the same time we believe the perspectives you are trying to convey are very important. Perhaps the words 'outcomes', 'changes' and 'aspects' are too unspecific and could be replaced with more descriptive words. [Government of Norway, Norwegian Environment Agency]
9311	18	47	18	47	Because near-term projections are part of emission scenarios, delete "and near-term projections". [Government of United States of America, U.S. Department of State]
3021	18	48	18	48	A space between "impact-drivers" and "would" is required. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
7889	18	48	18	48	Add a space before "would". [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
6215	18	49	18	49	"largest" --> "very large". Suggest to avoid the superlative here because the ensemble may still be too small. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
3389	18	49	18	50	There is no confidence statement. [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
4743	18	49	18	50	Human and ecological systems is a bit vague. What systems does this exclude exactly? Physical systems? Well, presumably some of those impact on the human systems mentioned. Please could you make this more precise? [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
2737	18	49	18	51	Sentence is unclear mainly because the use of the phrase 'largest impacts' implies impacts associated with high emission scenarios/high amounts of global warming. Is that the intent? if the intent is to capture the consequences of warming exceeding the projected very likely levels across all emission scenarios (consistent with the context in the previous sentence), then consider rephrasing as "Such high-warming outcomes would be associated with potentially larger impacts and higher risks for human and ecological systems". [Government of Canada, Environment and Climate Change Canada]
7467	18		19		In Chapter 11, P.24, L.9-19, BOX 11.2, the text explicitly states, "SREX (Chapter 3) assigned low confidence to low-probability high-impact (LLHI) events." The chapter text continues to demonstrate that "the low confidence does not by itself exclude the possibility of such events to occur, it is instead an indication of a poor state of knowledge. Such outcomes, while unlikely, could be associated with very high impacts, and are thus highly relevant from a risk perspective" This is imperative and should be reflected in the SPM, specifically relevant to the heading HS.12, which includes H.S.12.1 to H.S.12.5. Instead of including an ambiguous definition of the low probability stated in the footnote, it should be in the body text of pg. 18-19. Either omit this section from the SPM in its entirety OR include "the low confidence does not by itself exclude the possibility of such events to occur, it is instead an indication of a poor state of knowledge. Such outcomes, while unlikely, could be associated with very high impacts, and are thus highly relevant from a risk perspective." [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
4151	19	1	19	1	It would be helpful if the details of particular emission scenarios are noted at H.S.12.2, because it is difficult to find quoted parts from each Chapter. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]

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6457	19	1	19	1	The current wording: „For global warming within the very likely range for a particular emission scenario“ might be misleading. A better wording will be: Even for global warming within the very likely range for a particular emission scenario...“ [Government of Austria, Federal Ministry of Agriculture, Forestry]
4439	19	1	19	2	Would the nature or magnitude of such outcome be different for different emission scenarios (or come with different probabilities for different levels of warming/emissions)? It would be useful to indicate if low CO2 scenarios would stand a better chance of avoiding such developments that high CO2 scenarios, if this applies. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
3391	19	1	19	3	There is no confidence statement. [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
4745	19	1	19	4	"...for a particular emission scenario" is a bit too vague to be useful. There is a link between higher levels of warming and greater risk (as alluded to in the next HS). It's not very helpful to simply say that risks exist, without describing under what conditions they might be met. e.g. collapsing ice sheets, is this likely under SSP1-1.9? [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
4149	19	1	19	5	We request that the impact of tropical cyclones to be included as one example of "low-likelihood, high-impact outcomes" for sea level rise. The corresponding description can be found in 9.6 (9.6.4.1). [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
6217	19	1	19	5	H.S.12.2: Do you want to express that inside the "very likely range" some processes in the climate system could lead to extreme events? Has this kind of uncertainty and internal variability not been mentioned already? [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
9313	19	1	19	5	Missing confidence level. [Government of United States of America, U.S. Department of State]
4991	19	1	19	5	Please consider if elements from our suggested plain language wording could be used in this para: 'There are increasing risks that regional and global scale events, that previously were assessed as extremely unlikely and associated with low-likelihood and high impact outcomes, might occur in the future, such as large precipitation changes, additional sea level rise from collapsing ice sheets, or abrupt ocean circulation changes.' [Government of Norway, Norwegian Environment Agency]
7773	19	1	19	10	These two paragraphs seems very similar to H.S.12.1. In order ot make the SPM more concise , please omit some of the text. [Government of Hungary, Ministry of Innovation and Technology - Climate Policy Department]
4515	19	1	19	15	The expression "tipping point" could also be brought up here, as it probably is more recognisable for many. This would align with the Technical Summary (Box TS.9) that refers to ”irreversibility, tipping points and abrupt changes”. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
4441	19	2	19	2	It is not readily clear what "large" signifies. Large compared to what? How much larger? [Government of Sweden, Swedish Meteorological and Hydrological Institute]
9315	19	2	19	2	"might occur" is weak and could imply a low probability. Recommend changing to "may". [Government of United States of America, U.S. Department of State]
2511	19	2	19	2	Concerning the large precipitation changes, what are the regions which could experience low-likelihood but large precipitation changes. [Government of France, Ministère de la Transition écologique et solidaire]
2531	19	2	19	2	Concerning the footnote 20 : The definition of "outcomes" could be refered earlier than in H.S.12.2 paragraph, e.g. in the HS.12 paragraph when the word "outcomes" is used for the first time [Government of France, Ministère de la Transition écologique et solidaire]

Comment ID	From Page	From Line	To Page	To Line	Comment
9317	19	2	19	3	Revise to begin list with "including" and change "or" to "and" so this sentence reads: "High-impact outcomes may occur at global and regional scales including large precipitation changes, additional sea level rise associated with collapsing ice sheets, and abrupt ocean circulation changes." [Government of United States of America, U.S. Department of State]
9319	19	3	19	3	Recommend to better clarify when global mean sea level is being discussed (to distinguish it more clearly from local sea level rise). Change "sea level" to "global mean sea level". [Government of United States of America, U.S. Department of State]
8593	19	3	19	3	Suggest clarification: Rapid discharge events can occur not just due to collapse. Suggest wording can be modified to include "rapid discharge". [Government of Australia, Department of Industry, Science, Energy and Resources]
4153	19	7	19	10	It is better to show the example of compound events similar to H.S.12.2. It can be "surge-rain or surge-discharge events" as shown in 9.6.4.2. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
6219	19	7	19	10	H.S.12.3: The general message "With higher warming levels more extreme events would occur" has been mentioned several times in the text before. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
4443	19	7	19	10	This would seem to mix both such "low likelihood - high impact outcomes" as already mentioned in H.S.12.2 (combine?) and compound events which are fundamentally something else (true?). Suggest reorganisation of H.S.12.2.-3. for added lucidity. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
4993	19	7	19	10	The word 'chance' is not good here, even if it's strictly correct (it means the same as probability) because it is often associated with an opportunity rather than a risk. Please consider to rather use 'risk' to better connect with the decision-maker or 'probability' to be more neutral. [Government of Norway, Norwegian Environment Agency]
4747	19	7	19	10	While this paragraph is clear that risk increases with warming, it remains quite vague. For some systems we have more detail on where thresholds lie. It would be helpful to include this, as currently it is very difficult to assess risk [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
8595	19	7	19	10	Suggest revising for accuracy: The confidence in this statement does not match the accompanying chapter. Box 11.2 states "the future occurrence of LLHI events linked to climate extremes is generally associated with low confidence." It also should be made clear many types of LLHI events are not represented by the GCMs generally used to project climate changes and extremes in the WG1 report. Suggest stating that many of these LLHI events are anticipated on conceptual and/or other physically plausible grounds not currently included in GCMs. [Government of Australia, Department of Industry, Science, Energy and Resources]
2569	19	9	19	9	The term "chance" could be confusing. We suggest to use something like "likelihood risk" or "risk" [Government of France, Ministère de la Transition écologique et solidaire]
9321	19	9	19	9	Examples of events unprecedented in the observational record would be helpful to add. [Government of United States of America, U.S. Department of State]
81	19	9	19	10	Consider adding 'will', i.e. ..and there is a higher chance that events unprecedented in the observational record 'will' occur (high confidence). [Government of Singapore, Ministry of Environment and Natural Resources]
6851	19	9	19	10	"there is a higher chance that events unprecedented in the observational record occur": this is a bit vague. In the narrow sense it seems trivial (e.g., all temperature records are, by definition, "unprecedented", and they will become more frequent with higher warming). If it refers to "more exotic" events, they should be better specified. Moreover, in the case of such events, perhaps it is less important to refer to the observational record. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
2513	19	9	19	10	The statement seems quite weak. Isn't it certain that events "unprecedented in the observational record" will occur with higher global warming levels? [Government of France, Ministère de la Transition écologique et solidaire]
6459	19	12	19	12	Insert „the“ before „Atlantic Meridional Overturning Circulation“. [Government of Austria, Federal Ministry of Agriculture, Forestry]

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7531	19	12	19	12	Add: the word "further", as there is already a weakening observed [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
4997	19	12	19	12	Please consider adding a footnote to explain "Atlantic Meridional Overturning Circulation"? [Government of Norway, Norwegian Environment Agency]
6853	19	12	19	12	Explain the Atlantic MOC by mentioning word "Gulf Stream" somehow in the sentence (even though its not exactly the same), for readability by non-experts [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
243	19	12	19	12	In the mentioned paragraph the wrong subchapter is cited, the correct subchapter is 4.3 [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
6225	19	12	19	13	Please check and revise text. The "but … not" construction is misleading. As it reads now, it seems to be welcomed that there is "only medium confidence" that a collapse of AMOC will not happen in the 21st century. The construction "and there is…" might be more neutral. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
9323	19	12	19	13	Negative phrasing is confusing. Suggest revising to read: "It is likely that the Atlantic Meridional Overturning Circulation will decline over the 21st century, but there is low confidence that it will experience an abrupt collapse before 2100." The authors can assign the appropriate confidence level here based on existing literature. Although the models indicate a potential reduction in AMOC, there is no convincing evidence yet of a decline in AMOC over the past decades that can be distinguished from natural variability. Therefore, reduce the likelihood assessment for a decline over the 21st century to "likely" instead of "very likely". [Government of United States of America, U.S. Department of State]
4995	19	12	19	13	The clause after 'but' is unclear as it currently reads. Please consider rephrasing it in terms of the possibily of experiencing an abrupt collapse rather than in terms of not experiencing if possible. [Government of Norway, Norwegian Environment Agency]
8597	19	12	19	13	Suggest clarification: Replace "but" with "and". These statements are not in opposition, but complement each other. [Government of Australia, Department of Industry, Science, Energy and Resources]
5125	19	12	19	15	"Abrupt changes in weather patterns" is not sufficiently policy relevant: could you provide more specific information? Reader might guess that this means a colder climate, therefore it is important to provide information on the nature and magnitude of the changes. [Government of Belgium, Belgian Science Policy Office - Belspo]
2825	19	12	19	15	Which regions would be affected by a MOC shutdown and would there also be weather pattern changes for the projected MOC decline? Please add this information if possible. [Government of Jamaica, Meteorological Service Division]
4155	19	12	19	15	Does this sentence mean that the confidence level of experiencing an abrupt collapse of AMOC before 2100 also is medium? As Chapter 9, page 30, line 34 puts it, there is some risk of abrupt collapse in this century. We suggest that SPM needs to reveal a risk to encourage readers to do immediate actions. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
6221	19	12	19	15	As this is the only part in the SPM, where the AMOC is discussed, we strongly request the authors to include the very policy relevant information, that future AMOC decline is dependent on the emission scenarios at least after 2060 as discussed in Ch 9 (9-33:3-4): "In CMIP6 projections, the modelled decline starting in the 1990s continues in all future projections, almost independent of the forcing scenario until about 2060, after which low emission scenarios show stabilization, while high-emission scenarios continue to exhibit AMOC decline (Figure 9.10)." [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
6223	19	12	19	15	H.S.12.4: Important message on the decline of the "Atlantic Meridional Overturning Circulation", but perception of the second half of the sentence is difficult. Please consider separating the sentence and continue as e.g.: "There is XXX confidence that an abrupt collapse will occur before 2100." [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]

Comment ID	From Page	From Line	To Page	To Line	Comment
375	19	12	19	15	This paragraph does give the impression that AMOC is going to decline independent of the emissions scenarios. However, in Chapter 9 is highlighted that after 2060, low emission scenarios show stabilization, while high-emission scenarios continue to exhibit AMOC decline. Please include this statement here, as it is very policy relevant. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
7293	19	12	19	15	Please provide more information on the implications of a MOC decline. Are changes in weather patterns also to be expected in this case. Which regions will be affected around the globe? [Government of Saint Kitts and Nevis, Department of Environment - Ministry of Agriculture, Marine Resources, Cooperatives, Environment and Human Settlements]
4749	19	12	19	15	It feels slightly incongruous to have most paragraphs in this section deal in quite vague generalities and then one to focus very specifically on a single risk, AMOC. We encourage the authors to discuss other high impact, low probability risks to also be discussed like AMOC is. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
6855	19	12	19	15	introduce the word tipping point- as familiar to many policy makers. Which other tipping points has the report evaluated, and what was assessed? [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
7369	19	12	19	15	The following text in Chapter 4, Pg. 31 Line 4-5 should be added to Pg. 19 H.S.12.4 of the SPM, "... the rate of weakening is approximately independent of the emission scenario (high confidence)" as it give a clear idea that the decline of Atlantic Meridional Overturning Circulation will continue independent of the emission scenario. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
8273	19	12	19	16	Projected to decline and by what range would be of interest? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
527	19	13	19	13	Has the assessment of the abrupt collapse changed since SROCC? If not, it might be better to use something closer to SROCC language, because the sentence with the negation in it is hard to understand: SROCC: ” The AMOC is projected to weaken in the 21st century under all RCPs (very likely), although a collapse is very unlikely (medium confidence).” [Government of Denmark, Danish Meteorological Institute]
4445	19	13	19	13	The "but there is only medium confidence that it will not experience an abrupt collapse before 2100." is very complicated. How much does this depend (the finding and the confidence level) on the emission scenario / global warming level? Further clarification would be very useful here, including what lies behind the "medium confidence", how much does (i) confidence in the projections, (ii) in models, (ii) in observations, (iii) number of studies, (iv) coherency across studies, contribute. If the confidence level is due to shortness of information or to results showing different outcomes, is quite different. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
7533	19	13	19	13	The word but suggests a contradiction, while both aspects are different; thus replace the word "but" by "and" [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
4751	19	13	19	13	This sentence is confusing as it is comparing a likelihood in the first clause with a confidence statement in the second clause. If the authors wish to make such a comparison, then the second clause requires a likelihood statement of abrupt collapse. Otherwise, it should be split into two sentences which both convey useful information independently. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
2515	19	13	19	13	We suggest to replace "but" by "and" as the following statement does not oppose but reinforces the first statement of the sentence. [Government of France, Ministère de la Transition écologique et solidaire]

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7891	19	13	19	13	Is the "but" really appropriate here? It might also be a good idea to split the sentence into two, the second part is not easy to understand (and could in fact easily be misunderstood). [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
2739	19	13	19	15	The statement regarding the potential sudden collapse of the Atlantic Meridional Overturning Circulation seems convoluted and obscures the meaning. The current wording "...but there is only medium confidence that it will not experience an abrupt collapse before 2100" is hard to understand, and may be understood to mean "There is medium confidence of an abrupt collapse before 2100....". And the latter interpretation may be incorrect. The phrasing in the Ch. 9 ES is better: "The AMOC will very likely decline over the 21st century for all SSP scenarios. There is medium confidence that the decline will not invovle an abrupt collapse before 2100." [Government of Canada, Environment and Climate Change Canada]
2539	19	13	20	13	Please add the meaning of the acronym (Transient Climate Response to Cumulative CO2 Emissions) to make the Table self-explicit [Government of France, Ministère de la Transition écologique et solidaire]
6857	19	14	19	15	"the regional water cycle": it should be specified which region(s) this refers to, or perhaps "regional" could be dropped (as a collapse of the AMOC would likely have impacts world-wide). [Philippe Tulkens, European Union (EU) - DG Research &
2517	19	14	19	15	We recommend to detail the kind of expected shift in weather patterns and regional water cycle, and regions impacted, in case of an AMOC. [Government of France, Ministère de la Transition écologique et solidaire]
7833	19	17	19	17	H.S.12.5 - "series of very large volcanic eruptions" - it is hard to attribute the probability to such event(s) and to postulate possible substantial alteration of the 21st-century climate trajectory as compared to AR6 projections [Government of Poland, Ministry of Environment, Department of Air Protection and Climate]
2981	19	17	19	17	Like last sentences in Box TS.3, I hope H.S.12.5 expresses the nuance that a low likeihood, high-impact outcome can come from natural factors as well as anthropogenic causese. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
3393	19	17	19	18	There is no confidence statement. [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
4157	19	17	19	19	The topic about large volcanic eruption can be integrated into H.S.10.2. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
6227	19	17	19	19	As the "climate trajectory" is being compared in this sentence, please revise whether a comparison should refer to "model projections" (e.g. based on the core set of emission scenarios assessed in this Report") in order to ensure the distinction between "scenarios" and "projections" according to the underlying definition of the terms (see also glossary entries "projections" and "scenarios" resp. "emission scenarios"). [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
6229	19	17	19	19	H.S.12.5 It seems trivial that any event that has not occurred in the past decades or century and is thus not included in the emission scenarios and not taken into account in the projections has the potential to substantially alter the projections. This has been mentioned already in SPM-16:18-30. In the interest of keeping the SPM as concise and focussed on the essentials as possible it is suggested to leave out this H.S. from the SPM. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
4447	19	17	19	19	This is a very speculative aspect, and as such not very relevant for policy. Suggest deletion. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
9325	19	17	19	19	Recommend deleting this point. H.S.10.2 discusses the impact of volcanic eruptions. [Government of United States of America, U.S. Department of State]

Comment ID	From Page	From Line	To Page	To Line	Comment
8599	19	17	19	19	Suggest clarification: Can any probability be assigned to this statement (since H.S.10.2 estimates the likelihood of an eruption)? [Government of Australia, Department of Industry, Science, Energy and Resources]
6859	19	17	19	19	This paragraph is valid, but not particularly informative. Similar statements could be made about meteorites or escalating armed conflicts. It would be more relevant to include more considerations for climate change-induced "tipping points", in particular involving ecosystem changes. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
2519	19	17	19	19	We suggest to remove the part on the volcanic activity while mentionning the impact of such event in H.S.12 [Government of France, Ministère de la Transition écologique et solidaire]
6231	19	20	19	26	As mentioned in this paragraph, methodological improvements for estimating the remaining carbon budget have been developed. In order to better understand and track the size, and more particularly, the changes of the remaining carbon budget estimates, it may be helpful to briefly elaborate on the advances integrated. Highlighting important advancements as for example including additional Earth System feedbacks in the updated estimates (e.g. permafrost thaw, described in the Technical Summary, Section TS.3.2.2 and Section TS.3.3.1, page TS-64) would help to better understand the remaining carbon budgets and evaluate uncertainties in its quantification. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
2521	19	22	19	22	We suggest to change the title in order to specify that the findings below do not consider most of socio-economical constrain. A title such as "Limiting Climate Change from a Geophysical Perspective" would better reflect the scope of the section. [Government of France, Ministère de la Transition écologique et solidaire]
4999	19	22	19	34	Strong support on including a section and headline statement like this, it provides a very useful link to the more detailed WG3 report. [Government of Norway, Norwegian Environment Agency]
495	19	22			It is suggested that the gaps and needs of current climate change understanding should be appropriately added to the section of "limiting climate change", so as to point out the future direction of scientific support for the global scientific response to climate change and to achieve carbon neutrality. [Government of China, China Meteorological Administration]
4159	19	24	19	24	"SR15" must be "SR1.5". [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
4449	19	24	19	24	Perhaps "improved" would be a better choice of expression than "strengthened". [Government of Sweden, Swedish Meteorological and Hydrological Institute]
4451	19	24	19	24	"SR1.5" rather than "SR15". [Government of Sweden, Swedish Meteorological and Hydrological Institute]
6861	19	24	19	24	Explain in more detail "remaining carbon budget" (relative to what?) [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
3023	19	24	19	24	Unify " SR15" to "SR1.5" across the SPM. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
8275	19	24	19	28	Is the methodology the same as used in the 1.5C SR or not the wording is ambiguous? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
9327	19	24	19	28	Rewrite second and third sentences as follows: "A comprehensive range of options for managing anthropogenic and natural emissions has been used to consistently assess scenario outputs of climate impacts and air pollution. A key development since the AR5 has been the ability to ascertain when climate responses to reductions to emissions respond significantly above natural variability." [Government of United States of America, U.S. Department of State]

Comment ID	From Page	From Line	To Page	To Line	Comment
6423	19	24	24	28	how has the methodology been improved? What is the updated evidence? Perhaps a textbox with a bit more detail on this would be useful [Government of Saint Lucia, Department of Sustainable Development - Ministry of Education, Innovation, Gender Relations and Sustainable Developement]
6863	19	28	19	28	In addiiton to "natural variability", consider adding "uncertainty of projections" or "other sources of uncertainty". Projections are uncertain not only due to natural variability but also a number of other factors, including human behaviour. Therefore, the emergence of responses would not be trivial to quantify even in the absence of natural variability, [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
9329	19	28	19	32	"emissions reductions" should be changed into "emission reductions". [Government of United States of America, U.S. Department of State]
8321	19	30	21	30	It would be useful to highlight the fossil methane is fossil carbon in a warmer molecule which remains in the carbon cycle once the methane has oxidised in the atmosphere. Hence actions to reduce fossil methane emissions to zero, as part of getting to net-zero carbon emissions are an effective contribution to climate actions. A clear statement on this would be useful as well as its possible cooling contribution. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
7617	19	31	19	31	South Africa is not in agreement with the use of the net zero concept, since there's no universally agreed definition under the UN. We also feel that this is only one scenario in a host of scenarios and should be seen as that. In essence, upon investigation of how the net zero concept is applied by various coutries, we found that it is not applied consistently. Therefore, this concept needs to be dicussed further, since it can also be viewed as policy prescriptive. This goes against the mandate of the IPCC, which has to be policy relevant and not policy prescriptive. There is also large confusion around the concept because some do not know and understand that NET zero is NOT equal to zero. [Government of South Africa, Senior Policy Adviser International Climate Change Cooperation Department of Environmental Affairs]
4453	19	31	19	32	Achieving net zero CO2 emissions is one determinant, and staying within some set CO2 budget another one. It would seem useful to mention both. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
9331	19	31	19	32	The way this first sentence is phrased may be making it untrue. "Limiting" warming at any level at all would not require net zero. "Stabilizing" would. Suggest using the word "stabilizing" to better convey a temperature threshold rather than just less warming. Also, this sentence is too passive, with no actor implied. Suggest rewording to something like: "To stabilize [...] warming, the world must achieve global net zero CO2 emissions." [Government of United States of America, U.S. Department of State]
155	19	31	19	32	"Limiting human-induced global warming at any level requires achieving net zero CO2 emissions." This statment is policy prespetcive. Remove. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
2523	19	31	19	32	We advise to clarify if it shouldn't be net zero GHG emissions, not just net zero CO2 emissions. Also, "Stabilizing" instead of "limiting", as in the text H.S.13.1 would much clearer [Government of France, Ministère de la Transition écologique et solidaire]
3395	19	31	19	33	There is no confidence statement. [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
8277	19	31	19	33	A clear statement on CO2 need to get to net zero and within a budget range to stabilise the temperature in the Paris Agreement range would be useful including numbers and timing of next zero as was provided in the 1.5C report. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]

Comment ID	From Page	From Line	To Page	To Line	Comment
7535	19	31	19	33	Need to add some qualification on changes in C-budget since AR5 /SR1.5 and some figures on budgets for 2 and 1,5 degrees : "compared to AR5 remaining carbon budget estimates have increases, but they are rather similar to SR1.5." [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
125	19	31	19	33	HS.13 states that net zero CO2 anthropogenic emissions are required for the stabilization of global warming at any level. Is it really so? For years, centuries, millennia and longer periods, there were natural CO2 emissions, e.g., from volcanoes and weathering processes (the analog of modern anthropogenic emissions). However, this did not lead to unlimited warming on the Earth. The reason is that the carbon cycle is not completely closed. Namely, there is a small 'irreversible' sink of carbon, e.g., due to the sedimentation from the ocean waters to the ocean floor (in particular). Of course, it is small but it exists and may help to stabilize carbon content in the Earth's system even under positive net emissions of CO2 to the atmosphere, not necessarily under net zero emissions. Thus, the statement is correct just for comparatively short periods, e.g., few centuries. This is expedient to reflect in the statement. [Government of Russian Federation, Institute of Global Climate and Ecology]
8601	19	31	19	33	Suggest including a statement about the changes in emissions of N2O, consistent with its inclusion in Figure SPM.4. [Government of Australia, Department of Industry, Science, Energy and Resources]
7075	19	31	19	33	Under these circumstances, what is the guarantee that the atmospheric carbon budget will remain stable due to the natural factors? Have all geological events (such as forest fires, volcanic activity, etc.) been identified for long term (for example by the end of this century), and is the rate of emission from these events calculated and definitive? other wise, based on the above definition, it recommends to add the phrase "from natural and human made resources" to the end of this sentence: HS.13- Limited human-induced global ... CO2 emission from natural and human made resources . furtheremore... [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]
231	19	31	19	33	The text is not balanced in reflection to the PA. Article 4.1 of the PA clearly states "...as to achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century, on the basis of equity, and in the context of sustainable development and efforts to eradicate poverty." The text should align with Article 4.1 of the PA. Insert "and removal" after "reduction" in "Furthermore, stringent methane emissions reductions would limit additional non-CO2 warming and improve air quality. " [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
237	19	31	19	33	The text states "limiting human-induced global warming at any level requires achieving net zero CO2 emissions" This text is not reflective of the PA as the PA does not state "net zero". Article 4.1 of the PA clearly states "...as to achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century, on the basis of equity, and in the context of sustainable development and efforts to eradicate poverty." The text should align with Article 4.1 and 2.1 of the PA. Omit "net zero". [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
9333	19	31	19	34	Why focus only on CO2 and CH4 in the headline statement, and not N2O and other gases as well? [Government of United States of America, U.S. Department of State]
6865	19	31	19	34	The wording of this headline is important since it will be of high interest to policy makers. It is important to highlight, but not overstate, the importance of non-CO2 reductions. Suggest the following: "Limiting human-induced global warming at any level requires achieving net zero CO2 emissions *and declining non-CO2 radiative forcing*. Furthermore, stringent methane emissions reductions would limit additional non-CO2 warming and improve air quality". [Philippe Tulkens, European Union (EU) - DG Research & Innovation]

Comment ID	From Page	From Line	To Page	To Line	Comment
7895	19	31	19	34	HS.13 is rather weak. This is the first IPCC Assessment Report that can base statements on the Paris Agreement. Make use of it! Surprisingly, the Paris Agreement is nowhere mentioned in this SPM. IPCC has much policy-relevant information to precisely this question, even a Special Report was dedicated to this. Rather than changing the focus of this HS from CO2 to CH4, it would be more compelling to include the time information: When to achieve zero-emissions, what does this mean for the emissions, etc etc. The current formulation of this top-level HS misses the opportunity to make a clear and actionable statement of urgency. [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
265	19	31	21	30	The use of the term "net zero CO2 emissions", whose definition is still somewhat evolving creates room for ambiguity. In this body of work, the language needs to be as agreeable to most as possible. Replace "net zero CO2 emissions" with "emision neutral". [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
2525	19	31	21	30	This section provides no information on the possible role, risks and limits of Solar Radiation Modification. It might be appropriate to include some language in a separate paragraph drawing on the first paragraph of Box TS.8. For example : "These investigations have consistently shown that SRM could offset some of the effects of increasing GHGs on global and regional climate, including the carbon and water cycles (high confidence). However, there would be substantial residual or overcompensating climate change at the regional scales and seasonal time scales (high confidence), and large uncertainties associated with aerosol–cloud–radiation interactions persist. The cooling caused by SRM would increase the global land and ocean CO2 sinks (medium confidence), but this would not stop CO2 from increasing in the atmosphere or affect the resulting ocean acidification under continued anthropogenic emissions (high confidence). It is likely that abrupt water cycle changes will occur if SRM techniques are implemented rapidly. A sudden and sustained termination of SRM in a high CO2 emissions scenario would cause rapid climate change (high confidence)". However it is necessary to note the limitation of the assessment of such a question by WG1 (concerning risks and impacts) and it could be mentionned such as in the TS page 70 : "There are important other considerations, such as risk to human and natural systems, perceptions, ethics, cost, governance, and trans-boundary issues and their relationship to the United Nations Sustainable Development Goals—issues that the WGII (Chapter 16) and WGIII (Chapter 14) reports address. {4.6.3}" [Government of France, Ministère de la Transition écologique et solidaire]
4455	19	32	19	32	The "additional" is not readily clear. "Additional to CO2 or "additional non-CO2? Also, other non-CO2 emissions are also important, and the headline statement should not provide a message excluding them. The focus on methane becomes sort of clearer in the text below, but it would be useful if the Headline statement was self-contained as well. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
7585	19	32	19	32	Suggestion to add an appropiate time limit on when net zero CO2 emissions should be reached to limit human-induced global warming (for example "by the second half of this century" or "as soon as possible"). [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
203	19	32	19	32	The statemtent " Limiting human-induced global warming at any level requires achieving net zero CO2 emissions. Furthermore, stringent methane emissions reductions would limit additional non-CO2 warming and improve air quality ". The discussion should provide equal treatment of all sources. A holistic discussion of all greenhouse gases and all sources should be included. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
6407	19	32	19	33	Given the importance of CH4, kindly elaborate more on the fact that reducing CH4 is in fact necessary to reach the Paris Agreement goals. [Government of Saint Lucia, Department of Sustainable Development - Ministry of Education, Innovation, Gender Relations and Sustainable Developement]

Comment ID	From Page	From Line	To Page	To Line	Comment
8279	19	32	19	33	The use of the term stringent is odd for the IPCC. How is this defined? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8281	19	32	19	33	Can some quantified statement be made on methane rather than this current formulation? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8283	19	32	19	33	Is there a reason to signal out methane from other nonCO2 GHG such as N20? If so make this clear [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8285	19	32	19	33	Why is N2O not mentioned? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
7027	19	32	19	33	The highlighting of CH4 here is appreciated and could be strengthened further in order to emphasise that stringent CH4 emission reductions are a prerequisite for reaching the Paris Agreement goals. [Government of Fiji, Fiji Meteorological Services]
7295	19	32	19	33	We very much appreciate highlighting the effect of CH4 reductions. In fact, all pathways in line with the Paris Agreement (PA) would require stringent CH4 emissions reductions. Please be more explicit that CH4 reductions are an actual requirement to limit warming in line with the Paris Agreement! [Government of Saint Kitts and Nevis, Department of Environment - Ministry of Agriculture, Marine Resources, Cooperatives, Environment and Human Settlements]
7659	19	32	19	33	Delete sentence "Furthermore, stringent methane...". Explanation: This refers only to the information in HS 13.9 and hence singling it out for mention in HS 13 is unnecessary. It does not represent the contents presented in further subsections. It talks about methane emissions which is discussed only in one paragraphs that too partly, out of 9 paras under this HS. Making it part of the HS highlights it disproportionately. There is no need to combine methane with net zero CO2. This is covered under the HS 14. [Government of India, Ministry of Environment, Forests and Climate Change]
7163	19	32	19	33	Information on CH4 is critical, maybe more information could be added (to emphasize the importance of reducing CH4 for reaching the Paris Agreement)? [Government of Samoa, Ministry of Foreign Affairs and Trade]
267	19	32	22	31	The use of the term "emissions reductions" is exclusionary. Removal of emissions provides a major path to achieving neutrality. As the SPM uses science-based arguments to offer content useful for articulation of policy statements, the langauge needs to be inclusive. Replace "emissions reductions" with "emissions removal" or "emissions mitigation". [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7537	19	33	19	33	Need to add something on physical implications of negative emisisons: "Negative emissions after achieving net zero emissions could reverse surface warming, but other climate changes would continue for decades to millennia." [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
5127	19	36	19	37	The use of units should be consistent through the SPM. Here PgC are presented first then GtCO2 are provided between brackets ; by contrast, page 20 line 1 only provides GtCO2. Please use the same units and take into account that GtCO2 amounts are better known among policymakers. [Government of Belgium, Belgian Science Policy Office - Belspo]
2915	19	36	19	37	indicate the corresponding timescale of the response (TCRE) [Government of Chile, Ministry of Environment]

Comment ID	From Page	From Line	To Page	To Line	Comment
6363	19	36	19	37	Please, include the following text after "cause." (line 37): "The processes that translate emissions of CO2 into a change in global temperature (terrestrial and oceanic carbon uptake, radiative forcing from CO2, and ocean heat uptake) are governed by complex mechanisms that all evolve in time". [Government of Brazil, Ministry of Foreign Affairs]
2527	19	36	19	38	It reads as if this estimates for the TCRE comes from IPCC AR5 while they have been revised upward compared to AR5. This should be stated more clearly (maybe the range of the AR5 value can be reminded) [Government of France, Ministère de la Transition écologique et solidaire]
4753	19	36	19	42	This is a very helpful description of TCRE [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
157	19	36	19	42	The discussion on relationship between cumulative CO2 emissions and the global warming they cause should include CO2 and all other GHGs. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
8287	19	36	19	43	This statement is relatively clear but Figure SPM 10 and its caption is not. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8289	19	36	19	43	Inclusion of spent and remaining carbon budget data in this text would be useful. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
6867	19	36	19	43	Mention if and how different the likely range per 1000 PgC of 1.0-2.3 is compared to AR5. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
189	19	36	19	44	Overall, there is high agreement between multiple lines of evidence (robust evidence) resulting in highconfidence that TCRE remains constant for the domain of increasing cumulative CO2 emissions until at least 1500 PgC, with medium confidence of it remaining constant up to 3000 PgC because of less agreement across available lines of evidence as indicated in Ch.5 P88 Line 2-5. Therfore, this should be clearly added to the SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
191	19	36	19	44	As indicated in Ch.5 P89 Line 23-25 , there is a low confidence that the TCRE remains an accurate predictor of temperature changes in scenarios of net-negative CO2 emissions on timescales of more than a half a century. Therfore, this should be clearly added to the SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
193	19	36	19	44	As indicated in Ch.5 P89 Line 49, the land carbon feedback and ocean heat uptake or ventilation are crucial to uncertainty in TCRE. This Should be clearly reflected in SPM [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
6869	19	37	19	37	It would be useful to add a footnote clarifying that the amound of 1000 PgC is chosen by scientists for the purpose of calculating TCRE and is not any kind of scenario projection See similar point above concerning ECS. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
8603	19	37	19	38	Suggest clarification: TCRE is a function of the present climate (ie this relationship does not apply throughout geological time). [Government of Australia, Department of Industry, Science, Energy and Resources]
6871	19	37	19	38	For clarity, the following should be added. "Each 1000 PgC (3664 GtCO2) of cumulative CO2 emissions is assessed to likely cause a 1.0°C–2.3°C increase in global surface temperature, *meaning that every tonne of CO2 we put into the atmosphere adds to global warming*". [taken from the Figure SPM.10 title] [Philippe Tulkens, European Union (EU) - DG Research & Innovation]

Comment ID	From Page	From Line	To Page	To Line	Comment
6233	19	38	19	38	" ...cumulative CO2 emissions is assessed to likely cause a 1.0°C–2.3°C increase in global surface temperature". Please explain this big range, also in the context of the range of the ECS, including the updates for the TCRE and the ECS compared to AR5. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
9335	19	39	19	39	It might be helpful, perhaps in a footnote, to briefly define the difference between TCRE and ECS, or even drop the TCRE jargon here in the SPM. [Government of United States of America, U.S. Department of State]
497	19	39	19	39	It is suggested that "Transient Climate Response to Cumulative CO2 Emissions (TCRE)" be defined or explained in the form of footnotes. [Government of China, China Meteorological Administration]
2529	19	40	19	41	If one takes the warming effect of the other GHGs into account, shouldn't these CO2 emissions be negative in order to achieve a stabilization of the global temperature? We therefore suggest to keep the effect of CO2 and add the effect of non-CO2 as a seperate aspect because we understand that CO2 is the important one for policy makers [Government of France, Ministère de la Transition écologique et solidaire]
9337	19	42	19	42	Change to "specific levels can be quantified PRIMARILY in terms of a carbon budget" since N2O is still a long-lived greenhouse gas contributing to cumulative CO2-eq over a century or more. And, the SLCFs cause the cum-CO2 vs warming line to deviate. [Government of United States of America, U.S. Department of State]
6873	19	42	19	42	Insert "remaining" to read "in terms of a remaining carbon budget". [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
4161	20	0	20	0	It would be reader-friendly if the Table TS.3 is annotated to the Table SPM.2. Also, to promote more appropriate understanding, it is recommended to indicate the uncertain range of the best estimate and add the paragraph of TS page 63 L.8 – 13 in the footnote of the Table SPM.2. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
6235	20	1	20	1	Why is the uncertainty of past emissions given in terms of SD, and not as usual in this report as the likely range? Please modify or explain. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
9339	20	1	20	1	What does "standard deviation" mean in this context? [Government of United States of America, U.S. Department of State]
8605	20	1	20	1	Suggest clarification: amend to 'Over the period 1850–2019, a total of 2390 ± 240 (1 standard deviation) GtCO2 of anthropogenic was emitted'. [Government of Australia, Department of Industry, Science, Energy and Resources]
8607	20	1	20	1	Suggest revise the units to be consistent with H.S.13.1: e.g. express both as GtCO2 (with PgC in parentheses). [Government of Australia, Department of Industry, Science, Energy and Resources]
6365	20	1	20	2	Please, include the following text between "Over the period 1850–2019, a total of 2390 ± 240 (1 standard deviation) GtCO2 of anthropogenic CO2 had been emitted" and "Remaining carbon budgets for limiting warming to specified levels have been quantified and depend on the chosen warming level, the percentile of TCRE and other uncertainties": "Fossil CO2 emissions have grown continuously since the beginning of the industrial era with short intermissions due to global economic crises or social instability". [Government of Brazil, Ministry of Foreign Affairs]
4267	20	1	20	4	Would a large scale CDR technique cause changes in mid- to large scale atmospheric systems? [Government of Indonesia, Ministry of Environment and Forestry Indonesia]
7979	20	1	20	6	It would be interesting to include a reference of the rate of increase of historical emissions over time resulting in the total emitted, or some reference to the evolution of the cumulative CO2 emissions over a nearby historical period. [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]

Comment ID	From Page	From Line	To Page	To Line	Comment
3397	20	1	20	6	There is no confidence statement. [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
2533	20	1	20	6	We highly recommend to revise this paragraph with the following elements : state that the remaining carbon budget depends primarily on: chosen warming level, TCRE values, warming from non-CO2, historical warming and ZEC. At the moment, only the first two are mentioned here. Mentionning the central estimate for 1.5°C and 2°C (with their likely range or not) would be a plus and introduce the table. Among the uncertainties, there is the estimate of the observed global warming to date using GSAT rather than GMST. The uncertainty on the observed global warming to date could be here explicitely mentionned with a reference to relevant sections of TS and chapter 2. Finally, the impact of non-CO2 should be clarified. Does it mean that the estimates of remaining carbon budget have been made with some specific assumptions about non-CO2 emissions pathways, but that other plausible pathways of non-CO2 emissions would change these estimates either upwards or downwards by up to 220 GtCO2? the "at least" in the sentence is in particular difficult to interpret. [Government of France, Ministère de la Transition écologique et solidaire]
2749	20	1	20	16	If possible, we would like to see at least one representative statement here about the estimated remaining carbon budget for limiting global warming to a given level with a stated probability level. Our concern is that policymakers will be left wondering if it is valid or not to state, based on the values in Table SPM.1, that (e.g.) for a 50% chance of limiting global warming to 1.5C, the estimated remaining carbon budget is 500 GtCO2 (plus or minus the 220 GtCO2 to account for uncertainty in future non-CO2 emissions). Our concern is that there is a risk this table will be interpreted in this way, and the SPM should clearly state whether such an interpretation is valid or not (we think not because the text notes additional uncertainties besides uncertainty in TCRE). But a clear statement about this is needed. [Government of Canada, Environment and Climate Change Canada]
9341	20	1	20	26	The SPM needs improved clarity in its presentation of the remaining carbon budget for limiting global surface temperature rise, as captured in Table SPM.2 and surrounding text. This improved clarity is needed with respect to a few issues, including the reason for differences between AR6 and AR5 (and SR1.5), how uncertainties are represented, and which radiative forcers and carbon cycle feedbacks are accounted for in the various calculations presented. For example, the SPM refers to both "improved observations and modelling" and "methodological improvements" when explaining the difference between AR6, AR5, and SR1.5. The SPM should clarify whether these are, in fact, different things, and furthermore whether these improvements include adjusting for future changes in the fraction of emissions that remains in the atmosphere (and, if not, how would including that uncertainty affect the findings). In addition, it would be helpful if Table SPM.2 was more explicit in stating that the percentiles are intended to represent uncertainty ranges for TCRE, but exclude other uncertainties. Also, Footnote 21 should be specific about which carbon feedbacks have been accounted for in calculating allowable emissions. For example, the Arctic has in recent years been found to be a source of CO2 that is larger than all but a few of the world's countries. Has this already been accounted for? Finally, Table SPM.2 and surrounding text needs to clarify that global temperature increase refers to multi-decadal average warming, and that individual years may well exceed a given value due to natural variability. [Government of United States of America, U.S. Department of State]
6345	20	1	20	26	This information is not easy to understand - what is the meaning of using TRCE percentiles? How does this impact the remaining CO2/GHG budget? How does the new information that 1.5C warming will reached earlier than in previous reports impact the budget? It is important for policymakers to have a clear understanding of these. [Government of Estonia, Estonian Meteorological & Hydrological Institute]

Comment ID	From Page	From Line	To Page	To Line	Comment
4555	20	1	20	26	The discussion is not clear about the significance of the geophysical and some other uncertainties. These would not seem to be included in the Table SPM.2 nor provided with som sense of mangnitude in HS.13.3. It would be useful to more explicitly note that these uncertainties are not included in the Table and, perhaps, provide some additional information in the text. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
7567	20	2	20	2	had = has [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
2741	20	2	20	3	The issue of carbon budgets is important. Clear language is needed to explain what factors affect the remaining carbon budget estimates. In that regard, the language about "percentile of TCRE" is problematic. This language presents a barrier to understanding. Can this be reworded similar to phrasing on page TS-61 line 47 where it is explained that the uncertainty is really about how much warming will occur after cessation of emissions (as represented by the distribution of TCRE values). This language would be more straightforward to understand. [Government of Canada, Environment and Climate Change Canada]
4457	20	2	20	6	Should provide some figures here about the size of the budgets, not least as both the historical and uncertainty are given quantitatively. (Alternatively, focus on the description and refer to the table for all quantitative estimates.) [Government of Sweden, Swedish Meteorological and Hydrological Institute]
6237	20	3	20	3	It is difficult to understand the concept behind the 'percentile of TCRE'; perhaps it would make it easier to understand if reference were made here once again to the range of the TCRE (see H.S.13.1). [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
8609	20	3	20	3	Suggest change 'quantified' to 'estimated' for consistency with Table SPM 2. [Government of Australia, Department of Industry, Science, Energy and Resources]
195	20	3	20	3	“Other uncertainties” should be elaborated clearly [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
6367	20	3	20	3	Please, include the following text after "TCRE" and before "and other uncertainties": ",estimates of historical warming, future emissions from thawing permafrost, variations in projected non-CO2 warming". [Government of Brazil, Ministry of Foreign Affairs]
8611	20	3	20	6	It's not clear what is the meaning of "…could increase or decrease… by at least..". Is there a number bigger than 220 GtCO2 for which a more certain statement could be made? [Government of Australia, Department of Industry, Science, Energy and
2745	20	4	20	4	Suggest the 'and' be replaced by 'although' to improve the clarity of this sentence. That is, the remaining carbon budgets take into account non-CO2 emissions ALTHOUGH if future non-CO2 emissions are different than assumed, then this will increase or decrease the estimates of remaining carbon budgets by at least 220 GtCO2. [Government of Canada, Environment and Climate Change Canada]
6875	20	4	20	4	Replace "warming of" with "radiative forcing by". [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
8291	20	4	20	6	These points warrant greater clarity, including the premise for assumptions made on how non-CO2 emissions are linked to or treated with respect to CO2/Carbon budgets [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
6359	20	5	20	13	Marine Heatwaves. There's a lack of resources on physical charactrization of marine heatwaves, specially on the conditions that preceed them, how to spot them, their dynamics (spatial mobility, and temporality). This phenomenon is very harmful for coastal ecosistems, specially coral reefs, rocky reefs, macroalgae forests, and aquaculture infrastructure. Some description is requiered, not just the porbability of occurrence worldwide, as well as basin-specific dynamics. [Government of Mexico, Directora General del Instituto Nacional de Ecologia y Cambio Climatico]

Comment ID	From Page	From Line	To Page	To Line	Comment
6239	20	9	20	17	_Consistency of budgets across WGs: Please give clear indications how the budgets of WG I and WG III are related to each other and what sort of differences can be expected. Even if the differences between WG I and III cannot be quantified yet, please describe the nature of the foreseeable differences. This is critical since this information is an important basis for policy decisions. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate
7775	20	9	20	17	Table SPM.2: The definition of TCRE is a bit complicated, cannot we phrase it in an easier way? See H.S.13.1 as well. E.g. How much can we still emit?; At H.S.1.2 it is a different official mean number for the change until now: 1.09 °C and with very likely range, maybe it could be harmonized? [Government of Hungary, Ministry of Innovation and Technology - Climate Policy Department]
6241	20	9	20	17	_Quantifying the remaining Carbon budgets: Thank you very much for this very useful table SPM.2. It would highly profit from clearer explanations about what the numbers really show. We kindly request the authors in particular to consider the following questions and issues: - If the information in this table should be relevant for climate change and the Paris Agreement, it should use time periods that are relevant for climate change and not be dominated by short term variability. Therefore, please use a period of at least 20 years for the current warming. '- How is “global warming” defined? Over which period of time is the global mean temperature averaged, and how is this averaging done? - Please assure that these numbers are relevant for the Paris Agreement's temperature goals. - It is unclear to us, if the budget numbers consider the effect of non-CO2 or not, please improve footnote *(1). - We understand from Footnote 21 that the TCRE partially includes uncertainty due to Earth system feedback. However, the explanation is not clear enough. We would highly appreciate more specific information on uncertainties. Please provide the numbers given in Table TS.3 also in the SPM. - We welcome the reduced granularity of the warming levels provided in the SPM. Given the considerable uncertainties in the budget estimates, we think providing budget information for warming levels of 0.1 °C digits, as unfortunately done in the TS, is misleading and suggests an accuracy that does not correspond to the ranges of uncertainty. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
6243	20	9	20	17	Table SPM.2: Please explain how the percentiles should be read as policy makers may not be familiar with this approach. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
5001	20	9	20	17	Table SPM.2: This Table is rather technical and potentially difficult for readers not familiar with statistic language (policy-makers are perhaps not used with the concept of percentiles?). This makes the Table difficult to understand and introduces doubt about how the table should be read and interpreted. Would it be possible to change to, or additionally implement, the likelihood language used in previous reports? This would also improve comparisons with AR5 and SR15. [Government of Norway, Norwegian Environment Agency]
5003	20	9	20	17	Our review showed that it is easy to misunderstand and confuse the concepts and potential relationships between current human-induced temperature increase (1.07C) and associated cummulative CO2 emissions (2390 GtCO2) from Table SPM.2 on the one side, vs. the TCRE temperature range of 1.0C-2.3C with associated cumulative CO2 emissions (3664 GtCO2) from para H.S.13.1 on the other side. Please consider reassessing if the TCRE concept has to be quantified in the SPM. In addition, these concepts' relationship to climate sensitivity creates confusion for policymakers. We believe that it is useful to have these concepts (TCRE/carbon budget and climate sensitivity) treated in different sections of the SPM. [Government of Norway, Norwegian Environment Agency]
499	20	10	20	10	Table SPM.2, which is too technically complex, is suggested to be given more detailed descriptions for different distribution values (17th-83rd) to be accessible. [Government of China, China Meteorological Administration]

Comment ID	From Page	From Line	To Page	To Line	Comment
9343	20	11	20	11	Should the units be GtCO2eq? H.S.13.2 says that non-CO2 gases are included. [Government of United States of America, U.S. Department of State]
6877	20	11	20	11	Replace "Estimates of the historical and the remaining carbon budgets." with "Estimates of historical CO2 emissions and the remaining carbon budgets." [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
2535	20	11	20	11	this is a place where it could be clearer that we are talking about CO2 only. One way to do this is to bring some text from the footnote to the table caption. [Government of France, Ministère de la Transition écologique et solidaire]
377	20	11	20	14	Table SPM.2: This is a very policy relevant table. As climate change is defined over longer period, we are surprised to see a 10-year period used to assess the global surface temperature increase. Please modify to a 20-year period also to increase consistency through the SPM. As we commented earlier, there is a shift to 0.08°C in the numbers of global average temperature between the AR5 and the AR6 (Cross-Section Box TS.1), please specify what this shift means for the remaining carbon budget. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
5129	20	11	20	15	Table SPM.2: the role of the "percentiles" line does not appear clearly given the current layout of this table. We suggest replacing "xx th" with "xx %" and explaining within the table that it provides values for "the probability that global warming (...) will not exceed the temperature levels provided in the left column". Please explore graphical ways to explain that in a way that is clear and easy to understand. For clarity, the upper and lower part of the table might also benefit from being a little more separated. [Government of Belgium, Belgian Science Policy Office - Belspo]
5131	20	11	20	15	The first part of the footnote within the table provides the same information as the text in lines 5 - 6 : we suggest avoiding this duplicate. We would like to suggest reconsidering the formulation of the second sentence of this footnote, about the contribution of WGIII : what is missing here and what is expected from WGIII? Will those estimates become obsolete when the WGIII report is published, or will the current estimate be supplemented by new information? [Government of Belgium, Belgian Science Policy Office - Belspo]
5005	20	11	20	15	Table SPM.2: Please consider adding in the table caption a short explanation as to why the temp reference period starts in 1850 and not before. Please also consider possible ways of facilitating the interpretation of the carbon budget values, as it might be difficult to understand "percentiles of TCRE" for many readers. [Government of Norway, Norwegian Environment Agency]
159	20	11	20	15	Table SPM 2 dicusses remaining carbon budgets should also include all Greenhouse gases budgets. This is important since values in this table can vary depending on other GHGs. Include all GHGs in the table. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
8613	20	11	20	15	Suggest revising Table SPM 2 for clarity. Percentiles (17th, 33rd etc.) are used to communicate probability of a given carbon budget producing a given warming. This is overly technical and meaning could be missed. It would be more consistent with the rest of the report if the table were adjusted to use the IPCC likelihood ranges instead (likely, very likely etc.). [Government of Australia, Department of Industry, Science, Energy and Resources]
8615	20	11	20	15	If you retain the percentiles, please include the word ‘percentile’ in the first or last column (e.g. 83rd percentile). The explanation is included in the caption and that is logical, but it seems easier to read quickly through the table when the word percentile is there. [Government of Australia, Department of Industry, Science, Energy and Resources]
8617	20	11	20	15	Suggest including the Global Carbon Budget initiative, to advise policymakers that a yearly estimate of global GtCO2 emissions is provided each year. [Government of Australia, Department of Industry, Science, Energy and Resources]
2743	20	11	20	15	Table SPM.2: While the transparency in presenting so many different values for the remaining carbon budget is laudable, we do wonder if all these values need to be in the SPM. It would be more in keeping with the way other quantities are reported in the SPM to show the likely range (17th to 83rd percentiles) and median value, or alternatively, the 5Oth and 67th percentile values perhaps. [Government of Canada, Environment and Climate Change Canada]
2747	20	11	20	15	Table SPM.2: footnote (1). Suggest the language here be clearer that the ±220 GtCO2 needs to be added TO the values in this table. Perhaps "Choices related to non-CO2 emissions mitigation can increase or decrease the values in this table by 220GtCO2. " [Government of Canada, Environment and Climate Change Canada]

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4307	20	11	20	15	We suggest to transform Table SPM2 in a figure [Government of Italy, CMCC - Centro Euro-Mediterraneo per i Cambiamenti Climatici Instituto Nazionale di Geofisica e Vulcanologia (INGV)]
7897	20	11	20	15	Table 2: This is a key Table, but its importance can only be appreciated if the budget estimates are linked to current CO2 emission levels. The urgency should be expressed by adding to each budget estimate an estimate of the remaining number of years until the budget is exhausted, assuming constant current emissions. It is important to declare this as "Paris target missed". [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
6879	20	11	20	15	Mention how the choice of percentiles is related to the *likely* interval. What is meant by at least +/- 220. Can the at least be dropped and instead an indication of what the +/- means (likely range?) [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6881	20	11	20	15	This table is currently not easy to grasp. What probability distribution are the percentiles referring to? It can be assumed they are the percentiles in the probability distribution of reaching the given temperature on the left, but this is not obvious to a non-expert reader. And why not use standard IPCC language ('likely','highly likely') here as well. More explanation needs to be provided. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
2577	20	11	20	17	Concerning SPM Table 2 we suggest reminding the reader that values of carbon budgets for every 0.1°C of warming are available. This could be done in a footnote while refering Table 5.8 [Government of France, Ministère de la Transition écologique et solidaire]
283	20	11		15	Table SPM2 only provides some of the points explored in the estimation (1.5,1.7&2.0). Wherase It should explore and highlight the other points such as 2.4. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
285	20	11		15	Table SPM2 only provides a general uncertinity (i.e. "Values can vary by at least ±220 GtCO2) wherase the uncertinity for all estimated points and remaining budget should be highlighted for to avoid any misunderstanding of the estimations. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
287	20	11		15	Table SPM2 only provides one of the uncertinties mentioned in table 5.8. Table 5.8 highlights several Geophysical uncertinities such as ZEC uncertinity, Historical temperature uncertinity..etc. All the uncertinities associated with the table should be highlighted and mentioned in the SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
6409	20	11			Table SPM.2: The AR6 temperature assessment comes with methodological changes, and estimates of historical temperature change are still subject to uncertainties. Therefore, the remaining carbon budget should also be presented relative to the remaining warming instead of relative to warming above pre-industrial levels. For clarity, instead of percentiles, maybe the likelihood of staying below chosen target could be shown. [Government of Saint Lucia, Department of Sustainable Development - Ministry of Education, Innovation, Gender Relations and Sustainable Developement]
2827	20	11			Is it possible to display likelihoods instead of percentiles in Table SPM.2? [Government of Jamaica, Meteorological Service Division]
7029	20	11			Table SPM.2: It would be advisable that the remaining carbon budget is presented not only in relation to warming relative to pre-industrial levels (as there are uncertainties in the historic warming assessment), but also in relation to the remaining warming. See for instance the approach in SR.15, Chapter 2, carbon budget table. [Government of Fiji, Fiji Meteorological Services]
7297	20	11			Table SPM.2: Given the changes in the assessment of historical warming, it is crucial to present the remaining budget also in relation to the remaining warming rather than the warming relative to pre-industrial. See e.g. the approach taken in the SR.15 Chapter 2 table on carbon budgets. In addition, would it be possible to display likelihood of staying below chosen target and not percentiles? [Government of Saint Kitts and Nevis, Department of Environment - Ministry of Agriculture, Marine Resources, Cooperatives, Environment and Human Settlements]

Comment ID	From Page	From Line	To Page	To Line	Comment
7165	20	11			Table SPM.2: We suggest that the table shows the remaining carbon budget also relative to the remaining warming (given that there are revisions to the historical warming assessment). [Government of Samoa, Ministry of Foreign Affairs and Trade]
4459	20	12	20	12	Please provide some additional guidance on how to interpret the percentiles, in terms of probabilities. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
2537	20	12	20	13	This formulation and the associated "percentiles" in the table (17th, 33rd, 50th, etc.) have little chances to be understood by policymakers or citizens. Is it an estimation like the ones in SR1.5 ("Using global mean surface air temperature, as in AR5, gives an estimate of the remaining carbon budget of 580 GtCO2 for a 50% probability of limiting warming to 1.5°C, and 420 GtCO2 for a 66% probability (medium confidence)" SPM, p.12)? If so, it is clearer with percentages of probability. If percentiles have to be kept, we suggest to highlight the 50th (by making it bold for example) [Government of France, Ministère de la Transition écologique et solidaire]
9345	20	12	20	15	The percentile of TCRE (page 20, lines 3 and 12, and in Table SPM.2) may be a bit difficult for policymakers to understand. Particularly in the table, it looks like the percentiles (17th, 33rd, etc.) are of the carbon budget, not percentiles of TCRE. This could use a better caption or descriptive footnote. [Government of United States of America, U.S. Department of State]
9347	20	13	20	13	With regard to Footnote 21, it would be helpful to indicate what carbon feedbacks have been accounted for. For example, the Arctic has in recent years been found to be a source of CO2 that is larger than all but a few of the world's countries. Has this already been accounted for? Without elaboration, it is just not clear how the allowance for such feedbacks has been done and if there really are allowable emissions. [Government of United States of America, U.S. Department of State]
7587	20	13	20	13	Suggestion to describe the meaning of TCRE so that table can be read on its own. [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
4163	20	14	20	14	In table SPM2, "Estimated remaining carbon budgets (GtCO2)" could be illustrated as narrative of "Estimated remaining carbon budgets (GtCO2) in each assessed percentile" as the different numbers are shown by pre-determined percentile. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
8293	20	14	20	14	Footnote 21 indicates that the uncertainty due to choices related to non-CO2 mitigation is independent of the TCRE. Is the central estimate of the contribution to remaining carbon budgets from non-CO2 forcing also assumed to be independent of the TCRE? Is this reflected in the uncertainty levels provided? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
4461	20	14	20	14	Please explain the range on the top right-hand corner of the table i.e. the "0.8-1.3". Some uncertainty interval for global mean temperature rise, but to 2019 rather than 2020 like in H.S.1.2? [Government of Sweden, Swedish Meteorological and Hydrological Institute]
4463	20	14	20	14	An asterisk and a (1) may not both be needed for the table's footnote. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
4465	20	14	20	14	As the WGIII assesses also the potential for CO2 mitigation, the second sentence of the "footnote" could be deleted, or amended, as appropriate. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
9349	20	14	20	15	Not clear what the percentiles signify in the second half of Table SPM.2. [Government of United States of America, U.S. Department of State]

Comment ID	From Page	From Line	To Page	To Line	Comment
9351	20	14	20	15	In Table SPM-2, the column heading "Global warming since 1850-1900" needs to be modified to something like "Multi-decadal average warming since 1850-1900" because at these levels of warming, as the calculations are being done, about 50% of the years will have warming above this amount, sometimes by a few to several tenths of a degree. As presented here, it implies that every individual year would stay below this value and this is simply not true and will be very confusing to the public when the world is well below the allowable emissions and the first year the observed warming is greater than 1.5°C (or any of the other values). Along with changing the heading in the table, both its title and the accompanying text need to be changed and made forthright. In addition, in the other places in the SPM text (e.g., the text around H.S.13.1 and Figure SPM.10) where increase in global surface temperature is mentioned, it again needs to be made clear that the text is actually referring to the multi-decadal average of the temperature increase (or temperature) and that, for the observed world, half of the actual years will be above the indicated value as a result of variability (if not also other factors). [Government of United States of America, U.S. Department of State]
4755	20	14	20	15	Could it perhaps be made slightly clearer what the percentile values refer to and why they are relevant? [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
6883	20	15			Table SPM.2: treatment of Non-CO2 forcing needs to be made more clear in footnote (1): "(1) Values consider non-CO2 greenhouse gases and other forcers as from the scenario runs in SR15. Depending on assumptions on mitigation of these compounds, values can vary by at least +/- 220 GtCO2. The WG III contribution to AR6 will reassess the potential for non-CO2 mitigation." [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
9353	20	20	20	23	Do the improvements include adjusting for future changes in the fraction of emissions that remains in the atmosphere? If not, how would including that uncertainty affect the findings? [Government of United States of America, U.S. Department of State]
3399	20	20	20	26	There is no confidence statement. [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
8295	20	20	20	26	Inclusion of TS box in the SPM may assist in comparing the AR5 and 1,5C analysis with the SPM data. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
9355	20	20	20	26	The "improved observations and modelling" referred to in line 21 could also be described as "methodological improvements" (line 24). Are these in fact different modifications? If so, explain. As carbon budgets are of great interest, the methodologies, sources of uncertainty, and explanation for changes in estimates over time must be extremely clear. [Government of United States of America, U.S. Department of State]
4757	20	20	20	26	Noting that despite great effort to coordinate with WGIII, there may be differences in carbon budgets between the two working groups. Is it possible to add a sentence here emphasising that the carbon budget discussed in this report is specific to the WG1 report and does not take into account other details such as how deeply non-CO2 can or cannot be mitigated (that will be in WGIII). [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial
2751	20	20	20	26	Policymakers need to understand clearly whether or not the uncertainties identified in this paragraph have been incorporated into the values in Table SPM.2 or not. Given that table SPM.2 is not referenced in curly brackets at the end of this paragraph, this is currently unclear. If these uncertainties are taken into account (e.g. as per footnote 21), perhaps this paragraph (H.S. 13.3) should precede H.S.13.2, where those values are presented. If they are additional uncertainties then the position of this paragraph is fine as is, but a clear statement about this is needed. [Government of Canada, Environment and Climate Change Canada]

Comment ID	From Page	From Line	To Page	To Line	Comment
197	20	20	20	26	As indicated in Ch.5 P9 L25, the remaingin carbon budget can increase or decrease by (550 GtCO2,) due uncertainties in the level of historical warming, and by (220 GtCO2) due to geophysical uncertainties surrounding the climate response to non-CO2 emissions such as CH4, N2O, and aerosols. This should be added to the SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7899	20	20	20	26	HS.13.3., line 24: "budget estimates are larger ...": Note: because the carbon budget is so central to mitigation, this statement should be quantified by all means. [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
6885	20	20	20	26	The more important re-assessment seems to be the one compared to AR5, while updates since 1.5 are less impactful. How much has the remaining budget changed since AR5? And since 1.5 report? [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6887	20	20	20	26	SR1.5 gave two carbon budgets. The switch back to a single system is welcome, but the comparison with SR1.5 needs to be clearer. Add a footnote to clarify which SR1.5 budgets this paragraph is referring to - the GMST-based or the GSAT-based. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6889	20	20	20	26	Please explain why the carbon budget (adjusted for latest annual emissions) is still broadly the same magnitude as SR1.5. This SPM has listed several factors which would suggest, at first glance, that the budget should be smaller. Higher historic temperature (so we are closer to 1.5/2°C at today's concentration), higher best estimate climate sensitivity, inclusion of more positive feedbacks compared to the SR1.5 estimate. The fact that the budget remains unmoved is surprising. Are there countervailing factors that, balance out the afore-mentioned? If so, please list them. Chapter 5.5 seems to suggest that 66th TCRE percentile budgets are about 40-60 GtCO2 larger due to a lower TCRE estimate. Can you explain in non-expert terms why the best estimate of ECS has broadly increased while for TCRE it has fallen? Since they are both types of 'climate sensitivity', why have they moved in opposite directions? [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6369	20	20	20	32	Please, include the following text between lines 26 and 28 as a new H.S. message: "Advances in methods to estimate remaining carbon budgets have shown the importance of applying an as accurate as possible estimate of historical warming to date (Millar et al., 2017a; Tokarska and Gillett, 2018). This becomes particularly important when assessing remaining carbon budgets for global warming levels that are relatively close to present-day warming, such as a 1.5°C or 2°C levels (Rogelj et al., 2018b). Also the definition of global average temperature by which historical warming is estimated is shown to be important. The remaining carbon budget depends on how much the world has already warmed to date. This past warming is caused by historical emissions". [Government of Brazil, Ministry of Foreign Affairs]
4165	20	23	20	26	When compared with Table 2.2 of SR1.5 considering about 85 GtCO2 during 2018-2019, differences are found depending on warming levels and probabilities. We suppose that this is partly resulted from the reduced uncertainty range of TCRE among others, which may be worth explained. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
6245	20	23	20	26	_Consistency of budgets across IPCC reports: Please explain why the budget estimates are similar to those in SR1.5 given the increased historical warming and the stronger near-term warming, leading to less time until 1.5 °C is reached. As a consequence of these updates, we would have expected a smaller budget estimate in the AR6. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]

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379	20	23	20	26	We compared the carbon budgets given here with those presented in the SR1.5. Given that the historical temperature is assess to higher in WG1 contribution compared to SR1.5 and that the timing of crossing 1.5°C is reached earlier than in the SR1.5 we would have expected the carbon budget to be smaller. Please explain why this is not the case. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
381	20	23	20	26	The carbon budgets are an important issues of cross-WG consistency. We strongly encourage WG3 to refer back to the carbon budgets and use the same numbers. If there is a strong scientific reason why this is not possible, this reason should be clearly spelled out. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
5007	20	23	20	26	The sentence compares the remaining carbon budget to the findings in AR5. Could additional information be added that explains in some more detail how the AR6 carbon budget compares to the one in SR1.5? Perhaps stating if there are an increase or decrease in the remaining budget compared to SR1.5 instead of just stating "similar magnitude" could help. [Government of Norway, Norwegian Environment Agency]
4167	20	24	20	26	On page 11, lines 9-12, it is stated that the AR6 estimate of crossing 1.5°C warming level is earlier by ten years than in SR1.5. One would naturally expect that carbon budget estimate becomes smaller. It is contra-intuitive that the carbon budget remains similar between AR6 and SR1.5. Explanation on this apparent discrepancy would be preferable. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
4467	20	25	20	25	The "methods are similar and" does not seem to be necessary here and could be deleted to focus the information. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
6347	20	27	21	9	What are the risks associated with CDR technologies, particularly at a large scale and how do these compare with rapid emission reducutions without CDR? Is this mainly nature based CDR? Or are there other technologies used? Which? There is relevant information in chapter 5. [Government of Estonia, Estonian Meteorological & Hydrological Institute]
5009	20	28	20	28	Please consider replacing the word "some" with a clearer and more quantifiable term. Perhaps significant or substancial are better alternatives? [Government of Norway, Norwegian Environment Agency]
5011	20	28	20	28	Please consider if the term "deliberate removal of CO2 from the atmosphere" is appropriate in this context? It can be understood as only direct air capture. We assume that you are intending to describe CDR more in general, and it may therefore be appropriate to use carbon dioxide removal techniques throughout the para. Another alternative would be to replace "Deliberate" with "Anthropogenic" in the start of the sentence. In case you mean something else than CDR with "deliberate removal" this should be clarified. [Government of Norway, Norwegian Environment Agency]
6249	20	28	20	30	The second part of the sentence could leave the impression that removal of CO2 (CDR) to compensate for residual emissions implies an implementation "at a small scale" and suggests that CDR generating negative emissions is very distinct from the first motivation. In fact, depending on what is considered "residual emission" CDR for compensation may well be called "large scale" and CDR generating negative emissions are only an increment away from the amount that exactly balances residual emissions. It is suggested to change this into "if implemented at larger scale" or "if implemented at even larger scale". [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
9357	20	28	20	30	Not all Carbon Dioxide Removal (CDR) is the same. It is harder, maybe impossible, to indefinitely maintain net positive levels of natural sequestration because natural reservoirs eventually saturate. While technological CDR may not face this constraint, it faces others such as cost and uptake. These differences and constraints should be more clearly communicated. Otherwise a reader could incorrectly conclude that one can merely plant trees indefinitely to offset continued emissions. [Government of United States of America, U.S. Department of State]
5015	20	28	20	30	Please consider if the wording "generate net negative emissions" is meant to describe net negative global emissions, or something else. If it is not global e.g. from an industrial facility it does not necessarily need to be on a large scale. [Government of Norway, Norwegian Environment Agency]

Comment ID	From Page	From Line	To Page	To Line	Comment
5133	20	28	20	32	The wording "net-zero" might be perceived differently by different audiences. We would like to ask for a definition of "net-zero" in the SPM, with full clarity on the meaning of "removals" - such as provided in SR15 Box SPM.1. [Government of Belgium, Belgian Science Policy Office - Belspo]
8297	20	28	20	32	The word "could" here seems odd. In what circumstances would CO2 remoavls not be needed to compensate for residual emissions? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8299	20	28	20	32	Can the term "cooling potential" be elaborated, how and what scale over what time period? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
9359	20	28	20	32	Suggest making it clear that CO2 removals can be achieved not only through CDR technology, but also through forests, wetlands, soils, oceans, and othrer natural climate solutions. [Government of United States of America, U.S. Department of State]
4759	20	28	20	32	Change to read: Deliberate removal of CO2 from the atmosphere could compensate for some residual emissions to reach net zero CO2 or greenhouse gas emissions, if removals exceeded emissions, generate net negative emissions. Carbon dioxide removal (CDR) techniques have various potentially wide-ranging side-effects on biogeochemical cycles and climate that can either weaken or strengthen the carbon sequestration and cooling potential of these techniques (high confidence). [Rationale: removal of "if implemented at a large scale" and replacement with "if removals exceeded emissions" is clearer about the actual scale that is needed. "Large scale" is too vague] [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
4281	20	28	20	32	This is a comparatively weak and vague statement that as it stands is not particularly informative ("could compensate", "some residual emissions", "reach net-zero CO2 or greenhouse gas emissions or, … , generate net negative emissions." There are some much stronger information contained in chapter 5 though that may be taken up here: page 5-9, lines 38-40, It could be backed up with some of the more specific statements from chapter 5 (chapter 5, page 5-10, lines 1-3, 5-7, 9-10). [Government of Italy, CMCC - Centro Euro-Mediterraneo per i Cambiamenti Climatici Instituto Nazionale di Geofisica e Vulcanologia (INGV)]
199	20	28	20	32	According to Ch.5 P10 Line8, these effects are often highly dependent on local context, management regime, prior land use, and scale of deployment (high confidence). This should be added to SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7901	20	28	20	32	HS.13.4: Current lack of global feasibility of CDR should be acknowledged. Currently the text comes across as if CDR would be a solution. It is also at the heart of all overshoot scenarios. The question of feasibility should be called out with a pointer to WG3. If WG1 is more determined on this issue, you could say that today, global scalability of all negative emission technnologies is not established, and therefore it is not a ready option to count on in view of fulfilling the Paris Agreement. However, mitigation is a ready option, if not the only option, for the coming decades for keeping us within the rapidly shrinking carbon budget determined by the temperature limits and the probabilities of not exceeding them (see Table 2). [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
6891	20	28	20	32	Re-phrase the first sentence for precision and clarity. The fundamental point is that (successful) CDR reduces net CO2 emissions, hopefully to zero. Whether it contributes to net zero GHG / net negative emissions is more speculative. Suggested alternative wording: "Deliberate removal of CO2 from the atmosphere could help reach net zero CO2 emissions and, if implemented at a large scale, net negative emissions such that net CO2 removal compensates for residual emiissions of other greenhouse gases". [Philippe Tulkens, European Union (EU) - DG Research & Innovation]

Comment ID	From Page	From Line	To Page	To Line	Comment
2541	20	28	20	32	When introducing CDR techniques in this SPM, the wording used in the SR1.5° would be relevant to be reflected, as the constraints in terms of feasibility and sustainability as well as actions that can be taken to reduce reliance on CDR to achieve net zero are not introduced in this paragraph. This would also help to ensure consistency with the SPM to come from WGII and WGIII, which are mentionned in footnote 22 of this SPM, and which detail further what is meant by feasibility and sustainability constraints. As a reminder, this is the wording used in the SPM of the SR1.5°, in item C3 : "CDR deployment of several hundreds of GtCO2 is subject to multiple feasibility and sustainability constraints (high confidence). Significant near-term emissions reductions and measures to lower energy and land demand can limit CDR deployment to a few hundred GtCO2 without reliance on bioenergy with carbon capture and storage (BECCS) (high confidence). {2.3, 2.4, 3.6.2, 4.3, 5.4} " [Government of France, Ministère de la Transition écologique et solidaire]
2543	20	28	20	32	Concerning footnote 22 : These important side-effects should be mentioned in the statement rather than in a footnote [Government of France, Ministère de la Transition écologique et solidaire]
6247	20	28	21	4	_Side effects of CDR: Please improve the language of these two paragraphs: the text in 5-9-38 -> 5-9-52 and in TS-64-20 -> TS-64-25 is easier to understand. In addition, please provide more information on the "wide-ranging side-effects" of CDR drawing on information given in 5-9-54 to 5-10-11, potentially in an additional paragraph because this new information is of key importance to policy makers. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
383	20	28	21	4	While we fully understand the need to rely on CDR to achieve stabilization scenarios, policy makers need to be made aware of the risks involved. The current text does not convey these risks as clearly as paras TS-64-20 to TS-64-25 do. We would thus suggest switching to language that is much closer to the Technical Summary here. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
5013	20	28	21	9	The term 'negative emission' is challenging for most people to understand. Please consider to clarify the term. [Government of Norway, Norwegian Environment Agency]
4761	20	28	21	9	This is a useful paragraph that highlights the valuable role that CDR will play in reaching net-zero while tempering it with valuable caution about its long-term effects and the expectations that policy-makers should have. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
4763	20	28	21	17	A link between overshooting the 1.5 or 2 degree target and CDRs should be drawn. Could the authors consider adding a sentence here commenting on the potential negative impacts on the physical climate system of relying on CDRs to reduce temperature in this context and in comparison to avoiding an overshoot in the first place. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
4527	20	29	20	29	Does this refer to readily available CDR (i.e., "implemented") and/or techniques that still require (further) development? If the latter applies, then something like "developed and implemented" would improve clarity. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
7619	20	30	20	30	Some clarity on what CDR technologies entail would be useful for policymakers. Perhaps in a footnote. Or perhaps a reference to WGIII report, where mitigation is covered in more detail. [Government of South Africa, Senior Policy Adviser International Climate Change Cooperation Department of Environmental Affairs]
5017	20	30	20	32	As policy makers are not necessarily familiar with the term, please find a more accesible term such as "carbon removal", "carbon uptake" or even "the amount of carbon removed". [Government of Norway, Norwegian Environment Agency]
8375	20	30	20	32	How so uncertain directions "either weaken or strengthen the carbon sequestration" can result in high confidence of the statements? [Government of Ukraine, Director Ukrainian Hydrometeorological Institute]
6893	20	30	20	32	It is important to bring attention to these side-effects. However, it would also be important to highlight the interactions with sinks discussed under HS.8. Such interactions are currently not recognised, although they are likely to be significant. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]

Comment ID	From Page	From Line	To Page	To Line	Comment
6895	20	30	20	32	Suggest mentioning the relevant energy needs of Carbon Capture and Storage methods (5.6.2.2.4) [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
225	20	30	21	9	The text needs to be revised to reflect consistency with Chapter 5.6, Page 99, Line 34. Since the paragraph discusses the general and methods-specific effects of CDR on the global carbon cycle and other biogeochemical cycles, the term "wide-ranging side effects" implies negative consequences, while also emitting the fact these effects are methods-specific. Replace "wide-ranging side effects" to include a clear indication of "general and methods-specific effects of CDR". [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
229	20	30	21	9	While the text depicts the biogeochemical responses of CDR, there is very limited to no mention on the strengths of carbon sequestration and cooling potential. Carbon capture utilization storage (CCUS) technologies play an important role in climate change mitigation pathways. Since these paragraphs reflect "wide-ranging side-effects", explicit information on CCUS and the co-benefits should be included. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
9361	20	31	20	31	"can either weaken or strengthen" needs explanation. [Government of United States of America, U.S. Department of State]
9363	20	31	20	31	H.S.13.4 leaves out the part of the underlying chapter where it mentions that side effects may have impacts on reaching sustainable development goals. Yes, side effects may have feedback impacts on the efficacy of CDR itself, but the ecological and social impacts of the side effects may be more troubling. Also, on line 30, "potential" is the side effects, not the wide range. So use "wide-ranging potential side effects" instead of "potential wide-ranging side effects". [Government of United States of America, U.S. Department of State]
6251	20	32	20	32	Please consider to note also that no method has yet matured to the point where efficient and sustainable application is possible at large scale. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
5019	20	32	20	32	Footnote 22: Should be rephrased to fit better with the sentence in line 32, by including "potential" in the start of the sentence. "Potential side-effects ..." [Government of Norway, Norwegian Environment Agency]
7661	20	32	20	32	It may be clarified what the high confidence refers to. [Government of India, Ministry of Environment, Forests and Climate Change]
7123	20		20		The relationship between countries' GDP and climate change adaptation scenarios should be mentioned in the report(https://doi.org/10.1080/17565529.2020.1711698 and DOI 10.1007/s10584-011-0346-8 and http://dx.doi.org/10.1016/j.gloenvcha.2012.06.005) [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]
161	21	0	21	0	Figure SPM 10 should not limit the discussoin to CO2. The discussion and the figure should cover all Greenhouse Gases. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
5135	21	1	21	2	Line 2 : of the same magnitude as what ? Please clarify. [Government of Belgium, Belgian Science Policy Office - Belspo]
39	21	1	21	2	The sentence has been sformulated in a negative manner, We suggest the sentence to be formulated in a postive sense [Government of United Republic of Tanzania, Tanzania Meteorological Authority (TMA)]
8301	21	1	21	3	Essentially CO2 degasses from oceans and land, but this can be made clearer in that removals need to match the original emissions. Consider rewording this. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]

Comment ID	From Page	From Line	To Page	To Line	Comment
6253	21	1	21	4	This is an important message and crucial basis for further discussion. However, data/results need to be better described: If possible, please provide the order of magnitude - or a fraction - for CO2 removal being counteracted by CO2 release from land and sea. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
6255	21	1	21	4	This is an important point and thus important for the SPM. We are not quite sure, but it seems that this H.S. does not yet include the findings from CDRMIP regarding the asymmetry in the response to a positive and a negative CO2-emission pulse (Chap. 5.6.2.1.3 of the SOD). The statement currently could be understood (misunderstood?) as a simple symmetric response of the carbon cycle. In the SOD it was our impression that the finding about asymmetry comes on top of what the H.S. currently says. In the SOD it reads "In other words, an emission of CO2 into the atmosphere is more effective at raising atmospheric CO2 than an equivalent CO2 removal is at lowering it, particularly for larger emissions/removals." We are not quite sure if this really means the same thing. We suggest a very careful rethinking and a very precise phrasing, perhaps an addition to this important H.S. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
2753	21	1	21	4	Editorial suggestion to change "In a similar way a fraction of historical anthropenic CO2 emissions.." to "Similar to the way that a fraction of historical anthropenic CO2 emissions". Also suggest adding "from the atmosphere" after "net CO2 removal" on line 3. [Government of Canada, Environment and Climate Change Canada]
6897	21	1	21	4	Please make a distinction between the ocean and terrestrial sinks. Whilst the former is primarily driven by concentration differences and can reasonably be pesented as reversible, the same should not be implied for the land sink, which is driven by biological processes. Lower Co2 concentrations in the atmosphere could reduce the CO2 fertilisation effect (compared to a counterfactual with higher CO2), but would not accelerate the release of carbon already fixed in major pools, such as soils or tree biomass. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6899	21	1	21	4	It is unclear why the possible reversal of the sink is discussed only in the context of CDR. The processes implied are governed by atmospheric concentrations, regardless of the reasons for those changes. Therefore, a reduction/reversal of sinks could happen not only in reaction to CDR, but equally in response to any other mitigation action, such as rapid emission reductions. This mechanism is important to highlight but should not be asociated with CDR only. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6901	21	1	21	4	Could some typical percentages be given for 3 scenarios, e.g. for 2050? [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6903	21	1	21	4	It is unclear why the possible reversal of the sink is discussed only in the context of CDR. The processes implied are governed by atmospheric concentrations, regardless of the reasons for those changes. This mechanism is important to highlight but should not be asociated with CDR only. It should refer back to H.S.8.1-2 (p.13-14). Maybe: "CO2 sequestration will not linearily decrease atmospheric CO2 concentrations, due to the multiple feedbacks between atmosphere and biosphere. Similar to the historical land and ocean sinks (H.S.8) that under low emission scenarios take up less carbon and eventually may become sources, similar effects can partially counteract also CDR." [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
8619	21	2	21	4	Suggest inserting "that", ie "In a similar way that a fraction…" [Government of Australia, Department of Industry, Science, Energy and Resources]
2545	21	2	21	4	This paragraphs needs clarification telling why the drop in atm CO2 will be different than CO2 sequestered, and make sure there is no ambiguity in the fact that the two sentences refer to different aspects. We suggest to split the sentence into 2 as the link (if there is any) between the two parts of this sentence is not clear. [Government of France, Ministère de la Transition écologique et solidaire]
501	21	6	21	6	"H.S.13.6 CDR could reverse surface warming if global CO2 emissions become net negative", the finding from which lacks confidence information, is suggested to be added. [Government of China, China Meteorological Administration]

Comment ID	From Page	From Line	To Page	To Line	Comment
2755	21	6	21	7	Would it be more consistent with the underlying evidence to change "CDR could reverse surface warming if global CO2 emissions become net negative" to "CDR could reverse surface warming if net negative global CO2 emissions were obtained and sustained". If sustained net negative emissions is key, this should be included in the text. [Government of Canada, Environment and Climate Change Canada]
9365	21	6	21	8	In the last IPCC assessment, "net-zero" emissions referred only to the direct emissions due to human activities -- the definition not really even being clear if tropospheric ozone and aerosols are included. Very clearly, however, the definition does not include natural greenhouse gas emissions that have been stimulated by global warming. So, with the warming of the Arctic apparently having changed the region from a sink to a source of CO2 and with some forested areas also being already or near to being flipped from a sink to a source of CO2, even if direct human emissions go to zero (or net-zero) there are going to be ongoing natural emissions that have been stimulated and climate change will continue as it is dependent on total natural plus human influences. Therefore, the SPM should make clear that it will be harder to reverse warming with CDR than if carbon cycle feedbacks cause natural emissions to increase. [Government of United States of America, U.S. Department of State]
4765	21	6	21	8	Change to read: H.S.13.6 If global CO2 emissions become net negative, surface warming could be reversed, but other climate changes would continue for decades to millennia. For instance, sea level rise would not be reversed for several centuries to millennia even under large net negative CO2 emissions (high confidence). Rationale: removal of "CDR could reverse surface warming" and addition of "surface warming could be reversed" removes the implication that CDR can bring about cooling directly. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial
2757	21	6	21	8	There is a risk this statement about reversing surface warming could be interpreted to mean global warming can be largely undone. This would depend on the amount of CDR achieved. While the WGI report is not addressing sustainability concerns around CDR, nonetheless there is text to draw on to provide some constraints on the capacity of CDR to reverse global warming. Chapter 4 Executive summary has a clarifying statement that says "Because of the near-linear relationship between cumulative carbon emissions and GSAT change, the cooling or avoided warming from CDR is proprotional to the cumulative amount of CO2 removed through CDR." Space allowing, including this sentence (or part of it) would at least give an indication that reversing global warming by large amounts would require very large amounts of CDR. [Government of Canada, Environment and Climate Change Canada]
8303	21	6	21	9	The logic of this should be clearer, we cannot reverse key changes such as …. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
6349	21	6	21	9	This is too abstract. When can be the warming reversed under negative emissions and how much of these are needed? [Government of Estonia, Estonian Meteorological & Hydrological Institute]
6905	21	6	21	9	However, additional sea level rise can be avoided- and this could also be mentioned. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
9367	21	7	21	7	Recommend to better clarify when global mean sea level is being discussed (to distinguish it more clearly from local sea level rise). Change "sea level rise" to "global mean sea level rise" [Government of United States of America, U.S. Department of State]
2547	21	7	21	8	This sentence seems to be in contracdiction with what Figure 4.37 shows. Maybe add that only the rate of change would be reduced? Sea levels would peak and decline. Other examples could also be given [Government of France, Ministère de la Transition écologique et solidaire]
247	21	7	21	8	In the following " For instance, sea level rise would not be reversed for several centuries to millennia even under large net negative CO2 emissions (high confidence)." The Authors must remove the word millenia as it is not mentioned in the referenced chapter. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]

Comment ID	From Page	From Line	To Page	To Line	Comment
6371	21	9	21	11	Please, include the following text between lines 9 and 11 as a new H.S item: "The report does not recommend an emission metric because the appropriateness of the choice depends on the purposes for which gases or forcing agents are being compared. Emission metrics can facilitate the comparison of effects of emissions in support of policy goals. They do not define policy goals or targets but can support the evaluation and implementation of choices within multi-component policies (e.g., they can help prioritise which emissions to abate). The choice of metric will depend on which aspects of climate change are most important to a particular application or stakeholder and over which time- horizons. Different international and national climate policy goals may lead to different conclusions about what is the most suitable emission metric (Myhre et al., 2013b). GWP and GTP give the relative effect of pulse emissions, i.e. how much more energy is trapped (GWP) or how much warmer (GTP) the climate would be when unit emissions of different compounds are compared. Updated values are provided in the underlying Report {7.6}" [Government of Brazil, Ministry of Foreign Affairs]
9369	21	11	21	11	Change "used to aggregate" to "for aggregation of". Fix run-on sentence. [Government of United States of America, U.S. Department of State]
5139	21	11	21	14	The link between the choice of metric and its consequence is not made sufficiently clear. You may consider changing the order of the elements, for example : "For a given greenhouse gas emission trajectory, the calculated net emissions depend on the chosen metric. As a consequence, the time when the emissions would be diagnosed as reaching zero also depends on the metric used in this calculation. For emission trajectories reaching net-zero, the actual emissions depend on the metric used in defining net-zero, hence the temperature trajectory also depends on how net-zero is defined." [Government of Belgium, Belgian Science Policy Office - Belspo]
8309	21	11	21	14	The evolution of GMST would depend on subsequent emissions. Once emissions reach net zero, they do not necessarily stay there, deleting "as well as the implications etc" may avoid confusion about this. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
5027	21	11	21	14	We feel that this para curently suffers slightly from conveying too many things at the same time. The para might additionally raise a general misinterpretation that results in the SPM are dependent on which emission metrics that is applied. We understand from the current draft that all results in the SPM, except those described in HS.13.7, do not rely on emission metrics. If that is correct, we think it is imporatnt to highlight this in this para. In addition, it might be stated that choice of metrics will not alter the physics of the climate system. [Government of Norway, Norwegian Environment Agency]
2759	21	11	21	14	This is a rather long complicated sentence and the use of the word "diagnosed" will not be readily understood. There is shorter, and we think essentially the same text in the summary box at the start of Section TS3.3.3 (pg TS-66) that simply says "The choice of emission metric....affects the quantification of net zero GHG emissions and their resulting temperature outcome (high confidence). [Government of Canada, Environment and Climate Change Canada]
6373	21	11	21	14	Please, replace "The choice of emission metric used to aggregate emissions and removals of different greenhouse gases affects whether and when net zero greenhouse gas emissions would be diagnosed, as well as the implications of reaching net zero greenhouse gas emissions for the subsequent evolution of global surface temperature (high confidence)" by "The choice of emission metric used to aggregate emissions and removals of different greenhouse gases affects the quantification of net zero GHG emissions and therefore the resulting temperature outcome after net zero emissions are achieved". [Government of Brazil, Ministry of Foreign Affairs]

Comment ID	From Page	From Line	To Page	To Line	Comment
6907	21	11	21	14	It is important that this SPM deals with the net zero concept, since the term has become commonplace outside of official science-policy discourse. However, it is not helpful to introduce the concept of "net zero GHG emissions" at this point, since it is different from the net zero concepts mentioned earlier in the SPM. The terminology and underlying definitions need to be clear and consistent throughout this SPM. The important 'zero' point for the purposes of this SPM is the point required to stop warming - i.e. net zero CO2 combined with decrease in net non-CO2 forcing (see comment on HS.13). This should be (re-)stated here. If there is any SPM comment on GHG metrics, it should simply say that they are valuable tools for climate policy, but that none is ideally suited to declaring when this net zero point is reached since metrics serve a different purpose. If applicable, it should also point out that some scenarios (1.9 & 2.6), exhibit net negative CO2 emissions during the 21st century and / or net negative emissions when measured in GWP-100 (the most commonly used metric). [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
5137	21	11	21	16	These are very important statements but they needs to be written in a clearer way. [Government of Belgium, Belgian Science Policy Office - Belspo]
2829	21	11	21	17	It is important to clarify here that GWP-100 is used for the UNFCCC emissions accounting. [Government of Jamaica, Meteorological Service Division]
8305	21	11	21	17	This has some very important information but obscured in a number of ways including the reference to other metrics, this should be clarified, Also the potential of different GHG to providing cooling, e.g. methane, should be clearer here and elsewhere in the text. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
7539	21	11	21	17	This is very relevant, but very unclear: what are the new metric approaches referred to? This paragraph also suggests that the choice of the metric affects the temperature change. Please rephrase. [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
8307	21	11	21	17	Achievement of a stable global temperature is really important and should be properly recognised as essential for the Paris Agreement. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
4469	21	11	21	17	This is somewhat unclear and the significance is elusive (that different metrics can lead to different characteristics is rather trivial). Also, focus on alternative metrics in this way may confuse as the climate response itself is insensitive for the metric. Furthemore, "diagnose" is ambiguous, including if it refers to the application of some metric. GWP100 is the agreed policy choice, so it would be useful to focus on it. The first and third sentences of H.S.13.7 might be candidates for deletion, or at least a clarification. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
385	21	11	21	17	This section contains information that is very technical in nature and not easily to understand by policy-makers and we thus propose to delete it or to revise it substantially. We rather think that such a discussion on metrics should be done in the TS. The whole para actually gives the impression that the choice of the metric would have a consequence on the physical climate systems, which it does not have. This perception might lead to erroneous conclusions. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
7299	21	11	21	17	This paragraph on the implications of using different emission metrics is useful. Please add a footnote clarifying that GWP-100 is applied for emissions accounting under the UNFCCC. Importantly, it also has to be highlighted that using new metrics could easily lead to very problematic results, e.g. "negative" equivalent CO2 emissions for remaining positive CH4 emission that cause warming. [Government of Saint Kitts and Nevis, Department of Environment - Ministry of Agriculture, Marine Resources, Cooperatives, Environment and Human Settlements]

Comment ID	From Page	From Line	To Page	To Line	Comment
1679	21	11	21	17	The metric paragraph (H.S.13.7) seems a bit out of context in the overall flow of the SPM. However, we understand the idea of noting them in the WGI SPM due to their role in estimations of net zero GHG emissions. We suggest that an explanatory sentence would be added to the beginning about their role in such estimations, for example, “Emission metrics are used to aggregate emissions and removals of different greenhouse gases and to diagnose whether and when net zero greenhouse gas emissions would be achieved. However, the choice of the emission metrics has implications for the results on reaching net zero greenhouse gas emissions for the subsequent evolution of global surface temperature (high confidence). Achieving sustained net zero greenhouse gas emissions aggregated with the Global Warming Potential over a 100-year period (GWP-100), typically leads to a peak and decline in global surface temperatures. In contrast, achieving sustained net zero greenhouse gas emissions aggregated according to new metric approaches would lead to approximately stable temperatures. {7.6} [TS.3.3.3] [Government of Finland, Finnish Meteorological Institute (FMI)]
9371	21	11	21	17	The wording of H.S.13.7 is confusing, and could use clarification about how metrics influence emissions. In particular, it should be clear that the latter half of this key message applies when using the metric to allocate emissions under a global policy (e.g., cap and trade or tax). Consider rewording as follows: "The choice of emission metric used to aggregate emissions and removals of different greenhouse gases affects whether and when net zero greenhouse gas emissions would be diagnosed, as negative emissions of carbon dioxide can be offset by differing amounts of non-CO2 greenhouse gases depending on the metric chosen. If metrics are used to allocate the global greenhouse gas emissions pathway to net zero, then the global surface temperature trajectory will be influenced by the choice of metric. Using the 100-year Global Warming Potential for allocating such an emissions pathway will typically lead to a peak and decline in global surface temperatures. In contrast, achieving sustained net zero greenhouse gas emissions aggregated according to new metric approaches would lead to approximately stable temperatures. {7.6} [TS.3.3.3]" [Government of United States of America, U.S. Department of State]
5021	21	11	21	17	We would prefer if this para could focus on what is achievable in order to fulfill relevant goals of the Paris agreement. We currently understand that this para relates to Art. 2 and 4, and especially to "achieving balance between anthropogenic emissions by source and removals by sink" and relations to both the temperature goal and peaking and reductions of greenhouse gas emissions. We suggest lifiting material from the TS p. 66 l. 39-41 and Ch 7, box 7.3, p. 126, l. 29-32 by e.g. saying: Stabilizing the global surface temerature [to e.g. well below two degrees], requires anthropogenic CO2 emissions to become net zero, and non-CO2 radiative forcing to decline. To accurately determine the current and future effect on the global surface temperature of different climate drivers, their emissions needs to be known by component." Another sentence could deal with net-zero GHGs e.g. "Modelling can inform about how net zero GHGs can be obtained with associated outcomes for individual forcers in different GHG emission pathways linked specific temperature stabilizing scenarios.". [Government of Norway, Norwegian Environment Agency]

Comment ID	From Page	From Line	To Page	To Line	Comment
4767	21	11	21	17	HS13.7 could potentially be a confusing section, as it is not currently clear whether it is implying that the choice of metric itself has a real-world impacts and affects the atmospheric impact and temperature repsonse, or our ability to detect when we have reached net zero. It would help if this paragraph was rephrased to say 'For equivalent emissions profiles, the choice of emissions metric used to aggregate emissions and removals of different GHGs affects what point of the emissions profile is defined as net zero, and hence its timing but would not affect the atmospheric and climatic response. Similarly, the implications of reaching net zero GHG emissions for the subsequent evolution of global surface temperature when the point of net zero is defined under different metrics.'. This would also remove the need for the statement "In contrast, achieving sustained net zero greenhouse gas emissions aggregated according to new metric approaches would lead to approximately stable temperatures." which is misleading and could be deleted, as it suggests that this is the case for all new metrics - when in reality there are a wide range of metrics whose implications for temperature are not assessed in this report. Any statement about the use of alternative metric approaches should be placed into context with a statement clarifying what is known about the use of alternative metrics in terms of the effect on mitigation incentivisation, and the effect on temperature responses if existing national and global targets and agreements are followed without translating their underlying commitments into these new metrics. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
5023	21	11	21	17	H.S.13.7: When explaining and refering to net zero, various greenhouse gases, and related conclusions in the SPM, please consider using language that does not depend on the choice of metrics, i.e. avoiding the term "metric" altogether when describing net zero CO2 or GHG. We think this has been achieved in H.S.13.8, and suggest that this para is moved before H.S.13.7 or replaces 13.7 in its entirety. [Government of Norway, Norwegian Environment Agency]
5025	21	11	21	17	Firstly, we believe that the current paragraph only makes an observation where the message is somewhat unclear for policy makers. However, we believe that there is some merit to include text that makes policymakers aware that there have been interesting scientific developments when it comes to metrics, and how the choice of a metric can have different implication on policy-relevant perspectives. We suggest that the SPM could better reflect such differences, and especially when it comes to comparing Long-lived and Short-lived climate forcers. Therefore, please consider adding further insights building on chapter 7.6 and Technical summary section 3.3.3, such as: "Greenhouse gases and other climate forcers can be separated into Long-lived (LLCF) and Short-lived (SLCF) climate forcers. Additional warming at any given point in time is the function of the cumulative (or stock) emissions of LLCFs until that time, and the rate (or flow) of SLCF emissions in a period prior to that time. There is high confidence that achieving net zero CO2 emissions and declining non-CO2 radiative forcing would halt human-induced warming. Novel metrics are under development to capture the differences between emissions of LLCFs and SLCFs, while allowing to account for combined effects and temperature responses.". If appropriate, further insights and messages for policy makers could be extracted from chapter 7.6 page 124, lines 2-4, Box 7.3 page 126 lines 12-16, page 126 line 25-28, or the SPM could simply refer the reader to chapter 7.6 and TS section 3.3.3. [Government of Norway, Norwegian Environment Agency]
5029	21	11	21	17	Please consider if the text in this para is needed in the SPM, or could be deleted. The rationale for this could be that WGI to a very limited degree discusses net zero GHG emissions. If the intention is to discuss net zero GHG emissions it would need to be discussed in a broader way than only in light of choice of metrics. E.g. TS page 68 lines 25-26 state that the magnitude of the cooling effects of aerosols remains the largest uncertainty in the effect of SLCFs in future climate projections. This illustrates that other factors besides metrics are important in this regard. We also recognise that Box TS.7 describes the temperature response of various greenhouse gases without using metrics, and therefore it seems that the conclutions in Box TS.7 are robust independently of metrics. [Government of Norway, Norwegian Environment Agency]

Comment ID	From Page	From Line	To Page	To Line	Comment
5031	21	11	21	17	This is the first time you write about the effects of using different metrics. Please consider clarifying if the different metrics have a physical effect on the climate, or if they are more theoretical and model-specific effects only. [Government of Norway, Norwegian Environment Agency]
8621	21	11	21	17	Suggest rephrasing for accuracy: One might interpret this sentence to mean that the choice of metric changes the projected temperature. The final sentence might also lead readers to wonder 'what new metric approaches'? Suggest instead: 'warming-equivalent metric approaches'. [Government of Australia, Department of Industry, Science, Energy and Resources]
8377	21	11	21	17	This H.S.13.7 as it is written is not clear. Especially how "new metric approaches would lead to approximately stable temperatures"? [Government of Ukraine, Director Ukrainian Hydrometeorological Institute]
7621	21	11	21	17	Refer to comment 13 on the issue with the NET ZERO concept. [Government of South Africa, Senior Policy Adviser International Climate Change Cooperation Department of Environmental Affairs]
4301	21	11	21	17	It is unclear how the choice of metric would affect the temperature profile [Government of Italy, CMCC - Centro Euro-Mediterraneo per i Cambiamenti Climatici Instituto Nazionale di Geofisica e Vulcanologia (INGV)]
7663	21	11	21	17	Delete. This is a technical issue best left to the technical summary. [Government of India, Ministry of Environment, Forests and Climate Change]
2549	21	11	21	17	This sentence is difficult to understand without reading the referred chapter. It is diffult to get what the new metric approaches can be and why it might be useful to distinguish them from the GWP-100 metric. Since the most adequate emission metric is discussed further in the WGIII contribution, it would be relevant to specify the confidence indicator for each outcome when describing future global surface temperatures evolution. [Government of France, Ministère de la Transition écologique et solidaire]
6909	21	11	21	17	please explain what are the "new metrics" compared to the old metrics. Without this explanation it is very difficult to understand the implications of this paragraph. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
9373	21	12	21	13	Suggest adding a word for clarity: "as well as the implications of reaching ESTIMATED net zero greenhouse gas emissions for the subsequent evolution of global surface temperature (high confidence)." [Government of United States of America, U.S. Department of State]
5141	21	14	21	16	The reference to "peak and decline" is unclear: does it mean that if this approach is followed, temperatures would increase to a higher "peak", or peak later, than with other approach? Is the message really about the level of temperature reached (the peaking level) or is it about the decline after reaching that level? We guess that it is about the decline, but this is not indicated. If achieving net-zero calculated with GWP100 implies that temperature start to decline from approximately the time when this net-zero criteria is reached, please consider writing it in this way. [Government of Belgium, Belgian Science Policy Office - Belspo]
8311	21	14	21	16	This is the case if carbon dioxide removal is used to offset warming by climate forcers such as methane, as noted in the TS. The reverse may occur if cooling due to methane reductions is used to offset ongoing emissions of CO2. This is inherent and problematic in approaches to aggregate emissions. This could also be oulined here as a risk for consideration in policy development and actions. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]

Comment ID	From Page	From Line	To Page	To Line	Comment
531	21	14	21	17	The last two sentences in this para are very hard to understand; it sounds like the choice of metrics affects the physical world. Suggest to delete these sentences and use instead policy-relevant and easy-to-understand text from the TS (TS-66 line 11-14): Over 10- to 20-year time scales, the temperature response to a single year's worth of current emissions of SLCFs is at least as large as that of CO2, but because the effect of SLCFs decays rapidly over the first few decades after emission, the net long-term temperature response to a single year's worth of emissions is predominantly determined by cumulative CO2 emissions. [Government of Denmark, Danish Meteorological Institute]
3401	21	14	21	17	There is no confidence statement. [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
6257	21	14	21	17	The 2nd part of H.S.13.7 will be confusing for policymakers, who are in general not familiar with the scientific differences and effects of different metrics. Please reformulate or delete. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
4769	21	14	21	17	Non-specialist readers will find it very difficult to understand these 2 sentences, which say that whether a given scenario of emissions warms or not depends on how you calculate the warming. Even the educated but non-expert reader will recognise that this can't be right, it depends on the laws of physics! Suggest this paragraph is either explained much more clearly, or omitted, on the grounds that the ideas are complicated and not particularly relevant to the messages which should be in the SPM. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
5033	21	14	21	17	These sentences give the impression that the choice of metrics influences how global temperature evolves. We believe that it is opposite, ref title and sub-titles of Figure SPM.4 a) and b. That future emissions determine future warming, and that CO2 and non-CO2 are key determining factors. In our view, it is merely when the individual emissions are aggregated to a total, that the total amount will be influenced by the choice of metric. [Government of Norway, Norwegian Environment Agency]
5035	21	14	21	17	We would suggest that the discussion related to peak and decline in global surface temperatures is taken out of this para. We believe that according to Table SPM.1 the only scenario that experiences a peak and decline within this century is SSP1-1.9. The other scenarios do not have a peak in this century according to table SPM.1. Therefore for us, it seems that choice of emission scenario is more relevant for peak and decline than choice of metric, at least within this century. We believe that the way especially peak and decline is expressed here, connected to choice of metrics, is on a very theoretical level, and potentially can create more confusion than enlightment for policymakers. [Government of Norway, Norwegian Environment Agency]
6351	21	14	21	17	This is confusing. GHG metrics do not achieve emission reductions. Please revise these sentences. [Government of Estonia, Estonian Meteorological & Hydrological Institute]
6911	21	14	21	17	The finding on GWP-100 is interesting but difficult to understand. It is stated more clearly in Ch7.6.2 ("net zero GHG emissions as quantified by GWP-100 typically leads to reductions from peak global surface temperature after net zero GHGs emissions are achieved, depending on the relative sequencing of mitigation of short-lived and long-lived species"). But even here the rationale for the peak-and-decline finding is not explained. Ideally this should be explained in the SPM, but even the underlying chapter has so little detail. It would be best to have a 'trickle-back' to expand the 7.6.2 explanation. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
8313	21	15	21	15	As written, this implies that net zero emissions is sustained "over a 100-year period", which is incorrect. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]

Comment ID	From Page	From Line	To Page	To Line	Comment
6913	21	16	21	17	The last sentence is overly vague and confusing. The presented outcome presumably refers not to "new metric approaches" in general, but one specific approach. If the reference is retained, it would seem appropriate to mention the approach in question, or at least indicate that it is a specific proposal. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
5143	21	16	21	17	What are these "new metric approaches" ? This is too vague to be useful. The GWP* would be impractical for policymaking, and it suggests that no metric solely based on the emissions in a given year would ensure temperature stabilisation. Achieving stable temperature is a complex topic and one might argue that from a practical viewpoint, it needs separate targets for short / medium / long -lived forcings. This discussion might perhaps benefit from being deferred to the WGIII SPM. [Government of Belgium, Belgian Science Policy Office - Belspo]
4169	21	16	21	17	"New metric approach" sounds too enigmatic and ambiguous. Adding a very short description of the new method would be reader-friendly. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
8315	21	16	21	17	This is cryptic and warrant clarification, the implications of a metric choice for a shared policy objective e.g. balance of emissions and removals, should be clear. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
9375	21	16	21	17	What are "new metric approaches"? [Government of United States of America, U.S. Department of State]
2917	21	17	21	17	which are the new metric approaches? briefly name them [Government of Chile, Ministry of Environment]
9377	21	17	21	17	Define the "new metric" (is it GWP*?). [Government of United States of America, U.S. Department of State]
3029	21	17	21	17	Specific examples of new metric approaches different from GWP-100 are needed. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
6375	21	17	21	17	Please, replace "new metric approaches" by "other emission metrics". [Government of Brazil, Ministry of Foreign Affairs]
7799	21	19	21	19	„core set” is defined in the Box SPM1. A reference to it could be helpful here. [Government of Poland, Ministry of Environment, Department of Air Protection and Climate]
9379	21	19	21	19	It would be useful to make very explicit that the IPCC definiton of net-zero does not include all human forcings of climate change. [Government of United States of America, U.S. Department of State]
2551	21	19	21	19	Could you clarify the core set used here ? The 5 SSPs considered in the SPM? They don't all achieve net zero CO2 emissions. [Government of France, Ministère de la Transition écologique et solidaire]
6915	21	19	21	20	Amend the sentence as follows: "net zero CO2 emissions *are assumed* to be accompanied by reductions…". It is important to clarify that this is an assumption on how anthropogenic emissions (e.g. policy-driven) behave in such a scenario, not a purely physical science projection. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
3403	21	19	21	22	There is no confidence statement. [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
1681	21	19	21	22	We welcome that the role of the non-CO2 forcers is evaluated and presented in the SPM text as well as Figure SPM.4. Would it be possible to present an indication in the text of how much the maximum mitigation potential of non-CO2 and aerosols could be, i.e. in %, compared with their total temperature effect presented in SPM.4. [Government of Finland, Finnish Meteorological Institute (FMI)]
9381	21	19	21	22	H.S.13.9 captures this sentiment better, such that perhaps H.S.13.8 could be cut. [Government of United States of America, U.S. Department of State]

Comment ID	From Page	From Line	To Page	To Line	Comment
4775	21	19	21	22	Please could the authors add a separate and specific statement on the contribution of methane to temperature in net zero pathways and the direct impact of methane emissions reductions (in addition to their contribution to countering the warming from other SLCFs)? This is of significant interest to policymakers. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
8379	21	19	21	22	We suggest to delete H.S.13.8 as not giving any new information. Or at least the last sentence to merge with H.S.13.9 [Government of Ukraine, Director Ukrainian Hydrometeorological Institute]
6917	21	19	21	30	The logic of these paragraphs is difficult to grasp, since it relies on the basket of positive and negative forcers changing in the precise combinations foreseen in the scenarios - which are the result of assumed evolutions of human emissions, not natural phenomena. The paragraph would be improved by: 1) adding the warming estimates from Box TS.7 (e.g. over 0.4°C in no mitigation scenarios, compared to under 0.3°C in stringent scenarios). 2) pointing out that these scenarios' suggested correlation of methane & aerosol should not be taken for granted. i.e. whatever the scenario, higher warming could happen if there was ambitious action taken on aerosols but not on methane. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6259	21	19	21	30	Paragraph 13.8. states that reductions of aerosol emissions lead to warming (i.e. implies a cooling effect of aerosols in general), whereas in paragraph 13.9 a "warming due to methane, aerosol and ozone" is mentioned. Please state clearly in which cases "aerosols" refer to "black carbon" (warming) and in which cases to cooling aerosols. Better defining the "changes in methane, aerosol and ozone precursors" in line 24 (e.g. by indicating a direction of change) would help clarifying this further. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
4471	21	20	21	20	Where does soot fit in here (is the net impact of reductions of soot and aerosol precursor gases one of warming?)? [Government of Sweden, Swedish Meteorological and Hydrological Institute]
5037	21	20	21	20	This sentence, and especially the ", respectively." in conjunction with the end of the former sentence, listing aerosols and non-CO2 greenhouse gases, makes it unclear if both aerosols and non-CO2 are warming or cooling. [Government of Norway, Norwegian Environment Agency]
4771	21	20	21	22	I wonder whether the sentence "Their net effect on future global surface temperature is thus determined by their respective contributions, driven by levels of air pollution control and climate change mitigation." would be clearer as "Their net effect on future global surface temperature is thus determined by their relative contributions, driven by the timing and effectiveness of actions to control air pollution and greenhouse gas emissions." [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
8623	21	20	21	22	Suggest clarification: This text may be read as saying the contributions of GHGs are *driven* by levels of air pollution control. Whereas GHG emissions can occur independently of, or despite air pollution controls (e.g. SO2 scrubbers on coal fired power plants; NOx controls on vehicles). [Government of Australia, Department of Industry, Science, Energy and Resources]
4551	21	24	21	24	Given the prevalence and importance in policy discussions of BC (warming) and SO2 and OC (cooling), it would be useful to explicitly mention also about the significance of BC, SO2 and OC (this would be in line with the fig SPM.2), given their different forcing characteristics, sources and related challenges. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
6919	21	24	21	25	This sentence can be confusing as it may suggest that these three forcers alone will lead to a net warming regardless of other factors. Suggest replacing "net global surface warming" with "combined net increase in climate forcing due to these factors". [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6261	21	24	21	25	_SLCF: Please provide information on how the timing of the mitigation of short-lived climate forcers (especially methane) can influence the temperature peak, see Ch 6, e.g. 6.6.3.3. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]

Comment ID	From Page	From Line	To Page	To Line	Comment
387	21	24	21	25	The influence of short-lived greenhouse gases like methane and long-lived greenhouse gases like CO2 on the temperature peak as well as the dominance of CO2 for the stabilization of temperature could be highlighted here as is done in section 6.6. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
3031	21	24	21	25	Warming or cooling depends on the direction(positive or negative) of simulatneous change. Some change may cause net global cooling, but all the changes are represnted as causing net global warming. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
2553	21	24	21	25	Could you clarify if "changes" always mean decrease in this sentence? If yes, using "decrease" would be clearer. Also, could you clarify if there is a contradiction between this sentence and the rest of this paragraphe? If not maybe explain what is the near term and the dynamic in temperature decreases and increases between the near term, middle term and 2100. [Government of France, Ministère de la Transition écologique et solidaire]
8317	21	24	21	28	The text is unclear and confusing, not all aerosols are cooling, e.g. black carbon, and aerosol cloud effects can also be warming. This confusion is implicit in Figure SPM2 and should be avoided here and through out the WGI SPM and report. Please correct. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
6921	21	24	21	30	More could be said about the other GHG, besides CO2. Methane releases as part of thawing; methane from the deep ocean. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
8319	21	24	21	30	The focus on methane and air pollution is welcome but a similar focus on fossil fuel combustion for PM, NOx etc which also impacts on human health and ecosystems should be included here for balance. Similarly, excessive use of Nitrogen fertilizer has major pollutant impacts, hence a focus on N2O is also warranted. The SPM should not give the impression that addressing climate change and wider challenges is limited to addressing CO2 and methane [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
4773	21	24	21	30	I may be reading this incorrectly but doesn't this assume that all non CO2 emissions would be reduced as a basket? Is it possible for CH4 emissions to remain high, for example, whilst reducing aerosols and those that have a negative forcing effect, resulting in a higher warming than all being brought down at the same rate? [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
4777	21	24	21	30	H.S.13.9 is unclear and we request that the authors re-write the paragraph to bring out the important messages. Specifically on the lack of clarity, the first sentence discusses simultaneous changes in methane, aerosol and ozone precursor emissions, however does not mention the direction of change, which makes the sentence quite confusing. The 2nd and third sentences seem to repeat the same information in different ways but still without mentioning the direction of change in some cases, then noting them in others. Suggestion for redrafting 'Reduction in aerosols, as a result of air pollution control, leads to net global surface warming in the near term and by 2100, even when combined with stringent methane emission reductions. Methane reductions not only counteract warming from aerosol reduction, but also reduce global surface ozone, thus contributing to improved air quality.' [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
4269	21	24	21	30	Short examples of effective, small- or large scale air pollution control should be given [Government of Indonesia, Ministry of Environment and Forestry Indonesia]
2919	21	25	21	25	what is the near term? name it explicitly [Government of Chile, Ministry of Environment]
9383	21	25	21	25	"control" should be plural. [Government of United States of America, U.S. Department of State]
6923	21	25	21	28	Make the sentence easier to read as follows. "This net warming [the fact that it comes from methane, aerosols etc. is already explained in the previous sentence] can be limited by air pollution control, combined with stringent methane emission reductions as considered in the scenarios reaching net zero CO2 emissions". [Philippe Tulkens, European Union (EU) - DG Research & Innovation]

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6925	21	25	21	28	It is unlear what "can limit" means: does it imply a reduction in the combined forcing, or just a limited increase? Please clarify. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
2555	21	25	21	29	Whereas the overall warming effect of reducing aerosol dominates when looking backwards, it seems inaccurate to assume it will still hold in the forward look. With a large part of sulfate reductions being behind us in 2020, a large fraction of remaining aerosols have a warming effect as clearly showed by the top left panel of Fig 6.22 in Chap 6 of the FGD. Furthermore, the reference to SSPs reaching net zero CO2 emissions, it should be clarified that SSP1-1.9 and SSP1-2.6 cross the zero line and then have negative CO2 emissions. [Government of France, Ministère de la Transition écologique et solidaire]
6927	21	26	21	26	When speaking about reducing methane emissions, clarify whether this include the methane emissions from melting permafrost? [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
7801	21	27	21	28	„warming due to (…) aerosol (...)" and „warming due to aerosol reduction" sounds confusing [Government of Poland, Ministry of Environment, Department of Air Protection and Climate]
6411	21	28	21	30	We welcome the emphasis on the need to also reduce CH4 and would like to see quantitative information on the potential of avoided warming with reduced CH4. [Government of Saint Lucia, Department of Sustainable Development - Ministry of Education, Innovation, Gender Relations and Sustainable Developement]
7301	21	28	21	30	This is a very important finding as it clearly illustrates the importance of not only reducing CO2 but also CH4. Could the authors provide quantitaitve indformation and specify how much warming could be avoided by reductions in methane? [Government of Saint Kitts and Nevis, Department of Environment - Ministry of Agriculture, Marine Resources, Cooperatives, Environment and Human Settlements]
5039	21	28	21	30	Please add that reduced methane emissions not only improve AQ and benefit health due to lower ozone levels, but also give several other co-benefits, notably reduced food loss and higher food security. Also other ecosystem services will be affected by lower levels of troposheric ozone. You might argue that WGI does not assess effects in detail, but as these additional co-benefits are established facts we think that it would be useful to mention them in line with other benefits. [Government of Norway, Norwegian Environment Agency]
7167	21	28	21	30	Please include quantitative information on avoided warming through the reduction of CH4. [Government of Samoa, Ministry of Foreign Affairs and Trade]
4271	21	28	21	32	Short examples of effective, small- or large scale Carbon dioxide removal (CDR) techniques should be given. [Government of Indonesia, Ministry of Environment and Forestry Indonesia]
6929	21	29	21	29	Is 'by 2100' needed here? [Philippe Tulkens, European Union (EU) - DG Research & Innovation]

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7903	21	31	21	31	SRM is not mentioned in the SPM. This is a step back from the previous version of the SPM or AR5. This risks leaving a gap where clear and policy-relevant statements would be required. It should be noted that there is an extensive box in the TS (TS.8) that should help to introducing relevant information on SRM in this SPM. Incidentally, in that box' lead text in the orange frame, the following sentence should be included: "Overall, SRM bears the risk of constituting additional dangerous anthropogenic interference with the climate system, and would therefore be in direct conflict with Article 2 of the UN Framework Convention on Climate Change." Such a stentence would be very well placed in the SPM as well. It is within the responsibility and the duty of IPCC WGI to use clear language in the emerging and intensifying discussion of climate intervention. A clear statement of general caution vis a vis SRM is needed; the termination problem and unintended side effects must be explicitly stated in this high-level document. Please refer to the last bullet in AR5 WGI SPM as an example. Surely, 8 years past, AR6 could go much further on this issue. [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
8625	21	33	21	48	Suggest adding horizontal dashed lines at 1.5C and 2C of warming, linked to vertical lines from the SSPs in Figure SPM 10. This would show readers visually what the respective emissions budgets are for the 1.5 and 2C warming thresholds. [Government of Australia, Department of Industry, Science, Energy and Resources]
4473	21	41	21	42	The "Cumulative carbon emissions are also shown as a link to Figure SPM.7." could be deleted, for brevity. It would not seem to be needed. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
4171	21	41	21	44	The original emissions scenarios should be clarified in connection with Figure SPM.7, in which the cumulative CO2 emissions are calculated from the residual of the land and ocean sinks and prescribed concentration changes in the CMIP6 simulations, and land-use emissions taken from the IIASA database. We are confused about what is original. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
4475	21	45	21	45	It could be useful to explicitly note here that the period that is considered is until 2050 (and not 2100 or suchlike). [Government of Sweden, Swedish Meteorological and Hydrological Institute]
7905	22	1	14	3	HS.14: make more it compelling by linking to the Paris Agreement. E.g: "Stringent reductions of CO2 and non-CO2 emissions are required to limit warming and fulfill the Paris Agreement. This will lead to discernible effects on atmospheric composition and air quality within years." The last sentence of this HS is not needed, rather add something on the long-term comittment beyond 2050. This time horizon is ignored here and more importantly in Figure SPM.10. [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
5041	22	1	22	1	Please consider replacing "discernible" with a more common word such as "noticeable" or "significant", if suitable. [Government of Norway, Norwegian Environment Agency]
7169	22	1	22	3	We have concerns about this statement as it appears to suggest that stringent reductions in emissions only have effects on temperature in several decades (instead of much sooner). Kindly reword this statement carefully. [Government of Samoa, Ministry of Foreign Affairs and Trade]
6413	22	1	22	3	This H.S. should be revised, as the second sentence could be misunderstood in the sense that emission reductions would only much later show effect – which is not the case. [Government of Saint Lucia, Department of Sustainable Development - Ministry of Education, Innovation, Gender Relations and Sustainable Developement]
2831	22	1	22	3	The second sentence could be misread as indicating that the effect of emission reductions would only be felt in a very long time from now. This is not true, as for example clearly stated in the first sentence of H.S.14.3 or the headline statement of Figure SPM.10. Please reword carefully! [Government of Jamaica, Meteorological Service Division]
3405	22	1	22	3	There is no confidence statement. [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]

Comment ID	From Page	From Line	To Page	To Line	Comment
6263	22	1	22	3	H.S.14.: Important information on the expected changes after stringent reductions of emissions, since the (political and social) expectations should be realistic. The statement on the late emergence of the effects of strong mitigation in HS.14 is misleading because HS.14.3 states that immediate and sustained effects are indeed happening, only they are not easily detectable. Highlighting the scientific challenge of detecting mitigation effects since they are masked by large natural variability (small signal/noise ratio) is not useful for policy makers. For them it is much more important to know that strong mitigation alleviates climate change on no matter what time scale. Please replace the second sentence in HS.14 by the first sentence in HS.14.3. In addition, please add "improvements of" before "air quality". [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
7031	22	1	22	3	This statement is potentially misunderstanding as it seems to suggest that the effect of stringent emission reductions on e.g. temperature will only emerge in a few decades. This however is not the case, as the literature shows. Kindly revise this statement to reflect this. See also related comment on H.S.14.3. [Government of Fiji, Fiji Meteorological Services]
389	22	1	22	3	This headline statement is important as was evident from drops of emissions due to COVID-19 pandemic, and the expectation that this would have an immediate effect on atmospheric concentrations and/or temperature. The last sentence is however difficult to understand for policy makers and the first sentence of H.S.14.3 seems to convey the message in a clearer way: "Stringent emission reductions have immediate and sustained effects on human-caused climate change, even if early responses can be masked by natural variability." We suggest replacing it. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
7303	22	1	22	3	Please reword this headline statement carefully as it can be easily misunderstood in the context of the emergence of avoided climate change due to emissions reductions, in particular. While the first sentence is in line with the important headline statement of Figure SPM.10, for example, the second sentence could be misread as indicating that the effect of changes in emission would only trigger a very delayed climate response. This is not the case. [Government of Saint Kitts and Nevis, Department of Environment - Ministry of Agriculture, Marine Resources, Cooperatives, Environment and Human Settlements]
4779	22	1	22	3	Could the authors please consider adding the word improved (i.e. '...and *improved* air quality within years...') as 'discernible effects' is ambiguous about whether the impacts are negative or positive. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
4781	22	1	22	3	Could you please provide information on the reduction of methane as warming reaches 1.5C or other temperature levels in the HS14 section somewhere? [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
127	22	1	22	4	Sometimes, policy prescriptive language is used in this SPM. For example, ‘stringent reductions’ of CO2 emissions are mentioned in HS.14. We would consider ‘drastic reductions’ as more appropriate. Some editorial efforts are still needed to avoid policy prescriptive language and tone throughout the text. [Government of Russian Federation, Institute of Global Climate and Ecology]
4173	22	1	22	35	Very good summary. Readers may understand the messages easily. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
9385	22	1	22	35	Clearly define "stringent" emission reductions in this section, as the term is used frequently; what does it mean in this context? More reductions than in projections of current policies? Is there an RCP-SSP combination or combinations that it represents? Perhaps a footnote is needed. [Government of United States of America, U.S. Department of State]
6931	22	1			Talking about "CO2 and non-CO2" is somewhat redundant. Maybe: "Stringent reduction of anthropogenic emissions …" [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6933	22	1			Please replace "non-CO2 emissions" with something more specific, like "non-CO2 GHG emissions", or "non-CO2 climate forcers". The current formulation is too vague. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
7665	22	2	22	2	Remove from line 2 "and air quality". Explanation: Leads to critically confusing emissions, GHGs and pollution and especially in the context of statements in HS 14.2 posing it in this form is unnecessary. [Government of India, Ministry of Environment, Forests and Climate Change]

Comment ID	From Page	From Line	To Page	To Line	Comment
2557	22	2	22	3	Concerning the last sentence of this H.S we strongly suggest to add the following clarifications : mitigation efforts will have a direct effect on the atmosphere but, the global climate response will only be visible after a decade or more and also to clarify that global warming stops when net zero is reached. This is to avoid confusion about mitigation efforts. Elements of SR 1.5 can be taken up to reformulate. Emphasise that strict policy implementation will have an effect on the rate of warming and significant benefits for adaptation and ecosystems. Proposal to add these clarifications here and in HS.14.3 [Government of France, Ministère de la Transition écologique et solidaire]
7667	22	3	22	3	Add the following sentence in HS 14 "Air quality improvements driven by rapid decarbonization, as in SSP1-2.6, are not sufficient in the near term to achieve air quality guidelines and existing technologies lead to air quality benefits more rapidly than climate mitigation". [Government of India, Ministry of Environment, Forests and Climate Change]
4177	22	7	22	8	As this sentence refers to "net" radiative forcing, it seems better to mention not only positive changes but also negative ones, by quoting such as " positive forcing from aerosol changes dominates over negative forcing from CO2, Nox etc.", as mentioned in Chapter 6. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
6487	22	7	22	8	Is there a confidence statement? [Government of Austria, Federal Ministry of Agriculture, Forestry]
4477	22	7	22	8	This sounds somewhat strange. The GHG emissions were still large, and conceivably increased the net radiative forcing. Would something like the following clarify: "Temporary emission reductions in 2020 associated with COVID-19 containment did not decrease the net radiative forcing. This was due to both the continued greenhouse gas emissions, and reductions in human-caused aerosols. The latter had also discernible but temporary effects on atmospheric composition and air pollution". [Government of Sweden, Swedish Meteorological and Hydrological Institute]
4175	22	7	22	11	We suggest adding the information of Chapter 6, page 75, line 9-11 which is critical for the topic of COVID-19. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
9387	22	7	22	11	The aerosol changes due to the reduction in activity associated with COVID-19 would have led to an increase in forcing in the near term; but, presumably if the forcing changes resulting from changes in 2020 emissions were integrated over a longer time period, the CO2 reductions would lead to a long-term decrease in forcing. (Note, though, that any decreases in CO2 emissions due to COVID-19 are not reflected as significant in the global record of atmospheric CO2.) See also TS-67, lines 26-28, for the same issue in more detail. [Government of United States of America, U.S. Department of State]
5043	22	7	22	11	Please include some qualifying language that explain clearly why it is expected that the reductions similar to those due to Covid-19 will be temporary. Perhaps it would be better to explain that reductions are due to exceptionally low activity in general, and also please consider including the magnitude of reduction both with respect to aerosols (cooling) and GHG (warming), if possible. [Government of Norway, Norwegian Environment Agency]
9389	22	8	22	8	Change "discernible" to "measured". [Government of United States of America, U.S. Department of State]
5045	22	8	22	8	Please concider explaining the difference between "human-caused forcings/aerosols" and "anthropogenic aerosol forcings", and if possible, use one term only. See also page 7, lines 8 and 9, where it says "anthropogenic aerosols", and page 16, lines 7 and 39 where it says "human-caused forcings" and "anthropogenic aerosol forcings". [Government of Norway, Norwegian Environment Agency]
9391	22	9	22	9	Add "reductions" after "air pollution". [Government of United States of America, U.S. Department of State]
9393	22	9	22	9	Not all regional climate responses (e.g., in temperature and precipitation) are weaker than internal variability, depending on how the "region" is defined and at what time scales. There are many ongoing studies that are investigating regional climate responses. Suggest removing "regional" here. [Government of United States of America, U.S. Department of State]

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2559	22	9	22	9	Concerning the atmospheric composition, please add that there is no discernible effect on atmospheric CO2. [Government of France, Ministère de la Transition écologique et solidaire]
6935	22	9	22	11	It needs to be clarified which atmospheric composition changes where discernable, to our understanding e.g. it was not possible to evaluate a signal in CO2 levels. I guess it is mostly about N2O and aerosols, whereas ozone is more difficult from limited observational evidence. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
9395	22	10	22	10	Suggest "this temporary forcing" [Government of United States of America, U.S. Department of State]
6265	22	13	22	14	Future changes in global air quality will also include NO2 (nitrogen dioxide), which should be added in the brackets (surface ozone, particulate matter and nitrogen dioxide). [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
391	22	13	22	14	Please ass nitrogen dioxide to the list of pollutants that are affected. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
9397	22	13	22	14	Does this statement consider the impact of wildfires and dust storms on "emissions changes" which are highly relevant to climate change? [Government of United States of America, U.S. Department of State]
9399	22	13	22	14	Currently human emissions of air pollutants are the largest determinant of air quality. Is this statement responding to the implied possibility that, all else equal, increased temperatures would increase ground-level ozone concentrations? If so, this premise should be explained. To a non-expert unaware of the effect of temperature on ground-level ozone formation, the SPM statement seems obvious and could therefore be confusing. Moreover this is a fairly specific matter that is not of the general nature of the SPM. [Government of United States of America, U.S. Department of State]
6937	22	13	22	20	The reference to air quality is pertinent, but also seems unbalanced. It is unclear why air quality guidelines and WHO are mentioned along with some other SDGs, but not other global objectives and international bodies, such as interactions with biodiversity objectives and the CBD. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
4479	22	13	22	20	This would seem less to do with climate change and more with air quality. Consider deletion of revision to inform on the climate change science aspects. Some of the content would seem to fit better in WGIII (or WGII) than WGI. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
1683	22	13	22	20	H.S.14.2 presents a good summary of the role of air pollution in climate context. However, the sentence "Air quality improvements driven by rapid decarbonization, as in SSP1-1.9 and SSP1-2.6, are not sufficient in the near term to achieve air quality guidelines set by the World Health Organization in some highly polluted regions (high confidence)." would read more clearly with slightly different order, i.e. the authors could consider: "Rapid decarbonization, as in SSP1-1.9 and SSP1-2.6, are not sufficient in the near term to drive air quality improvements or achieve air quality guidelines set by the World Health Organization in some highly polluted regions (high confidence).". Also suggest a small addition: "Further implementation of air pollution controls, relying on existing technologies, leads to air quality benefits more rapidly than climate mitigation policy." [Government of Finland, Finnish Meteorological Institute (FMI)]
9401	22	13	22	20	Emphasize the near-term health benefits of reductions in surface ozone and particulate matter. These co-benefits often translate to significant reduction in morbidity and mortality related to local/regional air quality. [Government of United States of America, U.S. Department of State]

Comment ID	From Page	From Line	To Page	To Line	Comment
9403	22	13	22	20	Reading the underlying Chapter 6 (page 58, lines 16-23), there seems to be some consensus that climate change will lead to increases in ozone pollution in ozone-producing regions (e.g., where people actually live): "While warming is likely to lead to increases in ozone pollution in ozone-producing regions, future changes in global air quality will be mainly driven by precursor emissions changes rather than climate change." Consider elevating that statement. Climate-related ozone changes can lead to consequential changes in mortality (e.g., 1400 to 2700 deaths per degree warming in the US depending on precursor emission scenario -- from Fann et al doi:10.1001/jamanetworkopen.2020.32064). See also TS-36, lines 28-29. [Government of United States of America, U.S. Department of State]
6267	22	14	22	16	To achieve air quality meeting the WHO guideline values in most regions of the world, rapid decarbonization will not be sufficient (and not only in some highly polluted regions). For example a recent publication cited in Ch 6 (6-72:2), Amann et al. (2020) „Reducing global air pollution: the scope for further policy interventions“ shows that a reduction of PM2.5 pollution below the recommended value by the WHO in large areas of the world until 2040 is possible with a scenario not only including energy and climate policies but also agricultural policies and food policies. Therefore, the statement should not only refer to „some highly polluted regions“ but to „polluted regions“. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
5215	22	15	22	15	We request to change the word "decarbonization" since it has no multilaterally agreed definition. A possibility could be: "decline of greenhouse gas emissions". [Government of Argentina, Ministry of Environment and Sustainable development of Argentina]
6269	22	16	22	16	Please replace "guidelines" by "meeting guideline values". [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
6271	22	17	22	18	"Implementation of air pollution controls, relying on existing technologies, leads to air quality benefits more rapidly than climate mitigation policy." From our point of view, this statement is not fully true for highly industrialized countries in general. Inn the case of Germany, most sectors use advanced technologies to reduce emissions of air pollutants already, a rapid improvement of air quality will arise from reduction of activities emitting air pollutants which is achieved mostly by climate mitigation policies like the coal phase-out. Hence, the statement should refer only to regions where existing technologies are only sparsely implemented. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
9405	22	17	22	18	Simplify to: "improves air quality more rapidly than climate mitigation." Mitigation is a policy? [Government of United States of America, U.S. Department of State]
3407	22	17	22	20	There is no confidence statement. [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
5047	22	18	22	20	Please consider to add som language that links this with the SDGs, especially since it relates to food security because reduced near-surface ozone levels will increase food production. [Government of Norway, Norwegian Environment Agency]
9407	22	18	22	20	While the preceding sentences helpfully contrast the climate benefits of air pollution policies and vice versa, the last sentence does not seem to relate to climate change. [Government of United States of America, U.S. Department of State]
5217	22	19	22	19	We request to change the word "clean" for "sustainable" which has been agreed multilaterally. [Government of Argentina, Ministry of Environment and Sustainable development of Argentina]
9409	22	22	22	22	Define "stringent emission reductions". [Government of United States of America, U.S. Department of State]

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2561	22	22	22	23	We feel the actual formulation shows a contradiction in this sentence: an immediate effect but masked by natural variability? Also the next sentence says effect would emerge around 2040. . May be rewrite as: Stringent and sustained emission reductions will have effects on human-caused climate change, although early responses can be masked by natural variability [Government of France, Ministère de la Transition écologique et solidaire]
8323	22	22	22	23	The use of the word "stringent" is not very useful. Please quantify what is needed. See comment on zero fossil methane emissions for example. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8627	22	22	22	23	Suggest rephrasing for accuracy: This is written in present tense but refers to possible future events in SSPs, not present changes. Suggest: "Stringent emissions reductions *would* have immediate and sustained effects…" [Government of Australia, Department of Industry, Science, Energy and Resources]
6939	22	22	22	25	The potential effect on mid-term temperature should be illustrated. For example, by pointing out that as per Box TS1, Table 1, up to 0.5°C warming could be avoided by following the pathway 1.9 compared to 7.0 (or 0.9 if compared to 8.5). [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
3409	22	22	22	28	In this paragaph the terms "natural variability" and "internal variability" are used, it would be useful to have an explanation of why these two different terms are used in the same context. [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
7171	22	22	22	29	There are issues with this paragraph, as it appears to argue that emission reductions will only later in the 21st show effect in the climate response. However, as the literature and Figure SPM.10 shows, stringent emission reductions will in fact show effects much sooner. Kindly revise these statements accordingly. [Government of Samoa, Ministry of Foreign Affairs and Trade]
6415	22	22	22	29	We suggest this paragraph to be revised. In its current form, it is misunderstanding and potentially incorrect: As the literature suggests, emission reductions today do in fact have nearer-term effects on the climate and do not, as this paragraph seems to suggest, show effect only later in the 21st century. [Government of Saint Lucia, Department of Sustainable Development - Ministry of Education, Innovation, Gender Relations and Sustainable Developement]
2833	22	22	22	29	The last sentence in this paragraph seems to be scientifically wrong. How is it, even accounting for natural variability, that the climate response to emission changes only materialises "later in the 21st century"? The authors cannot base this kind of assessment on when the average projected response emerges from the full uncertainty range. This would misrepresent the sensitivity of the climate system to changes in emissions as also presented in many parts of AR6. [Government of Jamaica, Meteorological Service Division]
7777	22	22	22	29	Why SPM.7 figure is a reference here next to SPM.8? It is about carbon budgets. Please remove it. [Government of Hungary, Ministry of Innovation and Technology - Climate Policy Department]
7033	22	22	22	29	Similar to H.S.14, this paragraph is problematic as it seems to argue that stringent emission reductions would have an effect on global temperature only in a few decades and on e.g. regional temperature only later in the century – which appears to not be correct according to the literature. Thus, it is strongly suggested that this paragraph is reworded so as not to send a potentially misleading message on necessary mitigation action. [Government of Fiji, Fiji Meteorological Services]

Comment ID	From Page	From Line	To Page	To Line	Comment
7305	22	22	22	29	Please revise this paragraph as it contains apparent contraditions and confusing statements if not mistakes. Stringent emission reductions have an immediate effect on human-caused climate change, as also highlighted by Figure SPM.10. The following sentence, however, is confusing and unclear in this regard. Most importantly, the last sentence appears to be scientifically wrong. The climate response (e.g. regional temperature change which is oftentimes more extreme over land areas compared to global mean) to changes in emissions only emerges later in the 21st century? This cannot be right as there is ample literature pointing to clear climate effects of strong mitigation efforts a lot earlier than mid-century, for example. [Government of Saint Kitts and Nevis, Department of Environment - Ministry of Agriculture, Marine Resources, Cooperatives, Environment and Human Settlements]
6941	22	22			Insert "greenhouse gas" to read "Stringent greenhouse gas emission reductions". [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6461	22	23	22	23	It is suggested to insert „now“ after „If stringent mitigation is implemented“. The sentence would then read: If stringent mitigation is implemented now, … [Government of Austria, Federal Ministry of Agriculture, Forestry]
5049	22	23	22	25	It is somewhat challenging to understand what you are trying to convey in this sentence. We believe we understand you point, but since the language currently is so connected to the different scenarios we think there is a chance that the message might be lost for the general policymaker. Please consider re-writing without using SSPx-YY, we believe in other parts of the SPM the diffent scenarios has been grouped together with more descriptive language (low, intermediate and high emission scenarios). [Government of Norway, Norwegian Environment Agency]
2761	22	23	22	25	Unclear text. Is something missing here? The concept of emergence is understood to be about detecting a signal of change outside the 'noise' of natural climate variability. Why is the time of emergence of a global temperature signal in scenarios SSP1-1.9 and SSP1-2.6 compared here to warming from emissions following higher emission scenarios? Is there missing text about the timing of emergence of a temperature signal from these other scenarios? Unclear what is being compared here. [Government of Canada, Environment and Climate Change Canada]
5051	22	24	22	24	Please consider replacing 'would' with 'will'. [Government of Norway, Norwegian Environment Agency]
2921	22	27	22	27	what is the near term? name it explicitly [Government of Chile, Ministry of Environment]
4783	22	27	22	28	I find it surprising that there are high confidence statements attached to the claim that benefits for these climate variables will only be felt later in the century. This is contradicted by at least some literature I think - https://www.nature.com/articles/nclimate3259 https://link.springer.com/article/10.1007/s00382-018-4073-y [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
6273	22	27	22	29	We kindly request the authors to be more specific about the mitigations benefits in the second part of the 21st century. The last sentence of the paragraph reads, as if it is not clear that mitigation benefits will happen, since it is only about the timing. There are many mitigation benefits comparing the low with the high emission scenarios that will occur in the second half of the century. We ask the authors to include a list of mitigation benefits beyond temperature and precipitation here. Some examples could be - AMOC: as found in 9.2.3.1 (9-33:3-4): after 2060 "low emission scenarios show stabilization, while high-emission scenarios continue to exhibit AMOC decline" - SLR: difference in GMSL for different emission scenarios as shown in SPM.8 emerging around 2050 - Surface Ocean pH: significant differences between emission scenarios emerging already before 2050 - Sea Ice loss in the arctic will be much more pronounced under high-emission scenarios as found in Ch 9 (9-6:37-39): "The practically ice-free state is projected to occur more often with higher greenhouse gas concentrations and will become the new normal for high-emission scenarios by the end of this century (high confidence)." - health benefits due to less heat stress, improved air quality - Less land degradation, which is of great importance for global food security as we learned in the SRCCL - the need for CDR will be significantly reduced [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]

Comment ID	From Page	From Line	To Page	To Line	Comment
393	22	27	22	29	The last sentence of this paragraphs read as if there would be mitigation benefits only for temperature and perception, The SPM clearly shows that this is not the case. We would thus suggest reformulating as "The mitigation benefits for many climate variables emerge only later in the 21st century (high confidence)". [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
2563	22	28	22	28	could you be more precise on the dates of emergence of some quantities if supported by the chapters [Government of France, Ministère de la Transition écologique et solidaire]
6943	22	31	22	31	Not clear if this is only about emission reduction in SLCFs or the complete package of reductions included in scenarios. Suggest different wording for climate impact drivers (temparture and precipiation?), as drivers is here mostly about emissions and concentrations. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6945	22	31	22	31	Insert "short-term" to read "Stringent short-term emission reductions". Also please provide some examples. E.g. by how much can the frequency of extreme sea level events be avoided. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6275	22	31	22	31	Does "beyond 2040" mean "from now on until after 2040" or "after 2040"? Please explain why you refer to this specific year. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
8629	22	31	22	31	Suggest rephrasing for accuracy: This is written in present tense but refers to possible futures (2040) in SSPs, not present changes. Should be written: "Stringent emissions reductions *are projected to* …" [Government of Australia, Department of Industry, Science, Energy and Resources]
8325	22	31	22	32	The use of the word "stringent" is not very useful. Please quantify what is needed based on science and outcomes including in terms of concentration ranges. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
6947	22	31	22	35	Add reference to reducing the likelihood of low-probability, high-impact events. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6277	22	31	22	35	Please revise text. "Strongly" and drastically" are not quantified. Can this be expressed in IPCC-terminology (likelihood, certainty)? [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
6949	22	31			Insert "greenhouse gas" to read "Stringent greenhouse gas emission reductions". [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
4179	22	32	22	33	"drastically reduces..." --> It would be desirable to clearly state relative to what the frequency is reduced. I believe it is relative to high emission cases, but some readers may think it is relative to the present. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
2565	22	34	22	34	Concerning the term exceedances : Adding the reduction of compound floodings (as mentioned in the report) might be useful. [Government of France, Ministère de la Transition écologique et solidaire]
3033	22	36	22	36	"extreme sea level events" is more appropriate that " extreme sea level" with frequency. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
6951	22	37	22	37	Strange ending of report, with no "conclusions" or summary. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
2857	23	0	23	0	Figure SPM1. X-axis should be indicated in both panels (years CE). [Government of Chile, Ministry of Environment]
2873	23	0	23	0	"observed temperatures" within the legend of panel a should be highlighted. [Government of Chile, Ministry of Environment]
2875	23	0	23	0	"any sustained period": is it posssible to assert "any decade"? [Government of Chile, Ministry of Environment]

Comment ID	From Page	From Line	To Page	To Line	Comment
4181	23	0	23	0	In panel a, the inserted text touches upon surface temperature around 125,000 years ago, while there is a bar on the left showing temperature range of 6500 years ago, which is rather confusing. I think the inserted text should also mention temperature of 6500 years ago. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
6279	23	1	23	1	Figure SPM.1: Please explain the reasons for the 'estimated multi-century peak global surface temperature during the Holocene' and how it has been derived. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
6281	23	1	23	1	Please change text in panel a) of Figure SPM-1 to: "[...] temperatures HAVE REACHED levels last seen during the previous interglacial [...]" in order to exclude the misleading interpretation of "are reaching" as referring to future warming. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
4785	23	1	23	1	Figure SPM.1: the use of annual temperatures for the instrumental record and 10-year smoothed temperatures for the proxy in panel (a) could be problematic. Annual data have higher variance so the very recent past is warmer relative to what it would be in an apples-to-apples comparison. The label also specifically mentions the last decade with an arrow pointing at the 2016 peak. Please reconsider this combination of timescales and averaging on this figure. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
8631	23	1	23	1	Suggest making a thicker arrows in SPM1: going from the left 1850 to 2020, and the top arrow where text says "The last decade...". [Government of Australia, Department of Industry, Science, Energy and Resources]
8633	23	1	23	1	Suggest rephrasing for readability: The text in the caption a) “Changes in global surface temperature reconstructed from paleoclimate archives” is a better description to use in the figure than “10-year smoothed reconstructed temperature.” Same for b) text in the caption and figure. [Government of Australia, Department of Industry, Science, Energy and Resources]
8635	23	1	23	1	Suggest clarification: Text inset in this first figure of the SPM figure refers to 'current interglacial' and 'Holocene'. These are technical terms -- likely unclear to policymakers. Suggest add to caption the approximate time period in years: "current interglacial period (past ~10,000 years) prior to industrialization". [Government of Australia, Department of Industry, Science, Energy and Resources]
5053	23	1	23	1	SPM:1 panel a: Please consider including an additional bar along the y-axis to also illustrate temperatures during the previous interglacial (125.000 yrs ago) as a reference to the text in the figure. If possible it would also be good if you could shorten the text in the figure. Please also consider describing the mid-Holocene (6500 yrs ago) in para H.S.2.2. [Government of Norway, Norwegian Environment Agency]
9411	23	1	23	1	To be consistent with the opening sentence of the Figure SPM.1 caption, change the figure subtitle to "Changes in the global average surface temperature relative to 1850-1900". [Government of United States of America, U.S. Department of State]
9413	23	1	23	1	Delete arrow and associated statement "The last decade is more likely than not warmer than during any sustained period in the current interglacial; temperatures are reaching levels last seen during the previous interglacial, around 125,000 years ago." This is a weak statement and the confidence level does not rise to the SPM level. This reflects U.S. concerns about the mismatch of temporal and spatial scales and averaging when picking time periods to compare most recent global conditions previous multi-century periods. [Government of United States of America, U.S. Department of State]

Comment ID	From Page	From Line	To Page	To Line	Comment
7907	23	1	23	1	Fig. SPM.1: the inclusion of a longer time perspective for observed GST with the range for the Mid-Holocene is well appreciated. However, there is a problem of comparability with the temperature time series of the last 2 kyr. Without further explanation it is not clear why the last 2 kyr are systematically cooler by about 0.5°C than the mid-Holocene 6500 yars ago (note that in the TS "mid-Holocene" is referred to as 6000 year ago - check consistency across docs). The role of changing insolation over a quarter of a precession cycle cannot be ignored when going back 6 kyrs. Therefore, some more information must be provided in the caption, or at least a pointer to where the reason for the multi-millennial cooling since about 6500 years ago would be discussed and assessed. A natural place could be Cross-Section Box TS.1 where the warmer mid-Holocene temperature is noted, but currently no further insight is given there. I see two approaches: a) delete the mid-Holocene range bar in SPM Fig.1, or b) -- much preferred -- briefly mention the reason for the multi-millennial cooling and point to Cross-Section Box TS.1 or further assessment. [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
4787	23	1	38	1	Figures SPM.1, 8 and 10 plot global surface temperature changes since 1850-1900 and do not give any source for the observations. The data used should be clearly traceable to the main report and the source/combination of data sets used for these figures clearly defined there. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
5145	23		23		Figure SPM.1, panel (a). On the horizontal scale (x-axis), please add intermediate years (e.g. 500, 1500) to avoid giving the impression that the scale is logarithmic. [Government of Belgium, Belgian Science Policy Office - Belspo]
83	23		23		Please ensure that the choice of brown, green shades in Fig. SPM1 are conducive to readers who may be colour-vision deficient/colour-blind. [Government of Singapore, Ministry of Environment and Natural Resources]
395	23		23		Figure SPM1: The figure is understandable even for people who are not used working with such SPM graphs. On panel b, the authors make the difference between natural (solar and volcanic) as well as human and natural drivers, but wouldn’t it be possible to represent a climate model simulation of the temperature response to only human drivers? [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
6953	23				Fig SPM-1. If possible, panel a should distinguish between the 1850-1900 and 1901-2020 periods. This would aid transparency since the SPM's historical warming estimates are stated relative to 1850-1900. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6955	23				The meaning vertical bar on panel a) is quite confusing- please explore a more instructive graphic way of showing this. Indicate if the 90 th confidence interval also applies to this bar. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
3685	23				In Fig SPM.1b, it would be recommended to show the number of CMIP6 simulations for human+natural and only natural drivers for a better quantification of uncertainties [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
4183	24	0	24	0	The coverage of greenhouse gases for ozone are different between the two panels; greenhouse gases in panel a) excludes ozone while those in panel b) includes ozone precursors. For clarification, axis label 'Greenhouse gases' in panel a) should be replaced with 'Long-lived greenhouse gases' or 'Well-mixed greenhouse gases'. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
4185	24	0	24	0	It would be helpful to show the most likely values for main blocks (not for error bars). [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
7549	24	0	24	0	Figure SPM.2: It should be made clear that panel a & b are additions of the two categories ("contributors to greenhouse gases changes" and "main contributors to aerosols changes", resp.) [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]

Comment ID	From Page	From Line	To Page	To Line	Comment
4297	24	0	24	0	Figure SPM.2: we suggest to use the same reference period in panel a) and b) [Government of Italy, CMCC - Centro Euro-Mediterraneo per i Cambiamenti Climatici Instituto Nazionale di Geofisica e Vulcanologia (INGV)]
6285	24	1	14	1	SPM.2: Middle panel: It might be helpful to use another colour for the net human influence, possibly the same as in the left panel. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
6283	24	1	24	1	SPM.2.b) Description of Panel b) only refers to emissions and land-use-change although contrails are also shown in the figure. Should be amended as follows: "Warming and cooling from emissions and land-use change due to human activities, quantified over 1750 to 2019 and aviation-induced contrails, quantified over 1940 to 2019." [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
8637	24	1	24	1	Suggest clarification in the presentation of information Figure SPM.1 and Figure SPM.2. From the bar in Fig 2 we can conclude that the upper limit of the range is what is used in Figure 1 for the observed T increase (the black line). Is that the case? If so, Figure 1 should say that the black line represents the upper bound of the range. If it is not the case, please explain why Figure 2 show a bar reaching around 1.1C, while the black line in Figure 1 shows values around 1.2 to 1.3 C? Also in SPM2, it seems that the bar of 'Net human influence' is the same as 'Observed warming'? If so, it's redundant to have it. If not, please explain in the notes how that bar is derived.... it seems that is just the sum of the other four bars? [Government of Australia, Department of Industry, Science, Energy and Resources]
9415	24	1	24	1	Replace "masked" with "offset" in the SPM.2 figure title since the fingerprint of aerosols cooling is also detectable. [Government of United States of America, U.S. Department of State]
9417	24	1	24	1	In Figure SPM.2a, use a different color for the "Net human influence" bar than the GHG bar following it, since it's the sum of GHG and other human forcing bars. [Government of United States of America, U.S. Department of State]
2763	24	1	24	1	Figure SPM.2, panel b: Is it possible to show a total or observed warming since 1750 to compare against? [Government of Canada, Environment and Climate Change Canada]
9419	24	1	24	1	Figure SPM.2 caption comments: 1) Are the 'attribution' bars shown in Panel (a) drawn out of the same sets of model simulations than those shown in Panel (b)? 2) Is an 'emulator' being used to perform these attributions rather than a coupled climate model? If so, this distinction should be indicated. 3) If one sums up the mean and range from Panel (b), will one arrive at the sums shown in Panel (a)? This would be a sanity check. The Panel A title ""a) Contributions to warming (OC) over 1850-1900 to 2010-2019"" and the Panel B title ""b) Contributions to warming (OC) over 1750 to 2019 OC from individual human emissions or human induced changes"" suggest different time intervals and imply the units in these two figures are likely not the same. Resolve and clarify in the figure caption text. [Government of United States of America, U.S. Department of State]
9421	24	1	24	1	Provide an explanation for the source of the error bars in the Figure SPM.2 caption. [Government of United States of America, U.S. Department of State]
9423	24	1	24	1	The AR6 is using a very different ERF calculation for CO2 and CH4 compared to AR5 (AR6 does not use abundance based approach). This leads to CH4 having a much larger relative contribution to radiative forcing (previously 20-25% of warming, to now, potentially equal to CO2 given the uncertainty bars). AR6 calculates lower ERF for CO2 and higher ERF for CH4 (indirects from lifetime, O3, H2O, aerosols, lifetime of HCFC and HFCs). Address this issue and explain why there is a difference between AR5 and AR6 ERF for CO2 and CH4. [Government of United States of America, U.S. Department of State]

Comment ID	From Page	From Line	To Page	To Line	Comment
9425	24	1	24	1	Why are ammonia and carbon monoxide spelled out versus the chemical formula like CO2 and NOx, etc. Be consistent in this figure and throughout the SPM. [Government of United States of America, U.S. Department of State]
9427	24	1	24	1	Provide a definition for 'lines of evidence' in the figure caption text. If the same 'lines of evidence' concept is referred to on page 4, line 5, then providing a footnote there that gives a clear definition could be cross-referenced. [Government of United States of America, U.S. Department of State]
9429	24	1	24	1	It's unclear whether water vapor and other non-well-mixed GHGs are included in the "other human drivers". The left-most panel is noted as observed warming. Then the natural question would be whether the estimated contributions are purely based on modeling or some observations. Provide text clarifying the source of the estimates being presented. [Government of United States of America, U.S. Department of State]
9431	24	1	24	1	The GHG emissions in (b) includes the indirect. O3 is a greenhouse gas and is created from those emissions. CO emissions increase CH4 which is a long-lived GHG. The contribution to GHG changes in (b) clearly include O3. Thus the GHG listed in (a) should be the sum of those in (b) and include O3. Authors indicate that O3 is in the "other human forcings" but it does not look that way. Most important, adding tropospheric O3 and SO2 together makes no sense. Address these issues appropriately. [Government of United States of America, U.S. Department of State]
9433	24	1	24	1	Given the interest in black carbon, it would be good for the IPCC authors to be very clear regarding the much lower contribution of BC to temperature. In fact, the uncertainty bars for both temperature (Figure SPM.2) and radiative forcing (Figure TS.15) appear to show a substantial probability that the contribution for BC could be negative. In Section 7.3.3.1.2 (page 7-34, lines 46-55), the paragraph starts by discussing the BC contribution to IRFari, but halfway through the paragraph starts discussing organic carbon and sulfates. At 7SM-7, the ERFari for BC is listed at +0.3 ± 0.2, which seems substantially larger than what is shown in Figure TS.15 (and which, while lower than AR5's estimates, would be much more in line with expectations). It is not clear from the underlying report what the evidence base is for the lower assessed ERF for BC and in particular for the potential negative contribution to temperature (although from Figure TS.15 it appears to be due to aerosol-cloud processes). Given the space constraints in the SPM, the additional explanation may need to be included in the TS. [Government of United States of America, U.S. Department of State]
7911	24	1	24	1	Fig SPM.2: The vertical labels below the panels are normally written upwards and right justified, not downwards. Same comment applies to Fig SPM.6. Note that in Fig. SPM.9 the vertical labels are oriented in the normal way. [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
7913	24	1	24	1	Fig SPM.2: There are two different reference periods for panel a and panel b. This is confusing and prevents comparability. [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
8327	24	1	24	5	SPM2 This figure should be replaced by a standard radiative forcing figured which would be clearer and of more interest for policy [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
4187	24	4	24	4	Caption of Figure SPM.2, Panel a) “Albedo change due to land-use change” would be better instead of “land-use change”. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]

Comment ID	From Page	From Line	To Page	To Line	Comment
7135	24	36	24	44	Is it just the effects of man-made activities that have caused widespread and rapid climate change? The impact of other natural activities as well as natural cycles in areas with different climates must also be considered. [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]
5147	24		24		Figure SPM.2: The subtitle mentions "two lines of evidence". Are two lines of evidence provided? What are these based on? If these are two ways to disaggregate the contributions to warning shown in the panels, please reformulate. The caption or subtitle should explain that the same human forcings are shown in the two panels, while (a) synthesize all forcings, human and natural, and (b) provides more details on the human forcings only. [Government of Belgium, Belgian Science Policy Office - Belspo]
5149	24		24		Figure SPM.2: "Halogenated compounds" is a wording that may be unclear to most policymakers. In AR4 and AR5, these were called "halocarbons" (while this term is used in the UNFCCC, it does not include SF6). Would it be possible to refer to fluorinated gases, which appear to designate the same GHGs as "halogenated compounds" while being easier to understand ? (if there are halogenated compounds which are GHGs while they do not contain fluoride, that would certainly need an explanation, as the gases are known as F-gases in policymaking). [Government of Belgium, Belgian Science Policy Office - Belspo]
5151	24		24		Figure SPM.2 : This figure would be clearer if the reference periods where the same in left and right panels. We suggest restricting to panel (b) because the panels mostly show the same information with nuances that are hard to capture: for example, the reader might wonder why ozone is mentioned in the caption about panel (a) but is not found in panel (b). A revised panel (b) could include the natural drivers from panel (a)(solar, volcanic, variability), as it is already broader than emissions (due to land-use and contrails). Lastly, the caption uses the word "driver" while panel (a) refers to "forcings". Are drivers and forcings necessarily the same thing? [Government of Belgium, Belgian Science Policy Office - Belspo]
85	24		24		Panel caption of (a) potentially confusing. Suggest to state "Contributions to warming in 2010-2019 relative to 1850-1900" to match caption text of Fig. SPM2. [Government of Singapore, Ministry of Environment and Natural Resources]
397	24		24		Figure SPM.2: Why did the authors use different time references for panel a (1850-1900 to 2010-2019) and panel b (1750-2019)? Please also align the timespans with section HS.1 and following and consider our comment on that section too. Otherwise, the figure is rather clear. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
2983	24		24		Reference periods should be matched in Fig SPM.2 panel a)(start from 1850~) and panel b)(start from 1750~). [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
4819	24		24		Could the authors add a line explaining why the black carbon contribution to warming is so much less compared to AR5. From section 7.3.3.1.2, it seems this is mostly due to cloud changes creating a larger negative offset, along with lapse rate and atmospheric water vapour changes, resulting in a smaller net positive. {7.3.3.1.2} [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
7909	24		24		Figure SPM.2 panel a): the description "over 1850-1900 to 2010-2019" is hard to understand. The legend text is clearer. [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
6957	24				Clarify in title that this is about anthropogenic GHG emissions, as in equilbirum the natural emissions should not have a large effect on temperature. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]

Comment ID	From Page	From Line	To Page	To Line	Comment
3691	24				Be consistent in Figure SPM.2 and the corresponding caption. Use in both cases forcings and/or drivers, e.g., GHG drivers or GHG forcings. Although forcings (in plural) and drivers are equaly used, it is preferable to be consistent. The term driver would be better used when referring to some element (e.g. GHGs) perturbing Earth's energy budget.The term forcing would be preferred when referring to the perturbation itself of the Earth's energy budget. [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
503	24				In the sentence "… masked by cooling from aerosol emissions", the "aerosol emissions" is wrongly formulated. Some of the aerosols are directly emitted and some are formed by chemical reactions. So it is not suggested to be collectively referred to as aerosol emissions. It is suggested to change the phrase to "… masked by cooling from aerosol because of the changes in emissions of aerosols and aerosol precursors". [Government of China, China Meteorological Administration]
505	24				The label "contributors to greenhouse gases changes" in the bottom of the right panel of Figure SPM.2 is inaccurate and scientifically misconceived. Changes in NOx and volatile organic compounds emissions also affect changes in concentrations of nitrate aerosol and secondary organic aerosol. The concept here is not clear. In addition, the items listed in the bracket in the caption after Human Driver in line 4 do not correspond to those shown in the figure. So it is suggested to make a revision here. [Government of China, China Meteorological Administration]
4189	25	0	25	0	It is better to add a legend to the names of the regions in Figure SPM.3, or to overlay a layer of the map, as in Figure SPM.9Panel a), to identify which region the abbreviation refers to. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
8639	25	0	25	0	Suggest rephrasing the header and caption of Figure 3 for accuracy: changing 'every' to 'most'. The figures in panels a, b and c show us that there are regions where there is insufficient evidence, and even in some there is no change, therefore it is misleading to say that climate change is affecting every region across the globe. [Government of Australia, Department of Industry, Science, Energy and Resources]
8643	25	0	25	0	Suggest adding a note in the legend that the letters inside the hexagons refer to the WG1 reference regions. [Government of Australia, Department of Industry, Science, Energy and Resources]
8645	25	0	25	0	Suggest clarification: Is the flip in colours in Figure 3, panels b and c, made on purpose? It is confusing because they are not necessarily the opposite, and some can interpret them as opposite things. Please consider different colours between panels b and c, as done in panel a. [Government of Australia, Department of Industry, Science, Energy and Resources]
1685	25	0	26	0	There are multiple problems foreseen when using figure SPM. 3 in communication with decision-makers and media. 1) Hexagons and the acronyms of the regions are unlear, i.e. what region is described. On a "normal" world map the regions would be easier to identify. The acronyms need to be opened in the first fig they occur. 2) The problem of "sharp border/steep gradient" between regions between adjancent regions having opposing trends need to be explained in the text and visually avoided by using, eg. thick (white) borders between regions. N.B. Fig. SPM 9 has a similar type map. For reader a similar type presentation would ease undestading maps. [Government of Finland, Finnish Meteorological Institute (FMI)]
8641	25	0	26	0	Suggest correcting Figure SPM.3 captioning and header to for accuracy around the presentation of the IPCC AR6 regions. Header states "Climate change is already affecting every region across the globe". However the IPCC AR6 regions depicted do not include Antarctica, or indeed oceans. Some work is required to give context to "IPCC AR6 regions" and note this point clearly in the caption and correct the header. [Government of Australia, Department of Industry, Science, Energy and Resources]
2769	25	0	26	0	Consider including a legend of placename abbreviations for each hexagon in Figure SPM.3, to ensure there interpretation of regions in this figure are consistent with those in Figure SPM.9 panel (a). [Government of Canada, Environment and Climate Change
2853	25	1	25	1	Figure SPM.3: This figure shows the observed changes in agricultural droughts since 1950. I think the choice of showing only agricultural drought excludes all other uses of fresh water and minimizes the problem, as can be seen in the figure where many drought affected regions are white (i.e. no observed change). I understand that one cannot include all the different droughts in the figure, but choosing just one of them seems to be a poor choice as you always will miss important information related to other sectors. I suggest to replace this figure with a composite figure that includes information from all drought types. [Government of Chile, Ministry of Environment]

Comment ID	From Page	From Line	To Page	To Line	Comment
7491	25	1	25	1	On figure SPM.3: The hexagons resemble the popular board game 'The Settlers of Catan'. Why not simply use a world map? Also, the abbreviations of the regions need to be explained, for example in the description below the figure. [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
4481	25	1	25	1	Figure SPM.3: (1) Should also show the corresponding world map. (2) The lines bordering some of regions are confusing (continental separators?), and could be omitted. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
6287	25	1	25	1	SPM.3: Please clarify if the shown “agricultural drought” is only assessed for agricultural land. Please explain how this relates to the hydrological/meteorological drought. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
6289	25	1	25	1	SPM.3: The title of panel c is referring to observed change only, while the caption says it was based both on observed and projected changes, in contrast to panel a and b which is only based on observations. Please be consistent and explain the differences between panel c versus a and b. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
6291	25	1	25	1	SPM.3: Whereas for panel a for hot extremes and b for heavy precipitation for the region CAF "insufficient evidence" is noted, panel c shows a decrease in agricultural drought. Please clarify this inconsistency of the underlying data base. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
4511	25	1	25	1	Figure SPM3: Maybe state in text that the hexagons together represent a world map. This is not self-evident at first glance. Also, the abbreviations NEU etc. would need to be spelled out somewhere, or a reference provided to where they are explained. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
5055	25	1	25	1	It is very useful to have figures with information on a regional basis. While the hexagons make the graphics nice to look at they make the message less accessible and it is harder to understand that it is actually the world map we are looking at. Please consider to include this information in a map, like in Figure 9 Panel a). [Government of Norway, Norwegian Environment Agency]
5057	25	1	25	1	Figure SPM.3 is missing the Pacific Ocean as a region if compared to figure SPM.9. Both figures are presenting regions. If the Pacific Ocean is left out on purpose, it could be written in a footnote. [Government of Norway, Norwegian Environment Agency]
5059	25	1	25	1	Please consider the use of acronyms for the regions in figure SPM.3 and SPM.9. They do not completely match the regions defined in chapter 1.4 figure 1.15 of WG1. In figure SPM.3 and SPM.9 the regions NEN, WCE, SEAF, and ESAF have different acronymes compared to chapter 1.4 figure 1.15, and the regions ECA and EAU is included in the SPM, but not in 1.4 figure 1.15 [Government of Norway, Norwegian Environment Agency]
2767	25	1	25	1	Figure SPM.3: Suggest listing the type of observed change legend before the confidence in the human contribution, as that is the order in which they are assessed. [Government of Canada, Environment and Climate Change Canada]

Comment ID	From Page	From Line	To Page	To Line	Comment
9435	25	1	25	1	Key issue - Drought: The strong tendency toward increasing agricultural/(ecological) drought trends in this figure is likely driven by the reliance in the AGR ECOL rows of Tables 11.6, 11.9, 11.12, 11.15, 11.18, and 11.21 on the metrics other than total-column soil moisture (i.e., topsoil moisture, simple water balance models, and atmospheric drought metrics, which tend to produce very negative trends), as discussed in the U.S. Whole Document comment. It is not at all consistent with the projected trends in total-column soil moisture from Figures 8.19c,f,i and SPM.5d, which show roughly equal areas of increase and decrease. For example, a human-induced increase in agricultural/ecological drought is assessed with medium confidence in Western North America (WNA) in Figure SPM.3c, yet Figure SPM.5d shows increases in total-column soil moisture (wetting) or minimal changes in total-column soil moisture in WNA as a result of climate change. Given all of these issues, and the Whole Document comment to remove "ecological drought" from the SPM, recommend removing Figure SPM.3c entirely, since its methodology and findings are not consistent with the usual definition of agricultural drought based on total-column soil moisture, and instead rely on the controversial idea that metrics like the SPEI, PDSI, and topsoil moisture quantify increasing plant water stress and other agricultural and ecological drought impacts under climate change. If the authors insist on keeping panel c, it should be strongly disclaimed in the caption that these metrics are known to produce much more negative-trending results than total-column soil moisture alone would have done, and the many "low confidence" results -- shown by a single dot -- should not be strongly highlighted with bright orange colors. Furthermore, any region where the sign of the human influence is unclear (or even opposite to Figure SPM.3c) in Figures SPM.5d and 8.19c,f,i (such as the WNA example above) should clearly be marked low confidence in Figure SPM.3c if retained. [Government of United States of America, U.S. Department of State]
9437	25	1	25	1	The Figure SPM.3 headline convolutes the attribution statement of mean climate change with the assessment of attribution of human influence on extreme weather and climate events providing the impression that human influence has affected weather and climate extremes in every region of the globe. Change the headline statement so that it focuses on attribution of changes in weather and climate extremes consistent with what is presented in the figure, perhaps as follows: "Human influence has likely contributed to many observed changes in weather and climate extremes from 1950 to present" [Government of United States of America, U.S. Department of State]
9439	25	1	25	1	Figure SPM.3 improvements: 1) Make the attribution assessment of changes in extremes (regions where medium to high confidence of a human influence contribution is assessed) more visible through coloring (the tiny white dots are hardly visible, and the reader easily confuses change with human influence contribution), or make the regions less prominent where confidence in human influence contribution is low. 2) Add a global assessment. Provide a hexagon for the globe as a whole for each panel that provides the number of regions where a human influence on changes in extremes can be attributed with medium to high confidence. 3) Provide a key to the geographic abbreviations used and the definitions (list of countries) of the geographic divisions used in the analysis. 4) As noted in the drought key issue discussion, recommend removing Figure SPM.3c entirely, since its methodology and findings are not consistent with the report's definition of agricultural/ecological drought based on total-column soil moisture. [Government of United States of America, U.S. Department of State]

Comment ID	From Page	From Line	To Page	To Line	Comment
7915	25	1	25	1	Figure SPM.3: Interesting honey-comb design, unusual but fine. However, improvements could be the following: 4a) Continental boundaries should be closed. E.g. CAR, ENA, NEAF, ARP, etc. not captured by any continental boundary. 4b) All regional abbreviations must be spelled out in a footnote. 4c) Region PAC is missing in Fig. SPM.3, although it appears in Fig SPM.9. PAC is particularly important for many island states which are also impacted by extreme events. 4d) Climate change is assessed since 1950. This information is burried in the caption and should be elevated to the title statement of this figure for clarity at the outset. [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
41	25	1	26	1	Figure SPM 3 is not acceptable. The lack of assessment of Heavy Precipitation and drought for most of Africa make the assessment disbalanced and skewed. This is not acceptable [Government of United Republic of Tanzania, Tanzania Meteorological Authority (TMA)]
289	25		25		Include in the legend/footnote/description or reference to the atlas (as in figure SPM.9) spelling out the abbreviations of the different regions included in Figure SPM.3, in order to clearly identify the regions. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
5153	25		25		Figure SPM.3: The stylized diagram does not facilitate identification of the considered regions. We suggest using a map as in figure SPM.9(a). We also favour this presentation in view of increasing homogeneity across the SPM. [Government of Belgium, Belgian Science Policy Office - Belspo]
5155	25		25		Figure SPM.3 : The meaning of the green colour is not easy to understand, specifically in panel (b): it is meant to represent water but readers may also think that green comes from "green light" as opposite to "red light"and thus implies that it is "good" (which heavy rain is not mean to be). Please consider this difficulty in defining colours and try to achieve an homogenous meaning across panels and figures. [Government of Belgium, Belgian Science Policy Office - Belspo]
5157	25		25		Figure SPM.3: The dots used to indicate confidence aren't clearly visible in the panels and their actual colour is not the same in each panel (because they are transparent). Please use black dots, which would specially improve visibility in case of projection or poor quality printing. [Government of Belgium, Belgian Science Policy Office - Belspo]
2987	25		25		"agricultural drought" in Fig. SPM.3 panel c) but "agricultural and ecological drought" on page 26 in description of Figure. Please unify the expressions. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
6465	25		26		The figure caption should explain the abbreviations for the 44 regions addressed in figure SPM3. [Government of Austria, Federal Ministry of Agriculture, Forestry]
399	25		26		Figure SPM.3 : For someone who is not used to work with the SPM, the figure 3 is a little bit difficult to understand (like for example the representation of the regions as hexagons). It takes some time to comprehend all the information, since the figure is quite loaded (regions, confidence level, observed change …). Furthermore, it is not always clear why for some regions there is insufficient evidence or low confidence when for other regions there is enough evidence and high confidence. Alternatively, other regions like Antarctica are not represented. One might wonder if this difference (quality and quantity of the information) affects the interpretation. Last of all, panel c represents the agricultural drought, but in the text, the authors also mention ecological drought, but this cannot be found on the figure. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
7189	25				Trinidad and Tobago is concerned that the “Synthesis of assessed observed changes and human influence for (panel b) heavy rainfall and (panel c).” found insufficient evidence to form an assessment of the type of observed changes in the Caribbean for heavy precipitation and drought. Trinidad and Tobago is requesting that the authors revisit the literature on changes in heavy rainfall in the Caribbean. [Government of Trinidad and Tobago, Ministry of Planning and Development]

Comment ID	From Page	From Line	To Page	To Line	Comment
7191	25				In particular, Stephenson et al; 2014 that provides evidence of changes in heavy precipitation for the entire region. Specifically, the study found “The most significant change is found in the heavy rainfall events (R95p), which are generally rising. A significant R95p increase of 2.93, 4.93 and 2.07% per decade is observed in regions 1, 2 and 5, whereas a significant increase of 2.05% per decade is found in the regional average series for the entire Caribbean region during the past 25 years”. Also, the study found that “these results are in agreement with results presented in Peterson et al. (2008); Aguilar et al. (2005) and Peterson et al. (2002).” [Government of Trinidad and Tobago, Ministry of Planning and Development]
7193	25				These along with Dookie et al., 2019 should provide further clarity. Added to this there is literature available for Caribbean SIDS which point to observed increased dry spells /drought trends along with increased heavy rainfall (Herrera et all, 2020. Pulwarty RS, Nurse LA, Trotz UO. 2010, Cashman et al, 2009) in addition to those already assessed. Also, Atlas 7 and 10 clearly indicate that as a whole the Caribbean region experienced drought over time with attribution to anthropogenic forcing. [Government of Trinidad and Tobago, Ministry of Planning and Development]
6959	25				please use the same colour scheme for panels b and c. It is slightly confusing that they are reversed. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6961	25				The Figure is not completely clear: It says it reflects "change in agricultural drought", but earlier in the text, both 'severity' and ' frequency' is being mentioned. However, it is not clear whether this 'agricultural dorught' also reflects these two metrics? It was at first understood that the figure refers to soil moisture (as stated in the caption), but this is not possible, since there is no increase in Southern Europe and Southern Africa you would expect an increase in drought. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6963	25				Is it possible to add a graphic showing an assessment of observed change for the oceans, using perhaps some parameter related to ocean productivity such as change in chlorophyll a or stratification, or otherwise change in physical characteristics such as pH or oxygen concentration? [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6965	25				Figure spm.3: the figure legend seems inconsistent with the figure: red/green colors at least medium confidence, but there are several 'colored' regions with only 1 dot (low confidence). Not clear in the dsscription what is meant with 'no significant change for a region as a whole'? Perhaps it was meant low confidence in change, but this would not fit with the figure? Or describe significance levels. Please improve consistency for this important figure. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
3687	25				In Fig SPM.2, representation of areas as hexagones with the corresponding acronym could be misleading for many readers. It would preferable to use the same representation as in Fig,SPM.9a [Government of Spain, Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica]
2765	25				Suggest adding a reference to more detailed impacts/scenarios in other chapters, if available. This could make information on impacts and scenarios on specific sub-regions more accessible to the reader. [Government of Canada, Environment and Climate Change Canada]
507	25				In Figure SPM.3, it is not clear whether human influence includes aerosols. It is suggested that the scope of human influence should be clearly stated. [Government of China, China Meteorological Administration]
6967	26				Suggest not to us use the term 'ecological drought', but simply 'soil moisture drought', to avoid confusion. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
2893	27	0	27	0	SSP5-8.5, not SSP5-85 [Government of Chile, Ministry of Environment]
4191	27	0	27	0	The decimal point needs to be added to the names of the scenarios in the left graph ("SSP5-85") and the top-right graph (all scenarios) in Panel a) of Figure SPM.4. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
4193	27	0	27	0	It seems to be strange that there is no panel regarding Halogenated compounds on the right of Figure SPM.4. If the panel can be added between N2O and SO2, it would be better. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]

Comment ID	From Page	From Line	To Page	To Line	Comment
7569	27	0	27	0	SPM.4: It would be useful to also plot the historic annual CO2 emissions from let say 2000-2020 in the figure SPM.4 in order to have some idea how measured emissions compare with the scenarios in the overlapping period 2015-2020 [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
7669	27	0	27	0	Figure SPM 4 graph (a) to be extended to 1900. From figure SPM 4 (b) delete SSP1.1.9 and SSP5.8.5. [Government of India, Ministry of Environment, Forests and Climate Change]
7671	27	0	27	0	This following statement should be removed: "Future emissions determine future warming, with CO2 emissions dominating". Replace with "Emission trajectories and warming". Explanation:This has been discussed during previous reports. The language had been re-negotiated in the SR1.5 as follows: "Warming from anthropogenic emissions from the pre-industrial period to the present will persist for centuries to millennia and will continue to cause further long-term changes in the climate system, such as sea level rise, with associated impacts (high confidence), but these emissions alone are unlikely to cause global warming of 1.5°C " [Government of India, Ministry of Environment, Forests and Climate Change]
4483	27	1	27	1	Figure SPM.4., in some of the graphs (methane, also CO2), decimal markers are missing, e.g. from "SSP3-70". [Government of Sweden, Swedish Meteorological and Hydrological Institute]
4485	27	1	27	1	Figure SPM.4. Are the emissions due to land use change included in panel (b)? If yes, please indicate. If not, could they be addressed? [Government of Sweden, Swedish Meteorological and Hydrological Institute]
6293	27	1	27	1	SPM.4 The figure would clearer, if the bars for total warming for the five scenarios were shown in the same colours as the respective bars for specific drivers/groups of drivers, or in entirely different colours. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
5061	27	1	27	1	Figure SPM4a, right side. Please also show the emission trajectories for BC as in the SR1.5. BC is more indicative for air pollution than any of the other components shown. As far as we have understood, this SPM and assessment is making an effort to integrate climate change and air pollution so it would be highly relevant to also show BC even though we understand that the effect of BC on climate change has been reduces lately. [Government of Norway, Norwegian Environment Agency]
5063	27	1	27	1	Please consider stating in the caption that SSP-8.5 includes pollution control to help the reader understand that emissions of methane, N2O and SO2 are higher in SSP-7. [Government of Norway, Norwegian Environment Agency]
5065	27	1	27	1	Figure SPM.4 gives valuable information about the contribution to global surface temperature increase from different emissions that we have not seen previously. Please consider lifting panel b to be the main message upfront (i.e. switching positions so that panel a become b and vice versa). Please also correct the SSP annotations to include the full stops (e.g. replace SSP5-85 with SSP-8.5 etc.). [Government of Norway, Norwegian Environment Agency]
5067	27	1	27	1	In Box.SPM.1 p9, line 25-28, the current grouping into high, intermediate and low emission scenarios are appreciated from our side. Please consider including a legend box that visualises these groupings perhaps in the upper left corned of panel a), or by separating slightly and group the sub-panels in panel b into low, intermediate and high emission scenarios, perhaps also adding curly brackets with a heading above the current technical sub-titles (SSP1-1.9 etc)? [Government of Norway, Norwegian Environment Agency]
9441	27	1	27	1	Figure SPM.4b shows the contribution of each greenhouse gas to warming from 1850 to 2100. This is quite traditional and scientifically appropriate if looking at the overall issue, but it is not the figure that policymakers should really have available to them. So that the most efficient action can be taken, what policymakers really need now is a figure that shows the warming contributions from various species of future emissions from the present (or 2020) out to 2050 and out to 2100. What is needed is a plot that shows the relative influence of future emissions. [Government of United States of America, U.S. Department of State]
9443	27	1	27	1	The label on SSP5-85 trajectory of Carbon Dioxide panel in 'a)' should be 'SSP-8.5'. Similarly, trajectory labels on Methane panel are missing decimal points (70 rather than 7.0). [Government of United States of America, U.S. Department of State]

Comment ID	From Page	From Line	To Page	To Line	Comment
9445	27	1	27	1	The contribution of methane to global warming is graphically/visually understated as presented in Figure SPM.4a. The graph of methane in CO2e would be important to display as well. Although the amount of methane is much less than CO2, its role in forcing is much greater. It is unclear why SO2 is included. Suggest that volatile organic compounds + carbon monoxide should be included instead. [Government of United States of America, U.S. Department of State]
9447	27	1	27	1	Figure SPM.4b makes assumptions about other GHGs. So here GHG includes O3 but in panel a it does not? [Government of United States of America, U.S. Department of State]
9449	27	1	27	1	Figure SPM.4b is a great opportunity to include and group the SLCFs to show their impact. It would be more valuable to see CO2+N2O (they are the only two significant long-lived GHG) in one column and SLCF GHG in the next one. Readers could then see how the SLCF changes in the scenarios affect the temperature. [Government of United States of America, U.S. Department of State]
9451	27	1	27	1	There is an inconsistency in the units notation of emission rate of CO2 and other gases: "Gt CO2" vs "GtCO2". It also occurs in Figure SPM.7 and its caption. It's unclear what species the "other greenhouse gases" and "anthropogenic aerosols" include, which are important to note, especially, for anthropogenic aerosols. [Government of United States of America, U.S. Department of State]
8329	27	1	28	5	SPM.4 Why are different time frames used for a and b, for policy what happens in the future is most important, can these be harmonised? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8331	27	1	28	5	SPM.4 It is unclear why the species are included and why nitrous oxide emission remains high , can the changes be reflected in atmospheric concentrations of these gases? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8333	27	1	28	5	SPM.4 It is not clear why SO2 is given such prominence, it may give the impression that all aerosols act to cool the climate system which is not the case at all. Hence this may be problematic see earlier comments on aerosols. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8335	27	1	28	5	SPM.4 the packing up off all nonCO2 GHGs in panel (b) as other GHGs is very opaque and not helpful. For comparison with panel (a). Methane and Nitrous Oxide should be shown separately [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
7955	27		27		This may not be significant since the Figures are likely to be produced by other researchers. The naming of the level of radiative forcing in Figure SPM.4 is not consistent. For example, in some panels the naming is "SSP5-85" while in others the same is named as "SSP5-8.5". At least in Figure SPM.7 the naming is consistent. [Government of Kenya, Kenya Meteorological Service]
291	27		27		In Figure SPM.4 (b) There is no indication as to what "Other GHGs" constitute of. Kindly provide a footnote or in the description the breakdown of different GHGs coupled under "Other GHGs". [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
5159	27		27		Figure SPM.4: The figure is titled "Future emissions", yet panel (b) relates to past and future. Could you distinguish the role of past and future emissions in this panel, such as by showing past in a lighter color (but we would not favour removing information about the past) ? [Government of Belgium, Belgian Science Policy Office - Belspo]
6467	27		27		Figure SPM.4: It is confusing in panel b that the column describing the total warming is always kept in grey. Please try to find a better solution [Government of Austria, Federal Ministry of Agriculture, Forestry]
87	27		27		There is a missing dot in SSP5-85 plots (in Figure SPM.4(a)) for the CO2 graph. [Government of Singapore, Ministry of Environment and Natural Resources]

Comment ID	From Page	From Line	To Page	To Line	Comment
89	27		27		The high-end whisker SSP5-8.5 plots (in Figure SPM.4(b)) looks to be greater than 5.7C. Potential inconsistency with the quoted very likely range in text and Table SPM-1. [Government of Singapore, Ministry of Environment and Natural Resources]
5209	27		27		In Figure SPM.4, Panel a), there are missing decimal points in several line labels, e.g. "SSP5-85" in the Carbon dioxide plot or all the line labels in the Methane plot. Consider the inclusion of the decimal points to keep consistency along the different plots, and also with the figure caption and the main text. [Government of Argentina, Ministry of Environment and Sustainable development of Argentina]
6969	27				Is anthropogenic emissions meant in Title of figure spm.4? [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6971	27				Suggest adding an addition figure to panel b) showing the relative contribution of each source from pre-industrial to present. This is important for context, in particular because the relative future emissions of each substance are driven by scenario assumptions, and it is not the role of WG1 to discuss the feasibility of socio-economic scenario assumptions in detail. A past-present comparison could therefore be a neater way of contextualising the figure while remaining within the realms of physical science. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
2891	28	0	28	0	specify which years correspond to observations (2015-2020?) [Government of Chile, Ministry of Environment]
2903	29	0	29	0	add comma: "across warming levels, land areas warm more than oceans…" [Government of Chile, Ministry of Environment]
7561	29	0	29	0	Figure SPM.5: "where we live": this is either a redundant statement or if (densely) populated areas are meant here, this should be made clear. [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
7571	29	0	30	0	SPM.5: It would be usuful to extend the color scale for temperature and precipitation to recognise the patterns in the arctic and over land, especially in the 4 degrees scenario. [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
1687	29	0	30	0	For clear description of regional distribution of temperature changes in the 4C scenario it would be good to increase the upper range, now >5C. Also, is in panel a) temperature change on map on the right (simulated 1-deg) calculated in the similar way as maps in panel b)? If answer is yes, it would help reader to avoid misunderstanding to note it in the Figure caption. [Government of Finland, Finnish Meteorological Institute (FMI)]
7779	29	1	29	1	It is not mentioned next to the map that it refers to the period 1850-2020, only in the description below. [Government of Hungary, Ministry of Innovation and Technology - Climate Policy Department]
6295	29	1	29	1	SPM.5: We like to suggest adding maps for 3°C global warming to each of the panels, because this level is currently the most probable future situation. In panel c, absolute values in mm would be more explanatory than only percentage changes which can be misleading because the absolute baseline is not known to readers. For panel d, please use likely ranges as in other figures, instead of the SD which is more difficult to understand for non-scientists. Furthermore, it might be helpful for panels c and d to add comparisons of observed and simulated changes, as done in panel a. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
9453	29	1	29	1	In Figure SPM.5b, the reader may want to understand why the interior of South America is warming so strongly, contradicting the statement that "the Arctic and Antarctica warm more than the tropics" under the change at 4°C global warming. [Government of United States of America, U.S. Department of State]
7919	29	1	29	1	Figure SPM.5: the explanatory text "The panels show ..." is not helpful and it disturbs the visual perception of this Figure. This information should be typically placed in the Caption. Also, if such explanatory and rather long text, is the latest in Figure caption and hence useful, why then not have a similar text for panel b?? Overall, this is an inconsistent graphical construction of this figure which unnecessarily complicates the message. [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]

Comment ID	From Page	From Line	To Page	To Line	Comment
7921	29	1	29	1	Figure SPM.5a: delete "where we live", as it provides trivial and imprecise information. Does it imply that warming is not generally larger on the land where we dont live in? [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
4797	29	1	30	1	Where is the justification for not having hatching or stipling (or some other method for indicating uncertainty as was done in AR5) in this figure? [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
4799	29	1	30	1	Figure 5 (b) - (d) say "change at" different warming levels and don't specify whether this is "simulated" or "observed" - please make this clearer to maximise understanding by all readers. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
5161	29		29		Figure SPM.5: Could you consider adding "simulated" on top of each panel after (a), for consistency with panel (a) in which this information is provided. We welcome this new presentation of the results, which to our knowledge is the first time that climate change maps are shown with reference to a pre-industrial proxy. [Government of Belgium, Belgian Science Policy Office - Belspo]
5163	29		29		Figure SPM.5: Given the differences between the 2 and 4°C maps, we suspect that the warming in the Arctic is well above 5°C in the 4°C map, while the reader might think that it is limited to about 5°C. Could you explore ways of indicating the actual maximum reached? [Government of Belgium, Belgian Science Policy Office - Belspo]
6469	29		30		Figure SPM.5: It is noted that this figure informs about the comparison between observed and simulated data for temperature only. It is suggested to provide similar information also for changes in precipitation and soil moisture. [Government of Austria, Federal Ministry of Agriculture, Forestry]
401	29		30		Figure SPM.5 : The figure is clear and understandable. Something that is important to keep in the SPM is the annual mean temperature change, the annual mean precipitation change and the annual mean soil moisture change at 1.5 °C and 2°C. These 2 scenarios are essential, since they are also discussed in the SPM. The figures for the changes at 4°C are also important to show a worst-case scenario, but why exactly did the authors choose 4°C? [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
2997	29		30		Additional global warming can be clarified by adding data on "3℃" between "2℃" and "4℃" in Figure SPM.5 [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
4801	29		30		Figure SPM.5 says: “The left map shows annual mean surface temperature anomalies linearly regressed against global surface temperature (°C/°C) in the period 1850 –2020. Observed temperature data from Berkeley Earth, the dataset with the largest coverage and highest horizontal resolution.” This is a sound choice of data set but not for the reasons given. The actual resolution of the Berkeley Earth dataset is no higher than in the other data sets used in the main report. We should be wary of using only one data set to determine what trends have been in data sparse regions as there is no way to assess their robustness in that case. Can the authors please reconsider this text? [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
7917	29		30		Figure SPM.5: The global maps are very small (3 maps in a row). Readability would be better if arranged vertically instead of horizontally. [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
6973	29				Suggest panel a) The panels show linearly scaled REGIONAL observed temperature change…. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]

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6975	29				The intent of title of SPM5 Is not very clear: is the suggestion that the changes get non-linearly larger? If not explain better what is new about this? [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6977	29				the color scale of the panel b should be chosen larger, to understand how much regional delta T corresponds to 4 degree global warming. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
7487	30	0	30	0	Caption SPM.5: why is there a discrepancy in the determined averages between the temperature/precipitation, using multi-model mean and soil moisture using the median? We suggest also to use the median for temperature and precipitation. [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
4295	30	0	30	0	Figure SPM.5: we suggest to mask areas where precipitation is lower than a certain threshold (e.g. 0.5 mm/day) [Government of Italy, CMCC - Centro Euro-Mediterraneo per i Cambiamenti Climatici Instituto Nazionale di Geofisica e Vulcanologia (INGV)]
6297	30	1	30	1	SPM.5: Panel c, 4°C warming: The percent increase of precipitation in Northern Africa is outstanding (> 40%). It may be advisable to change to absolute values or to mention in the caption that this high percentage is related merely to the extremely low values in the reference period 1850-1900. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
9455	30	1	30	1	Comment on Figure SPM.5 (with related comments on Figure TS.5 and Box TS.6 Figure 1): Figure SPM.5c shows precipitation changes in percent, and panel d shows soil moisture changes in units of standard deviation. These units are not comparable, but are shown next to each other in the same color bar, which visually suggests that they should be compared. Specifically, if one considers the Amazon basin, the percentage change in precipitation may be small because the mean value of precipitation is large, meanwhile small deviations in soil moisture values will create very large changes in standard deviation because the interannual variability in soil moisture is low. The placement and color choice of these two panels implies that they are comparable, and on comparison it suggests that there must be some large influence outside of precipitation to create the soil moisture conditions. However, that is not necessarily the case and is thus misleading. This same set of panels is also shown in Figure TS.5. The unit for soil moisture should be changed to percent so that it is comparable between panels, showing changes in water cycling variables. The same comment applies to Figure TS.5, although within the TS it is even more confusing because the same quantity (soil moisture) is plotted in a different unit in Box TS.6 Figure 1, where four water cycling variables are all plotted in units of % change. In Box TS.6 Figure 1e, *surface* soil moisture is plotted when total column soil moisture would be more appropriate for comparison with the other three panels. Total column soil moisture is shown in the figure from which this plot was drawn (Figure 8.19) and should also be used here. Surface soil moisture does not adequately reflect total soil moisture which is a better representation of water availability (as used in metrics for drought in Chapter 11). Further the choice of colorbar range for this panel is misleading in that the other three panels have the same range for their colorbar (-40 to 40), which artificially inflates the appearance of change in this variabile (plotted on a scale of -10 to 10, same unit). In Box TS.6 Figure 1b, evapotranspiration is shown on a red-blue colorbar. This is both incorrect relative to the standard of other figures in the document as it is a wetness variable and should be brown-blue/green, and is further confusing because more water is plotted as a red color and less water as a blue color. This same issue appears in Figure 8.17, but at a minimum it should be corrected in the Technical Summary. [Government of United States of America, U.S. Department of State]

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9457	30	1	30	1	Figure SPM.5c and 5d do not contain any information regarding either the robustness or the uncertainty contained in the projections. ""Approach C"" as revised from WGI AR5 and detailed in the Cross-Chapter Box Atlas.1 (page Atlas-23 line 50 to Atlas-24 line 13) illustrates where projections are both robustly larger and smaller than a measure of internal variability. Recommend that Figure SPM.5c (precipitation) be replaced with a version of Figure 4.32. Unfortunately no such corresponding figure exists for soil moisture. [Government of United States of America, U.S. Department of State]
5165	30		30		Figure SPM.5 panel (d): Please provide a clearer explanation of what is shown. Is the figure about a change in variability? Or is it the change in the mean expressed as a fraction of historical standard deviation? Referring to a fraction of SD may not be a clear way to convey information to policymakers. Is it needed with regard to potential impacts? [Government of Belgium, Belgian Science Policy Office - Belspo]
91	30		30		Fig. SPM.5 Caption: Observed temperature data "is" from Berkeley Earth [Government of Singapore, Ministry of Environment and Natural Resources]
6979	30				It is strange that observed maps at 1 degree are not shown for panels c d. If observational evidence is still low or inconsistent with models, it should not be hidden. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
509	30				The meaning of soil moisture in Figure SPM.5 (d) is not clear. It is suggested to clarify whether it is "surface soil moisture" or "total soil moisture". [Government of China, China Meteorological Administration]
4195	31	0	31	0	The reference period for extreme temperature and extreme precipitation in this figure (1850-1900) is inconsistent with the caption (1851-1900). Please revise. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
2771	31	0	32	0	For Figure SPM.6 consider adding an asterisk or other symbol to the charts illustrating projected changes in the frequency of drought events. The caption text that explains which regions these results pertain to, and the fact that they are reported with medium confidence, is very beneficial, but there could be some complementary visual signal that the drought data do not follow the same assumptions as those for extreme temperature and precipiation. [Government of Canada, Environment and Climate Change Canada]
4487	31	1	31	1	Figure SPM.6: How do the times (frequency) and magnitudes relate to each other? For example, if the historical 50 year event will likely occur 38 times at 4oC (top left panel), what does the +5.2oC imply (is it the change in intensity of the future 50-year event (i.e., an event that in the future has a return period of 50 years) compared to the intensity of the historical 50-year event))? This is not really clear from the figure, or its caption. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
6299	31	1	31	1	SPM.6: The figure is not straight forward to understand, and the messages seem not suitable for a graphical presentation. We therefore suggest to delete this figure and to provide its main messages in the text instead. If kept, we would suggest to show only one diagram for the 20-year average event for all three extremes. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
5069	31	1	31	1	Figure SPM.6 contains critical messages, but is still easy to understand. Great work! [Government of Norway, Norwegian Environment Agency]
7923	31	1	31	1	Figure SPM.6: logically, the 10-year events in the extreme temperature should be left, the 50-year events right, as in a Gaussian where the rarer 50-yr event is further to the right on the temperature axis. The dot visualization is useful. But the comparison of the 10 and 50 is misleading. Why not also to use 50 dots for the 10-yr event, and hence "Once" would be indicated by 5 darker dots, etc. This way the 10-yr and 50-yr events can also be visually compared. [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]

Comment ID	From Page	From Line	To Page	To Line	Comment
7925	31	1	31	1	Figure SPM.6: 50-yr events are missing for extreme preciptation over land and for drought. This should be included in the figure in order to be consistent within this figure. [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
7927	31	1	31	1	Figure SPM.6 Caption: "Drought" is defined, but on line 10 of the caption it is referred to a "agricultural/ecological drought". What is the difference? [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
9463	31	1	31	1	Key issue - Drought: Figure SPM.6 (Drought, lower right) actually does seem to use model projections of total-column soil moisture alone, which is good. However, as discussed in the U.S. Whole Document comment, it omits any mention of wetting regions, where drought intensity and frequency is presumably decreasing. At a minimum, the caption needs to mention the existence of these wetting regions as well, and state the percentage of global land area occupied by both the drying regions and the wetting regions (as defined by total-column soil moisture, not by the other, lower-confidence metrics in the Chapter 11 tables). Furthermore, the assessment needs to take into account the robustness information in Figure 8.19c,f,i. If the multi-model projection of soil moisture change in those figures is not robust (i.e., it is diagonally hatched) in a particular region, then it seems contradictory to claim confidence in the sign of the agricultural/(ecological) drought projection in that region. [Government of United States of America, U.S. Department of State]
4803	31	1	32	1	This is a nice innovative figure (SPM.6) but it lacks information on spatial scale. Either the results are scale invariant, in which case that needs to be stated and justified by reference to the relevant chapter, or the figure refers to a specific spatial scale in which case this needs to be stated. Also, the whilst the 50-yr event section is very impactful in terms of graphics, the 10yr is less so, is it possible to improve this somehow? [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
8337	31	1	32	5	SPM.6 Thi sis very dense for a figure, perhaps a table could be used. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
9459	31	1	33	1	The Figure SPM.6 caption refers to temporal scales, but provides no reference to a spatial scale, which is essential to be able to interpret the meaning of the measures. [Government of United States of America, U.S. Department of State]
9461	31	1	33	1	In Figure SPM.6 (Drought, lower right), unlike the other bars, the "Present 1°C" bar is not based at 0 (y-axis). Is that a mistake? [Government of United States of America, U.S. Department of State]
5167	31		31		Figure SPM.6 : Thanks for this informative figure. For simplicity, we suggest restricting to the 10-year events also for extreme temperature, because the results for 10 and 50 years are not significantly different (the difficulty to correctly grasp the differences between the left and right panels for temperature may overshadow the actual message, and having the same illustration for all 3 variables may be a benefit). As regard to drawing, the "bunch of grapes" diagram is not very evocative of "years". This may depend on people's individual perception, but we would favour a line with clear and dark segments, which may be more evocative of a timeline. [Government of Belgium, Belgian Science Policy Office - Belspo]
5169	31		31		If the uncertainty ranges represent a "very likely" interval, then these should be surrounded by square brackets as indicated earlier in the text. [Government of Belgium, Belgian Science Policy Office - Belspo]

Comment ID	From Page	From Line	To Page	To Line	Comment
5171	31		31		Figure SPM.6 : Please clarify the units for precipitation extremes and drought intensities. For drought, spell out "sd" and explain that the change is expressed as a fraction of the historical standard deviation. [Government of Belgium, Belgian Science Policy Office - Belspo]
403	31		32		Figure SPM.6 : This figure shows the frequency and intensity of past climate events, but the term of intensity is not clear for everybody. Maybe the authors could add an explanation like they did for extreme temperature, droughts, extreme precipitation, ... [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
2999	31		32		" extreme temperature" can be confused as including "cold extremes". [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
3001	31		32		1850-1900" as reference period in page 31 Fig. SPM.6 but "1851-1900" of descriptiopn in Figure on page 32. Please unify the expressions. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
3003	31		32		There should be six(5.5 times) red colored circles at the warming level of 2℃ for the 10-year event of Extreme temperature overland. This should be unified with two(1.5 times) blue colored circles at the 1.5℃ warming level in the Extreme precipitation overland. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
6981	31				The caption of the drought figure is a bit confusing, since it says '…without human influence'. However, this only pertains to the base lines situation, so perhaps change the title of this graph into: ""“Projected future frequency and intensity of a drought event compared to the benchmark of once in 10 years on average across drying regions in a climate without human influence”. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6983	31				Some further information is needed as to the choice of likely for the future projections (in conjunction with the very likely ranges in the bars. It is also not entirely clear what is meant with 'intensity' of an extreme event?E.g. 1.2 C warmer with respect to the average 1 C global increase? Why is the value not given for the 1850-1900 period? [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6985	31				The intensity of the 50-year temperature events appears to be the same as that of the 10-year events. Is this right? Is it really correct that a much lower probability event is only a tiny bit more intense? Also, please clarify what the dots mean. The legend says that dark dots indicate years in which the extreme threshold is exceeded, and light dots indicate years when it is not exceeded. Surely the total number of dots (light + dark) should then be the same in each projection. Number of instances makes little sense as a metric since the chart and its legend do not say what the timescale is. Is it number exceedances over a 100 year sample for example? [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6987	31				Title in red over top panels should read "exreme high temperatures over land", as cold extremes are not covered. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
511	31				Figure SPM.6. In the lower right panel (drought), the first bar extends to below zero. It seems to be a misprint because the bar is supposed to represent the number "+0.3". Please check and revise as appropriate. [Government of China, China Meteorological Administration]
4197	33	0	33	0	Figure SPM.7 Panel a) Please add explanations for the gray shading below the X-axis. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
8647	33	0	33	0	Figure SPM.7. Suggest including the dot in the scenario names, e.g. SSP1-1.9 instead of SSP1-19. [Government of Australia, Department of Industry, Science, Energy and Resources]
7673	33	0	33	0	This figure (Figure SPM 7) by itself is misleading because it does not show that the radiative forcing per additional unit of CO2 in the atmosphere decreases with increasing concentration, which is why there is a linear relationship between cumulative emissions and temperature increase. The title statement must carry this information directly below. Further, in Panel 7 (a), the starting year on the x axis should be 1850 (and not 1950 as written) in keeping with the explanation provided below the graph for that panel. [Government of India, Ministry of Environment, Forests and Climate Change]

Comment ID	From Page	From Line	To Page	To Line	Comment
4199	33	1	33	1	The decimal point needs to be added to the names of the scenarios in Panel a) of Figure SPM.7. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
4489	33	1	33	1	Figure SPM.7. The "1850-2100" is called "reference period" in the part of the graph to the right. It would seem a strange way of depicting the whole period the emissions are accumulated over. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
6301	33	1	33	1	SPM.7: Please be consistent across the SPM: solid lines should show 'central estimates' rather than 'multi-model averages'. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
6303	33	1	33	1	SPM.7: The statement that the relative capacity of the sinks (land/ocean) to absorb CO2 decreases with the increase in the total CO2 concentration is confusingly illustrated in a confusing way in the figure. Furthermore, the representation does not consider any uncertainties in these proportions. We suggest omitting panel b because this relationship is already explained extensively in text HS.8. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
4805	33	1	33	1	How can the historical share of emissions take-up by land and oceans be reconciled with the future scenarios (the low end ones) having a greater share of emissions being taken up by land and ocean? The overarching message is that as emissions rise, the share dimishes whereas these 2 scenarios appear - at first glance anyway - to contradict this. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
5071	33	1	33	1	Showing vaues as PgC in Figure SPM.7 makes it less understandable to policy makers, please consider using only gt carbon or another metric that is more common. We suggest removing PgC fully from the SPM (in both figures and in text) and to instead use Gt which for policymakers are more common and easily accessible. [Government of Norway, Norwegian Environment Agency]
7929	33	1	33	1	Figure SPM.7: Title statement: Here you must include the relevant time horizon. They take up a diminishing share of these emissions during the 21 century. [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
9465	33	1	33	1	Explain the reasons for the decreasing fraction of CO2 uptake with increasing emissions in Figure SPM.7. [Government of United States of America, U.S. Department of State]
9467	33	1	33	1	The SSP labels are missing decimal points (e.g., 85 rather than 8.5). [Government of United States of America, U.S. Department of State]
9471	33	1	33	1	Make the opening caption explicit: "Projected change in the combined land and ocean carbon storage OF THE CUMULATIVE ANTHROPOGENIC CO2 EMISSIONS under..." The sub headline below (a) might say "Change in land PLUS ocean storage" so that it matches the "combined" in the caption. [Government of United States of America, U.S. Department of State]
8339	33	1	33	5	SPM.7 is interesting but very complex perhaps simplify with les details or include some detail in a table [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
9469	33	1	34	1	Are the numbers for Gt CO2 simply converted from those for PgC by multiplying a factor of 44/12? Or maybe the PgC numbers also include CH4. [Government of United States of America, U.S. Department of State]
4201	33	3	33	3	1850 written in the 3rd line of description and the starting point of the coordinate axis of Panel a) are different. To avoid confusion, it would better to modify them. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]

Comment ID	From Page	From Line	To Page	To Line	Comment
5173	33		33		Figure SPM.7 panel (a): The starting point for scenario SSP1-1.9 (in 2019) is not aligned with the other scenarios. This makes it hard to correctly perceive the difference between this an other scenarios. The figure makes it look like the storage in SSP1-1.9 only crosses the other scenarios in ~2040, but this is only an effect of differences (uncertainties?) regarding the starting point. [Government of Belgium, Belgian Science Policy Office - Belspo]
5175	33		33		Figure SPM.7 panel (a): We do not see a benefit in getting both a PgC and GtCO2 scales in an SPM. Even if both scales remain, we suggest making the GtCO2 scale the primary one, which means changing the horizontal lines to get rounded values in terms of GtCO2 (500, 1000, 1500... up to 3500). This would improve consistency in the use of units, as the right column in panel (b) provides values in GtCO2. Detail : please add the periods within the scenario names (SSP1-1.9, not 19). [Government of Belgium, Belgian Science Policy Office - Belspo]
5177	33		33		Figure SPM.7 panel (a): Could you consider providing rates of change in the land storage (= net sink) as a replacement for panel (a) or panel (b) ? This would be at least as relevant as the total carbon storage and could replace or supplement it in a useful way because the implication of changes in storage are not easy to explain. [Government of Belgium, Belgian Science Policy Office - Belspo]
5179	33		33		Figure SPM.7 panel (b): the link with panel (a) is hard to understand. In addition, we wonder about the cause of these results, from a scientific viewpoint. As panel (b) does not show a sink, but rather a total absorption until 2100, it seems to us that the total shown for higher emission scenarios is partly due to the fact that in these scenarios, emissions are still high near 2100 : part of the emissions are necessarily in the atmosphere because they did not have the time to be absorbed. If, instead of showing the total storage, you would show the net sink in 2100, it would likely provide a different conclusion. We question the policy-relevance of the message from panel (b), because it may imply that with increased emissions, there is a decrease in absorption, while this conclusion would be beyond what is shown. The role of absorption is complex: the primary effect of increased emissions is to increase absorption (as e.g. SSP1-1.9 shows: sinks becomes sources near 2100 given negative emissions, thus a correct understanding is that with low or negative emissions, the sink will disappear). By over simplifying the message we are afraid of generating confusion. [Government of Belgium, Belgian Science Policy Office - Belspo]
5181	33		33		Figure SPM.7 panel (b): the words "land and oceans" are not sufficiently visible. Please have them outside the pie charts, and possibly consider creating a separated key to explain the meaning of each element in the pie charts (similar to or consistent with panel a in fig SPM9). [Government of Belgium, Belgian Science Policy Office - Belspo]
6471	33		33		Figure SPM.7: There are several issues with this figure that would require further explanation. Either this figure is simplified (easy to understand for everyone) and reduced to the most important information, or it is deleted and only the most important message is written down. [Government of Austria, Federal Ministry of Agriculture, Forestry]
93	33		33		Fig. SPM.7 Caption: should it be "concentrations-driven" or "emissions-driven"? [Government of Singapore, Ministry of Environment and Natural Resources]
3007	33		33		"SSP5-85" -> "SSP5-8.5", "SSP3-70" -> "SSP3-7.0", (….) in 'Fig SPM.6 panel a) [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
3009	33		33		Fig SPM.6 panel b), It is better to express each share of land and ocean separately as numbers to make it easier to identify. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
3011	33		33		It was explained that “The land sink eventually turns into a source under SSP1-1.9” in page 14 line 5-6, but ‘Fig SPM.6 Panel b)’ shows an increase in land share when SSP1–1.9 compared to historical shares. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]

Comment ID	From Page	From Line	To Page	To Line	Comment
2773	33		33		Figure SPM.7: We expected to be able to derive the % shares of carbon taken up by land and ocean sinks (pie charts) from the numbers provided in the left-hand panel (carbon storage in land and oceans) and those in the right-hand panel (cumulative anthro CO2 emissions) but we cannot. For example, looking at SSP2-4.5, the carbon uptake is projected to be about 2200 GtCO2 by 2100 while the cumulative anthro CO2 emissions are projected to be 5390 plus/minus 240 GtCO2. So the % uptake would seem to be about 40% whereas the value in the pie chart is 54%. The answer may be in the caption, but it is not readily found. Recommend revisions to the caption to make it easier to follow the sequence of results across the panels. [Government of Canada, Environment and Climate Change Canada]
6989	33				Figure SPM.7: It would be preferable to simplify the titles of the two panels, e.g., by keeping only the text above or below the horizontal line. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6991	33				Figure SPM.7: As "carbon storage" (in panel a)) and "carbon stores" (in panel b)) are not defined in the glossary and have no standard definitions, it would be prefeerable to use standard terms, such as "[changes in] carbon stocks" or "carbon pools". [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6993	33				Figure SPM.7: For panel b), it would seem more intuitive to compare only future (projected, 2020-2100) shares to historical shares. The inclusion of the historical (1850-2019) data in the "projected shares" is confusing and hard to interpret. The scenarios differ only in the future, and the policy-relevance of sinks is also limited only to the future. Presenting only the future period would also make it easier to see the changes in the relative strength of ocean and terrestrial sinks. In any event, an indication of the expected future changes in the airborne fraction would be useful. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
4203	34	0	34	0	It would be helpful for readers to show more clarity on the shadings that indicates "very likely" or "likely" ranges. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
4205	34	0	34	0	Figure SPM.8 b) shows simulated results based on CMIP6 models for 1950 - 2015, while Figure TS.8 c) also shows observed data. It would be better to show observation, like Figure SPM.8 d). [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
4207	34	0	34	0	With regard to the Figure SPM.8 Panel e, we would like to request to add the SSP1-1.9 case. It would be also helpful if the best estimate of all cases including SSP1-1.9 could be shown in this panel. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
4807	34	0	34	0	Given the deep scientific uncertainty around the Marine Ice Cliff Instability based projections, we suggest that figure SPM8 focuses exclusively on high-confidence information. Could the authors consider removing the low cofidence elements of Fig SPM8 and, instead, expand on the narrative in paragraph H.S.9.2 to highlight the potential hazard (i.e. SLR of 2m by 2100 is possible) noting that in general low-probability/high impact SLR events cannot be ruled out. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
7675	34	0	34	0	Figure SPM 8 (d) remove dotted line marked "adding low confidence processes". This is in line with our comments on avoiding unbalanced focus on low probability outcomes. [Government of India, Ministry of Environment, Forests and Climate Change]
7937	34	1	34	1	Figure SPM.8, panel d: The label "adding low confidence processes" is hardly any help for the non-expert reader. You need to be explicit here: e.g., "including contributions of large-scale melting or disintegration of polar ice masses". [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
9473	34	1	34	1	Show the mean temperatures and total difference in cumulative CO2 emissions out to 2300; otherwise the 2300 numbers are without context and cannot be understood. This might be done with numbers on the right side, not with new plots. [Government of United States of America, U.S. Department of State]

Comment ID	From Page	From Line	To Page	To Line	Comment
4491	34	1	34	1	Figure SPM.8. In panel (c), "lower" and "higher" might be better than "low" and "high" (acidity), given the small range of pH-values covered here. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
4493	34	1	34	1	Figure SPM.8. The label for the y-axis in panel (a) should be oC, not Co. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
4495	34	1	34	1	Figure SPM.8. The "16 meters" in panel (e) would need additional characterisation, including in the figure caption. What the "if" refers to and under what assumptions does this apply should be discussed. Please consider adding explanatory text in the caption, and possibly also under H.S.9.2. Also, in Panel (d), it should be made clear that the dashed line applies to SSP5-8.5 (alt. high-end scenarios), not the lower-emission scenarios. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
6305	34	1	34	1	SPM.8.b) The graph shows sea-ice area reductions linked with the different scenarios, while the dashed line visualizes the "practically ice-free" part of the graph. In the text above, it is not written "practically ice-free" but only "Ice free Arctic". This should be consistent or delete the text in the upper part of panel b. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
6307	34	1	34	1	SPM.8: Please label the y-axis in panel c with the unit for the pH (negative decadic logarithm of the concentration of [H]+). [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
6309	34	1	34	1	SPM.8: Please move the title of panel e from its bottom to its top and the text to the bottom, with the title at the top like in the other panels, and because most people read from the top to the bottom. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
6311	34	1	34	1	SPM.8: Shadings are very weak and seem to be absent in panel c and possibly a. Please revise. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
5073	34	1	34	1	Figure SPM.8 is another impressing figure, given its critical and clear messages. However, I would like to suggest clarifying what "low confidence processes" are in panel d) and not only in the caption. [Government of Norway, Norwegian Environment Agency]
7931	34	1	34	1	Figure SPM.8: Title statement is non-quantitative: "quickly" and "longer timescales" should be quantified. [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
7933	34	1	34	1	Figure SPM.8: There is a serious inconsistency regarding the time horizon of year 2300 at which only estimates for SLR are given. It would be important to provide estimates also for the other four variables. [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]

Comment ID	From Page	From Line	To Page	To Line	Comment
7935	34	1	34	1	Figure SPM.8: Here is the opportunity for AR6 to extend the projection horizon. This is crucially important since there are now less than 80 years to reach the traditional projection horizon. Note that 30 years ago, FAR also used year 2100 for their projections. It is now high time to extend to 2300, as is done in this figure for SLR. The long-term committment of today's CO2 emissions can only be conveyed by providing estimates of change for the farther time horizon as well. This is most policy-relevant, and therefore WGI has an obligation to set the standards for this and future assessments. [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
4809	34	1	35	1	Figure SPM.8 uses a mixture of observations and historical simulations to show historical changes. (There are observations of historical sea ice changes that could have been used instead of simulations here.) It isn't clear how the uncertainty estimates have been calculated for the historical global surface temperature timeseries. Could this please be clarified? [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
8341	34	1	35	5	SPM.8 This is useful but perhaps the information could be combined in a better way including with material suggested in the comments on the text. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
5183	34		34		Figure SPM.8 panel (a): We suggest removing the line at 6°C. It is not useful and thus unnecessarily compresses the vertical scale. [Government of Belgium, Belgian Science Policy Office - Belspo]
5185	34		34		Figure SPM.8: Is interannual variability included in the shading area, especially in panel (b) ? We suggest making this clear in relation to the fact that given this variability as provided by the set of models, it shows a potential for nearly ice-free conditions in some years already by ~2020. Why is past variability or uncertainty so large in panel (b), grey area, while we have observations? [Government of Belgium, Belgian Science Policy Office - Belspo]
5187	34		34		Figure SPM.8 panel (e): why "around Antarctica" in the note on top of the panel? This is about land ice, while "around" may gives the impression that it is about floating ice. [Government of Belgium, Belgian Science Policy Office - Belspo]
5189	34		34		Figure SPM.8: panel (e) is particularly important to inform about the risks of sea-level rise. We welcome its inclusion in the SPM. [Government of Belgium, Belgian Science Policy Office - Belspo]
5191	34		34		Figure SPM.8: The dashed line is important to us: it is very relevant to know what could happen in the worst case. Would it be possible to indicate whether this upper limit only applies to the highest scenario or may also be experienced with lower emissions? If it is only for the higest scenario, would it be possible to have a line indicating the worst outcome in term of SLR but for at least one other scenarios ? [Government of Belgium, Belgian Science Policy Office - Belspo]
5193	34		34		Figure SPM.8: Shadings are too pale, they are hardly visible (for instance in case of projection or poor printing). We suggest moving the rightmost axis (SLR meters) to a position in between panels (d) and (e) so as to clarify that it applies to both. This layout change may also help clarifying that there is a "time axis rupture" between the 2 panels . In addition, it would be useful to clarify that all shadings do not have the same statistical meaning, by indicating on the figure which ones are "likely" ranges and which ones are "very likely" ranges. Figure TS.8 might help as it appears clearer. [Government of Belgium, Belgian Science Policy Office - Belspo]
6473	34		34		figure SPM.8 panel e): it is suggested to include also the long term sea level rise for SSP 1-1.9 (if available) [Government of Austria, Federal Ministry of Agriculture, Forestry]
6489	34		34		SPM.8: panel c: the unit is not "no unit", but a dimensionless number [Government of Austria, Federal Ministry of Agriculture, Forestry]
95	34		34		Fig. SPM.8: y-axis of panel (d) should be "1.5" and "0.5"; there should be dot in place of comma [Government of Singapore, Ministry of Environment and Natural Resources]
97	34		34		Perhaps useful to include a reference line of 1.5C warming and corresponding time of crossing in panel (a). Should also state in caption if lines are 20-yr rolling window averages. [Government of Singapore, Ministry of Environment and Natural Resources]

Comment ID	From Page	From Line	To Page	To Line	Comment
2775	34		34		In panel d) of Figure SPM.8, add "high potential impact" to the text label of the dashed line, which would now read as follows: "Adding low confidence high potential impact processes". This dashed line is added to the graph primarily because of the high potential impact on sea level rise of uncertain ice sheet processes. [Government of Canada, Environment and Climate Change
405	34		35		Figure SPM.8 : For this figure the numbers don’t seem to be easily matched up, since panel a and panel b are not exactly the same. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
3017	34		35		Please add a vertical line to detect the values of the x-axis, and add 2030, 2070yr (or 2075) to the x-axis to make it easier for understanding changes. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
6995	34				The figure title is not very appropriate for a figure that describes mainly 'slow' ocean components and global atmosphere. How can we infer 'quickly' versus 'slow' from this figure? The first line of the figure caption seems more appropriate. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6997	34				This diagram (or at least panel d) should show sea level rise projections will beyond 2100. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
233	35	0	35	0	Figure SPM.8 states "future assessed global surface temperatures changes relative to 1850-1900." Projections of future climate change should reflect forecast errors. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
235	35	0	35	0	Figure SPM.8 states "the assessment changes were constructed by combining scenerio-based projections with observational constraints based on past simulated warming...relative to 1995-2014" The report should note these models were built in simulations based on several assumptions and results of different models. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
9475	35	1	35	1	There may be too many legends in this figure. Particularly confusing is that the colors defined (1-6) in the top half of the figure use slightly different wording than the definitions (1-5) in the bottom half. Recommend changing the title to remove 'while': "Changes in climate impact-drivers are projected everywhere, with each region experiencing a specific combination of changes." [Government of United States of America, U.S. Department of State]
99	35		35		Fig. SPM.8 Caption: "Global surface pH, a measure of acidity" should be replaced by "Global ocean surface pH, a measure of acidity" [Government of Singapore, Ministry of Environment and Natural Resources]
6475	35		36		Figure SPM.9: is very complex. Furthermore the information seems not to be very policy relevant, but more of scientific interest. It would be most helpful if this information would be addressed by WG II. The WGI SPM could be shortened by deletion of this complex information which is not very policy relevant but becomes much more policy relevant in the context of impacts and adaptation and management of climate change risks – topics which are outside the scope of WGI. [Government of Austria, Federal Ministry of Agriculture, Forestry]
2913	36	0	36	0	"decrease in cold spell"? does it mean "decrease in the temperature associated with cold spells"? [Government of Chile, Ministry of Environment]
4209	36	0	36	0	This is a highly elaborate and very informative diagram. However, changes in CIDs in a certain group are not necessarily representative for changes in each region in the group, which might give wrong impression to policymakers. For example, we in Japan are facing increasing risks of river flooding seriously, but EAS including Japan is categorized into group 3 where river flood is not colored. In Table TS.5, EAS has medium confidence level for river flood, which may be qualified to be colored. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
4211	36	0	36	0	Some readers may misconstrue that combinations of future changes in CIDs without colors will not be never seen. We suggest adding legends for CIDs that have zero risk to happen for the foreseeable future, and for CIDs that have low confidence. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]

Comment ID	From Page	From Line	To Page	To Line	Comment
7573	36	0	37	0	SPM.9: this a very complex figure. Although it is a good attempt to visualise the projections of impact-drivers, it may also trigger discussion on the interpretation of compound drivers as it is stated now. In our view this figure needs much more explanation than is given in the caption. Figure SPM'3 already gives a nice view of the occurring tendencies of extremes in the climate system. We foresee a lot of discussions during the approval session about this figure. [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
7575	36	0	37	0	Please write GWL in full throughout the pages: Global warming level [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
153	36	0	37	0	Data availablity vary between regions. Therefore, confidence level of changes in climatic impact-drivers would vary. The confidence level of such changes for each region should be reflected in the figure and in the overall text in the report. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
1689	36	0	37	0	Figure SPM 9 contains too much material for a SPM figure. In addtion it includes many, many details that need to understood before getting idea what is being communicated. Panel b) is easier to grasp than a), but one can not interpret the magnitude of the change and it is not supporting the Headline of the figure. Please, consider leaving panel b) out of SPM. The map in panel a) communicates that combination of CIDs differs between regions, i.e. supports the Fig. Headline "While changes ...". The explanation of clustering analysis below map is very complicated, or at least it seems difficult to follow. At present format we question how much added value this kind of figure can provide to decision-makers. [Government of Finland, Finnish Meteorological Institute (FMI)]
6353	36	0	37	0	Figure SPM9 is too complex and does not add much to the SMP. Please delete. [Government of Estonia, Estonian Meteorological & Hydrological Institute]
9477	36	1	36	1	In Figure SPM.9a, why are the ocean regions left out entirely? If they were included as regions, the graph could show where marine heatwaves are increasing in frequency. [Government of United States of America, U.S. Department of State]
9479	36	1	36	1	In Figure SPM.9a, include ocean acidity increases in the description along with sea level rise, coastal flood, and coastal erosion as another change happening everywhere. [Government of United States of America, U.S. Department of State]
9481	36	1	36	1	In Figure SPM.9a, the wording is confusing. Rewrite as: "All coastal region except ... will be exposed to increases in at least 2 of 3 of the following climate-impact drivers: relative sea level, coastal flooding, and coastal erosion." [Government of United States of America, U.S. Department of State]
9483	36	1	36	1	Fix the descriptions 1-5 in the upper right to more closely match the identical ones in the lower half -- e.g., snow/ice appears in the lower pink (#4) but not the upper right. Also is it clear that CIDs are all negative? Or could be positive? This matters in the second part of the figure where CIDs increase or decrease. The increase or decrease depends on the definition of the CID and can be made arbitrarily positive or negative? [Government of United States of America, U.S. Department of State]
4497	36	1	36	1	Figure SPM.9: Panel (a), The Mid-21st Century is not a "reference period" as such, but rather the period which is shown/addressed/for which the results are provided. Also, the "GWL" should be written out in full. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
4499	36	1	36	1	Figure SPM.9: Panel (a) The legend (2nd half of the page) is overly complicated. The diagrams, summary text below each diagram and an extensive legend to the right is not very reader-friendly. The information could be condensed into text instead, for example using in coloured boxes or suchlike to provide a visual impression -link to the panel (a). [Government of Sweden, Swedish Meteorological and Hydrological Institute]
6313	36	1	36	1	Figure SPM.9: Please check and revise: group 4 is called "hotter and less snow/ice", but consists of a group of regions mostly in the tropics where snow would be a very rare event in any case. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]

Comment ID	From Page	From Line	To Page	To Line	Comment
6315	36	1	36	1	Figure SPM.9: Please revise figure. The titles of the groups in panel a) are not identical to the names in the legend to this panel. For example, group 4 is titled "Hotter and wetter and in some regions more flooding" or "Hotter and less snow/ice". [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
6317	36	1	36	1	SPM.9.a): In the graph showing the world regions, there is text written in the Antarctic area, which is at that site quite difficult to read and may be overlooked. It should be tested whether it is possible to put it under the world and shift the second part of the graph a bit. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
6319	36	1	36	1	SPM.9.a): Like in SPM.3 please include the explanations for the abbreviations of all regions in the figure and consider using hexagons like in SPM.3 to avoid discussions about proportional sizes of regions. Furthermore, Antarctica should be mentioned as well. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
4811	36	1	36	1	This figure (SPM.9) provides valuable information but omits anything on seasonality which could be important for some regions. For example north west europe (inc UK) is projected to have hotter drier summers but warmer wetter winters - thus the hotter wettter description for NEU fails to capture a potential increasing risk of drought at least in some parts of NEU. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
8651	36	1	36	1	Suggest clarification: The term "GWL" is not defined in the SPM (used in Fig SPM.9 panel a) and b)), please provide more information. [Government of Australia, Department of Industry, Science, Energy and Resources]
4813	36	1	36	1	SPM9a is a really clear and useful figure! One suggestion - it may be nice to change the icon for tropical cyclones to something slightly more impactful than a dot. I think b could probably be placed in the TS/chapter. Perhaps the key message of the figure could be captured briefly in the text somewhere. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
8653	36	1	36	1	Fig SPM.9. Please use an icon with 6-fold symmetry to represent "snow and ice". [Government of Australia, Department of Industry, Science, Energy and Resources]
5077	36	1	36	1	Please consider the use of acronyms for the regions in figure SPM.3 and SPM.9. They do not completely match the regions as defined in chapter 1.4 figure 1.15 of WG1. In figure SPM.3 and SPM.9 the regions NEN, WCE, SEAF, and ESAF have different acronymes compared to chapter 1.4 figure 1.15, and the regions ECA and EAU is included in the SPM, but not in 1.4 figure 1.15 [Government of Norway, Norwegian Environment Agency]
8649	36	1	36	10	To help avoid potential confusion in thinking Australia doesn't have fire weather increases, the key on the right side of the map could be worded to better match the content in the more detailed CID colour wheels below the map, or perhaps the key on the right side of the map could perhaps be removed given the details already provided below the map. [Government of Australia, Department of Industry, Science, Energy and Resources]
5075	36	1	37	1	Figure SPM.9: a) This is a useful figure for understanding general trends in climatic changes in different regions. It surely is a simplification, but that is necessary for keeping the figure less complicated. b) The last part with the bars, is a nice overview on changes in climate impact-drivers. However, it is not clear how the two circles with an arrow going from means or events or extremes to society and ecosystems is related to the bars that shows the changes. Are the two circles only a visualization of the definition of Climatic impacts-drivers? If so we are not sure if it is really needed. [Government of Norway, Norwegian Environment Agency]
8343	36	1	37	5	SPM.9 is very complex and some material may be better addressed in WGII [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]

Comment ID	From Page	From Line	To Page	To Line	Comment
7941	36	1	37	20	Figure SPM.9: This figure is totally confusing because it indends to include too many detailed assessment findings. The level of detail and load of information is not at all fitting the purpose of an SPM figure. The initial idea to illustrate new regional challenges arising from a COMBINATION of extreme climate events is excellent. However, the fundamental message gets totally lost in a myriad of new icons, arrangements, colors etc., that are only used in this figure. This figure beats by far all others in complexity and will easily rank top as being the most difficult figure to comprehend in this SPM. This figure is even more complex than the two most criticized of AR5 IPCC WGI SPM (see Harold et al., 2016, doi: 10.1038/NCLIMATE3162, and Harold et al., 2020, doi: 10.1007/s10584-019-02537-z). This is a step backwards when IPCC seeks to improve communication of regional impacts. It would be quite easy to more effectively communicate the major message by keeping only the map in the SPM and moving all other panels/items to the Technical Summary. The headline statement of this figure could also be made more compelling: e.g., "While changes in climate impacts are projected in all regions, new challenges arise by their combined occurrence." Simple and more to the point, with only the map as an illustration. [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
7939	36		36		Figure SPM.9 panel a) - Is there enough evidence to justify the dot (Increase in Tropical cyclones intensity or Severe winds) in the WCE region? There might be an increase in Tropical stroms in MED and some increase in winter storminess in NEU, but are you sure there really is for WCE? [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
101	36		36		In (a), the difference between points 4 and 5 (more flooding vs wetter extremes of more precipitation) is not obvious. Also, if these are meant to reflect the 5 points at the bottom figure, it would be good for the titles to match. [Government of Singapore, Ministry of Environment and Natural Resources]
103	36		36		Figure SPM9-a: A general comment on the choice of global regions: Australia has now been cut into 4 regions (and not 2 as in AR5 and AR4). From a scientific standpoint, it may be useful to consider a similar approach in the Southeast Asian region in the future: this is currently encompassing both the Maritime Continent (MC) as well as the mainland SEA region - both of which are quite different in terms of their response to climate processes and impact of future changes. The MC region is especially known to be poorly simulated by GCM, and there might be a case to separate this region into 2 regions. We understand this is not possible for AR-6 at this stage, but perhaps it could be considered for AR-7. [Government of Singapore, Ministry of Environment and Natural Resources]
7035	36		36		chapter of ATLA,page20, Figure Atlas.SM.5 and Chapter 12, page 48,table 12.4 and Chapter of SPM page 36 ,Figure SPM.9: Panel a "in ARP region the line that is drawn over the Persian Gulf region must be corrected because The Persian Gulf does not belong to the Arabian Peninsula" http://nationsonline.org/oneworld/map/Arabia-Map.htm [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]

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2779	36		36		Figure SPM.9. Panel A of this figure is extremely complex and there is no clear message presented in this Figure; rather, the messages are very convoluted. As currently constructed, the main message conveyed is that groups of regions are projected to experience a common set of changes. Hence the five colour coded clusters. The emphasis is on commonalities rather than uniqueness. The title, however, indicates an intent to convey a different message - that each region is unique, and is projected to experience a specific combination of changes. The only way to get information about the uniqueness of each region is to dive into the details of the characteristics of the 5 clusters and yet even there, the information is ambiguous because within a cluster, some regions may have some features, some may not etc. This difficulty was clearly evident to the Figure creators because the short-form labels beside the upper panel were not very successful in trying to capture appropriate key features that apply to all regions within a cluster. For example, the legend for the wheel #2 reads “Hotter and more fire weather, and in some regions more pluvial flooding or drought or less mean precipitation or snow and ice or combinations of these”. A policy-maker in a particular region of cluster #2 will not be able to tell what change will occur in their region other than hotter and more fire weather, as it is not clear if any individual region belongs to “some regions” and which of the possible changes in other CIDs are projected for their region. Policy-makers will want to understand what changes are projected in their region and the ambiguity about this from the descriptions of each cluster, is problematic. For these reasons, the Figure is not usable for briefing policy-makers. We recommend it not be included in the SPM in its current form (see comment below for a suggested alternate approach to Panel A). We consider Panel B, with revisions as suggested in detailed comments, suitable for inclusion in the SPM. [Government of Canada, Environment and Climate Change Canada]
2781	36		36		Canada offers these additional technical comments which add further support to our overarching comment that as currently constructed, Panel A is too complex to be included in the SPM. 1. Cluster labels. The labelling of the clusters next to the map and in the description of each wheel is not consistent and this leads to some confusion. It was hard to discern if a systematic approach was used for the 5 cluster labels. One such approach could be: High Confidence changes across all regions, and, where there are at least 2 other "like" (similar) indicators (i.e. for hotter, drier, wetter conditions) indicating changes across some regions. Using this system, the labels would be 1. Hotter and drier, 2. Hotter, drier and more fire weather, 3. Hotter, more rainfall-related flooding, less snow and ice, 4. Hotter, wetter and and less snow and ice, and 5. Hotter and wetter. However, trying to apply a systematic approach to cluster labels reveals the complexity of doing so, given that changes in CIDs do not apply to all regions in a cluster. 2. Icon arrangement: Suggest rearranging the icons in the legend so that variables are grouped according to whether they support the general categories of Hotter, Drier or Wetter. In effect, this would just mean shifting the groups of drought, mean precipitation and fire weather icons together, followed by the less snow and ice icon, and then the three water cycle variables indicating wetter conditions. Similarly, for the circle charts, it might work better to group the icons around the circles so that "like variables" are together. Again, this would mean shifting the fire weather icon to be beside the icon for drought, and the mean precipitation decrease icon. 3. Icon symbols: consider modifying the symbol for "mean precipitation decrease" to narrow diagonal lines with downward pointing areas on the left/lower sides of each line. Similarly, for "mean precipitation increase", modify the symbol to bold lines with upward pointing arrows on the right/upper sides of each line. This could help avoid misinterpretation associated with display resolution, visual impairments, etc. Also, snowflakes have only six sides/points whereas the symbol shows eight. This should be corrected. [Government of Canada, Environment and Climate Change Canada]

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5213	36		37		"GWL" acronym is used in Figure SPM.9, Panel a) and Panel b) (Reference period: Mid 21st century or 2°C GWL compared...) but it has not been explicitly defined in the SPM. [Government of Argentina, Ministry of Environment and Sustainable development of Argentina]
7781	36		37		It should also be shown in Figure SPM.9 panel a) that the frequency and intensity of cold extremes on the northern hemisphere seem to be on the rise due to the warming-induced trend-like weakening of the polar vortex. This possibility was raised already in AR5 Chapter 14.8.6 Page 1266), but since then a large number of observational evidence have emerged which are partly referenced in Chapter 10 Page 20-21 in AR6 ("Mechanism for a potential influence in winter") and several extreme cold spells hit the northern continents with severe consequences. It is now high time including this possibility in the SPM as well. [Government of Hungary, Ministry of Innovation and Technology - Climate Policy Department]
3025	36		37		The "legend" next to the map and "combination" in Figure 9 panel a) do not seem to match. The legend and description of the figure on page 37 also do not match. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
3027	36		37		"Mid 21st century or 2℃ GWL" in Fig. SPM.9 panel b) but " around 2050 if 2ºC of global warming" on page 37 in description of Figure. Unify the expressions. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
2783	36		37		Figure SPM.9b: In this panel, the progression of variables under "Heat and Cold", "Wet and Dry", "Wind" etc. all make sense, but this is not the case for "Snow and Ice". Why are snow, glaciers, and ice sheets grouped together? This mixes a seasonal fast response component of the cryosphere (snow) with perennial slower responding glaciers and ice sheets. Similarly lake ice (which includes mid-latitude lakes like the Laurentian Great Lakes) is grouped with sea ice, which is of course primarily in the Arctic. These groups should be re-thought because they also result in double counting. For example permafrost and snow overlap completely but are in separate groups. [Government of Canada, Environment and Climate Change Canada]
2785	36		37		Due to our overarching concerns with Panel A of this Figure (see other comment from Canada), we suggest an alternate and much simpler approach for Panel A of Figure SPM.9. Since Panel B provides information about the number of regions where climate impact drivers are increasing or decreasing with high or medium confidence, our suggestion is that Panel A could be redesigned to show, simply, the number of climate impact drivers increasing or decreasing with high or medium confidence in each region. So it would be a simple map, with a number in each region. Furthermore, we think it would be possible to direct users to the interactive atlas where 'pop up' information could then be provided about which climate impact drivers are increasing, and which decreasing, in each region. We strongly urge the authors to consider this suggestion. Such a map would also be directly relevant to headline statement 11 that emphasizes the concurrent changes in multiple climate impact drivers in each region. In addition, by removing the clusters, it will also save considerable amount of space. This way, it might be possible to fit both panels onto one page. [Government of Canada, Environment and Climate Change Canada]
7199	36				Trinidad and Tobago is requesting that the authors revisit Stephenson et al; 2014 that provides evidence of changes in heavy precipitation for the entire region. Specifically, the study found "The most significant change is found in the heavy rainfall events (R95p), which are generally rising. A significant R95p increase of 2.93, 4.93 and 2.07% per decade is observed in regions 1, 2 and 5, whereas a significant increase of 2.05% per decade is found in the regional average series for the entire Caribbean region during the past 25 years". Also, the study found that "these results are in agreement with results presented in Peterson et al. (2008); Aguilar et al. (2005) and Peterson et al. (2002)." These along with Dookie et al., 2019 should provide further clarity. Figure SPM 9 must convey the evidence deduced from the literature. [Government of Trinidad and Tobago, Ministry of Planning and Development]
6999	36				What is 'fire weather' and how does this link to more precipitation? The grouping of clusters seems somewhat arbitrary, e.g. it is difficult to understand if the 'some regions wetter extremes' in group 2 is a characteristic or rather the exeption to the rule. It is correct that for group 4 there is nowhere an increase in precipitation extremes? The sentence about coastal regions seems incomplete (two among increases). [Philippe Tulkens, European Union (EU) - DG Research & Innovation]

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2777	36				Figure suggests that much of Canada is characterized as “Hotter and wetter extremes and in some regions more precipitation or fire weather”. However, this does not capture the temporal variation in expected precipitation and that “more precipitation” will occur in certain times of the year while less precipitation may be expected in others. Suggest adding a reference to more detailed, regionally specific projections in other chapters, if available. [Government of Canada, Environment and Climate Change Canada]
4213	37	0	37	0	Panel b): The total number of areas on land and at sea, respectively, needs to be indicated. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
4215	37	0	37	0	What does it mean that the item "air pollution weather" is zero? What is the "air pollution weather"? If the explanation is not carefully given, it may be taken to mean that there is no relationship between climate change and air pollutants (short-lived climate forcers). [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
8655	37	0	37	0	Suggest including the total number of regions considered to be used as a reference point In Panel b). For example, when looking at the bar chart, we read 50 regions will have climatic impact drivers increase in terms of 'Mean air temperature'. However we do not know whether those 50 are all the (possible) regions considered. Suggest a circle which says 'xx regions in total' under the bar chart. [Government of Australia, Department of Industry, Science, Energy and Resources]
9485	37	1	37	1	In Figure SPM.9b, it's not clear if the "other" section is referring to ocean surface or earth surface. Given its placement between Coastal and Ocean, one would assume that it is sea surface but needs clarification. [Government of United States of America, U.S. Department of State]
9487	37	1	37	1	In Figure SPM.9b, there are NO regions where air pollution weather is expected to either increase or decrease. Many studies have shown a "climate penalty" for ozone in North America. [Government of United States of America, U.S. Department of State]
9489	37	1	37	1	Key issue - Drought: The "Hydrological drought" and "Agricultural and ecological drought" bars of Figure SPM.9b show exactly zero regions of projected drought decrease, and many regions of projected drought increase. As discussed in the U.S. Whole Document comment, these results seem to strongly contradict Box TS.6 Figure 1d and Figures SPM.5d and 8.19c,f,i, which show roughly equal areas of wetting and drying in runoff and soil moisture respectively. For agricultural and ecological drought, this is because the Figure SPM.9b bar relies on Table TS.5 and, in turn, on the assessments in the table rows at the end of Chapter 11, which are mostly driven by controversial sources other than total-column soil moisture. The agricultural drought bar should be re-assessed based only on the GCM total-column soil moisture projections that informed Figure SPM.6 (lower right), and not on the other metrics from the tables. This will bring about consistency with the total-column soil moisture figures, which will improve credibility. For hydrological drought, the reason for the contradiction is less clear (since all sources in the hydrological drought rows of the Chapter 11 tables presumably assessed runoff and not some other variable), but for consistency with the rest of the report, the hydrological drought bar should be re-assessed based only on the GCM runoff projections that informed Box TS.6 Figure 1d, and not on the studies from the tables, unless the reason for the contradiction can be explained here. [Government of United States of America, U.S. Department of State]
6321	37	1	37	1	Figure SPM 9: Please add information why panel b is important for the SPM? If it is needed please rotate the figure 90 degrees. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
4815	37	1	37	1	The drought data in this figure seems to conflict with the underlying data in 11.6.5. SPM9.b) seems to show no regions projected to see an increase in ecological/agricultural or hydrological drought but in the underlying text two regions “NEAF, SAS are also projected to experience less agricultural and ecological drought with global warming (medium confidence).” (section 11.6.5.6 p.86 L12-13). [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy &

Comment ID	From Page	From Line	To Page	To Line	Comment
4817	37	1	37	1	Where it talks about "mean air temperature" and "mean ocean temperature", could it perhaps be clarified if this is surface air, and surface ocean (especially for the ocean?)? [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
2787	37	1	37	1	Figure SPM.9, panel b: To provide more context, could the total number of elligible regions be indicated or the counts of regions be instead expressed as a percentage? The figure labelling and repeat of some oceanic CIDs indicate that the land and ocean regions are counted separately; but, it is difficult to understand why the mean temperature and extreme heat metrics show counts exceeding the number of land regions in panel a. Additionally, it is not easy enough to know for how many regions the coastal/oceanic CIDs were considered. [Government of Canada, Environment and Climate Change Canada]
5195	37		37		Figure SPM.9 panel (a) : the key under the CID circles is not clear: it seems to imply that the small circles provide additional information because there is an "and" (such as: "and in some regions more fire (...)), while the legend on the right provides different information (the small circles relate to effects which happen only in some regions). Please check the general consistency. [Government of Belgium, Belgian Science Policy Office - Belspo]
5197	37		37		Figure SPM.9: panel (b) provides the same kind of information as panel (a) but in more detail. We suggest keeping only one of these panels, and we have a clear preference for panel (b): please explore ways in which its design might become more attractive while being easy to understand and providing all the key messages. [Government of Belgium, Belgian Science Policy Office - Belspo]
7037	37		37		Figure SPM.9: in the Panel b please replace "Meteorological drought" instead of " aridity" in Wet and Dry option [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]
407	37		38		Figure SPM.9 : Like for the figure SPM 3, there is a lot of information on the graphs which makes it difficult to understand. For panel a the authors added a lot of explanation (especially how they defined the clusters) which is rather helpful. The authors could also add an explanation for the abbreviations of the regions. However, panel b still takes some time to understand. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
7001	37				Now suddenly 'hydrological drought' is being introduced, which is good. However, it would better to address this indicator a bit more. In the current document, the focus is very much on soil moisture, which is understandable, but hydrological drought deserves more attention in the summary. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
7687	38	1	38	1	Reader may find it difficult to understand that the bottom panel is not an independent representation but has to be read with the above panel. Clarity should be brought in the text detailing Figure SPM.10. [Government of India, Ministry of Environment, Forests and Climate Change]
7943	38	1	38	1	Figure SPM.10: Thsi figure presents a much appreciated new design and composition, but therre is a big problem with this figure: in fact, the figure stops at year 2050. This is a dangerous signal to policymakers as it does not provide information that is most policy-relevant for post 2050! As IPCC states in the SPM, many changes are committed already now beyond 2050. Why suppress >2050 in this key figure? [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]
7945	38	1	38	1	Figure SPM.10: This figure should be simplified by deleting the horizontal bars in the lower panel part altogether. The additional information is trivial, apart from the time information, Instead of cluttering the otherwies elegant figure, the time information could be provided by the small dots on the time axis (already done for 2050. By using another set of symbols (e.g., up and down triangles, diamonds etc.), the time horizons 2030 and 2040 could be easily added . Consequently, the bars and the somewhat akward explanatory text would then not be necessary. [Government of Switzerland, Swiss Federal Office for the Environment Federal Department of the Environment, Transport, Energy and Communications DETEC Federal Office for the Environment FOEN International Affairs Division]

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529	38	1	38	1	For the x-axis it is hard to see exactly where 1000 GtCO2, 2000 GtCO2 etc is. Please add little helping lines on the axis. [Government of Denmark, Danish Meteorological Institute]
9491	38	1	38	1	The bottom panel (bar chart) of Figure SPM.10 is hard to decipher. It would be easier to understand if it were noted that the length of the bar represented cumulative CO2 emissions in some way, similar to the top panel. Recommend adding "units" to the bars that represent cumulative CO2 emissions. [Government of United States of America, U.S. Department of State]
9493	38	1	38	1	The colored dots on the bottom x-axis should be better defined in the caption. The PgC emissions axis and the GtCO2 emissions axis are rather far apart in Figure SPM.7, which may be somewhat confusing since the colored dots are on the PgC axis in Figure SPM.7 but on the GtCO2 axis in Figure SPM.10. Perhaps putting the dots on both axes would help. [Government of United States of America, U.S. Department of State]
9495	38	1	38	1	Point out 1.5 and 2°C targets on the figure. [Government of United States of America, U.S. Department of State]
9497	38	1	38	1	Note in the Figure SPM.10 caption that it is only to 2050. The phrase "contribution from non-CO2 gases as described in each respective scenario" should say PRESCRIBED instead. There is no description in the SPM of the contribution of non-CO2, is there? [Government of United States of America, U.S. Department of State]
9499	38	1	38	1	If CO2 emissions were to drop to zero in 2051, then the cumulative carbon theory would imply that temperatures would stabilize at the temperature reached in 2050, correct? If so, is that worth noting in the figure? [Government of United States of America, U.S. Department of State]
7041	38	1	38	1	This report does not mention ENSO phenomena. It is appropriate to refer to the contents of the attached reports in the chapter 8. For example, the following reference can be added ch8,page 51, line 38 and considered here as well. "The influence of El Niño Southern Oscillation (ENSO) on the north Indian temperature, precipitation, and potential evapotranspiration (PET) change patterns were evaluated during the monsoon season across the last century (Tamaddun, et al ,2019). Also, El Nino and La Nina lead to major effect on the amount of monthly maximum temperature in the south of Iran (Hamedani Azmoodehfara and Azarmsa,2013)." ref: 1-Hamedani Azmoodehfara, M. and Azarmsa, S.A.,Assessment the Effect of ENSO on Weather Temperature Changes Using Fuzzy Analysis (Case Study: Chabahar),APCBEE Procedia,Volume 5,2013,Pages 508-513,ISSN 2212-6708,https://doi.org/10.1016/j.apcbee.2013.05.086. 2- Tamaddun, Kazi & Kalra, Ajay & Bernardez, Miguel & Ahmad, Sajjad. (2019). Effects of ENSO on Temperature, Precipitation, and Potential Evapotranspiration of North India's Monsoon: An Analysis of Trend and Entropy. Water. 11. 189. 10.3390/w11020189. [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]
4501	38	1	38	1	Figure SPM.10. The text in the figure, "The pace we follow determines how much warming we will experience by 2050." applies also to the time beyond 2050 (cf. cumulative emissions), perhaps even more so. Suggest expanding to 2100. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
4503	38	1	38	1	Figure SPM.10. The figure seems to focus on the period until 2050. This should be stated explicitly in the figure and the caption. An alternative and probably a better one would be to expand the figure all the way until 2100. This would reduce the risk of confusion viz. the budgets and warming levels for the different emission scenarios, and improve comparability with the other findings in the SPM. "The pace we follow" is perhaps even more applicable to the time beyond 2050... [Government of Sweden, Swedish Meteorological and Hydrological Institute]
6323	38	1	38	1	SPM.10: Clear and important figure! Please use for the figure only one wording: either "carbon emission" as above or "carbon-dioxide emission" as below in the figure. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]

Comment ID	From Page	From Line	To Page	To Line	Comment
8657	38	1	38	1	Suggest adding right-hand vertical axis indicators for improved readability. [Government of Australia, Department of Industry, Science, Energy and Resources]
5079	38	1	38	1	The sentence "every tonne of CO2 we put in the atmosphere adds to global warming" is a key message and must be kept and possibly given more prominence [Government of Norway, Norwegian Environment Agency]
8067	38	1	38	2	Figure SPM 2 goes from emissions to temperature impacts. This likely includes the range of uncertainties that this encompasses, including those related to the global enhanced carbon cycle. Hence the figure suggests a high uncertainty range of the contribution of CO2 to warming while previous AR reports shows a high level of confidence in CO2 forcing/warming. To avoid such confusion including of a standard WG1 RF figure with the estimated contribution to temperature increase shown is preferred. This should also include ozone and aerosol forcing rather than that of their precursors. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8069	38	1	38	2	Figure SPM 2 It is not clear what message the authors wish to communicate to policy are SO2 and NOx emissions to be maintied to provide cooling? [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
8345	38	1	38	5	SPM.10 This is a really important figure but should be a lot clearer and is confused by the 2050 cut off, which is inappropriate. The emissions should be to 2100 at least. [Government of Ireland, Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division]
6419	38	31	38	31	It is only half a degree that causes siginifcant increases? [Government of Saint Lucia, Department of Sustainable Development - Ministry of Education, Innovation, Gender Relations and Sustainable Developement]
7039	38	39	38	39	please add this new reference after sentence " the Middle East, and parts of East Asia," and consider it in the chapter 8, page 28 ,line 13. " For a 60-year period as well as for the periods of 1970-2008, 2003-2008 and 2008, and comparing them to the long term means, it indicates a decreasing behavior in the precipitation amount especially in the winter and spring months, so the maximum decrease is remarkable in the 5-year period of 2003-2008 and the intensive drought year of 2008.However the anthropogenic effects seem to be crucial important in the desertification progress and consequently in the dust rising over the Middle East, especially through the water reservation and dam construction in the upstream extremely in the recent decade. (Zoljoodi,et al, 2013)." Ref: Zoljoodi , et al “Dust Events in the Western Parts of Iran and the Relationship with Drought Expansion over the Dust-Source Areas in Iraq and Syria”, Atmospheric and Climate Sciences, 2013, 3, 321-336, http://dx.doi.org/10.4236/acs.2013.33034. [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]

Comment ID	From Page	From Line	To Page	To Line	Comment
7043	38	44	38	44	It seems that in this report, polar glaciers are more considered and other glaciers are omitted. Therefore, it is recommended to add a summary of the volume changes of other glaciers. In this regard, we can refer to the following research. This research can also be added in the ch9, page 79, line 37. "For example, the most part of the Alamkouh glacier in Iran has experienced lowering which the overall 1955–2010 geodetic volume change is estimated to be -0.29 ± 0.03 km3 which the highest retreat (equal to 42% of total volumetric change) occurred during 1997–2002 (Karimi et al., 2012b). Also in another study, the satellite-based analysis revealed that the clean ice areas of Khersan and Merjikesh glaciers (located in Takht- e-Solaiman region) shrank since 2010 with an overall area decrease of about 45% and 60% respectively. During 1987-1991 the maximum decrease in the glacier area was observed. The elevation change results over the Takht-e-Solaiman region revealed that, the glacier surface lowering has occurred during 1955-2010 continuously without any thickening with the mean annual thinning of about 0.4 ± 0.04 m per year. The maximum thinning rate has been observed during 1997-2002 (about 1.1 ± 0.09 per year and 0.96 ± 0.01 m/year), which was compatible partially with area change analysis. (Karimi et al., 2015, 2012a; Karimi and Eftekhari, 2014). " Ref: Karimi, N., Eftekhari, M., Farajzadeh, M., Namdari, S., Moridnejad, A., Karimi, D., 2015. Use of multitemporal satellite images to find some evidence for glacier changes in the Haft-Khan glacier, Iran. Arab. J. Geosci. 8. https://doi.org/10.1007/s12517-014-1578-5 Karimi, N., Farajzadeh, M., Moridnejad, A., Namdari, S., 2014. Evidence for Mountain Glacier Changes in Semi-arid Environments based on Remote Sensing Data. J. Indian Soc. Remote Sens. 42, 801–815. https://doi.org/10.1007/s12524-013-0343-7 Karimi, N., Farokhnia, A., Karimi, L., Eftekhari, M., Ghalkhani, H., 2012a. Combining optical and thermal remote sensing data for mapping debris-covered glaciers (Alamkouh Glaciers, Iran). Cold Reg. Sci. Technol. 71, 73–83. https://doi.org/10.1016/j.coldregions.2011.10.004 [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]
6477	38		38		Figure SPM.10: This figure is very clear and relevant and should definitely be kept, including the key message on top. [Government of Austria, Federal Ministry of Agriculture, Forestry]
5199	38		38		Figure SPM.10: It is surprising that all curves only extent to 2050. Why don't they continue until either peaking temperature, 2100, or the right-side of the graphic? If it remains so, we suggest making the note "(until year 2050)" more prominent by removing the parenthesis and clarifying, such as "data shown until 2050 only". However, we have the strong feeling that stopping all the curves in 2050 would be misleading, because it suggests that the warming may not be above 2°C even for SSP3-7.0. The same holds for the horizontal bars in the bottom: why is data only available until 2050? Could you add 2070 and 2100? [Government of Belgium, Belgian Science Policy Office - Belspo]
5201	38		38		Figure SPM.10 After the sentence “Cumulative CO2 emissions for projections are from the original (...) each respective scenario", we suggest adding the following: “The warming effect of CO2 alone is typically 10% lower” (TCRE of 0.45°C/tCO2 compared to a slope of 0.5°C/tCO2 with non-CO2 emissions). This is useful to understand the figure and also provides a link to how it was shown in AR5. [Government of Belgium, Belgian Science Policy Office - Belspo]
105	38		38		Figure SPM10: Suggest to add "by 2050" into the title. It takes a while to realise that this figure represents the projections on up to 2050 (mentioned only twice somewhere small in the text). This should be up front in the title of the figure. [Government of Singapore, Ministry of Environment and Natural Resources]
7245	40	33	40	34	[Chapter 9] About the changing formation of water masses in marginal seas, especially in the East Sea, new reference was published. "Decadal changes of Meridional Ocerturning Circulation in the East Sea" (2019, Journal of Physical Oeanography 50(6)) was clearly reported about the basin-scale circulation change related to climate change. I hope to add this reference in this sentence. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]

Comment ID	From Page	From Line	To Page	To Line	Comment
7203	40	49	40	50	[Technical Summary] "more than 90%" is more appropriate than "about 90%" as expressed in TS.3.1 taking the context into account. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
7205	43	20	43	22	[Technical Summary] It is believed that there is no reason to emphasize "no tipping point". It is more objective to merely describe the linearity between temperature and sea ice. Although it is a scientifically interesting discovery as it has been discussed for a long time in this field of research, it is somewhat far from convincing the dangers of global warming to the public or policymakers. Rather, it is more importantt that Arctic summer sea ice responds linearly to temperature rise. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
7049	43	41	43	48	(Chapter5: Global Carbon and other Biogeochemical Cycles and Feedbacks): In the new generation of developing power plants with class F Technology and even more improved ones, the installation of LNBs burners has been designed in these types of power generation units. More over, 95% of nitrous oxide emissions at power plants is mainly NO, which transforms to NO2 due to the sunlight irradiation in the ambient. Therefore, power plants should not be considered as a source of N2O emissions (IRAN energy balance sheet ,MOE,2018-2019). [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]
7207	45	42	45	43	[Technical Summary] "the majority of coastal locations have a median projected regional sea level rise within ± 20% of the projected GMSL change" should be modified because it should be further emphasized in this sentence that not only mean sea level rise and variability, but also rises of several orders of magnitude relative to the mean may occur in some coastal areas. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
7211	46	10	46	13	[Technical Summary] "Timing of exceedance of GMSL thresholds of 0.5, 1.0, 1.5 and 2.0 m, under different 11 SSPs considering only medium confidence processes" this modification will make the figure descriptoin clearer. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
7209	46	11	46	11	[Technical Summary] "1th7" should be corrected as "17th" [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
7213	80	4	80	4	[Technical Summary] In Table TS. 4 (a) Assessments on MoV, human influence on the observed change for SAM does not well match in Chapter 3. In Chapter 3, the influence of GHG on the observed change for SAM is not mentioned as well as in summary. It is not staed in Chapter 3 that GHG affects all seasons. I recommond adding a description of the GHG impact in Chapter 3 or change the Table TS. 4. (Technical Summary) [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
7247	94	50	96	34	[Chapter 9] I hope to add new reference about the termal expansion related to sea level change like following. "Increasing in sea level variability with ocean warming associated with the nonlinear thermal expansion of seawater" by Widlansky(2020, Cxommunications Earth & Environment, http://doi.org/10.10.38/s43247-020-0008-8). [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
6357	94	54	95	10	This parragraph compares the findings of pre-satellite sea-level change budget between SROCC and Dangerdorf et al2019 and Frederikse et al 2020b, and because these studies have a very similar conclusion, they are compared with the AR5 assessment. However, the three aforementioned studies have a "substantially larger uncertainty" than the later one, which raises the question of which one to consider under what scenario. Recomendations and warnings around which data/model to use could be added [Government of Mexico, Directora General del Instituto Nacional de Ecologia y Cambio Climatico]

Comment ID	From Page	From Line	To Page	To Line	Comment
7253	103	55	104	1	[Chapter 11]The Republic of Korea would like to draw your attention to the use of the name “Sea of Japan” to designate the sea area between the Korean Peninsula and the Japanese Archipelago. Lying between Korea and Japan and extending north towards Russia, the sea area includes the territorial waters and exclusive economic zones (EEZs) of the countries encircling the area. When a geographical feature is shared among two or more countries and an agreement on a standardized name cannot be reached, it is the general rule of international cartography that the names used by each of the countries are used concurrently. This general rule is also confirmed in the resolution of the International Hydrographic Organization (IHO) and the UN resolution on the standardization of Geographic Names. Following these cartographic rules and resolution, Korea request for your consideration on the concurrent use of both the names “East Sea” and “Sea of Japan.” In addition, the phrase, “over the Japan Sea” is unnecessarily and differently inserted from the original version of “Murata et al.(2015), ”Covective clouds are shallower in the future climate compared with those in the present climate” Accordingly, the Korean government suggests this sentence should be altered as follows : Murata et al. (2015) investigated future projections of precipitation around Japan and showed a decrease in monthly mean precipitation in the eastern Japan Sea (East Sea) region in December, suggesting convective clouds become shallower in the future climate compared with those in the present climate. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
7249	115	14	115	15	[Chapter 9] "GMSL projections exhibit little scenario dependence" Because the amount of sea level rise is quite proportional to the scenarios even though the gaps among them are little, this sentence could be corrected as "GMSL projections exhibit a linear scenario dependence but threre are only little differences" [Government of Republic of Korea, Korea Meteorological Administration
7251	117	16	117	18	[Chapter 9] "the majority regional sea-level rise within ±20% of the projected global mean sea level increase" Based on Figure 9.28, it should be further emphasized in this sentence that not only mean sea level rise and variability, but also rises of several orders of magnitude relative to the mean may occur in some coastal areas. And the "majority" should be defined somewhere so that it chould be expressed as a percentage of ocean area, or the number "20" should be further specified based on the siginificance level 95% or 99% [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
7215	121	21	121	23	[Technical Summary] "Timing of exceedance of GMSL thresholds of 0.5, 1.0, 1.5 and 2.0 m, under different 11 SSPs considering only medium confidence processes" this modification will make the figure descriptoin clearer. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
7217	121	22	121	22	[Technical Summary] "1th7" should be corrected as "17th" [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
7223	151	8	151	8	[Chapter 6] To describe the multiplication, using '×' looks better instead of *. [Government of Republic of Korea, Korea Meteorological Administration (KMA)]

Comment ID	From Page	From Line	To Page	To Line	Comment
8705					The IPCC definition of "net-zero" focuses on only the direct human emissions of greenhouse gases and IPCC suggests that getting to net-zero will stop climate change. Such a definition of net-zero includes only direct emissions of CO2 and other greenhouse gases. The fact that warming is leading, for example, to permafrost thawing which is releasing CO2 and CH4 to the atmosphere -- and is also leading to the Arctic and some forests flipping from being sinks to sources of CO2 -- is not being accounted for in net-zero. To stop further warming, one has to stop changes in atmospheric composition and, even without additional direct emissions, what is happening due to perturbed natural influences will continue for some time. Authors should consider broadening the definition of net zero to include warming-induced emissions due to the perturbed carbon cycle, etc. If not done, this omission needs to be made clear. [Government of United States of America, U.S. Department of State]
8707					The SPM is too long. Many key messages have no quantitative estimates. New metrics have been introduced, but there is little regional information both regarding observed changes and projections. [Government of United States of America, U.S. Department of State]
8709					Drought Comment 1 of 7: The discussion of drought in the underlying report text (i.e., Section 11.6) is on the whole balanced and well-done. However, the SPM's statements and figures on drought consistently give the impression that global warming systematically increases the incidence of drought, which does not seem credible given the near-balance between areas of increases and decreases in total-column soil moisture (Fig. SPM.5(d), Fig. 8.19(c,f,i)) and runoff (Box TS.6 Fig. 1(d)) elsewhere in the report. [Government of United States of America, U.S. Department of State]
8711					Drought Comment 2 of 7: This apparent contradiction, which again could damage the SPM's credibility, arises for two main reasons. First and foremost, Figure SPM.3(c), the drought bars of Figure SPM.9(b), and the SPM statements that rely on them, incorporate (via Tables TS.5, 11.6, 11.9, 11.12, 11.15, 11.18, and 11.21 and the studies cited therein) several putative indicators of "agricultural and ecological drought" that attempt to account for how rising temperatures and vapor pressure deficits increase plant water stress and cause other ecological drought symptoms. Increases in agricultural and ecological drought are assumed to be closely linked to changes in such temperature-sensitive indices as the Palmer Drought Severity Index (PDSI), Standardized Precipitation-Evaporation Index (SPEI), topsoil moisture, and simple water-balance models. As a result, those tables and figures have far more regions of increasing drought than decreasing drought, despite nearly equal projected areas of increasing and decreasing column soil moisture (the more usual definition of agricultural drought). A key issue therefore is: How strong is the physical quantitative linkage between the various temperature-sensitive indices mentioned above and agricultural/ecological drought, and is this linkage dominant over other influences (such as direct CO2 influence on plants, for example)? [Government of United States of America, U.S. Department of State]
8713					Drought Comment 3 of 7: Furthermore, the use of the phrase "ecological drought" is faulty throughout the current SPM draft. "[E]cological drought" is only mentioned in conjunction with "agricultural drought" as a de facto synonym. The latter phrase ("agricultural drought") is well accepted by the scientific and operational drought-monitoring communities as referring to a deficit in soil moisture: It is in this context that the phrase is (correctly) used throughout the SPM. However, within these same communities, the former phrase ("ecological drought") is by no means constrained to a soil-moisture deficit. [Government of United States of America, U.S. Department of State]

Comment ID	From Page	From Line	To Page	To Line	Comment
8715					Drought Comment 4 of 7: A good definition of ecological drought is provided in Crausbay et al. (2017) (https://journals.ametsoc.org/view/journals/bams/98/12/bams-d-16-0292.1.xml): "an episodic deficit in water availability that drives ecosystems beyond thresholds of vulnerability, impacts ecosystem services, and triggers feedbacks in natural and/or human systems" (p. 2544). Ecological drought is therefore an ecosystem-wide event, with impacts on ecosystem services to humans (e.g., via freshwater quality and quantity, air quality, wildfire hazard increases) and impacts on the ecosystems themselves (e.g., species migration, stand composition change, fish mortality). There is no mention of soil moisture. Indeed, analysis of ecological drought does require metrics that go far beyond the familiar standardized metrics to a holistic understanding of the ecological, hydrologic, hydroclimatic, and socio-economic aspects of drought. [Government of United States of America, U.S. Department of State]
8717					Drought Comment 5 of 7: The notion that long-term temperature-driven drying trends in the PDSI, SPEI, and topsoil moisture are actually indicative of increasing agricultural or ecological drought, including plant water stress, in a rising-CO2 world is rather controversial (page 11-70, line 1; page 11-69, lines 42-43; page 11-70, lines 51-53; page 11-71, lines 27-29) and as a result that notion should not form the basis of headline statements or figures in the SPM. Rather, recommend the SPM stick to more confident statements about agricultural drought that are directly grounded in total-column soil moisture, which uncontroversially implies plant water stress. Further recommend that the term "ecological drought" be removed from the SPM since ecological drought depends on far more than soil moisture, PDSI, SPEI, or any of the other metrics considered. [Government of United States of America, U.S. Department of State]
8719					Drought Comment 6 of 7: The second major issue is that there are several other places in the SPM, most notably Figure SPM.6 (lower right) and the statements that rely on it, where countervailing results about regions of decreasing drought are simply omitted, giving the false impression of globally increasing drought. [Government of United States of America, U.S. Department of State]
8721					Drought Comment 7 of 7: Eight "Key Issue - Drought" comments are provided in the line-by-line comments suggesting specific changes to the figures, their captions, and statements derived from them, and to several other statements in the SPM, to make the SPM drought conclusions more balanced, careful, credible, and less reliant on the low-confidence hypothesis that long-term warming drives drought. These changes also have implications for some figures elsewhere in the report (e.g., Technical Summary) which should be revised accordingly. [Government of United States of America, U.S. Department of State]
2579					Overall, we found the document to be very accomplished, balanced and showing a real concern for conciseness, clarity and pedagogy, as for the choice of the four themes, which have a different and more communicative approach than the AR5 SPM. [Government of France, Ministère de la Transition écologique et solidaire]
8723					Remove the phrase ""ecological drought"" from the following places in the SPM: - Figure SPM.3 caption, lines 30 and 46, p SPM-7 (repeated on p SPM-26) - Figure SPM.6 caption, line 50 p SPM-12 (repeated on p SPM-32) - H.S.11: Line 20, p SPM-17 - Figure SPM.9: see ""Agricultural and ecological drought"" in the ""Wet and Dry"" CID [Government of United States of America, U.S. Department of State]
2581					We would like to acknowledge all the efforts made in order to keep this SPM short [Government of France, Ministère de la Transition écologique et solidaire]
2583					The figures are very interesting, they also show a lot of work and reflection but some still require some investment in order to be able to apprehend all the information [Government of France, Ministère de la Transition écologique et solidaire]

Comment ID	From Page	From Line	To Page	To Line	Comment
2585					We suggest, as much as it is possible regarding the scientific sources assessed in the main report, to unify the baselines used in this report. The most important ones to unify would be • Figure SPM 2 (legend) page 5 line 43 : replace 1750 by 1850-1900 if possible • Figure SPM 2 : if possible harmonize baseline for panels a) and b) • Figure SPM 6: on the figure the reference period is 1850-1900 for all event categories. The figure or the legend should be corrected accordingly. • Page 8 line 7 : H.S.4.1 : Suggestion to replace 1750 with “pre-industrial state” • Page 10 footnote 15: In the text, there is a reference to the 1850-1900 period. Therefore, it is not clear why a 'multi-century' period is mentioned in the note. • Page 4 line 20-22 : if possible we recommend to unify the baseline for the global surface temperature and the warming due to GHG forcing (either use 2010-2019 or 2011-2020) to allow comparison and clarity. [Government of France, Ministère de la Transition écologique et solidaire]
2587					The use of both of the terms “climate drivers” and “climatic impact drivers” can lead to confusion. If possible, we suggest to either unify of find another term. Indeed, concerning “climatic impact drivers”: It focuses on climate/physical change whereas (i) chemical [e.g. ocean acidification] and (ii) land-use/deforestation are major drivers of ecosystem changes. Besides, it does not tell anything on tipping elements nor compound events or how the combination of physical and chemical changes may interact leading to stronger impacts. Suggestion to use something like "society-relevant climatic impacts" instead [Government of France, Ministère de la Transition écologique et solidaire]

Comment ID	From Page	From Line	To Page	To Line	Comment
2589					While supporting a shorter SPM, we strongly feel that many statements and paragraphs need to be stronger in their message. In order to do so, we recommend: First to bring some of the numbers present in the paragraphs (H.S.i.j) to the High Level Statement (HS.i) in order to support the messages conveyed in these and inform the policymakers that would only read those. (Examples of numbers that could be placed in the H.S.i: sea level rise, greenhouse gases). Secondly, we also recommend bringing into the paragraphs some of the data displayed in either the TS or the chapters to support the messages of these paragraphs and add quantitative information. Some of the numbers that we recommend to add are in the following: o H.S.1.4 : the increases in atmospheric moisture, ocean salinity and precipitation should be quantified o H.S.1.5 : Like for para H.S.1.7, it would be helpful to specify some order of magnitude for the retreat of glaciers o H.S.1.5: the decrease of Arctic sea ice and spring snow cover should be quantified. The evolution of the Greenland and Antarctic Ice Sheets should also be mentioned, in this subsection or another. o H.S.1.6: Like for para H.S.1.7, it would be helpful to specify some order of magnitude for the warming of ocean. o H.S.1.6: the ocean acidification should be quantified. It would also be useful, for greater clarity, to remind that the phenomenon is due to the absorption of CO2 by the ocean. o H.S.2.1: It is very useful to highlight the fact that CO2 and methane increases are above natural variations over the past 800 ky, but the excess should be quantified. o H.S.2.3: the decrease in Arctic sea ice should be quantified. o H.S.3.1 : some quantification about hot extremes would be welcomed (cf chapt 11) o H.S.12.2: Box TS.4 provides some quantification of possible impacts, such as a possible further one meter sea level rise by the end of the century in a low-likelihood, high-impact storyline. Providing some illustrative figures - carefully hedged - might provide greater clarity on the sense of this section. For all the data that are imported from the TS or the main report, we recommend clarifying shortly or at least put a code that can identify how the results were obtained. For examples, it could be mentioned at the beginning of the report or in the projections section that if nothing is specified, the methods for the projection is the following and precise every time what has changed if the method is different. (Are we considering the ECS constrain or if it is a direct output from CMIP6 simulations , is it only historical emissions, observations, etc). [Government of France, Ministère de la Transition écologique et solidaire]
7453					The text uses policy-prescriptive language: Refrain from using policy-prescriptive language, such as in Chapter 11, P103, L6-7, that include terms like "should", "have to", "need", or "must". Replace these terms with policy-neutral terms. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
2591					Concerning scenarios, we strongly feel that it could be misunderstood that these scenarios go beyond emissions. They also take into account many variables such as land-use. We strongly recommend referring to the scenarios in the text as just scenarios and then specify when we only talk about the emission results of these scenarios. [Government of France, Ministère de la Transition écologique et solidaire]
2593					Also concerning the SSP scenarios. As SSPs are new to the WG1, we feel that it could be explained a bit more what hypothesis they take into account and how they are constructed. This would also help justify their use and the choice of the 5 SSP into this. It could also be mentioned what the difference is between these scenarios and the old RCPs. [Government of France, Ministère de la Transition écologique et solidaire]

Comment ID	From Page	From Line	To Page	To Line	Comment
7457					The text in the SPM must not include words that are not a part of the calibrated language. Such as in Chapter 11, P25, L5-9, the use of the word "rare", as it has a wide-ranging definition depending on applications and certain studies defining various events as extreme, there should be a calibrated language to ensure a clear measurement and avoid misinterpretation of texts. Include various definitions of rarity in the Glossary and reference the Glossary in the text itself. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
2595					Finally, we feel it is extremely important to describe and detail more the methodology around models and their results in this report. Though we are satisfied with the use of the assessed ECS for constraining the global temperature evolution derived from CMIP6 simulations, we find that more detailed information on the method and on its main consequences, including lower warming rates, is necessary in the SPM. We suggest clarifying, when not obvious, the methodology used and how this is different from previous model results. It could also be mentioned how this affect the results (is the methodology better but increases or decreases the projections of temperatures, SLR, etc). For each projection estimates it needs to be very clear if these are from CMIP6 models only, from CMIP6 models constrained by observations, and/or from CMIP6 models scaled with the ECS estimate. This applies for all numbers (mean and uncertainty) in the text, in tables and figures. [Government of France, Ministère de la Transition écologique et solidaire]
2597					Please be crystal clear in this SPM when referring to CO2 versus all GHG. There is a lot of confusion in the world on this point, with many readers having interpreted the findings of the SR1.5 as Net Zero GHG when they are in fact for CO2, with major implications in the assessment of government policy efforts within the Paris Agreement. This point is worth repetition and extra words throughout the SPM. [Government of France, Ministère de la Transition écologique et solidaire]
7461					The text in Chapter 11, P.18, L.19-22, states, "Overall, the effects of land use forcing may be particularly relevant in the context of low-emissions scenerios, which include large land use modifications, for instance associated with the expansion of biofuels, biofuels with carbon capture and storage (BECCS), or re-afforestation to ensure negative emissions, as well as with the expansion of food production." This should be reflected in the SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
2599					We feel that there is a lack of discussion on climate feedbacks, their uncertainties, and impact on future projections. Current Box SPM1 is very positive (new, better, improved, …) but fails to assess what are the key sources of uncertainties in climate projections. [Government of France, Ministère de la Transition écologique et solidaire]
2601					We are very pleased with the unique Global Surface Temperature and the clarity that this brings. However, we feel that it deserves a detailed explanation in the SPM, considering the centrality of this variable. [Government of France, Ministère de la Transition écologique et solidaire]
2603					There is little information on the biophysical role of land use and land cover changes in this SPM. We regret that some of the statements found in section 4 of the SRLCC report linking vegetation and climate seasonality have not been integrated. This comment echoes the fact only land-use pattern is mentioned when presenting the SSPs in Box SPM.1 without mention of what it means in terms of vegetation (or human practices on it). The biophysical effects can be very large at regional scale. [Government of France, Ministère de la Transition écologique et solidaire]
2605					Concenring the figures : • Suggestion to think about the form of this figures for their reading on modern devices such as smarthphones and tablets [Government of France, Ministère de la Transition écologique et solidaire]
2607					• A figure for the evolution of GG atmospheric concentrations is absolutely necessary here (as in the previous SPM-AR5), in line with the text (H.S.1.1) (could be added in figure SPM.1 or SPM.4) [Government of France, Ministère de la Transition écologique et solidaire]

Comment ID	From Page	From Line	To Page	To Line	Comment
2609					Figure SPM.1 Panel a) : • In the title of panel a) we suggest to change “temperature” into “temperature changes/anomalies". Indeed, even if these specific words are explicitly written in the subtitle above, the non-scientific reader can still misinterpret the vertical figure axes. • Concerning the text on the figure of panel a) : The second assessment is unclear since there is no reference to the lengths of the average time periods (comparison of a 10-year period for the present and multi-centennial periods for the previous interglacial ?). The two assessments might be replaced (if not deleted) by the second sentence of H.S.2.2 ("It is more likely than not that the most recent decade was globally warmer than any multi-centennial period since the peak of the last interglacial, about 125,000 years ago"). Also, the “more likely than not” is difficult to grasp for the wide public and might be disturbing to see in this figure, which of course speaks about the confidence in past climate reconstructions, but can be interpretated as a nuance in the attribution of human-induce climate change. Futhermore, the term “sustained” could be replaced by a clearer term. The take-home message could have a larger impact if formulated instead like "the warming that has been observed is unprecedented over the past 2000 years". The way it is currently formulated with details about previous interglacial periods seems more relevant for the main report or the technical summary than the SPM. This figure title would benefit from being reformulated in a more policy-relevant way. • Concerning the “observed temperature” legend on the figure, it could look like it is the grey curve as this legend is placed just above it. Suggestion to move it to the right or use a more obvious colour code. • The vertical text for the mid-Holocene could be placed better, as such it might seem confusing • A few more dates and more tick marks would be welcomed on the x-axis • Concerning the legend of panel a) : The mention to the GST reconstructed is a bit unclear, the observed temperature is also shown for 1850-2020. As it is, it reads as it is all based on paleo reconstructions. The legend for the vertical bar on the left is not in agreement with the figure. On the figure the bar seems to show the temperature range for the Mid-Holocene (but we do not know the duration of the period considered) whereas according to the text of the legend it concerns the whole Holocene. "multi-century peak" is not very clear if the vertical bar shows the likely temperature range for the Holocene or Mid-Holocene. Also suggestion to add “vertical” before “grey bar”. Finally, since the interglacial period is mentioned, we recommend to define it. Panel b) : • Suggestion to rephrase the title of panel b) into : "Comparison of the annual temperature changes observed from 1850 to 2020 with the temperature changes simulated by climate models under natural drivers only and under both human and natural drivers. • Suggestion to change the colours of the curve human and natural as it doesn’t read so well compared to the observed one • adding "only natural" instead of just "natural" (for the natural curve) will make the figure even clearer [Government of France.

Comment ID	From Page	From Line	To Page	To Line	Comment
2611					Figure SPM.2 In this figure we recommend to add the term « anthropogenic » before « emissions ». We also suggest reformulating the term “aerosol emissions” as they are not emitted per se. Concerning the formulation “two lines of evidence” : What two lines of evidence means here is not entirely clear. panel b seems to be the decomposition of panel a into difference species (even though the baselines are different). It sounds like a complement rather than a different line of evidence. Panel a) : • Concerning the x-axis, “other human forcings” : It would facilitate the reading if the contributions of aerosols could be singled out since the panel (b) provided some details of its drivers • Concerning the x-axis, “other human influence” : some separation of "Net human influence" is needed here to highlight that this is the sum of the other terms. This box could be presented on the left besides the observed warming as the "human influence" (suggestion to delete "net") or by saying "Total human influence" (sum of GHG + other human drivers)" would be clearer. The same should be done for the text in the figure itself. This comment applies to the legend as well. • Concerning the x-axis”, “GHG” : please clarify if these are GHG or well mixed GHG • Concerning the legend : we suggest to harmonize the terms used to qualify the temperature change in panels a) and b). Indeed, for a) term used is "temperature change" and for b) its "warming and cooling". Panel b) : • Concerning the title of the panel b) : "from individual human emissions" does not read well (it sounds like per capita emission). Suggestion to write: "from individual contributors to human influence" • Concerning the x-axis, “VOCs and NOx” : the proposed simplification of this figure compared to AR5 SPM figure 5 can be understood in terms of clarity. It includes however a regrettable inaccuracy in the fact that NOx and VOC are also precursors of aerosols, which was more clear in the AR5 SPM figure. Whereas VOC are mainly important for secondary organic aerosols which may not be included in all ESM contributed in AR6, the inaccuracy is more of a concern for NOx while the representation of nitrate aerosols was greatly improved in AR6 models. • Concerning the x-axis, everything under “main contributors to aerosols changes” : Please clarify how these relate to the third bar "other human forcings" in panel a? Are they a decomposition of it? Also, does the term “reflectance” refers to albedo? [Government of France, Ministère de la Transition écologique et solidaire]

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2613					Figure SPM.3 Concerning the form of the figure: the choice of hexagons with identical size makes the figure rather difficult to understand since the reader has no idea of the limits of the different regions. By comparison Fig. SMP.9.a is much easier to understand. However, on the other form aspects, this figure is a very good representation of the information at regional scale and seems to properly convey the messages. Panel a): • Concerning the term “human contribution”: Could it be clarified how much contribution? is it the primary driver or a minor driver? Concerning the legend: • The acronyms used for the regions are not given in the caption. If these regions are those of the Atlas, please add a sentence similar to that of e.g. figure SPM.9: "Definitions of the acronyms of the regions are provided in Atlas and the Interactive Atlas." • Panel c mentions agricultural drought only. Please ensure a consistency between the text in the figure and the caption which uses “agricultural and ecological drought”. • The main figure title should mention the timeframe "1950 to present" as in the caption. • There is an error mentioning the colour code, the legend says blue/yellow for a decrease while in panel c) yellow represents an increase • Concerning “more local assessment made on shorter time scales” : it is unclear if there is something to look at on the figure or if it refers to the main SPM text, or the whole report (different chapters), therefore we suggest to make this clearer • Concerning “for hot extremes” : This last part of the legend raises some confusion and it is unclear if same indicators are considered for all regions or if it varies from one region to the other and what is the part of expert judgment. • Concerning ‘agricultural and ecological droughts ….projected changes”: It is not clear why observed changes in agricultural and ecological droughts are assessed based on projected changes. It is coherent with Technical Summary Box TS.10, Figure 1 which refers to Chapter 11.9.3. However, droughts are treated in Chapter 11.9.4 (not 11.9.3). So this is a mistake in the Technical Summary. Chapter 11.9.4 deals with observed and projected droughts, hence the wording "observed and projected". This chapter shows that the assessment for observed droughts does not use projections. [Government of France, Ministère de la Transition écologique et solidaire]

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2615					Figure SPM.4 We suggest harmonizing the size of all the GHG showed in panel a) to avoid any hierarchy. Also, maybe work a little bit on the design to make it more attractive Panel a): • We would recommend to add historical emissions on the figures of panel a) • We suggest to add emissions to the name of the GHG on the y-axis • In the legend, a note could mention that SO2 rapidly transforms into sulphate aerosols, otherwise a broad audience may not relate SO2 to aerosols Panel b): • We suggest checking the consistency in the chosen time horizon (while prioritising central estimates on 2100) because here the level of warming is projected for 2100, whereas it is for 2081-2100 in table 1, which might be confusing. Despite these different time horizon, the medians seem to be similar (visually), but not the very likely range. • Could you clarify if ozone is included in « other GHG" on the x-axis • Please clarify if estimates here account for both direct emissions into the atmosphere and their effect, if any, on other climate drivers, similarly to figure 2 • Please clarify if these warming are from CMIP6 models, and/or from ECS central estimate. If the latter, suggestion to explain how it is done for non-CO2 contributions [Government of France, Ministère de la Transition écologique et solidaire]

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2617					Figure SPM.5 If this is available, we suggest adding similar panels as panel a) for the panel c) on precipitations We also recommend mentioning or showing uncertainties on this figure, as they do not seem to be discussed. For example, given the uncertainties in projections of the hydrological cycle the maps of annual mean precipitation changes should display the areas where models are (or are not) in agreement on the sign and/or the magnitude of the change as in Fig. 4.32 for planel c). Concerning all the title of the maps, suggestion to add "simulated" ("simulated change") to be clear and fully consistent with panel a) For the simulated annual means : It is a little bit complex to understand why the way the changes are represented is not the same for the different variables. A caution mark should also be included for % and changes/internal variability on the fact that a very small difference can lead to very large % or ratio to internal variability in dry regions. Panel a): • We suggest to show on the left figure of the panel the significance of the white areas, as it is mentioned in the legend but the colour is close to the 0 of the coloured bar. We suggest to add black dots or similar features to highlight the regions where data are missing. • The caption for panel a is confusing ; 1850-1900 mentioned in the figure but 1850-2020 in the caption; "regressed" implies some sophisticated treatment, while it is just that the global mean temp increase was 1°C at the end of this period ; for clarity it could mention that The global surface temperature increase was about 1°C during the 1850-2020 period (see figure SPM.1) • Panel b): • Would it be possible to extend the range to see differences in the map at 4°C? Panel d): • Please clarify the unit for the variable here. It is unclear what is shown exactly "standard deviation of interannual variability)? Is it showing the change in soil moisture showed as the departure from the natural historical variability (1.5 = soil moisture is 60% above the historical mean +1 sigma)? Or is it, as one could assume, just showing the standard deviation of the interannual variability relative to the one over the historical period (1.5= 50% more variability). For drought in the following SPM.6 legend "the standard deviation of annual soil moisture" is used, which is easier to understand • In the legend, suggestion to add "changes «after soil moistures (the changes are simulated, not the absolute annual mean)

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2619					Figure SPM.6 In general, the representation with the dots is a nice way to try to convey the message. However, it is not clear at first look that there are 50 dots on the first left panel representing 50 years, and the fact that they are more or less randomly distributed because extremes are randomly distributed (indeed the red dots are gathered at the center and not fully randomly located). Maybe the dots should be spread all over the pink area to avoid the confusion, and make it clear that it represents any sequence of years. Another suggestion could be to represent the frequency with a classic curve. Concerning the description under 50-year event or 10-year event: Suggestion to add something like "Observed and projected changes in ..." for each of the four panels Concerning “without human influence”, we suggest to find a more appropriate term as humans had an influence on the climate system before the industrial period (even if limited). The reference period is merely the climate state in 1850-1900. Concerning “future warming levels”: maybe it could be changed to "future global warming levels", to clarify Concerning the y-axis “intensity” : it is unclear what these intensities refer to. Maybe the answer is in the caption "results are shown for the global land" but it is not clear at all. Could it be clarified if it is the intensity of an event that occurs once in 50 years in a warmer climate (which would contradict the upper text)? Comparing the two panels suggest the increase in the intensity of 50-yr event is only a little warmer than the increase in the intensity of 10-yr event. If this is correct, we suggest to make it more comprehensive When referring to global warming levels “+XX°C warmer”: suggestion to use either "+ X °C" or "X°C warmer". [Government of France, Ministère de la Transition écologique et solidaire]
2621					Figure SPM.7 Concerning the title of this figure: it is necessary to add "carbon" before "stores" to improve understanding Panel a): • Concerning the y-axis: As everything else in in GtCO2 in the SPM, it would probably be better if the Y-axis of this figure was primarily in GtCO2 as well. Especially given that, the right side shows cumulative CO2 emissions in GtCO2. Otherwise it can be easily confused: SSP5-8.5 looks like 10580 GtCO2 emitted, less than 1000 in land+ocean which amounts to 38% In any case it is PgC, not Pg Carbon and it be best placed next to the title above. Suggestion to change the title of the panel then to: Change in land and ocean carbon storage from 1950 to 2100 (GtCO2) • Concerning the -50 on the y-axis: There should be an explanation for this number in the caption as well as for the grey shading under the zero line • In the legend, we wonder if “biome” is easy to understand or should a word like vegetation type be used for simplicity [Government of France, Ministère de la Transition écologique et solidaire]

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2623					Figure SPM.8 We find this figure very clear and think that it is very good to have even the best scenario's impacts We suggest adding the very likely range for all scenarios while making clearer the overlap of the ranges for temperature projections under scenarios SSP5-8.5 and SSP3-7.0 as well as SSP1-1.9 and SSP1-2.6. This applies to all panels. We also recommend adding the panel d) of the Figure SPM 8 in the SOD AR6 concerning the NH spring snow cover extend, to the FGD Figure SPM 8. The term “quickly” could be substituted to a better defined term Panel a): • It should be mentioned that the historical part are simulations. The reader is led to believe the black curve with the grey shading refers to observations, which is not the case (see Figure TS.8 Panel a p115) • According to the legend for panel a) the projections of future global surface temperature do not come only from CMIP6 simulations (contrary to panel b, c). The methodology is unclear and the results are different from those shown in Fig SPM.4.b which is confusing. Panel e): • Recommendation to add the projections for all scenarios in this panel • We recommend to add Global mean sea level "change" Panel c): • Recommendation to add “ocean” before global surface pH • The small size of the vertical arrow may be confusing (for example, suggest no acidity issue for pH > ~7.85). We suggest moving it. • Suggestion to put the legend that is on the panel please around 8.1. It looks as if 7.9 is low ocean acidity, which is not the case. • In the legend, the change in acidity is not commented in the text. Regarding the narrow range of variation, it would deserve a specific comment. Panel d): • The meaning of this dashed line is unclear. We suggest to change the title associated with it (eg estimate including very uncertain processes) • Please clarify if sea level rise is based on CMIP6 models, constrained by observed changes [Government of France, Ministère de la Transition écologique et solidaire]

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2625					Figure SPM.9 First, we would like to point out this very nice figure; we can see that there has been a lot of thinking into it and it translates rather quite well many messages. Panel a): • In the subtitle of the panel, please expend GWL with Global Warming Levels, as it is the first time used here. • The colour definitions double the definitions of the combination of future changes in CID with some inconsistencies (for example brown colour for "Hotter and drier" corresponds to drought only in some regions and fire weather are not mentioned ...). We recommend unifying these. • Concerning the sentences that are written at the bottom of the map: We suggest to make this sentence much clearer and to check its consistency. A reformulation could be: "... will be exposed to at least two of the following increases: relative sea level rise, coastal flooding and coastal erosion" • We noticed that there are many more CIDs on figure b) than on the summary circles on panel a) (eg sea level rise not displayed). We suggest to add some more on panel a) • Concerning the legend of the CDI (circles), for droughts, we suggest to harmonize and add ecological drought if scientifically correct • In the legend, concerning “projected for around 2050 if a 2°C is reached”: this definition of the reference period is inconsistent with the one given in the legend:"within 1960-2014". Panel b): • This panel is more difficult to read than panel a), even though it is informative. In addition, it does not tell which regions have high or medium confidence. Perhaps a solution could be to supress this panel and on the map in panel a for each colour have the dark colour as is for high confidence and the same colour, but with reduced opacity, for medium confidence, so that the confidence statement is included on the map, for each region. The interested reader will have to dig into the TS and report to know more about the details. • Concerning the number of regions on the lowest part of the panel, we recommend showing the percentage of regions where an increase/decrease is observed out of the number of regions that are concerned by the CID displayed. • Concerning the definition of CID, we recommend adding “chemical” to “are physical climate system...” this would then be “are physical and chemical climate system...” • In this panel b), the weak amplitude and medium confidence attributed to severe wind and tropical cyclone increase seems to contradict the widespread increase in tropical cyclones intensity and severe weather shown in panel a) and mentioned in many

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2627					Figure SPM.10 Concerning the axis on the top of the graph: It can be misleading. These are still carbon dioxide emissions (not carbon emissions), as in the bottom X-axis. These are just expressed as PgC vs GtCO2. Carbon emissions could (rightly) be interpreted as emissions of CO2, CH4 and other agents that include carbon We highly recommend extending the time horizon to 2100, because limiting the 2050 and therefore 3°C (for SSP5-8.5) on the y-axis could be misleading and “bound” global warming to this GWL. All the other figures go to 2100 and it would be consistent to have that here as well. Concerning the y-axis, we suggest adding some lines for 1.5°C and 2°C to improve the reading It would be good to add information for which time horizon the range of temperature projections are given in the legend; a priori until 2050 according to the figure, and if the projections are from CMIP6 models and/or using ECS central estimate Finally, here as well, we used global mean temperature; please clarify if it is the "constrained" estimates or the "raw" model outcomes [Government of France, Ministère de la Transition écologique et solidaire]
1665					We would like to congratulate the authors for good work on further processing of the SPM. We think that it is now in a more appropriate form for a SPM. Headline statements are now proper in length and the figures are informative and relatively easy to digest. We hope that our additional comments will help the authors to further develop the SPM towards a smooth approval in the July/August session. [Government of Finland, Finnish Meteorological Institute (FMI)]
8347					Congratulations to authors for their very hard work resulted in very concise and high quality SPM of WGI AR6. Look forward to approve very important document with new and impressive results. [Government of Ukraine, Director Ukrainian Hydrometeorological Institute]
4265					Throughout the report there are a limited information related to the climate feedbacks and climate sensitivity, water cycle change in a chaning climate and information on linking global to regional climate change. These subject have explored comprehensively in the main report and have a substantial information to build our general understanding on climate change. [Government of Indonesia, Ministry of Environment and Forestry Indonesia]
8381					We want to express our special congratulations on the progress of WGI in AR6 due to the implementation of the Interactive Atlas. This modern tool will help many governments to plan their actions to combat climate change and to build a resilient future [Government of Ukraine, Director Ukrainian Hydrometeorological Institute]
8659					Temperature - GST: Reviewers sought consistency in global surface temperature comparisons between current and projected time periods. The observed temperature increase is reported as 10-year mean for the latest decade with available data (H.S.1.2), while projected increases throughout the 21st century are reported as 20-year averages (H.S.5.1 and Table SPM.1). The authors should consider revising the SPM to also include information on temperature averages over the most recent 20-year period for better comparability with projected future levels and to reduce concerns over inter-decadal variability. At a minimum, the SPM should include information on the recent past, 1995-2014, which is readily available from the Chapter 2 Executive Summary. [Government of United States of America, U.S. Department of State]

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8661					Temperature - 1.5°C Threshold: The authors should provide more information on the physical science basis of their assessment that global surface temperatures will exceed 1.5°C in the early 2030s -- a decade earlier than what was estimated in the Special Report on 1.5°C. The authors should further clarify whether this is due to an improved understanding of the climate system versus a change in the chosen methodology. The SPM notes that half of this 10-year time difference was due to a change in the dataset used to assess warming since the 1850-1900 baseline. Accordingly, Cross-Chapter Box 2.3 states that the updated assessment of historical warming does "not generally imply that projected climate impacts are now expected to occur earlier." This statement and the accompanying discussion on page 2-41 should be drawn into the SPM, so policymakers can better understand the implications of the revised timeline. Similarly, authors should provide more information to justify the other half of the time difference beyond the current explanation of "larger near-term future warming." Here, authors should link this discussion with the discussion on climate sensitivity in HS.4 and provide a clear explanation of basis for the larger near-term warming projection -- i.e., whether this is due to recent observations or improved physical understanding of the climate system or due to the choice of scenarios, methodologies, and models. [Government of United States of America, U.S. Department of State]
7127					Annex V, page 4 to 6 line 34,Annex V, page 4 to 6 line 34,If necessary, it is suggested in the section (AV.4 Definition of regional monsoons) under the section (AV.4.3 The South and Southwest Asian monsoons or Middle East monsoon)Be added.Because monsoon rains affect the Middle East and especially Iran.1-Noushin Khoddam; Parviz Irannejad; Farhang Ahmadi-Givi(2015) A study of the impact of Indian Monsoon on summer climate of Iran, Volume 9, Issue 2.ttps://doi.org/10.1002/joc.4648https://doi.org/10.1175/JCLI4248.1 https://doi.org/10.1016/j.aeolia.2020.100652 [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]
8663					Temperature - 1.5°C Mean Estimates: Within the discussion of crossing the 1.5°C global warming level, it is important that the authors also clearly convey the fact that this finding is based on the central estimate of a 20-year time period. This means that the "early 2030s" timeframe includes years from the 2020s to the 2040s and that multiple years within this range will exceed the 1.5°C above the historical baseline -- as much as several tenths of a degree Celsius greater -- with some likely before the 20-year average crosses the threshold. This reinforces the earlier point that current temperatures should be reported as 20-year periods, and possibly referred to by their center point in order to have consistent messaging across the headline statements of the SPM and avoid misunderstandings when a single year crosses 1.5°C. [Government of United States of America, U.S. Department of State]
7129					Annex V,page 19,If the Middle East monsoon sub-section is approved, it is suggested that the area affected by the Middle East monsoon be identified in Figure AV.1: Global and regional monsoons domains. https://www.nature.com/articles/srep00404 https://iopscience.iop.org/article/10.1088/1748-9326/aa76ca [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]
8665					Temperature - Scales Mismatch: The statement H.S.2.2, "the most recent decade was globally warmer than any multi-centennial period since the peak of the last interglacial …," is potentially problematic. What is the rationale for comparing average temperature in a single decade to a vaguely defined 'multi-centennial' average? In AR5, the 30-year period 1983-2012 was evaluated with respect to the available climate record for which statements could be made for that time period (e.g., "In the Northern Hemisphere, 1983-2012 was likely the warmest 30-year period of the last 1400 years" - SPM B.1, WGI AR5). Statements about the most recent decade (2003-2012) were only made with respect to the 51-year average over the beginning of the instrumental record (1850-1900). Suggest a similar approach be taken here or, if the text remains, additional information should be provided in the SPM on which paleoclimate archives have sufficient temporal and spatial resolution to support this statement. [Government of United States of America, U.S. Department of State]

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7131					A n n e x V I I - Glossary,page16,line 4 to 5,If necessary, the words is suggested Clouding(also known as cloudiness, cloudage, or cloud amount) be added refers to conditions when high temperatures are accompanied by cloudy conditions, affecting crops.causes premature aging, depletion of seeds and sterility of crop seeds. https://doi.org/10.1175/1520-0477(1991)072<0795:TREOCA>2.0.CO;2 https://doi.org/10.1016/S0034-4257(03)00095-6 https://doi.org/10.1175/1520-0442(1999)012<2128:RCCCAW>2.0.CO;2 Kharajpour,Hassan,(2020),Statistical and synoptic analysis of warm cloud temperatures and its effect on wheat yield in Kermanshah area,PhD Thesis Kharazmi University of Tehran Iran. Kharajpour,Hassan,(2020),Statistical and synoptic analysis of warm cloud temperatures and its effect on wheat yield in Kermanshah area,Journal of Applied Research in Geographical Sciences,Kharazmi university of Tehran Iran,number70. [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]
8667					Drought - Indices: Figure SPM.3c and the drought bars of Figure SPM.9b, and the SPM statements that rely on them, incorporate (via Tables TS.5, 11.6, 11.9, 11.12, 11.15, 11.18, and 11.21 and the studies cited therein) several putative indicators of "agricultural and ecological drought" that attempt to account for how rising temperatures and vapor pressure deficits increase plant water stress and cause other ecological drought symptoms. Increases in agricultural and ecological drought are assumed to be closely linked to changes in such temperature-sensitive indices as the Palmer Drought Severity Index (PDSI), Standardized Precipitation-Evaporation Index (SPEI), topsoil moisture, and simple water-balance models. As a result, those tables and figures have far more regions of increasing drought than decreasing drought, despite nearly equal projected areas of increasing and decreasing column soil moisture (the more usual definition of agricultural drought). A key question therefore is: How strong is the physical quantitative linkage between the various temperature-sensitive indices mentioned above and agricultural/ecological drought, and is this linkage dominant over other influences (such as direct CO2 influence on plants, for example)? The notion that long-term temperature-driven drying trends in the PDSI, SPEI, and topsoil moisture are actually indicative of increasing agricultural or ecological drought, including plant water stress, in a rising-CO2 world is rather controversial (page 11-69, lines 42-43; page 11-70, line 1; page 11-70, lines 51-53; page 11-71, lines 27-29) and as a result that notion should not form the basis of headline statements or figures in the SPM. Rather, recommend the SPM stick to more confident statements about agricultural drought that are directly grounded in total-column soil moisture, which uncontroversially implies plant water stress. [Government of United States of America, U.S. Department of State]
7133					in 11.SM Chapter 1 1: Weather and climate extreme events 2 in a changing climate - Supplementary Material,page 5 to 7 ,It is suggested that in Table (Table 11.SM.2) Gandum Briyan plain in Shahdad city in Lut desert of Kerman province of Iran is recorded as the hottest point of the earth.Which has significant day and night temperature changes. A temperature of 71 degrees Celsius has been recorded by NASA in this region. https://earthobservatory.nasa.gov/features/HottestSpot https://www.travelandleisure.com/trip-ideas/hottest-places-on-earth https://www.sciencemag.org/news/2016/12/incredible-ecosystem-earth-s-hottest-spot https://www.theitalianeyemagazine.com/en/10-hottest-places-in-the-world/ [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]
8669					Drought - Global Increase: There are several other places in the SPM, most notably Figure SPM.6 (lower right) and the statements that rely on it, where countervailing results about regions of decreasing drought are simply omitted, giving the false impression of globally increasing drought. The SPM should present a more balanced set of findings here, consistent with the findings of the underlying report. [Government of United States of America, U.S. Department of State]

Comment ID	From Page	From Line	To Page	To Line	Comment
8671					Drought - Terminology: Recommend that the term "ecological drought" be removed from the SPM since ecological drought depends on far more than soil moisture, PDSI, SPEI, or any of the other metrics considered. "Ecological drought" is only mentioned in conjunction with "agricultural drought" as a de facto synonym. The latter phrase ("agricultural drought") is well accepted by the scientific and operational drought-monitoring communities as referring to a deficit in soil moisture: It is in this context that the phrase is correctly used throughout the SPM. However, within these same communities, the former phrase ("ecological drought") is not constrained to a soil-moisture deficit. Analysis of ecological drought requires metrics that go far beyond the familiar standardized metrics presented in the SPM to a holistic understanding of the ecological, hydrologic, hydroclimatic, and socio-economic aspects of drought. [Government of United States of America, U.S. Department of State]
8673					Black Carbon: Authors should further discuss their assessment in the SPM or TS of the much lower contribution of BC to observed warming versus what was presented in AR5. In fact, the uncertainty bars for both temperature (Figure SPM.2) and radiative forcing (Figure TS.15) appear to show a substantial probability that the contribution for BC could be negative. In 7SM-7, the Effective Radiative Forcing due to changes from direct aerosol-radiation interactions (ERFari) for BC is listed at +0.3 ± 0.2, which seems substantially larger than what is shown in Figure TS.15 (and which, while lower than AR5's estimates, would be much more in line with expectations). It is not clear from the underlying report what the evidence base is for the lower assessed ERF for BC and in particular for the potential negative contribution to temperature (although from Figure TS.15 it appears to be due to aerosol-cloud processes). [Government of United States of America, U.S. Department of State]
8675					The abbreviation "H.S." used throughout the SPM is never defined. Also, punctuation is inconsistent between the levels of headline statements. For the highest level statements, there is not a period between the "H" and the "S" but at the more detailed level there is (i.e., HS.1 vs. H.S.1.1). [Government of United States of America, U.S. Department of State]
8677					Many numbers specifically refer to global surface temperature or changes, but there are also many temperature values for global warming or aerosol cooling. It is worth clarifying whether those are "surface temperature" or "surface air temperature" (e.g., for page 4, lines 22-23). [Government of United States of America, U.S. Department of State]
8679					The SPM accurately represents the underlying chapters of the WGI AR6. It also reinforces some of the conclusions made in Volume 1 of the Fourth U.S. National Climate Assessment (aka, the "Climate Science Special Report") -- in particular, the statement "The likely range of net human-caused surface warming is 0.8-1.3°C, with a central estimate of 1.07°C." [Government of United States of America, U.S. Department of State]
8681					It would be useful to include an "Evaluation of Climate Models" section like in the WGI AR5 SPM. Such information can provide guidance to experts outside the modelling community, including WGII and WGIII scientists, on how to use/interpret model results. Without such information, most readers may not be aware of the limits of current climate models. For example, there is more confidence in some (e.g., air temperature) than other fields (e.g., precipitation), more confidence on global than regional features, and more confidence on changes on the centennial than decadal time scales. There is low confidence in model-projected circulation trends or regional climate change information. From this report, there is no way for non-climate modelers to recognize the uncertainties in climate modelling. [Government of United States of America, U.S. Department of State]
8683					The SPM should more explicitly reference updates, changes, and improved understanding in AR6 compared to AR5 (e.g., in HS.4 statements on climate sensitivity). [Government of United States of America, U.S. Department of State]
8685					Internal or naturally forced (e.g., volcanoes) multi-decadal variability, which can cause some of the observed multi-decadal changes, has not been properly represented. Internal decadal variability was mentioned less in this report compared to AR5. In AR6, authors are more inclined to attribute regional decadal or multi-decadal changes (H.S.1.3, H.S. 1.6, H.S.1.8, H.S.4.2) to human causes. [Government of United States of America, U.S. Department of State]

Comment ID	From Page	From Line	To Page	To Line	Comment
8687					The SPM tends to attribute regional decadal or multi-decadal changes (H.S.1.3, H.S. 1.6, H.S.1.8, H.S.4.2) to a human cause. For example, in H.S.1.8: "... regional greening and browning have been observed since the 1980s ... (high confidence)." Does high confidence mean the trend is significant, or confidence that this trend is caused by human activity? Attribution of the regional decadal- to multi-decadal trend has low fidelity, partly due to lack of observational records and understanding of decadal variability, and partly due to low confidence in circulation trend. If the confidence only refers to the significance of the change, the section title ("HS.1. It is an established fact that human influence has warmed the climate system....") may make it look like the changes listed below are all human-caused. This SPM may mislead policymakers who have no background in climate variability that regional multi-decadal trends/changes are mainly caused by human activity. The SPM should point out the limitations in attributing regional trends to anthropogenic climate change, but also that an absence of evidence does not necessarily mean evidence of absence. [Government of United States of America, U.S. Department of State]
8689					When referring to a scenario, replace 'CO2' with "CO2-equivalent" since emissions scenarios address more than just CO2. [Government of United States of America, U.S. Department of State]
8691					Modes of variability and their changes are an important aspect of understanding regional climate changes and extremes. The SPM only provides key findings about the Southern Annular Mode. Suggest elevating the key statements about the other modes of variability to the SPM because of its above-mentioned importance, and to provide an update to previous assessment. [Government of United States of America, U.S. Department of State]
8693					The expressions of findings in the SPM tend to be overly technical instead of shifting to the relative (or prevailing) likelihood framing that policymakers generally use and are expecting to be used in a presentation of the science to them. For example, suggesting that ocean warming is "virtually certain" is an over-qualification that seems to leave open the possibility that the ocean has cooled, and there is no scientific evidence at all for thinking this (observations of warming are confirmed also by sea level rise, atmospheric warming, etc.). When there is no alternative explanation, statements are best made without qualification. The section on "Climate Information for Risk Assessment and Regional Adaptation" is much more readable and instructive with its focus being mainly on use of the "confidence" terminology instead of the "likelihood" terminology. [Government of United States of America, U.S. Department of State]
8695					In discussing the degree of global warming at any given time, the SPM (and indeed much of the discussion in the analyses) is focused on the average of the temperature change, typically over two decades. And the figures, by averaging over models and their individual simulations, present the running two-decade or so average of the increase in the global average temperature. For past temperature change, the average is taken over the preceding one to two decades. [Government of United States of America, U.S. Department of State]
8697					There is little discussion of the role of HFCs in the SPM. The SPM should address the issue that current emissions inventories do not fully account for emissions that must be occurring to cause the ongoing changes in atmospheric composition. If and where the SPM relies on HFC inventory data, it should be tactfully noted that this data does not match top down atmospheric measurements. [Government of United States of America, U.S. Department of State]
8699					Figure SPM-4(b) shows the contribution of each greenhouse gas to warming from 1850 to 2100. This is quite traditional and scientifically appropriate if looking at the overall issue, but it is not the figure that policymakers should really have available to them. So that the most efficient action can be taken, what policymakers really need now is a figure that shows the warming contributions from various species of future emissions from the present (or 2020) out to 2050 and out to 2100. What is needed is a plot that shows the relative influence of future emissions. [Government of United States of America, U.S. Department of State]

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8701					When the text refers to the ongoing increase in global warming, it is in essence referring to the running multi-decadal average change in the global climate. The value is typically arrived at by averaging across all the model results (from different modeling groups across the different simulations of each modeling group). This has the clear effect of wiping out the variations that occur as the result of natural variability, so it gives a nice smooth curve. But, this is not what is going to happen in the real world -- in which one particular temperature path is followed through time and this path included variability with half the years being above and half below the average. Urge a change in the text to make clear that the authors are talking about the multi-decadal average of the increasing temperature. This IPCC assessment needs to make this very clear or there are going to be serious misunderstandings when a single year goes above 1.5°C. [Government of United States of America, U.S. Department of State]
8703					Few of the major impacts are dependent on the running 20-year average of the amount of climate change. Coral bleaching is dependent on what happens in the hottest year. Similarly, for crops and food production, what matters is not the 20-year running average, but what happens over a particular season, etc. Authors need to consider the effect of variability. [Government of United States of America, U.S. Department of State]
7221					6SM-10 - [Chapter 6] O3 => number '3' should be written with the lower character [Government of Republic of Korea, Korea Meteorological Administration (KMA)]
7425					Chapter 9, page 44, lines 28-32 state "The significant variability driven by unforced oceanic variability of dynamic sea - level variability require fully three - dimensional ocean models and only high - resolution ocean models are statistically consistent on short timescales with satellite altimeter observations" and this should be added to the SPM [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
259					The use of material that comes with wide confidence ranges does not rise to the required level to support SPM content. For example, the inclusion of the of colored shades in Fig. SPM 1 and the use of this figure to support HS 1, HS 1.1, HS 1.2, HS 2. HS 2.2. Limit the use of wide (5-95%) confidence ranges as supporting material for HS's. Development of HS's need to be based on (high confidence) data. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7427					Chapter 9, page 48, lines 29-30 states "there is no tipping point or critical threshold in global mean temperature beyond which the loss of summer sea ice becomes self-accelerating and irreversible (high confidenc)" and this should be added to the SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7429					Chapter 9, page 46, lines 24-27 states "recent attribution studies now allow the strengthened assessment that it is very likely that more than half of the observed Arctic sea-ice loss in summer is anthropogenic" means the other half is nature, and should be added to the SPM [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
263					The specificity of the emission sources conveys lack of influence of other sources. In this science-based body of work, citing a single source of emissions detracts from the value of the argument being presented. Remove the source of emssions from the text and captions unless the of the source is material to the statement. For example, singling emissions from fossile fuels in figure SPM 7. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7431					The statement in Chapter 9, page 47, Line 3-4 "Most CMIP6 models fail to simulate the observed sensitivity of sea-ice loss to CO2 emissions (as a proxy for time) and to temperature simultaneously" should be added to the SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7433					The statement in Chapter 9, page 47, Line 56 "it is very likely that the Arctic Ocean will remain sea-ice covered in winter in all scenarios throughout this century" should be added to the SPM [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]

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7179					Our view continues to be that the WG1 authors, Co-Chairs and TSU have done a reasonable good job to date with the FGD and should be commended for the substantial amount of work that it has achieved in trying times. However, Trinidad and Tobago have concerns as it relates to the balance of the report, which we find to be insufficient, particularly the way Climate Extremes for Caribbean Small Islands, as a region, have been assessed. We are concerned that insufficient synthesis of results from available literature for the region have been done and particularly, the seeming lack of use of available grey literature, which are allowable for the assessment. Furthermore, even when there is information, the report fail to sufficiently articulate on the results for Caribbean Small Islands which we find to be disadvantageous. [Government of Trinidad and Tobago, Ministry of Planning and Development]
7435					Chapter 9, page 48, lines 15-16 states "CMIP5 models also have issues with capturing the seasonal cycle of observed changes in Arctic sea-ice drift speed, which affects their simulation of regional sea-ice concentration patterns" should be added to the SPM [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7437					Chapter 9, page 49, lines 20-22 states "there was no significant trend in annual mean Antarctic sea-ice area over the period of reliable satellite retrievals starting in 1979 (high confidence)" and this should be added to the SPM [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
6425					Thankful for the conciseness of this report! [Government of Saint Lucia, Department of Sustainable Development - Ministry of Education, Innovation, Gender Relations and Sustainable Developement]
6427					For ease of referencing while reading, it would have been good to include the actual SPM figures where they were intended to be placed. [Government of Saint Lucia, Department of Sustainable Development - Ministry of Education, Innovation, Gender Relations and Sustainable Developement]
7451					The text should align with Article 4.1 and 2.1 of the PA. Article 2.1 of the PA clearly indicates, "holding the increase in the global average temperature to well below 2C above preindustrial levels and pursuing efforts to limit the temperature increase to 1.5C above pre-industrial levels." These conditions pertaining to 1.5C should not be included in this text, whereas the focus of reaching 2C should be the focal point. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7455					The formatting of references could be improved as certain publication dates, chapters, tables, figures, and authors are not referenced. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7459					The author of the originally cited reference (Vogel et al., 2019) states "results reveal that the average high-exposure area projected to experience concurrent warm and hot spells in the Northern Hemisphere increases by about 16% per additional +1 °C of global warming", where as the text itself neglects to mention "per additiona +1 C of global warming." The text should not omit all information referenced by original authors to ensure accuracy and avoid misinterpretation. Include "per additional +1 C of global warming." in both the underlying chapter (Ch 11, P 25, L 5-9) and the SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]

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293					The use of material that comes with wide confidence ranges does not rise to the required level to support SPM content. For example, the inclusion of the of colored shades in Fig. SPM 1 and the use of this figure to support HS 1, HS 1.1, HS 1.2, HS 2. HS 2.2. Limit the use of wide (5-95%) confidence ranges as supporting material for HS's. Development of HS's need to be based on (high confidence) data. Additionally, the used of the term "established fact" in HS.1 is weakened by the use of such data. Replace this term with a term that is commensurate with the data that cannotate the risks introduced by human activities. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
295					HS 3, 13, and 14 discuss emission reduction in absence of regional contributions. The sceince-based evidence informs that magnitude of contibitions vary by region. Therefore, when presenting this material to policy makers, such regional effects need to be stated. These effects will have implications for commensurate efforts to the expected emission reductions from each region. Ensure that the regional component is reflected in these statements. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7465					Discussions pertaining to heavy precipitation events reflect inconsisties in confidence intervals in Ch. 11.2, 11.3, 11.4, 11.6, 11.8, 11.9, Table 11.2, Table 11.5 and the Executive Summary and thus the SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
2629					General comment: Figures. The Figures in the SPM are beautiful and easily understood. Congratulations. This is a seismic advance compared to previous IPCC reports. Your efforts are appreciated. [Government of Canada, Environment and Climate Change
2631					General comment: Congratulations on a excellent final draft SPM. It is succinct and draws attention to relevant key messages for policymakers. The line of sight to underlying sections of text was well done, and in that regard, we especially appreciated the links to the Technical Summary, including the section summary boxes there. The ease of cross-referencing these sections of text was very helpful in reviewing the SPM and improves traceability overall. [Government of Canada, Environment and Climate Change Canada]
7255					Heartfelt thanks and congratulations to WGI Co-Chairs and authors! The FGD SPM represents a great improvement compared to the previous draft. In particular, we would like to highlight the wealth of regional information that has been made available via the SPM and interactive Atlas. For SIDS, the inclusion of post-2100 climate change information, especially on future sea level rise, is a major step forward and we would like to encourage the authors to further strenghten this assessment due to its high policy-relevance. We are looking forward to constructively engaging in the virtual approval plenary format. [Government of Saint Kitts and Nevis, Department of Environment - Ministry of Agriculture, Marine Resources, Cooperatives, Environment and Human
7257					Co-Chairs, authors and support staff have to be commended for their hard work in preparing a very concise and clear SPM draft. The narrative is clear and the length is adequate. In particular, we would like to congratulate the authors for successfully compiling a set of very clear and powerful figures. [Government of Saint Kitts and Nevis, Department of Environment - Ministry of Agriculture, Marine Resources, Cooperatives, Environment and Human Settlements]
7003					Congratulations and thanks to the AR6 WGI Co-Chairs, authors and support staff for their excellent work on this clear and concise FGD SPM draft, which has very much improved since the previous version. The figures in particular are very clear and impactful. The comprehensive information at the regional level (via SPM and Interactive Atlas) is particularly notable. For the Pacific region, the post-2100 information, especially on sea level rise, is critical and further strengthening the assessment on this issue would be welcome. [Government of Fiji, Fiji Meteorological Services]

Comment ID	From Page	From Line	To Page	To Line	Comment
7259					We very much appreciate efforts undertaken in the underlying chapters, first and foremost Chapter 2, and in the SPM to clarify the details of the AR6 WGI temperature assessment since SOD. Unfortunately, the SPM still falls short in establishing a prominent and clear line of sight to the previous assessment. It is particularly important for AR6 to transparently report the methodological changes in the temperature assessment to allow for a straightforward comparison with AR5, which was instrumental for the Paris Agreement, and the Long-Term Temperature Goal (LTTG), in particular. The implications of the changed methodology for assessing historical global mean temperature change are not clearly laid out in the current draft document either. It has to be avoided by all means that AR6 inadvertently moves the Paris Agreement goalposts, affecting pathway classifications etc (1.5°C in AR6 being 1.42°C in AR5 and wrt the Paris Agreement). In the following, we will provide more specific suggestions on how to address this issue without playing down the scientific progress made. [Government of Saint Kitts and Nevis, Department of Environment - Ministry of Agriculture, Marine Resources, Cooperatives, Environment and Human Settlements]
7005					The efforts made in the SPM and in the chapters to provide clarifications on the AR6 WGI temperature assessment and its methodology are commendable. However, particularly the SPM should more clearly and transparently explain changes in methodology compared to previous assessments. This is especially important for allowing comparisons to AR5, as it informed the Paris Agreement and its Long-Term Temperature Goal (LTTG). [Government of Fiji, Fiji Meteorological Services]

Comment ID	From Page	From Line	To Page	To Line	Comment
7261					It is a big effort to provide the SPM temperature assessment relative to pre-industrial (1850-1900) levels and we appreciate the authors' hard work. This approach differs from the approach taken in the IPCC AR5, of course. Unfortunately, the approach chosen for AR6 comes with a range of issues, in particular in the context of deriving arguably highly policy-relevant messaging e.g. around crossing times of the 1.5°C limit. The following elements are specifically problematic: i) The new scenarios start in 2015 with stylized forcing. This is 6 years ago (or one-third of the period until the assessed 1.5°C crossing time). Key observed forcing parameters, aerosols in particular, are not following stylized trends since 2015. Also, the effect of the COVID pandemic on emissions is not captured. While we understand that the effect of the COVID-related emissions drop has hardly any long-term temperature implications, all of these aspects still have to be considered in the context of very sensitive and detailed near-term trends. The current scenario setup, however, does not come with the required applicability. ii) That these issues are not just theoretical in nature is illustrated by comparing different estimates provided in the SPM. 2011-2020 anthropogenic warming is assessed as 1.07°C since 1850-1900 and all scenarios are reach 1.5°C in 2030 (even earlier for SSP5-8.5). This corresponds to a warming of 0.43°C in 15 years or a decadal warming rate of 0.29°C per decade – well above what has been observed so far, but a strongly accelerated warming rate appears to be at least unlikely to materialize under any COVID recovery trajectory. iii) The re-assessment of historical warming compared to the AR5 leads to a shift to more warming for this component. How such a "backward looking" shift relates to the "forward looking" projections informing the goals of the Paris Agreement is not for the IPCC to decide, but for countries to discuss, for example, during the 2nd Periodic Review under the UNFCCC where this report will serve as an input. A clear line of sight to previous assessments (SR1.5 and AR5) is thereby critical. The current treatment of this issue is insufficient still. Taken together, it appears that scenario projections and observations are best addressed separately. This would allow for full transparency regarding different methodological approaches and limitations in relation to both observed and projected components. It would also eliminate a significant period of overlap with real world observations and stylized projections. It is thus strongly suggested to revert to the approach taken in the IPCC AR5 to present projections relative to the recent 1995-2014 reference period (as done in the SPM FOD) and assess observed warming until that reference period separately (for the different AR6 and AR5 methods), compare e.g. AR5 WG1 Table SPM.2. This should be applied throughout the SPM and the report. [Government of Saint Kitts and Nevis, Department of Environment - Ministry of Agriculture, Marine Resources, Cooperatives, Environment and Human Settlements]
7007					The effort to provide assessments relative to pre-industrial levels is commendable. There are however several issues with this approach: First, SSP-RCP scenarios started several years ago with stylized forcings and are not necessarily in line with observations. However, they are still informing the assessments of near-term trends, while resulting accelerated decadal warming rates (that are not presented in detail) appear rather unlikely. Overall, it would be desirable that observations and scenario projections are addressed separately, which would increase transparency and avoid overlapping time periods between the two. It is furthermore strongly suggested that AR6 takes the same approach as AR5 and presents projections relative to a recent reference period. It is critical that AR6 provides a clear line of sight to previous assessments. [Government of Fiji, Fiji Meteorological Services]
6513					Final copy editing needs a specific focus on footnotes (like footnotes 3,4,5,6,11) [Philippe Tulkens, European Union (EU) - DG Research & Innovation]

Comment ID	From Page	From Line	To Page	To Line	Comment
6515					Please clarify the terms used forglobal temperature and how they relate to those used in earlier reports. In particular, is "global surface temperature" the same as "global mean surface temperature (GMST)" used, e.g., in SROCC? Is it different from "global mean temperature" used, in Figure SPM.10? Neither "global surface temperature", nor "global mean temperature" is defined in the Glossary, but only GSAT, GMST, LSAT and SST. [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
6517					Full SPM: No reference to "tipping points". Suggestion: HS.12 should clarify the relationship of "tipping points" to "low-likelyhood events". A summary table should be added listing each of the main potential extreme outcomes, (possibly with some description or indication of state of knowledge - but even a simple list would help). [Philippe Tulkens, European Union (EU) - DG Research & Innovation]
123					The document makes an impression that GHG increase in the Earth's atmosphere has negative impacts only. This is actually not the case. For example, CO2 increase along with increases in temperature and precipitation may positively affect GPP and NPP of terrestrial ecosystems. Such things should not be ignored in the SPM. Otherwise the credibility of the report as a whole can be undermined. [Government of Russian Federation, Institute of Global Climate and Ecology]
129					AR6 WGI report "assesses the current evidence on the physical science of climate change, evaluating knowledge gained from observations, reanalyses, paleoclimate archives and climate model simulations, as well as physical, chemical and biological climate processes." The report also confirms the limitations of reanalysis, and thus the use of most recent generation of reanalysis products alongside more standard observation-based datasets. Reanalysis utilizes models constrained with observations in scientific papers using different methodologies with different assumptions and inherited uncertainties. An example discripance is shown in Chapter 1 page 80 'the global average surface temperature from MERRA-2 is far cooler in recent years than temperatures derived from ERA24 Interim and JRA-55, which may be due to the assimilation of aerosols and their interactions'. The mixture of these resources makes it impossible to bring about single conclusion on the projection of the future. This in itself is a fact showing the limitation in the tools which should be clearly stated in the SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
131					Past projections of global surface temperature and the pattern of warming are broadly consistent with subsequent observations (limited evidence, high agreement), especially when accounting for the difference in radiative forcing scenarios used for making projections and the radiative forcings that actually occurred. This has been described in Chapter 1.3 as "Limited evidence, high agreement". However, this means low to med confidence caused by the limited eveidnce. This should be included in the SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
133					The construction of climate change information and communication of scientific understanding are influenced by the values of the producers, the users and their broader audiences. Scientific knowledge interacts with pre-existing conceptions of weather and climate, including values and beliefs stemming from ethnic or national identity, traditions, religion or lived relationships to land and sea (high confidence). Science has values of its own, including objectivity, openness and evidence-based thinking. Social values may guide certain choices made during the construction, assessment and communication of information (high confidence).' This high confidence statement is very powerful as it shows the human influence on the literature and science. However, this fact has not been discuess in depth to reach a conclusion on the actual quantified or even qualitfied impact. This has to be included in SPM to show that the discussion in WG1 report influenced by policymaking and societal understanding about climate change. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]

Comment ID	From Page	From Line	To Page	To Line	Comment
135					Capabilities for observing the physical climate system have continued to improve and expand overall, but some reductions in observational capacity are also evident (high confidence). Improvements are particularly evident in ocean observing networks and remote-sensing systems, and in paleoclimate reconstructions from proxy archives. However, some climate-relevant observations have been interrupted by the discontinuation of surface stations and radiosonde launches, and delays in the digitisation of records. Further reductions are expected to result from the COVID-19 pandemic. In addition, paleoclimate archive such as mid-latitude and tropical glaciers as well as modern natural archives used for calibration (e.g., corals and trees) are rapidly disappearing owing to a host of pressures, including increasing temperatures (high confidence). The impact of these reductions on the robustness of the observational system should be included and highlighted in SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7307					The underlying chapters leading to the SPM discussion included elements outside the mandate of WGI and the approved outline such as the analysis of the countries NDCs progress towards limiting global warming objectives. The report concludes that 'NDCs submitted as of 2020 are insufficient to reduce greenhouse gas emission enough to be consistent with trajectories limiting global warming to well below 2°C above pre-industrial level'. This is not the objective of this report which should be focused on the physical science not the evaluation of the political declrations of the countries' contributions. Chapter 1 page 23 states that 'It can be informative to place current NDCs and their emission mitigation pledges within this low and high-end scenario range, that is, in the context of medium-high emission scenarios (RCP4.5, RCP6.0 or SSP4-6.0).' The climate response differences between future medium or high emission scenarios has a higher value for policymakers to inform them about the adaptation challenges. The reference of NDC can be helpful in formulating the scenarios not for the puprose of evaluting the current climate system state. Moreover, assessing countries' NDCs is not in the mandate of this WG and was not part of the approved outline for this WG report. Remove eny text which evaluates NDCs. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7309					The SPM authours and the underlying report are significantly coming from developed countries than developing countries. The under-representation of developing countries in a high-impact panel reflects an imbalance of the scientific information shared as well as ethical implications of equity and diversity. Achieving equitable geographical representation is crucial to ensure knowledge democracy. The SPM should make note of this clear imbalance. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7311					Original sources of the Figures in the report should be provided for each figure. It should be clear from which references in the literature the figure data was provided in following the citation style of the report. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7313					The report should align with Article 4.1 and 2.1 of the PA. Article 2.1 of the PA clearly indicates, "holding the increase in the global average temperature to well below 2C above preindustrial levels and pursuing efforts to limit the temperature increase to 1.5C above pre-industrial levels." The conditions pertaining to 1.5C should not be included in this report, whereas the focus of reaching 2C should be the focal point. This should be especially emphasized in Pages 19-22 of the SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7315					The anlaysis in the SPM and the report is focused for the most part on Paris Agreement goals. However, this report serves the convension UNFCCC goals and needs to address its goals in the first place. Special Report 1.5 has a specific context and the goal of the analysis in this report should remain 2 degress. For example statments like 'Understanding of the response to a change of anthropogenic emissions is important to estimate the scale and timing of mitigation compatible with the PA's long-term goals.' Chapter 1 page 23, should not be used. All the discussion and the anlaysis in this report should be focused on the convension goals. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]

Comment ID	From Page	From Line	To Page	To Line	Comment
7317					Scenarios have a long history in the IPCC as a method for systematically examining possible futures. A new set of scenarios, derived from the Shared Socio-economic Pathways (SSPs), is used to synthesize knowledge across the physical sciences, impact, and adaptation and mitigation research. The report neglects the likelihood core set of SSP scenarios used in the WGI report, scenarios to future emission and concentration scenarios that result from combining these socio-economic development pathways with climate change mitigation assumptions. In addition, the trade-offs betweent these scenarios should be stated clearly for policymakers for them to understand the elements at stake for each of these scenrios. This has to be clarified in the SPM as well. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7319					The discussion on SPM on emissions should be inclusive of all GHG emissions. Global warming depends on cumulative GHGs emissions and not CO2 alone, especially when the emphasize is put on deep emission cuts. GHG emissions should be discussed in replacement of CO2 alone. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7321					The SPM lacks the discussion on the understanding to the effects of the COVID-19 pandemic and their potential subsequences.The COVID-19 pandemic has yet to manifest its full overprint. It is useful to emphasize. Articulate, for example, its potential influence on the upcoming 2023 global stocktake in light of Article II Of the PA. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7323					In Chapter 1, page 16, Line 14-20, the argument shared can be improved by clarifying the contributions from anthropogentic sources. Such construct of the argument provides strength to the SPM. Add a sentence about coupling/decoupling of anthropogenic contributions from all other factors [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7325					CMIP models described in Chapter 1, page 66, line 15-17 and used for the underlying discussion presented in SPM, it is unclear what the effects of the abrupt events of the past are. Modeling these historic events helps assess their overprint on the record more accurately. Propose for a CMIP-type work to assess mangitude of effects of prior historic abrupt events and period of resiliency. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7327					The rate of changes of the events has implications for the attribtion method were not clarified in the SPM and the underlying report (Chapter 1, page 69, Line 26-37). Constructing the narative without these implications weakens the content and reduces its value. Clarify the effects/role of the frequency of events (accelerated/decelerated) as an attribution method, e.g., floods [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]

Comment ID	From Page	From Line	To Page	To Line	Comment
419					The Chinese government appreciates and thanks the Bureau members, lead authors, and Technical Support Unit (TSU) of the Working Group I Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC AR6 WGI) for their painstaking efforts made for the preparation of the present report. We believe that the Summary for Policymakers (SPM) of WGI Contribution to AR6 basically reflects the new knowledge of global climate change in physical science assessed in the underlying report. So it will provide an important scientific basis for the international community to further understand the basic facts, trends, impacts and causes of climate change. In order to further make WGI contribution a more scientific, accurate, regular and policy-neutral report, we wish to make the following comments which are hoped to be adopted. 1. Regarding the scientific and accuracy of SPM. The conclusions of WGI SPM will be an important scientific basis of global actions to address climate change, and also a foundation of WG II and WG III contributions and the Synthesis report. However, some conclusions of the present SPM are still inaccurate. For instance, in HS.1, the conclusion that human influence has warmed the climate system is less rigorous, lack of quantitative assessment and qualifications such as applicable time period. In addition, it is stated that AR6 estimates the global temperature rise of 1.5℃ by ten years earlier than SR1.5, and the comparison is not sufficient. The examples are not limited to the aforementioned ones. To ensure a scientific and accurate SPM, it is suggested to make further revision or delete the relevant conclusions. 2. Regarding the length and figures of SPM. The current SPM exceeds the length prescribed by IPCC. Considering that the SPM will be adopted line by line at the 54th Session of the IPCC in a virtual form, too long a report will pose great challenges to the review and approval process at the Session. Therefore, it is suggested to delete unnecessary details and streamline the text and figures. 3. Regarding the regular expression of SPM. Some conclusions in the SPM are not normally expressed, and too many complex terms and acronyms are used. For instance, reference periods used in the SPM includes 1750, 1850-1900, and 1851-1900, etc. To make the statements as normal and understandable as possible, it is suggested to make further revision. 4. Regarding Chinese sovereignty, nationality, map and improper examples of underlying report. Almost all the suggestions of the Chinese government in the previous government review were accepted, however, erroneous expressions occurred again in the current revised underlying report. First, there are erroneous expressions of Taiwan Province. Second, in some conclusions, maps with national and regional borders are used, and there are also some errors such as erroneous borderlines of West Section of China-India Border, omitting the Dotted Line of South China Sea,Nanhai Zhudao, as well as omitting the Diaoyu Dao and its affiliated islands. Third, erroneous marking of nationality of authors. The Chinese government does not recognize dual nationality of Chinese
7331					The finding on the contribution of halogenated gases to Effective Radiative Forcing (ERF) and its warming influence demonstrated in Chapter 2, Pg. 22 Line 45-50 is not reflected in the SPM. Add this finding to the SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
421					Multiple reference periods are used in the SPM, including 1750, 1850-1900, 1851-1900, etc. To avoid misunderstanding, the SPM should be consistent in this connection, e.g., for temperature changes, it is suggested to take 1850-1900 as the reference period. If consistency is not possible, it is suggested to add a reason in the text or footnote. In addition, different time periods are used for different spheres in HS.1, such as "since 1950s" and "since 1970s" or "1979". It is suggested to explain why different time periods are used in the SPM. [Government of China, China Meteorological Administration]
7333					The findings of crossing times of 2 C in Chapter 2, Page 23, Line 40 must be presented in the chapter along with 1.5 C crossing times as stated in this sentence. These findings must also be presented in the SPM alongside crossing times for 1.5 C. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]

Comment ID	From Page	From Line	To Page	To Line	Comment
423					In spite of the attempt to link the scientific basis of climate change with adaptation and mitigation, the current SPM shows from its structure and content that the basis is less linked to adaptation. It is suggested to add climate change adaptation related words in the section on Climate Information for Risk Assessment and Regional Adaptation. [Government of China, China Meteorological Administration]
7335					This finding on the temperature change of the stratosphere reflected in Chapter 2 pg. 48 Line 44-47 is not consistently illustrated in H.S.1.3 of the SPM. In the SPM it is stated that it is "virtually certain that the stratosphere has cooled". In the underlying report this only applies to the "lower stratosphere", whereas for the upper and middle stratosphere it is stated in the underlying report as "likely that middle and upper stratospheric temperatures have decreased since 1980". Rewrite to ensure consistency is shown in the SPM by adding the findings of all layers of the stratosphere as shown in the underlying report. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
425					The SPM in its current version reflects rather objectively the main scientific progress and new understanding in the fields of climate change observation, detection and attribution, and future projection since AR5, but its textual and graphical length far exceeds that stipulated by the IPCC. Considering that the WGI SPM will be considered and adopted line by line in a virtual form, the excessive length will also pose a great challenge to the IPCC Plenary Session. It is suggested to reduce the language and graphics significantly. At the same time, the current SPM figures are rather complex, and it is suggested to further streamline them into a concise graphic in the form of PowerPoint (i.e. one principal panel) instead of the current form of poster (i.e. several sub-panels arranged above and below), such as Fig SPM.3, Fig SPM.4, etc. It is suggested to further simplify the figures. [Government of China, China Meteorological Administration]
7337					The text reflected in Chapter 3, Pg. 7 Line 14-16 states, "The main driver of the observed increase in the amplitude of the seasonal cycle of atmospheric CO2 is enhanced fertilization of plant growth by the increasing concentration of atmospheric CO2 (medium confidence). However, there is only low confidence that this CO2 fertilization has also been the main driver of observed greening because land management is the dominating factor in some regions." As such, It is important to mention that CO2 has a positive impact on the plant to provide balanced report. Include this statement in the SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
427					The current SPM uses too many relatively complex technical terms and abbreviations, and it is suggested to make the technical language simplified or removed to the technical summary (TS). Some relatively important technical terms need to be further clarified, such as SSP, TCRE, etc., which are generally difficult for decision makers and readers to understand what they exactly mean (currently SSP in the SPM is only briefly explained in the footnotes, and TCRE has no relevant explanation). [Government of China, China Meteorological Administration]
7339					The statement shared in Chapter 3, Pg. 23, Line 40-47 states "the AR5 assessed with that most, though not all, CMIP3 and CMIP5 models overestimated the observed warming trend in the tropical troposphere during the satellite period 1979-2012". This indicates the overestimation of the models used in literature. This would be the case for current literature as all the knowledge is based on projections. This has to be included in the SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
429					Many terms are expressed inconsistently, such as human activities, human influence, human drivers and human-driven activities. In order to avoid misunderstanding, it is suggested to unify the expressions as much as possible. In addition, the formulation "aerosol emissions" used, which is scientifically inaccurate, should be accurately reformulated as "emission of aerosols and aerosol precursors". [Government of China, China Meteorological Administration]
7341					The statment reflected in Chapter 3, Pg. 67 Line 15-24, "models do not support robust assessment of the role of anthropogenic forcing in the observed AMOC weakening between the mid-2000s and the mid-2010s" provides clarification on the robustness of the assessment and should be added to the SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]

Comment ID	From Page	From Line	To Page	To Line	Comment
7343					The statment reflected in Chapter 3, Pg. 86 Line 17-23, "based on CMIP5 and CMIP6 results, there is no robust evidence that the observed changes in either the Atlantic Niño or AMM modes and associated teleconnections over the second half of the 20th century are beyond the range of internal variability or have been influenced by natural or anthropogenic forcing" should be added to the SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7345					The statement in Chapter 3, Pg. 88, Line 5-6 states "there is high confidence that internal variability has been the main driver of the PDV since pre-industrial times, despite some modelling evidence for potential external influence", which should be added to the SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7347					The caveats listed in Box 4.1 in Chapter 4, Page 4, Line 7-17 are of high importance to provide balanced information. Include a summary of these caveats and their implications to the near-term prediction in specific in the SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7349					The sources of uncertainty in the models and scenarios in the underlying Chapter 4 (Page 11-14) leading to the text in the SPM are multifaceted. Using techniques, such as PCA offer a way to constrain large number of uncertainties. Applying PCA to reduce number of compnonets and gain improved handle on the outcomes. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7351					There is an apparent bias (inherent) in the initialization methds as described in Chapter 4, Page 14-15). The bias will carry down all the subsequent analyses and affect the uncertainty of the results. Explicitly state in the SPM the effects of these biases since deconvolution and quantification of these effects is not realsitically possible with any measureable accuracy. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7353					Observationally constrained projections are problematic. By definition, they contain the biases of the "observer". This is especially impartant for decadal projections/predictions that can also be seen in Chapter 4, Pg. 14-15, Line 19-41. The upward probagations of these projections all the way to SPM requires closer scrutiny. Clarify the line probagations of the biases from observations to model results. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7355					Climate response to multi-vector stressors is non-linear. It is a coupled phenomenon. The coupling is not illustrated clearly in the SPM and the underlaying chapter (Ch4, P17-18). Articulate the spatial and temporal responses to these stressors and the combined associated uncertainties in the SPM to clarify the coupling. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7357					Restricting the focus on land due to societal focus steps out of the mandate of WGI. This can be seen in Chapter 4, Pg. 27-28, Line 29-31. The scince-based contributions from this WG provides value across all domains. Additionally, in the case of precipitation on oceans, it has long-term effects with implications for policy makers. Consider broadening the focus to a global one and reflect this clarity in the SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7359					Model results need to account for major forces. The Coriolis effect cerainly influences these results as described in Chapter 4, Page 31, Line 22-31. Include the effects of Coriolis forces in SPM qualitatively at the least. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7361					As seen in Chapter 4, Pg. 56-96, Line 48-29, discussion pertaining to spatial changes (tropics and extratropics) of calimate aspects are discussed. Spatial changes (tropics and extratropics) of calimate aspects are, collectively, an expression of coupled processes. These changes may be attributed to a variety of aspects and have wide ranging implications for policy. As such, they require reconciliation on multiple scales. Identify a method to couple the variables affecting temperature variability and reflect that in the SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]

Comment ID	From Page	From Line	To Page	To Line	Comment
7363					Energy efficiency as a mitigation option beyond the industrial sector treatment was not included in the SPM. Energy efficiency should be included along with Carbon Capture methods such as CCUS and DAC technologies as means of managing GHG emissions. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7365					Chapter 4 relies a lot on literature describing scenarios other than 1.5°C without clarity on whether they expect the finding better or worse comparing by the 1.5°C. Complete comparison needs to be provided for decision makers otherwise the analysis is incomplete. Provide complete analysis covering all scenarios and ensure this is also being reflected in the SPM [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7367					The examples cited are general and not 1.5c-specific. Hence, the agreement and the amount of evidence available do not necessarily inform the transition to or remaining below 1.5c world. Complete comparison needs to be provided for decision makers otherwise the analysis is incomplete. Provide complete analysis covering all scenarios in Chapter 4, Pg.5 Line 11-13 and ensure this is also being reflected in the SPM for better clarity. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7371					Throughout chapter 4 and the SPM varying levels of confidence are stated, without clearly stating the criteria for each level. The authors need to provide more transparency in that regard as is done with likeliness levels. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7373					The following text cited in Chapter 4, Pg. 4, Line 15-16, "Unless noted otherwise, the assessments assume that there will be no major volcanic eruption in the 21st century." As it is likely that at least one large volcanic eruption will occur during the 21st century, and such an event would "reduce GSAT for several years, decrease global-mean land precipitation, alter monsoon circulation, modify extreme precipitation, and change the profile of many regional climatic impact-drivers." This should be reflected in the SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7375					The finding in Chapter 5, Pg. 6 Line 46-48 starting with "Over the past six decades, the average fraction of anthropogenic CO2 emissions that has accumulated in the atmosphere (referred to as the airborne fraction) has remained nearly constant at approximately 44%." highlights the importance of Ocean and Land sinks which is higliy important to be presented in the SPM. Hence, this finding shlould be added to the SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7377					The finding in Chapter 5, Pg. 7 Line 13-14, "Atmospheric concentration of N2O grew at an average rate of 0.85 ± 0.03 ppb yr-1 between 1995 and 14 2019, with a further increase to 0.95 ± 0.04 ppb yr-1 in the most recent decade (2010–2019)", highlights the concentration trends of N2O which is highly important to be presented in the SPM. Hence, this finding shlould be added to the SPM [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7379					The finding shared in Chapter 5, Pg. 7, Line 53-54, " Increases in atmospheric CO2 lead to increases in land carbon storage through CO2 fertilization of photosynthesis and increased water use efficiency" highlights the increasing trend of land carbon storage. Hence, this finding shlould be added to the SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
4309					The report refers often to "global surface temperature". While this may be for readability, it is not clear how which metric is meant (cf. SR1.5). The glossary does not explain "global surface temperature" either, but rather refers to various global mean temperature metrics. A definition early on would be useful, for example by means of a footnote. [Government of Sweden, Swedish Meteorological and Hydrological Institute]
7381					Table 5.8 in Chapter 5, Pg. 96 highlights several geophysical uncertainties such as ZEC uncertainty, historical temperature uncertinity..etc. All the uncertinities associated with the table should be highlighted and mentioned in the SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
4311					The report refers to the SSP/RCP projection set both by "core set of (five) (emission) scenarios" and "(five) core scenarios". These references would be useful to harmonize, to avoid any risk of misunderstanding. [Government of Sweden, Swedish Meteorological and Hydrological Institute]

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4823					In general: The language in the SPM appears less technical than previous SPMs from WGI - this is a positive change that increases readability for non-science readers and also more clearly communicates main messages. The figures, with clear headings, also contribute in this respect. [Government of Norway, Norwegian Environment Agency]
7383					The finding shared in Chapter 5, Pg. 9 Line 38-40 states, "land- and ocean-based carbon dioxide removal (CDR) methods have the potential to sequester CO2 from the atmosphere, but the benefits of this removal would be partially offset by CO2 release from land and ocean carbon stores (very high confidence)" highlights the significance of CDR methodologies and thus should be highlighted in the SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral
4825					Please consider the multiple terms used for "human influence". Throughout the report the terms "human-induced", "human-caused", "human activity" and "anthropogenic" also occur. Please consider explaining differences of the terms, if relevant, or if one of them could be used consistently. For example, on page 16, the term "human-caused" is used in lines 7, 18, 22, and 33, while on page 19, "human induced" is used in lines 31 and 40. [Government of Norway, Norwegian Environment Agency]
5081					We would like to thank the authors for the general quality of this draft and its relative conciseness as compared to previous reports. However, it is still somewhat longer than we would prefer, therefore we hope that the overall length can be further reduced without losing key information, for example by reducing the number of figures. [Government of Belgium, Belgian Science Policy Office - Belspo]
7385					The finding in Chapter 6, Pg. 4 Line 29-30, "the concentrations of hydrofluorocarbons (HFCs) are increasing" highlights the concentration trends of HFCs without providing the regional variations as highlighted in the same paragraph in line 25. Hence, the regional variation should be highlighted in the SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
4827					The concept of carbon dioxide removal (CDR) is difficult to understand for policy makers, and are quite abruptly introduced to the readers without any explanation. Information from the Technical Summary is useful, and policy makers would benefit from such an explaination. Please consider lifting sentence from TS-64, lines 27-28 into SPM to ease understanding. [Government of Norway, Norwegian Environment Agency]
5083					General comment on figures: we would like to see more homogeneity in the use of colors in different figures. In particular, we understand that in figure SPM.3, green means "more water". However, green might be understood as "green light" = positive. We think that it is important to pay a lot of attention to possible misunderstandings like this one. [Government of Belgium, Belgian Science Policy Office - Belspo]
7387					The finding starting with "Reactive nitrogen, ozone and aerosols affect terrestrial vegetation and the carbon cycle through deposition and effects on large scale radiation" procided in Chapter 6, Page 5, Lines 25-26 highlight the scale of the effect and should also include the magnitude of the effect to provide a comprenensive finding in the SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
4829					The rationale of referring to the standardised IPCC wordings on confidenc and probability is well understood, however it unduly disturbs the readability when injecting the standardised language everywhere. A less intrusive way of communicating the scientific uncertainty should be considered, e.g. by coding the findings alphanumerically where this could be checked with a box up front that gives the full wording? [Government of Norway, Norwegian Environment Agency]
5085					There are many figures and they may not all be equally relevant in a SPM. A reduced number of figures would also be easier to approve in Plenary. Our priorities regarding figures to keep are as follows: 1; 2; 4 (panel a) which we suggest to combine with figure 8; 5; 6 (only 10-year events); 8; 10. As a medium priority, we would suggest keeping two parts of figure 9: the map from panel (a) and the panel (b). [Government of Belgium, Belgian Science Policy Office - Belspo]

Comment ID	From Page	From Line	To Page	To Line	Comment
7389					The finding in Chapter 6 Page 5 Line 33 starting with "Climate feedbacks induced from changes in emissions, abundances or lifetimes of SLCFs mediated by natural processes or atmospheric chemistry are assessed to have an overall cooling effect (low confidence),…etc" is based on low confidence and thus should not be highlighted in the excutive summary or the SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
4831					The changes from AR5 and and the recent Special reports are many places highlighted, in other places not. A box highlighting the changes in scientific understanding in AR6 from these reports would be usfeul from a policy-makers perspective, and make it less pressing to have consistent reference to such changes under the indvidual findings. [Government of Norway, Norwegian Environment Agency]
5087					We would like to suggest including a list of abbreviations in the SPM. [Government of Belgium, Belgian Science Policy Office -
7391					Data/interpretation designated with (low confidence) are not fit for the Executive Summary as seen in Chapter 6, Pg. 7 Line 28-29. Such levels of confidence detract from the statement(s) being presented. Remove data/information desginated with (low confidence) and implement the same by removing data/interpretation designated with (low confidence) in the SPM as well. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
4833					One recommendation from IPCC Expert Meeting on Communication, Oslo, Norway, 9–10 February 2016 was "The report should be written clearly and elegantly, with particular attention paid in this regard to the Summary for Policymakers (SPM), Frequently Asked Questions (FAQs), Executive Summaries and Headline Statements". We believe that the current draft is a step in the right direction to fulfill this recommodation, at the same time we think that there is still room for improvement, perhaps regarding technical terms. [Government of Norway, Norwegian Environment Agency]
5089					PgC is a unit that most policymakers will not understand, and it does not belong to the international system of units. We would like to ask the authors to restrict to GtCO2 (the most appropriate in a policy-relevant context) except when the topic requires GtC (i.e. the data is about carbon in forms other than CO2) so as to enable direct comparision of figures, with consistent units. [Government of Belgium, Belgian Science Policy Office - Belspo]
7137					There have been considerable improvements in the FGD SPM compared to the previous draft – congratulations to everyone involved. The clear narrative and the convincing figures have to be highlighted. Particularly, the level of detail for information at the regional level is highly relevant. We would also like to point out that the information on climate change beyond 2100, especially on sea level rise, is critical particularly for small island states, and that even more information on this issue would be most welcome. [Government of Samoa, Ministry of Foreign Affairs and Trade]
7393					As seen in Chapter 7, Pg. 15-16, Line 9-45, quantification of uncertaninty across temporal scales lacks accuracy. The implications are far reaching across AR6 WGI contributions. It affects the quantification of climate and emissions metrics and their impacts. Therefore, this should not be mentioned in the SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
227					Any model simulations are based on assumptions and results will change once underlying assumption changes. A statistical test will determine the sensitivity of the significance level in order to reflect the accuracy in the model; a higher significance yields an inaccurate model. Identify the confidence interval to reflect this relationship and indicate the basis of selecting this confidence level. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
4835					There is perhaps too many points that has been lifted into the SPM - The SPM does not need to cover the findings of every chapter. It should be as short as possible, with a careful selection of what the most policy-relevant findings are. [Government of Norway, Norwegian Environment Agency]
5091					General editorial comment: the treatment of number needs to be homogenised: for each value mentioned, it should be either always typed with words or always with digits, not a mix of these. See for example page SPM-6 : 2000 years in HS2.3 then 3 thousand years in HS2.4. References to X Million years also appear in the text. [Government of Belgium, Belgian Science Policy Office - Belspo]

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7139					We welcome the efforts made throughout the report and the SPM to clarify the AR6 WGI temperature assessment compared to the SOD. A clear line of sight to AR5 is however still lacking. It is important that the SPM transparently outlines any methodological changes in the temperature assessment so as to allow for comparisons to AR5 (due to its relevance for the Paris Agreement temperature goal). The SPM should therefore clearly explain the effect of the changed methodology on the historical temperature assessment. [Government of Samoa, Ministry of Foreign Affairs and Trade]
7395					Assessments of Earth's energy budget from multiple data, each with its own uncertainties, requires rigorous recoinciliation (Chapter 7, Pg. 18-19, Line 48-32). This is especially important between datasets that are generations-apart. Explicitly state the implications of varying datasets on the assessments/estimations of the Earth's energy budget in the Chapter itself and reflect this understanding in the SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
2789					We would like to thank the Co-Chairs and authors for their hard work in difficult times and congratulate them to a very promising FGD and a concise and clear SPM. Compared to AR5, the way regional information is presented is a step change and we would like to commend the author team in this regard. The interactive Atlas will be incredibly useful, in particular. As as Small Island nation, we are also grateful to see that sea level rise information is now provided beyond 2100 in the SPM. This information is incredibly powerful in showing the benefits of strong mitigation and the dire long-term prospects resulting from inadequate emission reduction measures. [Government of Jamaica, Meteorological Service Division]
5093					General comment on figures: when explanations or comments are provided within figure, we suggest that these should have a specific layout which helps identifying their role in the figure (e.g. colored background, specific typeset). [Government of Belgium, Belgian Science Policy Office - Belspo]
7141					We would like to point to several issues identified with the reference period being pre-industrial (1850-1900) for the AR6 WGI temperature assessment. The issues include: combining observations and projections, lacking a clear link to previous assessments, and using projections that are not taking into account most recent changes in atmospheric composition because the SSP scenarios start in 2015 with stylized forcing only; furthermore, potential effects of the pandemic on emissions can of course not be reflected. The SSP scenarios have clear constraints with regards to assessing very near-term future trends. Therefore, it is recommended that observations and projections are addressed separately, thereby increasing transparency and avoiding overlaps between observations and projections. We would urge that AR6 employs the same approach as AR5 and uses the respective most recent reference period (1995-2014). [Government of Samoa, Ministry of Foreign Affairs and Trade]
7397					The variations in degrees of mixing across zones of the atmosphere as well as within each zone influence not only model-based results, but also, observation-based ones. The interaction between the degrees of mixing and physical forces impact all physics and process-based models and in turn their outcomes. Clarify the effects of degrees, or ranges, of mixing in the underlying chapter (Chapter 7, Page 27-44) as well as SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
2791					The new SPM figures are excellent, the SPM narrative is clear, and the amount of information provided in the SPM is adequate. We greatly appreciate the efforts undertaken by the author team to improve the draft document and we are looking forward to the approval session that is approaching quickly. [Government of Jamaica, Meteorological Service Division]
7399					Chapter 7, Pg. 59-110, Line 8-28 discusses the topic of feedback processes. Feedback processes are, by their nature, non linear in both time and space. As such, the choice of correlation method(s) that the various processes or correlate the results from models and/or observations is very important. Using only linear regression to correlate non-linear data may mask important variabilities/trends; for example, Fig. 7.15. Specify the reasons for not using higher order correlations and ensure this is noted in the SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]

Comment ID	From Page	From Line	To Page	To Line	Comment
2793					We very much appreciate efforts undertaken to clarify the details of the AR6 WGI temperature assessment since SOD. Unfortunately, the assessment still falls short in establishing a prominent line of sight in the SPM to the previous assessment. Here, it is particularly important to transparently report any methodological changes in the temperature assessment to allow a straightforward comparison with AR5, which was instrumental for the Paris Agreement, and the Long-Term Temperature Goal (LTTG), in particular. The implications of the changed methodology to assess historical global mean temperature change for the 1.5°C goal, in particular, are not clearly layed out in the current draft document. [Government of Jamaica, Meteorological Service Division]
6377					We would like to thank and congratulate WGI Co-Chairs and authors on the FGD SPM, which we consider to have greatly improved since the previous draft, specifically regarding comprehensive information at the regional level in the SPM and the interactive Atlas. We welcome that post-2100 information is included on SLR, which is crucial for SIDS and we would be glad to see this assessment strengthened further, as it is highly policy-relevant. The virtual approval plenary format will be a welcome, novel opportunity to engage. [Government of Saint Lucia, Department of Sustainable Development - Ministry of Education, Innovation, Gender Relations and Sustainable Developement]
7401					Chapter 8 does not give attention to the aspect that there will be a shift from snowfall to rainfall, loss of frozen water stores in ice/snow dominated regions, and early spring melting, and their implications on flooding in high latitudes as another mode. This mode is very important in water cycle discussion and has to be covered in the report as well as reflected in the SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
2795					A lot of work has been undertaken to present the entire temperature assessment relative to pre-industrial (1850-1900) levels. We appreciate the efforts by the authors and the clarity coming with this approach. Unfortunately, this approach comes with a range of issues that are particularly policy-sensitive: 1. The SSP-RCP scenarios were designed to start in 2015 based on stylized forcing assumptions, the projections have therefore already started 6 years ago. To our knowledge, key observed forcing parameters, aerosols in particular, are not following these stylized trends since 2015. 2. The 2011-2020 anthropogenic warming contribution is assessed to be 1.07°C since 1850-1900 and all SSP-RCP scenarios are projected to reach average 1.5°C by around 2030. This corresponds to a warming of 0.43°C in 15 years, or decadal warming rate of 0.29°C per decade. These warming rates are above what is observed and appear unrealitstically high. 3. The re-assessment of 20th century warming compared to the AR5 leads to a shift in the historical warming component and parties will have to consider this during the 2nd Periodic Review under the UNFCCC, for example. In order to do so, clear lines of sight to previous assessments (SR1.5 and AR5) are needed. In order to address these major concerns, scenario projections and observations should be covered separately. This would ensure full transparency for both components of the temperature assessment. We would therefore strongly suggest to also apply to IPCC AR5 approach in AR6 to present projections relative to a recent reference period. Observed warming until that reference period would then be assessed separately and could be easily compared, similar to AR5 WG1 Table SPM.2, this time not only including the historical warming assessment from AR6 but also using AR5 methodology. [Government of Jamaica, Meteorological Service Division]
6379					We would like to congratulate everyone involved on a clear and concise SPM draft and would specifically like to highlight the very successful, easy-to-understand and effective figures. [Government of Saint Lucia, Department of Sustainable Development - Ministry of Education, Innovation, Gender Relations and Sustainable Developement]

Comment ID	From Page	From Line	To Page	To Line	Comment
7403					The estimated rate of presiciptation and evaporation increase with global warming is model-depenent with a very likely range of 1-3% per 1 degree celsius. This is because not all models are wetting and some are drying. This is represented as 'high confidence that global mean precipitation and evaporation increase with global warming' (Chapter 8). High confidence can not be concluded in model-dependent very likely range. The confidence level is not acceptable and should reflect the fact that model-dependent estimation is used. This should also be noted in the SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
6381					We welcome the clarifications that have been made in the SPM and chapters, especially Chapter 2, compared to SOD regarding the AR6 WGI temperature assessment; however, a clear link to AR5 is still missing. Especially the SPM should be transparent on any methodological changes in the temperature assessment, so that clear comparisons to AR5 can be drawn, considering its relevance particularly to the Paris Agreement and the Long-Term Temperature Goal (LTTG). The SPM should be clearer on how the changed methodology affects the assessment of historical global mean temperature change. Please consider the following comments for more in-depth suggestions. [Government of Saint Lucia, Department of Sustainable Development - Ministry of Education, Innovation, Gender Relations and Sustainable Developement]
7405					The key messages under the section of the future water cycle changes, with the exception of the first message, do not give a balanced view that reflect all the five core scenarios (Chapter 8, Pg. 7-8). The summarized changes are reflective of the most extreme radiative forcing scenario (SSP5-8.5). The AR6-WG1 report is built around 5 core scenarios (two high emission and two low emission scenarios, and one somewhere in the middle), and the results should not be biased toward the most extreme emission pathway. Thus, it is important to provide a balanced view by articulating how such changes would vary among the various scenarios instead of giving blanket statement without specifying which scenario. This balanced view should also be provided and demonstrated in the SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
6383					While the AR6 approach of providing assessments relative to pre-industrial levels (1850-1900) is appreciated, it differs from the AR5 approach and is problematic, as it combines observations and projections. Hence, is not able to provide a clear link to changes in the assessment of observed warming, and does not allow for direct comparison to previous assessments. Another issue comes up regarding most recent temperature change: 2011-2020 warming is assessed as 1.07°C relative to 1850-1900, as stated in H.S.1.2, while all scenarios point to 1.5°C warming in 2030 or even earlier. This means that in 15 years there would be warming of 0.43°C or 0.29°C per decade, which is higher than and not consistent with observed warming so far, and thus seems to be unlikely given any current post-COVID emissions path. Together with the other issues mentioned, this highlights that observations and scenario projections should be considered separately in order to provide full transparency of the different approaches and their respective limitations, and to eliminate overlap in time periods for observations and projections. We would therefore suggest employing the AR5 approach also here, presenting projections relative to the most recent 1995-2014 reference period and assessing observations separately up until this period. [Government of Saint Lucia, Department of Sustainable Development - Ministry of Education, Innovation, Gender Relations and Sustainable Developement]
7407					The paragraph (Chapter 8 Pg. 7 Line 34-53) indicates that annual precipitation is projected to increase globally and the atmospheric evaporative demand is expected to be limited in dry regions. This means that flooding would be enhanced in wet regions, and droughts would be alleviated in dry regions with projected increases in precipitation. This is then inconsistent with the very next statement which indicates that "The total land area subject to increasing drought frequency and severity will expand (high confidence), ...". The incosistency should be clarfied and the confidence level should not be high in this case. This should be clarified in the SPM as well. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
241					Throughout the SPM varying levels of confidence are stated, without clearly stating the criteria for each level. The authors need to provide more transparency in that regard as is done with likeliness levels. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]

Comment ID	From Page	From Line	To Page	To Line	Comment
7409					Urbanization has increased local precipitation (medium confidence) and runoff intensity (high confidence). This is not applicable to all regions. In this sence water cycle changes are regional, thus, all discussions in this section need to be clarified in regards to which ragions and at which cnfidence level. It is essential to clarify the regional differences and not to generalize unless the findings applies to every region. This clarity should also be demonstrated in the SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7411					"Representation of key physical processes has improved in global climate models (GCMs), but they are still limited in their ability to simulate all aspects of the present-day water cycle and to agree on future changes (high confidence). Climate change studies benefit from sampling the full distribution of model outputs when considering future projections at regional scales". This high confidence statement from underlaying Chapter 8, Pagge 39, Line 8 is significant and should apprear in SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7413					"Natural climate variability will continue to be a major source of uncertainty in near-term (2021–2040) water cycle projections (high confidence)." This high confidence statement in the underlying Chapter 8 Page 8, Line 49 is significant and should apprear in SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7415					The statement presents "stronger increase of interannual variability than in seasonal mean precipitation changes, apart from in the winter extratropics where both quantities increase at the same rate with increasing global warming levels" with only one SSP as indicated also in the attached figure. The statement must be balanced and provides dicussion based on all scenarios to allow comparison and understanding of the magnituted of events. Projected water cycle changes as a function of global warming needs to be discussed for all scenarions in the underlaying chapter (Ch 8, Page 69, Line 48) to provide solid basis for the text in the SPM. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
7423					The statement from chapter "There is medium confidence that urbanisation can increase local precipation and runoff intensity" in the underlying chapter has a different confidence level in the SPM H.S.11.5 where it is stated that "Urbanization alters the water cycle.... increasing runoff intensity (high confidence). Align the confidence level in the SPM to medium confidence as in the underlying chapter. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral
513					We find the SPM has overall a very good structure and very clear language and important statements. This SPM is in very good shape. [Government of Denmark, Danish Meteorological Institute]
515					The Figures in this SPM are of high quality, generally fairly easy to understand. The descriptive headlines are very useful and helpful. [Government of Denmark, Danish Meteorological Institute]
7695					An approximate equivalence / mapping / matrix between RCPs of AR5 and SSPs of AR6 could be included for comparison for continuity in understanding among the scenarios. This is missing in the document [Government of India, Ministry of Environment, Forests and Climate Change]
299					One of our main concerns is the way the AR6 and this SPM presents the global mean surface temperature (GMST). As one of the goals of the Paris Agreement is based on it, it is a very policy relevant concept and must be clearly explained to policy makers in the SPM and in particular, any changes to previous reports. We understand from Cross-Section Box TS.1 that the GMST assessed in AR6 is 0.08°C higher than AR5 solely due to the choice of a different averaging method. The SPM must include the information how to compare the temperature of AR6 and AR5 as well as the IPCC special reports produced in the 6th Assessment Cycle. Furthermore, it is very important that all three Working Groups rely on the same assessment of GMST. Please also include information on how these changes related to impacts of climate change that will be assessed by WGII as well as the assessment of mitigation pathways in WGIII, including carbon budgets. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
7723					Understanding the concept of different kinds of droughts is not evident. In our view, putting a footnote with a short description of the quoted droughts would give a better understanding for the reader. [Government of Hungary, Ministry of Innovation and Technology - Climate Policy Department]

Comment ID	From Page	From Line	To Page	To Line	Comment
301					While we appreciate the information included on the long-term perspective of climate change in particular in HS.9 on sea level rise, we would like the authors to include also information on other issues, such as permafrost, AMOC and marine ice sheet instability, as well as the dependencies on different emission pathways. Box TS.7 includes information that could be lifted to the SPM to this effect. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de
303					One of the main point we learned from the SRs produce in AR6 is that climate change is accelerating. We are thus very surprised to see that this notion is barely touched upon in the present draft of the SPM. Although it is clearly mention in the TS and the underlying chapters. In particular, we would suggest highlighting the accelerated increase of temperatures, the acceleration of SLR, the ocean warming and the increase in loss of mass from ice sheet. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
305					While the SPM highlights in different sections irreversible changes to the climate system, it never mentions once the word "tipping points". We suggest that this word is introduce where relevant as is done in the report and TS to highlight these important changes to policy makers. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
307					We would like to suggest elevating some information on permafrost thawing from the underlying report, in particular Chapter 5 Box 5.1 to SPM. In particular the following stamen: "Thawing terrestrial permafrost will lead to carbon release (high confidence), but there is low confidence in the timing, magnitude and the relative roles of CO2 versus CH4 as feedback processes. CO2 release from permafrost is projected to be 3–41 PgC per 1°C of global warming by 2100, based on an ensemble of models." seems very policy relevant for us and should be included in the SPM. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
5955					_Acknowledgement: We congratulate the author team on the excellent draft and express our sincere gratitude to the authors and all other experts involved in the preparation of this draft. We are extremely grateful for the tremendous effort that went into creating this well-structured, balanced, and understandable SPM with well-designed figures, especially in these challenging times of the COVID-19 pandemic. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
5957					_Climate change is accelerating: There is plenty of information in the TS, the underlying Chs and other recent reports (in particular the SROCC) on the increasing rate of change in many climate system elements. Therefore, we are really surprised that the current version of the SPM does not contain much of this particularly policy relevant information, if any at all. We urge the authors to recheck and consider the TS and underlying Chs and include information about climate change acceleration within the SPM as a crucial message on the current state of the climate. Please see our individual comments. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
5959					_Figure connecting the dots across time: This report covers the scientific knowledge of past climate change (up to several million years), current climate and possible climate futures up to 2300. The paleoclimate evidence is very helpful to understand possible climate futures and is integrated within multiple lines of evidence within the AR6. For policymakers, it would be very helpful to link paleoclimate evidence and possible climate future showing three major climate system elements such as global surface temperature, GHG concentrations and global mean sea level in one figure in the SPM. Therefore, we strongly encourage the authors to include Figure TS.1 extended with GMSL information (e.g. FAQ 1.3, Figure 1) in the SPM. At a glance this would provide a very important relationship (temperature, GHG concentrations, sea level) and would therewith help to assess the emission scenarios beyond 2100. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
5961					_Global surface temperature - consistency between working groups: Please provide information about how the IPCC is addressing the improved temperature assessment across WGs for the AR6. It should be clearly stated what this change in the historical warming means for WG II statements on climate impacts and risks at certain temperatures, see Ch2-40, Cross Ch Box 2.3. Further, we would like to understand if there are implications for the scenarios and budgets of WG III. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]

Comment ID	From Page	From Line	To Page	To Line	Comment
5963					_Global Surface Temperature: The presentation of information in the SPM related to the global mean temperature raises concerns since it could create confusion among policy makers and the public. Please explain how the improved temperature assessment can be reconciled with the AR5 and SR1.5 assessment (and the temperature goals of the Paris agreement). [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
5965					_Long-term perspective for different emission pathways: There is a lot of information about the long-term perspective of climate change beyond 2100 and their dependence on emission pathways available in the underlying report. What will happen after 2100 with permafrost, AMOC and marine ice sheet instability? What about the long-term perspective of abrupt changes on the regional scale? Can low-emission scenarios help to avoid abrupt changes in the long-term, and if yes, which ones? In HS.9, the long-term perspective beyond 2100 is described, but only in detail for SLR and without its dependency on emission-pathways. We found the executive summary of Ch 5 and 9, and Box TS.7 very helpful in this regard and urge the authors to include some of the statements in the SPM. Some information on these topics is already mentioned in HS.7.5 and HS.12 but only concerning their occurrence before 2100. We urge the authors to include the highly relevant statements about long-term changes in the SPM to inform policymakers who do not read the underlying Chs. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
5967					_Mitigation benefits: For policy makers it is very important to be informed about the benefits of emission reductions. HS.14 and its paragraphs only touch a few benefits and focuses only on the timing of their emergence, which is given with "after decades or more" (c.f. H.S.14) or "later in the 21st century" (c.f. H.S.14.3). This could be perceived as if there are no benefits before. But just because benefits are not detectable (due to e.g. masking by natural variability) does not mean that there are no benefits. Furthermore, without stringent emission reduction, the risk of low-likelihood high impact outcomes (c.f. H.S.12) and abrupt changes/tipping points leading to further warming (e.g., permafrost, ice shield instabilities) is much higher, which will in turn drastically increase future mitigation challenges. We strongly request the authors to better clarify these relationships already in the headline. Furthermore, we ask the authors to include in particular more policy-relevant areas of mitigation benefits. Please see our individual comments of HS.14. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
5969					_Permafrost: We miss statements about the very policy-relevant topic of permafrost thawing and strongly request the authors to add more information from Ch 5 and Box 5.1 and subCh 9.5.2, for instance the quantification of CO2 release due to permafrost and the role of abrupt thaw. Permafrost thawing is also not a question of if, but when and how much, as indicated in the underlying report. This important message should be brought forward. Please see also our individual comments. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
5971					_Tipping points: The term "tipping point" is not used once in the SPM, although the framing of irreversible changes in the climate system as tipping points is very helpful for policymakers and adds to clarity and accessibility. This is in particular hard to understand, since there is an entire box in the TS (Box TS.9) about "Irreversibility, Tipping Points and Abrupt Changes." We strongly request the authors to also use the term since it is accessible to a wider audience. Furthermore, it is a term also explained in the glossary. See also our comment on section H.S.9. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
5973					For political decision-makers, new findings and new developments in AR6 are of interest compared to the statements of AR5; not least for public communication. Therefore, and for the sake of comparability, the most important changes in statements on climate developments and climate states compared to AR5 (e.g. on Greenland ice mass loss) should also be made using the same units as in AR5 if possible. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]

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5975					For the next report, please use a pdf conversion option that allows accessing/reading footnotes by "mouse over" functionality. That is much more convenient than manually scrolling to the footnotes. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
5977					In view of the special circumstances of a virtual approval session, the number of figures/illustrations, some of which are very complex, could be too much and lead to extensive need for clarification and time-consuming discussions. We therefore suggest reconsidering the number of illustrations and their complexity. Perhaps a few main statements per illustration should be sufficient and more memorable. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
5979					Please check if all statements are linked with a confidence level and if all mentioned confidence levels are consistent with the underlying report. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
5981					The treatment of uncertainties and the special care required by the IPCC when communicating findings and uncertainties is detailed in Ch 1 (P1-30 L12-13). However, quantitative information is often given with too high precision, suggesting an accuracy that might not correspond to wide ranges of uncertainty. We very much appreciate quantitative information whenever possible, but a very high granularity in decimal places suggests a sometimes-unrealistic level of knowledge. This might create expectations from policy makers and the public to which science cannot respond adequately, and might create communication challenges when the IPCC revises its statements from one report to the next. Please revise the precision of quantifiable information throughout the SPM. Please see also our individual comments throughout the SPM. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
5983					We appreciate the clarity of language of the high-level statements and their accessibility for non-experts. However, some of the high-level statements, such as HS6 and HS10, seem to be rather cursory and lack substance. Please check whether the HS can be enriched with more quantitative information without being over-accurate, e.g. from the Technical Summary, to strengthen the messages. [Government of Germany, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy]
4221					Consistency in writing measurement unit of GHGs (CO_2, N_2O, CH_4, SO_2 etc) throughout the report. e.g. Mt CO_2/year or Mt CO_2 yr^{-1}, consistent with others [Government of Indonesia, Ministry of Environment and Forestry Indonesia]
4223					what does it mean for accounting for about -8%? (need further explanation to value of negative) [Government of Indonesia, Ministry of Environment and Forestry Indonesia]
4229					In the entire documents, there is still many numbers that may be hard to be understood by policymakers. [Government of Indonesia, Ministry of Environment and Forestry Indonesia]

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7045					Please remove this reference because of using wrong phrase "Arabian Gulf" instead of "Persian Gulf" ch8, page 176, line 31: Sandeep, S. and R.S. Ajayamohan, 2018: Modulation of Winter Precipitation Dynamics Over the Arabian Gulf by ENSO. Journal of Geophysical Research: Atmospheres, 123(1), 198–210, doi:10.1002/2017jd027263.This article cannot be referred to so as a wrong name of the “Arabian Gulf” is used instead of the term “Persian Gulf”. As a UN body, IPCC is obliged to use officially recognized names by UN (United Nations, 2006). The following documents recognize the term "Persian Gulf" as the only true name to be used in all documents: Document ST/CS/SER.A/29/ADD.2: dated18 August1994, Document ST/CS/SER.A/29/ADD.1: dated 24 January 1992, Document AD/311/1/GEN: dated 5 March 1991, Document ST/CS/SER.A/29: dated10 January 1990, Resolution UNLA45/ 8/2/ dated 10 August 1984, Resolution UNAD311/Qen dated 5 March 1971, Document CAB/1/87/63 dated 16 February 1987 UNESCO. The Persian Gulf is one of those unique places for which lots of historical maps, documents and references can be found and referred. Herodotus 500 B.C. (known as the Father of History) and, Ptolemy 200 A.D (known as the Father of Geography) had enormously mentioned the name of the Persian Gulf. In fact, it could be regarded as the universal heritage of mankind. In ancient historical-geographical texts including Muslim and Christian cartographies and travel reports as those of Marco polo, Eratosthenes ,Ibn e Rashid, Estakhri, Aburaihan Birooni, Edrisi.... the term "Persian Gulf' had been stated and reported. There are two main documents of United Nations in which the name of the Persian Gulf has officially been recognized: (UNAD 311/March5, 1971) and (UNLA 45.8.2(c) on August 10, 1984). All Arab countries have singed the UN documents. UN as the major legal source indicates the term Persian Gulf, so, all the members have to follow the Regulations. Since IPCC report is not a journal or unofficial report, it has to follow the UN officially recognized names. [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]
4231					Additional explanation such as glossary of some specific highly scientific terminologies is needed to help policy makers understand the statement made. --- Section 7 -- Glossarium [Government of Indonesia, Ministry of Environment and Forestry Indonesia]

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7047					Please remove this reference because of using wrong phrase "Arabian Gulf" instead of "Persian Gulf" ch2, page 137, line 10:Lachkar, Z., M. Lévy, and K.S. Smith, 2019: Strong Intensification of the Arabian Sea Oxygen Minimum Zone in Response to Arabian Gulf Warming. Geophysical Research Letters, 46(10), 5420–5429, doi:10.1029/2018gl081631.This article cannot be referred to so as a wrong name of the “Arabian Gulf” is used instead of the term “Persian Gulf”. As a UN body, IPCC is obliged to use officially recognized names by UN (United Nations, 2006). The following documents recognize the term "Persian Gulf" as the only true name to be used in all documents: Document ST/CS/SER.A/29/ADD.2: dated18 August1994, Document ST/CS/SER.A/29/ADD.1: dated 24 January 1992, Document AD/311/1/GEN: dated 5 March 1991, Document ST/CS/SER.A/29: dated10 January 1990, Resolution UNLA45/ 8/2/ dated 10 August 1984, Resolution UNAD311/Qen dated 5 March 1971, Document CAB/1/87/63 dated 16 February 1987 UNESCO. The Persian Gulf is one of those unique places for which lots of historical maps, documents and references can be found and referred. Herodotus 500 B.C. (known as the Father of History) and, Ptolemy 200 A.D (known as the Father of Geography) had enormously mentioned the name of the Persian Gulf. In fact, it could be regarded as the universal heritage of mankind. In ancient historical-geographical texts including Muslim and Christian cartographies and travel reports as those of Marco polo, Eratosthenes ,Ibn e Rashid, Estakhri, Aburaihan Birooni, Edrisi.... the term "Persian Gulf' had been stated and reported. There are two main documents of United Nations in which the name of the Persian Gulf has officially been recognized: (UNAD 311/March5, 1971) and (UNLA 45.8.2(c) on August 10, 1984). All Arab countries have singed the UN documents. UN as the major legal source indicates the term Persian Gulf, so, all the members have to follow the Regulations. Since IPCC report is not a journal or unofficial report, it has to follow the UN officially recognized names. [Government of Iran, Islamic Republic of Iran Meteorological Organization (IRIMO)]
4233					Translation of the document such as this SPM into parties’ national language to help disseminating the findings seems to be worth considering [Government of Indonesia, Ministry of Environment and Forestry Indonesia]
3983					The paragraph numbers start with “HS.” for the headline of each section and with “H.S.” for other paragraphs. Using simpler one (HS.) for all would be user-friendly. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]
4239					The SPM has comprised of five sub-chapters and summarises a number of compelling and robust findings of the current state of the climate, climate projection, adaptation process to various pathways on climate. The paragraph is easy to follow and complemented with several informative figures. As the SPM is intended to the policymakers, thus some aspects need to be adjusted, i.e. 1. Several paragraphs need to be written as concisely as possible and should explain one topic/findings per para. Several paragraphs have explained more than one subject and losing the main point that would like to deliver to the readers. In addition, some paragraph that contains technical terms and heaps of numbers. [Government of Indonesia, Ministry of Environment and Forestry Indonesia]
3985					Other than the Figure SPM.2 which shows contributions to warming from individual human emissions / induced changes including SLCF, a brief assessment of contributions to effective radiative forcing (ERF) based on TS page 56 – 57 and the Figure TS.15 is desirable. This would help policymakers to promote controlling SLCF emission. [Government of Japan, Climate Change Division - Ministry of Foreign Affairs]

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409					Luxembourg would like to thank and congratulate the co-chairs the vice-chairs and the TSU of WG1 and in particular the authors for the present draft of the WG1 contribution to the AR6. We consider that report covers all the topics addressed in the outline and would like to encourage the authors to continue along these lines. We in particular acknowledge the difficult task of continue the work on the IPCC reports in period of COVID-19 pandemic and would like to express our sincere gratitude to all the people who are dedicating their time in producing the IPCC reports. We also would like to thank the co-chairs and authors to organize informal exchanges with the focal points or their alternates on the present draft of the SPM, to clarify the contents of certain concepts and figures. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
411					We see the contributions of the different WGs to the AR6 as a continuation of the exploration of the findings presented in the three SRs that were already produce in this cycle and expect them to cover the open questions that were identified in these SRs. In addition, we expect the AR6 to present policymakers with the newest scientific findings published since these three SRs as well as the AR5. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
413					We congratulate the authors for providing us with this excellent draft. We consider that the current draft of the SPM is well structured, balanced, and understandable SPM and includes well-designed figures. We also appreciate the policy-relevance of the draft, in particular the inclusion of relevant information about scenarios related to 1.5 and 2.0°C as well as the long term projections up to 2300 in particular of sea level rise. These information needs to stay in the final draft. In addition, the inclusion of low probability but high impact events is very much appreciated. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
415					The present draft strikes generally in a very good manner the balance between being policy relevant while not being policy prescriptive. At the same time, it does not refer to sensitive issues in the policy context and we congratulate the author for this. We strongly encourage the authors to keep this very important balance when preparing the draft to be discussed in the virtual approval plenary. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
417					The present daft also elegantly strikes the balance between the mandate of the IPCC to provide a global assessment of the scientific literature of science, while at the same time providing also some key observed of projected impacts of climate change at the regional level. The latter being mainly done via the Figures while keeping the text of the SPM generally at a global level. When interested in more regional information de reader is directed towards the underlying chapters or the interactive atlas. We also strongly support the authors to keep this approach while preparing the final draft for approval in the virtual plenary also with a view to keep the text as short as possible. [Government of Luxembourg, Ministère du développement durable et des infrastructures, Département de l'Environnment]
7589					We would like to thank the Co-Chairs of WGI and the authors of the SPM for the improvements made since the first order draft, especially with respect to the reduction of the number of pages and its readability. Our concern is that the number of pages may increase as the result of the implementation of information due to the comments given by governments. We strongly advise the Co-Chairs and the writing team to stay within the present amount of pages by (keeping) prioritizing main messages. Also, we recommend to reconsider a reduction of the number of figures and to give special attention to (reducing) the complexity of (some of the) figures. This all in the light of the limitations of a virtual approval session. [Government of Netherlands, Ministry of Economic Affairs and Climate Policy]
4277					General comment: The SPM is very clear and the lenght is right. We would like to express our thanks to the WG1 bureau, TSU and all the authors for the substantial work conducted over this challenging period. [Government of Italy, CMCC - Centro Euro-Mediterraneo per i Cambiamenti Climatici Instituto Nazionale di Geofisica e Vulcanologia (INGV)]

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6325					Thank you for providing us with the final order SMP of the AR6 WGI report. We think it reads already realtively well and has nice highlevel messages that when read on their own form a good set of key messages. The SMP can still streamlined are a bit and some repetitions can be removed. Thank you very much for all your efforts and hard work and being able to complete the report despite the pandemic situation! [Government of Estonia, Estonian Meteorological & Hydrological Institute]
6327					Throughout the SPM we are missing the sense of how the speed of various climate change indicators (e.g. sea level raise, temperature increase) has been changing in recent times and how this is expected to continue. The recent SRs and TS have information of accelerating impacts. Please add. [Government of Estonia, Estonian Meteorological & Hydrological Institute]
6329					Global surface temperature increase - how this improved number relates to temperature increase assessment provided in AR6 SRs? What has changed? What does it mean for impacts in WGII? [Government of Estonia, Estonian Meteorological & Hydrological Institute]
6331					There is no information on permafrost thawing in the SPM. It is mentioned in several sections, but the important information of current and expected GHG release, speed of thawing etc is missing. Chapter 5 and 9 have relevent information that should be summarised in SPM. [Government of Estonia, Estonian Meteorological & Hydrological Institute]
6333					There is no mentioning of tipping points in SPM. TS have relevant informatiom and highlighting abrupt irreversible changes as tipping points in SPM would be helpful for policymakers. [Government of Estonia, Estonian Meteorological & Hydrological Institute]
6335					Please check the entire SPM and make sure that attribution is clearly marked with relevant confidence levels where applicable. It is important to be clear what is human induced and by how much and what is caused by other factors. [Government of Estonia, Estonian Meteorological & Hydrological Institute]
8383					Suggest including at the beginning or end of the document a list of terms and abbreviations for the reader. For example, information about the SSPs, the SR abbreviation, radiative forcing, an explanation of the basic reference period (1850-1900) and which parts of the analysis use a different reference period, what are agents of climate change etc. Suggest the 'likelihood' interpretation is taken out of note 5 and included in a table in the beginning. Suggest including a small table with the list of the scenarios and a short explanation for each, eg page 14 row 24 where the SSP1-1.9 is described as a combination of 5 models. [Government of Australia, Department of Industry, Science, Energy and Resources]
6337					What are the near and longterm benefits of mitigating GHG emissions? It is important for policymakers know what can be avoided with rapid emission reductions [Government of Estonia, Estonian Meteorological & Hydrological Institute]
8385					Compared to previous reports, there seems to have been an editorial decision to make more statements that are qualitative and general. These can be clearer than detailed projections and hence useful to policy makers. However, they also risk sounding trite (eg HS.4, H.S.6.5). Where possible, please include context about conclusions that represent changes in knowledge since the AR5, or reference the models/simulations involved, to reassure policy makers that the statements are supported by new evidence. [Government of Australia, Department of Industry, Science, Energy and Resources]
8387					Suggest reconsidering the use of the "Headline Statement" labelling. If a prefix is to be used throughout the SPM, suggest using one that identifies the statements as from the WG1 SPM. This single prefix also obscures the useful context of which SPM section a statement comes from. [Government of Australia, Department of Industry, Science, Energy and Resources]
4557					We would like to congratulate the authors on producing an excellent FGD SPM draft, and we appreciate their efforts in delivering text that is concise, clear and relevant. We have provided comments on specific issues but, in general, these are to improve the clarity of document and do not represet any major disagreements with the SPM content. Well done and thank you all for your hard work. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial
4559					We appreciate the effort to keep the SPM as short as possible. We would be happy, however, for more space to be given to information on scientific uncertainties that is pertinent to the understanding of key findings, such as where uncertainties have been reduced. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]

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4561					No change in surface temperature metric (from GMST to GSAT) is explicitly mentioned in the SPM. Only “global surface temperature” is discussed and not defined. In the technical summary (Cross-Section Box TS.1: Global Surface Temperature Change), it says, “long-term changes in GMST/GSAT are presently assessed to be identical, with expanded uncertainty in GSAT estimates. Hence the term global surface temperature is used in reference to both quantities in the text of the TS and SPM.” We suggest a footnote could be added to the SPM with this definition because the lack of a definition here could cause confusion. This is a key metric that has been subtly redefined by increasing the uncertainty estimate. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
4563					The HS messages in blue are generally excellent but, in some cases, could be improved with some quantification of the points being made. We will include specific examples in our more detailed comments, nonetheless, could the authors please check all HS level statements and identify opportunities to quantify the statements being made. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
213					Level of confidence is not expressed consistently throughout the main findings of the SPM. Each main finding must have a level of confidence indicated. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]
4821					It would be helpful to policymakers if the AR6 SPM could indicate where information has strengthened, confirmed or advanced understanding in the SR1.5. There are a number of areas where advances in the science have reduced uncertainties in scientific understanding and also a number of areas where a different method has been used from the SR1.5. In the case of the latter, it would be of interest to know what this menas in relation to the SR1.5 findings. [Government of United Kingdom (of Great Britain and Northern Ireland), Department for Business, Energy & Industrial Strategy]
215					When referring to lowest/highest CO2 scenarios in the findings of the SPM it must also be indicated the level of change in other GHGs in these scenarios in order to properly assess the impacts of the change of different GHGs. For example, H.S.5.1 showcases the global surface temperature rise under lowest/highest CO2 emission scenario. However it is not clear the levels of other GHGs that contribute to the increase of global surface temperature. Please include all levels of GHGs when impacts of the different emission scenarios. [Government of Saudi Arabia, Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources]