Comment ID	From Page	From Line	To Page	To Line	Comment	Response
28844	0	0	0	0	I really like this chapter and it is well presented. At the moment it seems completely isolated from the rest of the report. Is there anyway to tie it into Chapter 4 (projections), Chapter 7 (estimate of ECS), Chapter 9 (ocean/sea-level,cryosphere), as well as Chapter 11 of course. Also especially chapter 10 with its analysis of downscaling [Piers Piers Forster, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: We have substantially augmented CH12's role to synthesize WGI hazard material, engaging directly with CH1, CH2, CH4, CH6, CH8, CH9, CH10, CH11, and the Atlas. The main distinction is that most WGI chapters assess the physical mechanisms of change and then CH12 maps these into climatic impact drivers that can be hazardous or beneficial for sectors, surveying across major topics covered across WGI and now including air quality, water cycle, ocean, and extreme event trends and extreme events. Explicit connections to ECS from CH7 are not made, as these are aggregate physical responses that manifest as multiple global and regional hazards throughout the climate system. Our analysis of 'reasons for concern' look at warming levels and related uncertainties which are directly connected to various ESMs' ECS.
28846	0	0	0	0	I missed an analysis of downscaling and bias correction methods the report could link with chapter 10 here - this is something where WGI could really contribute? I was surprised to see so much unbiased corrected data in the diagrams - will you bias correct them for the SOD. Without bias correction it is hard to gauge the value of the figures. [Piers Piers Forster, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: We utilize bias-adjustment whenever real values are shown (rather than relative changes). We have also adjusted the discussion within Section 12.2 (which defines the climatic impact drivers) to note where bias adjustment is needed, and we link strongly to CH10 in sections 12.1 (framing), 12.2 (climatic impact driver definitions), and 12.4 (regional projections of climatic impact driver changes)
28880	0	0	0	0	FAQ 12.2 could be merged with FAQ 11.2. FAQ 12.1 and 12.3 could also be merged maybe? [Piers Piers Forster, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: We have removed FAQ 12.2 as this was redundant with FAQ 11.2. We have also heightened and clarified the distinctions between FAQ 12.1 and FAQ 12.3.
35360	0	0	0	0	I think we need to include one global map for each climate hazard that will be subdivided into regional maps within a same figure. This will give us a combined picture of a particular climate hazard (e.g. heat waves or floods or drought etc.) at one glance. It will also deliver a message about the most vulnerable region (hotspot) with respect to that climate hazard as compared to other regions of the world. [Mehwish Ramzan, Pakistan]	ACCEPTED: We now utilize global maps for more hazards, including extreme heat days (Tx>35C), extreme hot/humid conditions (Wet bulb), extreme sea levels, and drought (Standardized precipitation index). These are presented at the top of Section 12.4 and include regional summary analysis for each region so that we can represent uncertainty from climate models, time periods, and emissions pathways (RCPs). We also rely on the mean temperature and precipitation change projections assessed by the Atlas.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
35362	0	0	0	0	What is the new message for climate community in particular and public/stakeholders in general? [Mehwish Ramzan, Pakistan]	TAKEN INTO ACCOUNT: We have updated and refined our key messages in the executive summary with a focus on regional stakeholders.
48036	0	0	0	0	Scoping Outline Check: All bullets from approved outline are covered in the first order draft. [WGI TSU, France]	NOTED: This has been double checked
48054	0	0	0	0	Please check the correct use of IPCC Confidence/Uncertainty language. In some cases incorrect adjectives are being used with evidence or agreement terms, e.g., strong, growing, emerging, little, adequate, no robust, insufficient, weak, no contradictory, clear (some of them are redundant or not very precise). Please refer to the IPCC guidance note on uncertainty: https://wg1.ipcc.ch/SR/documents/ar5_uncertainty-guidance-note.pdf [WGI TSU, France]	TAKEN INTO ACCOUNT: We have examined all confidence statements for the chapter to ensure that they are used properly.
55482	0	0	0	0	A significant part of the text is dedicated to, clearly fundamentally important, background information. Would it be possible to move some of this to an appendix to the chapter to focus the chapter on more relevant sections. AT the moment, this is a very long chapter, though well written overall, which will make it hard for people to digest it all. [Daniela Schmidt, United Kingdom (of Great Britain and Northern Ireland)]	NOTED: The Ch 12 SOD streamlines presentation and has looked for material to shift into appendix or more appropriate chapters, and we have also improved overall digestibility through clarified organization that will allow readers to more rapidly find information they are looking for.
8728	0				I think that the chapter is a very good synthesis, but there are some questions relevant to WG2 which could deserve some statements from WG1? From my perspective, this includes: how these risks are evolving over time (incl., where relevant, after 2100)? When do they become major reasons for concern (e.g. erosion induced by sea-level rise is not a major concern yet, so when would this be?)? What could be high-end scenarios and their impacts for risks? These questions are very briefly adressed in chapters 4 9 and others, and mentionned in this report in some places (e.g. for tropical forests and sea-level rise), but they could be adressed in a more systematic way to provide WG2 with sound information aboud high-ends and the timing of risk evolution. [Goneri Le Cozannet, France]	TAKEN INTO ACCOUNT: We have added text in the opening section (12.1) to clarify that our mandate is to assess hazards and the types of information required even as it is not practical to detail all combinations of time periods, RCPs, downscaling methods, and hazard indices. - Section 12.5.1 is now focused on the global synthesis and temporal evolution of regional hazards, and we have explicitly noted that the hazardous conditions continue to evolve past 2100. - Our global and regional figures now include further representation of uncertainty in methods, time periods, and RCPs.
9454	0				Specific thanks to the authors for the well drafted executive summary. [Klaus Radunsky Radunsky, Austria]	NOTED: We appreciate the reviewer's positive feedback!
25492	0				While the chapter appears to cover the key issues, in some sections it doesn't appear to present much new information. Some of the Arctic components are a bit weak (maybe lacking appropriate expertise on author team?) including the permafrost aspects which appear to focus more on non Arctic areas. [Sharon Smith, Canada]	TAKEN INTO ACCOUNT: We have added a distinct polar section to focus on Arctic and Antarctic hazards, and we have also added detail on mountain cryosphere hazards.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
30090	0				There is a very large amount of overlap between the Executive Summary of Chapter 12 and that of Chapter 11. This has the potential to create very major consistency issues, and needs to be managed carefully. [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: We have coordinated with CH11 to ensure distinct executive summaries and assessments. CH11 focusses on the physics of extreme events, with a short discussion of temperature and precipitation extremes for various regions but no systematic regional assessment rising to the level of a section or executive summary statement. CH12 focusses on indices of climatic impact drivers (hazards and benefits) with systematic regional assessment sections and key messages noted in the Executive Summary.
30092	0				As a "WGI" scientist I had a very hard time engaging with Chapter 12. (As I symptom of this I didn't have any detailed comments on it, which I actually consider a bad sign, not a good one.) I understand that Chapter 12 is serving as a bridge between the WGI and WGII reports, but that means it needs to connect with the rest of the WGI report (or at least the relevant parts of it). At the moment I feel that it is failing to do so. [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: We have substantially augmented CH12's role to synthesize WGI hazard material, engaging directly with CH1, CH2, CH4, CH6, CH8, CH9, CH10, CH11, and the Atlas. The main distinction is that most WGI chapters assess the physical mechanisms of change and then CH12 maps these into climatic impact drivers that can be hazardous or beneficial for sectors, surveying across major topics covered across WGI and now including air quality, water cycle, ocean, and extreme event trends and extreme events. We have also increased connections to WGII to ensure that CH12 covers the major climatic impact drivers that are important to each WGII sectoral and regional chapter.
38586	0				Maybe I just overlooked it, but I could not find anything regarding rain-on-snow. Regarding its importance see e.g. http://dx.doi.org/10.1098/rsbl.2016.0466 or the SWIPA report [Annett Bartsch, Austria]	TAKEN INTO ACCOUNT: Both CH11 and CH12 have added further assessment of connected extremes such as Rain-on-Snow. There are too many combinations to handle each explicitly, but this is a very prominent hazard that we mention in 12.3 and some regional sections (e.g., 12.4.6).
39398	0				Excessive use of the uncertainty language throughout the chapter with few literature support [Noemi Chacón, Venezuela]	TAKEN INTO ACCOUNT: We have examined all confidence statements for the chapter to ensure that they are used properly.
40870	0				there is interesting and useful material on impacts of changing hazards and climate change. My question is whether this should be more properly part of WG2 chapter 13 Europe. I am focusing on Europe (I am a LA of chaper 12) , but this comment applies to the whole chapter 12 [piero lionello, Italy]	TAKEN INTO ACCOUNT: We have engaged extensively with WGII regional chapters to ensure consistency and coherence across WGI and WGII treatment of regional hazards within a cross-WG risk framework. This now includes a regional WGI-WGII handshake team that includes participants from WGI CH10, CH11, CH12, Atlas and the corresponding WGII Regional Chapters.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
40872	0				the IPCC confidence language is not always associated to specific statements on hazards in Europe. Could this be added? [piero lionello, Italy]	TAKEN INTO ACCOUNT: We have examined all confidence statements for the chapter to ensure that they are used properly.
40878	0				There is little sistematic information on differences among RCPs. Example: concerning heavy precipitation increase/decrease, would rcp8.5 make much difference with respect to RCP4.5? [piero lionello, Italy]	TAKEN INTO ACCOUNT: We have adjusted our global and regional maps to add an assessment of uncertainty and differences between time periods and RCPs. We also clarify in Section 12.1 that it is not practical to detail all combinations of time periods, RCPs, downscaling methods, and hazard indices, so we encourage the reader to also take advantage of the Interactive Atlas to explore these further
40890	0				no information on marine heat waves [piero lionello, Italy]	TAKEN INTO ACCOUNT: We now include marine heat waves as a distinct hazard given that they have different essential climate variables than atmospheric heat waves, and we discuss both in the continental sections (12.4.X) and also an open oceans section which we have elevated in prominence (12.4.8).
41286	0				This chapter might have some overlaps with the regional chapters and cross chapter papers of WGII. Although the scope of the chapter is indeed a handshake between the two working groups, it will be good to coordinate the inputs in order to avoid too many redundancies. For example Chapter 12 could reduce the text describing impacts in too much details, mostly when impacts and risks go beyond the physical description and the hazards and start referring to societal consequences. This should be covered by WGII. [Veruska Muccione, Switzerland]	TAKEN INTO ACCOUNT: This chapter has been revised after extensive consultation across WGI chapters (CH1, CH6, CH8, CH10, CH11, Atlas) and with WGII synthesis chapters (CH1, CH16, CH17; contributing particularly to 12.1, 12.2, 12.5, and 12.6), WGII sectoral chapters (CH2-8; contributing particularly to 12.3), and WGII regional chapters (CH9-15; contributing particularly to 12.4). CH12 perspective has also been incorporated into WGII First Order Draft preparation, and climate information for each region has been examined for coherence and consistency across WGI chapters with inputs from WGII regional chapter contributing authors for the Second-Order Draft.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
43904	0				For the regional studies, the focus in figures (and text) is on comparing CMIP5 or CMIP6 projections. What is missing is an assessment of past trends for each region for any key variables. Essential information for assessing confidence in a future regional projection are the following: 1) Is there already a detectable (distinct from natural variability) trend in the region? 2) Is the observed trend consistent or not with CMIP5 or CMIP6 historical runs for the same period? 3) Can the past trend be at least partly attributable to anthropogenic forcing. By answering these questions, you will either strengthen or weaken the case for the future projections being discussed. We have examples from our own work that can be used. An important one is our regional trend assessment work for precipitation (Knutson and Zeng, J. Climate 2018; https://journals.ametsoc.org/doi/full/10.1175/JCLI-D-17-0672.1). See Figure 3 for 1901-2010 trends or Fig. 4 for 1951-2010 trends, although I recommend the 1901-2010 as the longer trend results better control for multidecadal internal variability, though with less data coverage. For many of the regions/cases you are considering, these figures show observed trends, the CMIP5 multimodel ensemble historical trend on the same scale, and an assessment of where there is a detectable trend (non-gray shadings) and where observed and historical run trends are consistent (stippling). It also indicates where we assess the trend as being at least partly attributable to anthropogenic forcing (blue and dark blue regions for attributable wetting; red and dark red regions for attributable drying trends). Gray regions are where the trend is not detectable, and white regions have too little data for the trend analysis. This type of figure can provide some important additional context on how much confidence to place in the future projection of preciptiation trends for various regions. For example, it shows that trends since 1901 in southern Africa are generally not detectable, and that models simulate the wrong sign of trend compared to observations. And that over the southwest US and Mexico that trends since 1901 are not detectable. But it also shows that there are detectable drying trends around the Mediterranean, as	TAKEN INTO ACCOUNT: We have added text in 12.1 to emphasize that assessments are based on observed hazard changes, theoretical understanding, model performance in capturing historical changes, agreement of model projections, and the significance of projected changes compared to internal variability. Historical detection and attribution is spread across several WGI chapters examining the observations (particularly CH2) and physics of trends and extreme events (CH3, CH6, CH8, CH9 CH11). - *The Atlas also discusses observed trends in hazard characteristics.*

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
54020	0				It is good to see this chapter included in the WG I report (first time since the TAR that there has been true cross-WG co-operation in this area (see Ch 13 WGI and Ch 3, WG II, TAR). However, the adherence to the IPCC risk framework here needs to be done more subtly. It isn't helpful to refer to all climate driving variables used in impact assessment as climate hazards. They may be hazards in the context of risk, but that is a one-sided framing that does not offer explicit recognition of all dimensions of impacts (whether adverse, unexceptional or beneficial). I would suggest using the term climate and climate-related drivers (the latter cover sea-level, [CO2], and other non-climate factors covered in WG I) to describe all of the "information" being addressed in this chapter, but to make the explicit link to the risk framework at the beginning of the chapter. Currently, this reads like a disaster risk reduction analysis, and in my view that is only one aspect of climate change impacts, and one that has been given too much attention in recent years since the SREX, perhaps to the detriment of a more balanced treatment of impacts in general. I don't think it is necessary to refer to all climate drivers as hazards, just to fit the framework. Rather, the framework can be used to describe the approach to impact assessment, but the component parts should be described in more familar but also more neutral terms (mean changes, changes in variability, changes in extremes, etc.). Readers are more familiar with that terminology as well. One way of addressing this might be to re-think the terminology used in Figure 12.1. Some of you authors may recall Heathcote (1985) who distinguished four views of climate: climate as setting, climate as determinant, climate as hazard and climate as natural resource (Heathcote, R. L., 1985: Extreme event analysis. Climate Impact Assessment - Studies of the Interaction of Climate and Society, R. W. Kates, J. H. Ausubel, and M. Berberian, Eds., John Wiley and Sons, 369-401.) [Timothy Carter, Finland]	TAKEN INTO ACCOUNT: We have revised the entire chapter to reflect a more neutral framework to assess how 'climatic impact drivers' (which include hazards and benefits) feed into both risk and opportunity. We find more hazards than benefits and have a mandate to focus on dangerous anthropogenic influence on the climate system, but this framework allows for an even-handed approach. This allows our WGI analysis to define key attributes of the climate system that are changing (12.2), note the connections of these changes to sectors (12.3), assess changes in these climatic impact drivers in each region (12.4), discuss the global implications across time and warming levels (12.5), and highlight the ramifications of this climate information for climate services (12.6). The framework also allows us to avoid any sense of judgment regarding the overall balance of opportunity and risk (which is a WGII task). *- the precise use of terms and visual representation of this framework is being developed in consultation with WGI CH1 and participants of the AR6 Risk Framing working group across all three WGs (including bureau leadership).*
55744	0				I would use the term sand and dust storms throughout the report to be consistent with WMO naming convention (check the SDSWAS - Sand and Dust Storm Warning Advisory and Assessment System) [Carlos Perez Garcia-Pando, Spain]	ACCEPTED: We now use 'sand and dust storms' unless specifically distinguishing between physical mechanisms or regional hazard recognition that differ between the two
56280	0				Would chapter 12 be able to answer the following questions?: a) What levels of global warming can still be considered as safe, if any? (will depend on definition of what is considered "safe"); b) Beyond which level of global warming could the implied hazards be so high that they would be unsafe for a large fraction of population/ecosystems at regional scale or on global scale? [Sonia Seneviratne, Switzerland]	REJECTED: Chapter 12 cannot determine what is 'safe' given that this requires the other components of the risk framework (vulnerability and exposure in addition to the CH12 hazard information), which is under the mandate of WGII. However, Section 12.5.2 is devoted to translate the global changes in hazards as a function of global warming that links with WGII's reasons for concern.
8188	1	0	1	0	SROCC is listed in the chapter, but only for marine and coastal material. It may be interesting to also refer to SROCC Chapter 2 for all snow/glacier/permafrost related issues in mountainous areas, in the interest of saving time for AR6/WG1/Ch12 authors, but also strengthening the consistency between these IPCC products. SROCC authors can be contacted if need be. [Samuel Morin, France]	TAKEN INTO ACCOUNT: SROCC is now taken as a baseline for polar, ocean and also snow/glacier/permafrost, also in section 12.5.2 when not superseded by Chapter 9 of this report

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
48690	1	1	1	1	I missed some information concerning the South America Monsoon system. There are some papers that indicate an increase in precipitation during the SAM but with shorter temporal action, i.e, with later onset and anticipate its demise [Lincoln Alves, Brazil]	Taken into account - Further references on the South America Monsoon System are being included in the assessment.
48692	1	1	1	1	There are some overlaps with chapter 11 concerning the extremes events over South America. Chapter 12 the extremes are more well written and concise than in the chapter 11. [Lincoln Alves, Brazil]	TAKEN INTO ACCOUNT: A complete coordination between CH11 and CH12 as well as other chapters has been decided at LAM3, and the text is revised to avoid overlaps. For extremes, CH11 focusses on physics and CH12 on changes in regions, while summarizing CH11 findings for the sake of self-readability
54022	1	1	1	1	This title really doesn't read well. It suggests to me climate change information that causes regional impact and is also used for risk assessment. Can't it be re-drafted into something more intelligible? How about: "Climate change information for assessing regional impacts within a risk framework" or something similar (even in spite of my reservations with the application of the risk framework that you can read about elsewhere in my comments) [Timothy Carter, Finland]	REJECTED: A change in title is a long and difficult process as it has to be discussed at IPCC level. Despite the title is somehow long, we feel that it reflects with accuracy the fact that climate information is needed for impacts (detrimental and beneficial) while a focus on risks is necessary as a mandate of UNFCCC, hence climate information is needed for both impacts and risk assessment
50898	1	1	199	1	In general, across the chapter, the authors should refer to and correctly portray the findings of AR5, SREX and SR1.5 (Chapter 3) in terms of projected changes in various regions. This is not currently the case in the Chapter, and there are inctances (see some examples below) where the Chapter 12 findings directly contradict the AR5/SREX/SR1.5 assessments. Such instances need to be very well motivated/justified if indeed correct. From that baseline, the authors should then base their discussion on the latest CMIP6 findings, before supplementing the analysis from CORDEX and recently published papers. The discussion for many regions currently lack showing Figures and results from CMIP6. [Francois Engelbrecht, South Africa]	ACCEPTED: the chapter now takes more as baselines the AR5 and AR6 SRs, especially as the starting point of regional sections
26886	1	15	1	15	name mispelled Augustin Collette should be spelled Colette [Augustin Colette, France]	EDITORIAL - corrected
47302	5	32	12	36	Rephrase headings or tiltles to remove the forward slash [Siyabusa Mkuhlani, South Africa]	EDITORIAL: corrected
42160	5				Elaboration of IPCC [Lubna Alam, Malaysia]	EDITORIAL: corrected
9352	6	17	6	26	the sector of satellite communications is concerned with more extreme precipitations (eg https://www.hindawi.com/journals/ijmst/2014/958498/) occuring over much shorter periods of time (typically less than 1 hr, down to 5 minutes). You might check the possible existency of datasets about fading episodes.. In any case, talking of "extreme event" when referring to rain integrated over a 5 day period should be qualified. An additional interest in case statistics about very short and violent rain episodes become available is that maybe they might be interpreted as proxies for hail or tornado events. Whether such phenomena are affected by climate change is obviously of interest, and relevant for this chapter. [philippe waldteufel, France]	TAKEN INTO ACCOUNT: We have noted the hazardous connection between extreme precipitation events and satellite communications in Section 12.3

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9350	6	24	6	26	Concerning the influence of irrigation, maybe this depends how "hot extreme" is defined? see however Kang and Eltahir, DOI 10.1038/s41467-018-05252-y, who argue that irrigation plays an adverse role [philippe waldteufel, France]	TAKEN INTO ACCOUNT: We have considered the suggested reference to elaborate on heat waves over irrigated areas. Physical mechanisms related to feedbacks between irrigation and heat extremes are handled by CH11 and WGII.
32354	7	0	10	0	Coastal erosion is likely to increase not only along sandy coasts, but also along rocky coasts (particularly soft rock cliffs) as well as along gravel coasts and mixed rocky and sedimentary coasts. While there are less research on coastal erosion in these environments, it does not mean that there is low confidence that coastal erosion will increase on most coastal types. It is perhaps too limiting to restrict the summary statements of increased erosion on the coast and the regional sections on coastal hazards to sandy coastlines, specially considering cliffs represent approximately 52% of the world's coastlines (Young, A.P., Carilli, J.E., 2019. Global distribution of coastal cliffs. Earth Surface Processes and Landforms, 44 (6), 1309-1316. DOI: 10.1002/esp.4574). While there is high confidence that hard rock cliffs and shore platforms will evolve slowly and perhaps at rates that are too low to be meaningful at a decadal scale, there is also high confidence that erosion of soft rock cliffs will be significantly impacted by higher mean and extreme sea levels, particularly as higher wave setup and runup will contribute to more frequent an energetic wave impacts at the base of soft rock cliffs, triggering mass movements and progressive cliff retreat. [Carlos Loureiro, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: We agree with the reviewer that there is a possibility that cliffed coasts may face increased erosion in future, however so far we have been unable to find any global scale projections of how beaches other than sandy beaches may evolve over the 21st century. As this is a issue that is relevant for all regions in this assessment, we note that different coastal types may be affected differently in 12.2 and 12.3 and then discuss the lack of global projections for the types of coasts referred to here in sections 12.4 and 12.5.1. At the present moment we can only say something about sandy coasts due both to known/accepted physics and available projections.
48080	7	1	7	1	The executive summary is longer than recommended (2 pages), and key messages do not appear in bold. [WGI TSU, France]	TAKEN INTO ACCOUNT: we shortened the executive summary and boldfaced the key messages
15440	7	1	7	49	The purpose of this chapter should be be mentioned in the early part of this summary. At the current writing of the summary the purpose is not made clear. [Ruiqing Miao, United States of America]	ACCEPTED: The first statement now explains the chapter goals and context
55474	7	1	7	49	The executive summary of this section could benefit from focussing on key messages. At the moment, the text does not allow a succinct assessment of the main points [Daniela Schmidt, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: The executive summary has been completely revised to highlight key messages
45988	7	1	10	3	Excellent Executive Summary, good characterization of regional trends, and also, the ariculation of limitations in certain regions.Confidence levels, however, must be carefully calibrated. [Lourdes Tibig, Philippines]	TAKEN INTO ACCOUNT: confidence language is now strengthened
48674	7	1	10	3	It seems there are overlaps partly with Chapter 11 (droughts, heavy precipitation and heawaves) [Lincoln Alves, Brazil]	TAKEN INTO ACCOUNT: A coordination has taken place between chapters to minimize overlaps
53826	7	1	10	3	The ES was hard to read. It would benefit from more structure; such as bold statments. You may also consider splitting into sections like some other chapters have done. [Jan Fuglestvedt, Norway]	The structure of the ES has been revised accordingly and to better put forward key messages
53828	7	1	10	3	Usually it is not needed to explain the overarching objective of a chapter in the ES, but in this case I think it would be useful with a brief explanation in the beginning of the ES to help the reader understand the information later in the summary. [Jan Fuglestvedt, Norway]	TAKEN INTO ACCOUNT: the text has been completely revised

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
54030	7	1	10	3	Throughout this ES the emphasis seems to be only on climate hazards. I thought this chapter treated information for assessing climate impacts, whether slow changes or changes in extremes or changes in hazardous (and beneficial) events. I think the tone of the chapter should be more balanced from the start. This is actually more unbalanced than the text in Annex VII, which at least acknowledges that climate extremes are embedded in changes in average climate, some of which may be quite gradual. In fact, the changes in "hazards" reported by region in the latter part of the ES actually treat some average changes as well as changes in extremes. There is a fundamental problem of adopting the risk framing language without throught for how it reads for the uninitiated across the chapter. The word hazard really needs to be replaced here with more balanced terminology that actually reflects how impact studies are undertaken and climate information is applied. [Timothy Carter, Finland]	ACCEPTED: Several comments highlighted that the use of "hazards" as the structural elements of presentation provided an unbalanced view of physical elements driving to impacts. A new framing and change of vocabulary is now proposed starting in Chapter 1 and propagating here. The physical elements that lead to impacts are now called more neutrally "Climatic impact drivers" which can be hazards or boons depending on sector, regions etc. However it is also recognized that one of the mandate of UNFCCC is to assess in particular elements of the climate system that induce risks, hence a focus in the chapter on hazards.
42134	7	1		55	Some words written in italic fonts.example: likely can be wriiten as likely [Lubna Alam, Malaysia]	EDITORIAL: corrected
36516	7	3	7	4	The text should not combine different issues. On one side, information is required to monitor, analyse and assess vulnerability, exposure, impacts and climate services, from information to design and implement adaptation and mitigation policies and measures. [Urbano Fra Paleo, Spain]	REJECTED: Each paragraph of the executive summary in this range of text related to hazards in one continent. It therefore combines different types of hazards
8938	7	3	7	6	I would striongly recommend including resilience in the first sentence as this reflects the terminology of the Practitioner community and also the vernacular in the relevant cross cutting chapters of WG2. Resilience is introduced later in the chapter. It is currently "The determination of useful climate information for vulnerability, impacts, adaptation, and ...." I would recommend "The determination of useful climate information for impacts adapttaion, resilience and ...". Drop the word vulnerability as this is a component of risk (i.e., HxExV) and is likely to confuse practitioners. Further more on teh final line not too sure why "sectoral' is explicitly mentioned here, it may be better to write "tailored climate hazards that link climate conditions to vulnerability and exposure of assets, systems, individuals and communities across all sectors". [david Viner, United Kingdom (of Great Britain and Northern Ireland)]	REJECTED. We preferred not to overload the first sentence introducing a concept whose definition goes beyond "impacts" and prefer to stick to concepts of the Chapter 1 propeller figure. Resilience is largely a topic for WGII

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
50810	7	3	7	6	This might be my misconception, but I'm surprised by the emphasis on 'assets' here and in the rest of the chapter that seems to be a rather limiting aspect of sectoral impacts with a strong economic focus but excluding non-economic impacts? [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: Chapter 12 emphasizes in several ways that assets refer to a more extensive set of items with utility, economic, social, cultural, or intrinsic value. While an extensive definition would be out of place in the executive summary, we define multiple asset categories within Section 12.3 (and Table 12.2) with direct reference to WGII where different aspects of value are more directly discussed. We also note that the Glossary definition of risk includes the phrase: "...Relevant adverse consequences include those on lives, livelihoods, health and wellbeing, economic, social and cultural assets and investments, infrastructure, services (including ecosystem services), ecosystems and species", which further underscores that assets include cultural and social factors beyond economics, and that our interests are extensive in looking at climate risk
56276	7	3	10	3	Some of the material on changes in hazards in the executive summary is a bit repetitive compared to the assessment of Chapter 11 (e.g. increases in heat hazards on all continents). Could aspects related to vulnerability and exposure (which are not addressed in Chapter 11) be better highlighted here, which would provide an added value compared to the material of chapter 11? [Sonia Seneviratne, Switzerland]	TAKEN INTO ACCOUNT: A coordination has taken place between chapters to minimize overlaps
56278	7	3	10	3	The executive summary does not seem to highlight projected unprecedented hazards. It might be useful to include a paragraph on this topic, i.e. which types of previously unprecedented hazards could happen a) at current global warming levels, b) at 1.5°C, c) at 2°C, ...? [Sonia Seneviratne, Switzerland]	TAKEN INTO ACCOUNT: unprecedented hazard are now presented (e.g. heat in new areas)
50808	7	3	16	9	As an overarching comment to the summary and framing, I'm very much missing observations. We need observations to understand current hazards, identify thresholds, evaluate models etc. so they are absolutely crucial but get hardly mentioned at all. They are very often the bottleneck in our ability to provide any climate information which in my view is crucial to highlight to stakeholders in particular who might not necessarily realise just how precious they are. Furthermore, given that the key motivation for restructuring the WG1 outline was to bring lines of evidence together, it seems particularly important on local scales where hazards are changing for various reasons and only bringing observations and models together and looking across timescales we are actually able to disentangle different drivers and gain an understanding of the hazard that will ultimately allow sound future risk assessments. One example is here https://www.nat-hazards-earth-syst-sci.net/18/365/2018/ [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: Due to the lack of space, observational trends and attribution are now summarized based on CH11 findings and the assessment of mean trends made in the Atlas.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
50814	7	3	199	50	Evidence from the attribution literature is almost completely absent. Given that the literature explains observed trends and highlights where trends are indeed driven by climate change and where other factors are playing a major role this adds a very important component to our uinderstanding of current hazards and shows where what we expierence today is a harbinger for what is to come and where we can expect worse or we don't know. This literature is assessed for extremes in chapter 11 and for mean changes in chapter 10 so it should be straightforward to include it in the sectorial and regional assessment here. It is not only a major new development since AR5 but also allows stakeholders to connect experience and the past with what the future might hold and sould thus be included here. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: Due to the lack of space, observational trends and attribution are now summarized based on CH11 findings and the assessment of mean trends made in the Atlas.
46058	7	5	7	5	I suppose tailored here means local or regional specific climate hazards. if so better to say so otherwise tailored can also be interpreted as engineered climate hazards [Shuaib Lwasa, Uganda]	TAKEN INTO ACCOUNT: There are now many uses of 'tailored' in text which all strongly imply the connection between hazards and local conditions/assets. Includes several in 12.1-12.3, including caption of Figure 12.2., as well as in 12.6.
50900	7	5	7	5	It is not clear what is meant with "the changing profile of tailored climate hazards". [Francois Engelbrecht, South Africa]	TAKEN INTO ACCOUNT: FAQ12.2 addresses the ways that hazard profiles can change, and there is text in 12.2 and 12.3 on this topic

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
54024	7	5	7	6	I probably should resist commenting on what is a fairly unexceptional lead-in to the IPCC risk framing language. However, I want to raise a concern that I have had since the SREX and AR5 concerning the interpretation of the risk terminology. "Tailored climate hazards" (as defined here) are not actually what we study in IAV assessment. We work with tailored climate information that may or may not constitute a "hazard". Most weather outcomes are likely to be unremarkable or benign. Moreover, the converse of hazard would actually be an event that brings a benefit or windfall - call it a "boon" perhaps. For strict balance, shouldn't we be considering all of these types of outcome in an IPCC report, yet the language automatically draws us to the adverse - see also risk (vs. opportunity) and vulnerability (vs. resilience). This may be done to address the precautionary principle in relation to Article 2, but it should be remembered that effective adaptation requires responses both to adverse as well as beneficial outcomes, and there are usually some of the latter as well as the former. Even where benefits are acknowledged, these are usually couched as reduced frequency of adverse extremes such as cold snaps. On the other hand, how many examples do we see of studies that focus on beneficial conditions that offer bumper harvests, or optimal hydrological conditions for hydropower, or ideal skiing conditions in winter? These are not usually studied - maybe they should be, if only to track their increasing rarity in a warming climate if, as we hear oft-repeated, adverse effects are expected to increasingly outweigh positive effects. I'm not always sure we actually test this proposition in a balanced way. Note that I don't deny the usefulness of investigating the Reasons for Concern (RFCs), even though these too link global warming only to risks. By using lop-sided terminology, do we "risk" biasing our assessments? My suggestion would be to state up front in this ES what we understand by the different elements of the risk framework, how we interpret the terminology, and how IPCC attempts nonetheless to undertake as objective and unbiased an assessment of the potential impacts of climate change (that's neutral	ACCEPTED: Several comments highlighted that the use of "hazards" as the structural elements of presentation provided an unbalanced view of physical elements driving to impacts. A new framing and change of vocabulary is now proposed starting in Chapter 1 and propagating here. The physical elements that lead to impacts are now called more neutrally "Climatic impact drivers" which can be hazards or boons depending on sector, regions etc. However it is also recognized that one of the mandate of UNFCCC is to assess in particular elements of the climate system that induce risks, hence a focus in the chapter on hazards.
31824	7	8	7	11	The difference between "model projections…. Has enabled the investigation of a large variety of sectorial-relevant climate hazards" and "hazard modelling" is not clear. [Anna Sörensson, Argentina]	TAKEN INTO ACCOUNT: we removed hazard modelling
14846	7	8	7	14	The increased availability of evidence and advances in modelling are not specified in the main text for all regions. [Clare Goodess, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: The text in Section 12.4 is now more homogeneous on this issue. Note that the executive statement has now been broadened
54026	7	11	7	11	Hazard modelling - what is that? Modelling of climate hazards (I don't think so). Modelling of the impacts of climate, including hazardous climate - more likely. I would suggest using familiar language = impact modelling! [Timothy Carter, Finland]	TAKEN INTO ACCOUNT: we removed hazard modelling
54028	7	13	7	13	If the term "actionable scientific data and tools" is to be used here, it needs some explanation. This is fashionable jargon, but it should be meaningful and offer some valuable insight in this Executive Summary. So what exactly is being fostered and by what? [Timothy Carter, Finland]	TAKEN INTO ACCOUNT: this has been rephrased
26070	7	17	7	17	What is 'coastal forcing?' Erosion? [Arthur Lee, United States of America]	NOTED: Coastal forcing is a commonly used phrase to collectively refer to waves, tides and water level.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
39700	7	18	7	20	It might be important to mention that changes in climate hazards reflect broader dynamic, thermodinamic, and chemical changes FROM BOTH NATURAL AND ANTHROPOGENIC SOURCES to the earth system. [Carolina Vera, Argentina]	NOT APPLICABLE: Text completely revised and we no longer make reference to the types of climate changes that cause climatic impact driver changes. CH12 climatic impact drivers do include chemical changes as well.
8964	7	22	7	22	It is written "There is increasing evidence that climate hazards affect a number of sectors" shouldn't this be all sectors, is there anything that isn't impacted by weather, climate avd climate change? [david Viner, United Kingdom (of Great Britain and Northern Ireland)]	REJECTED: We cannot say all sectors as we cannot guarantee all sectors are covered by literature and there are a number of societal sectors that are not so clearly connected to environmental changes (i.e., other sectors of the economy that occur largely in controlled environments)
50816	7	22	7	25	It seems important to highlght here that global changes are no reliable predictor for local changes, nor are regional. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	REJECTED: this is hard to include in an executive summary with sufficiently explicit details, due to space constraints
39710	7	24	7	24	"Hazard profile" is not explicitely defined in neither of those two sections (12.2 and 12.3). It should be useful to do it if the idea is to use that name [Carolina Vera, Argentina]	NOT APPLICABLE: The paragraph in question has been removed. The phrase Hazard Profile no longer appears the Executive summary (or 12.2 , 12.3).
31826	7	24	7	29	It seems confusing to use both these two concepts: "region's hazard profile" and "hazard's profile". With "region's hazard profile" I understand a characterization of the hazards that occur in a given region. But "hazard's profile" suggest that each hazard has its own profile. I would prefer to change one of those (the one is less useful for you in the rest of the chapter), for example in the latter case not to use "hazard's profile" but "characteristics of the hazard" [Anna Sörensson, Argentina]	TAKEN INTO ACCOUNT: The executive summary now includes a statement that clarifies what is meant by the term when analysing regional changes: "information about the climatic impact driver's profile (magnitude, frequency, duration, timing, spatial extent)". [Note that we now discuss 'climatic impact drivers' rather than 'hazards']. When discussing a 'profile' the surrounding text clarified the context being discussed (regional, global, or otherwise).
39702	7	30	7	30	"atmospheric conditions" only? What about ocean or land surface condition as a proxy for hazards? (e.g. change in river flows as rainfall proxy in the upstream regions with no available precipitation observations, or the climate-related hazard indice described in the example of Fig. 12.1). The use of atmospheric conditions only, as proxy for hazards is not the general rule. [Carolina Vera, Argentina]	NOT APPLICABLE: we do not find "atmospheric conditions" in this location and in executive summary
26072	7	32	7	34	Need to explain further these hazard thresholds. Do these thresholds include step changes? [Arthur Lee, United States of America]	TAKEN INTO ACCOUNT: the sentence has been rephrased
50818	7	36	7	49	It comes later in a half sentence, but it seems very important to highlight here that locally other drivers like aerosols, irrigation, other land use change are as important as climate change and cane mask signals, induce trends or strengthen climaet change signals. E.g. in East Africa observed drying trends cannot be attributed to climate change while in parts of India the warming singal is masked (https://journals.ametsoc.org/doi/abs/10.1175/JCLI-D-17-0274.1, http://dx.doi.org/10.5194/nhess-18-365-2018) [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	REJECTED: This would lengthened the text and we do not find this issue as being central

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
8966	7	37	7	38	"Heat hazards have likely increased almost everywhere, and are likely to further increase" two points the use of the term liely is an IPCC prescribed term for probability and should be in italics furtehrmore should this not be very likely? [david Viner, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: We have sought to be clear on likelihood language and formatting, and have indicated high confidence in heat extreme increases in most regions (particularly within Section 12.4 and in the regional executive summary statements corresponding to those sections).
8578	7	42	7	46	Some of these assessment levels seem slightly dubiously low - why is it not certain that sea level rise will increase in the future? Why is the increase in flood frequency only medium confidence? Ch 9 concludes that "Sea level is projected to rise in most regions, regardless of emissions scenario (high confidence)" and "Extreme sea levels are increasing in frequency and will continue to do so in the future (high confidence)." Why is coastal erosion only likely to continue? [Robert Kopp, United States of America]	TAKEN INTO ACCOUNT: the text has been completely revised
55476	7	49	8	17	very good succinct summary of the main drivers. The information has to be made consistent across WG with good communication [Daniela Schmidt, United Kingdom (of Great Britain and Northern Ireland)]	NOTED: consistency is ensured by the ongoing efforts of handshake teams aiming to ensure coherence and utility across WG1 and WG2
41312	7	51	7	51	This seems to give the sense that the regions of the continent has not already warmed contrary to the SR15 assessment which noted that the Southern Africa region has warmed above the global average. Consider adding 'to continue' after 'very likely' [Debra Roberts, South Africa]	TAKEN INTO ACCOUNT: the text has been completely revised
32352	7	51	8	5	The summary makes no reference to impacts of the landfall of tropical cyclones in Africa, yet recent research has indicated that tropical cyclones making landfall in eastern Africa are increasing in frequency and intensity in association with oceanographic changes in the SW Indian Ocean (Fitchett, J.M., 2018. Recent emergence of CAT5 tropical cyclones in the South Indian Ocean. South African Journal of Science 114 (11/12), 4426, 6 p.), with dramatic consequences for coastal erosion and flooding in Mozambique, Madagascar, Tanzania and South Africa. [Carlos Loureiro, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: the text has been completely revised, but we could not mention detailed information for all continent
41314	7	51	8	5	Consider adding biodiversity loss particularly for Southern Africa [Debra Roberts, South Africa]	REJECTED: Biodiversity beyond WGI mandate and ecosystems mentioned already
32992	7	51	9	1	There is no uniform description of hazards for each of the regions considered. For instance, wind hazards were assessed for Europe but not for the rest of the regions. Similarly, there is no mention of changes in snow season in Central and South America. In later parts of the chapter the reasons for this are well described. Do you think that makes sense to include this limitation in the ES, linking the outputs of the assessment to the "research gaps" section? [Juan Antonio Rivera, Argentina]	TAKEN INTO ACCOUNT: The executive summary statements for regional climatic impact driver changes have been completely revised, with a paragraph on common changes across the regions and a paragraph on select climatic impact drivers changes for each region where we have high confidence and also an expectation of broad interest from stakeholders in the region. This does not cover all 28 climatic impact drivers in each region, but this information can be found within section 12.4.
31828	7	52	7	52	Should "exceedance" be changed to "ocurrence"? [Anna Sörensson, Argentina]	TAKEN INTO ACCOUNT: the text has been completely revised
9456	7	53	7	53	Delete "bracket" after "senarios". [Klaus Radunsky Radunsky, Austria]	TAKEN INTO ACCOUNT: the text has been completely revised

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
48010	7		10		Executive Summary formatting is incorrect. Please arrange paragraphs under subsections of key themes in the chapter and please bold the first sentence of each paragraph to highlight the main assessment conclusion, followed with additional details in unbolded text. Finally, please provide an introductory paragrah explaining the purpose of the chapter (see SR1.5 for guidance). [WGI TSU, France]	TAKEN INTO ACCOUNT: the text has been completely revised
8242	8	1	8	1	specify "African" continent, since the mediterranean is also part of the Eurasian continent. [Declan Finney, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: the text has been completely revised
46060	8	1	8	15	The argument about coastal erosion likely increasing along sandy coasts in African and Asia needs further revisiting. Does this assume that limestone and other geologically profiled coasts are not likely to experience increased erosion? Take the example of limestone coasts of southern UK and France? aren't they experiencing erosion as the sandy coasts in Asia and Africa? [Shuaib Lwasa, Uganda]	ACCEPTED: As this is an issue that is relevant for all regions in this assessment, the text in 12.4 and 12.5.1 has been modified to reflect that there aren't any global projections for the types of coasts referred to here and that at the present moment we can only say something about sandy coasts due both to known/accepted physics and available projections.
8580	8	1	9	9	Some of these assessments levels seem slightly dubiously low - why are extreme sea levels only likely to increase/medium confidence? Why are temperatures in Australia only very likely to increase? Etc. These statements are made without any conditionality on emissions -- is there an implicit assessment of the likelihood of different emissions scenarios here? [Robert Kopp, United States of America]	TAKEN INTO ACCOUNT: this paragraph has been completely rewritten, and in the introduction to 12.4 we have further emphasized that assessments related to changing climatic impact drivers are associated with mid-century RCP8.5 conditions, although the confidence is given for the direction of change which often scales with emissions.
32984	8	1	9	43	Liase with Ch9 (Kopp/Slangen) for sea-level projections as the basis for sea-level statements made here [Aimee Slangen, Netherlands]	ACCEPTED: Relative sea level rise statements within CH12 have been assessed in collaboration with CH9.
51244	8	1	#REF!	1	bit strange to discuss sea level rise impacts "throughout the continent", when we obviously mean the coastal areas of that continent only [Bart Van den Hurk, Netherlands]	REJECTED: No statement on SLR on line 1 of Page 8.
42136	8	1		53	Some words written in italic fonts.example: likely can be wriiten as likely [Lubna Alam, Malaysia]	TAKEN INTO ACCOUNT: the text has been completely revised
45990	8	7	8	15	I highly agree with the conclusion on drought and flood hazards. It is suggested, however, that some attention be given to the flood hazards that arise from the intense rainfall associated with extreme weather events such as tropical cyclones which adversely affect Asian countries near the warmest pool of ocean waters in the Western North Pacific basin (e.g., Member countries of the so-called ESCAP?WMO Typhoon Committee) and also to the drought hazards in subregions of Asia in viewof model simulations/projections of increse of extreme ENSO events in a warming world. [Lourdes Tibig, Philippines]	NOT APPLICABLE: The executive summary statements have been re-written and there is no space for this level of sub-regional detail on specific climatic impact driver changes. Regional changes in river floods, pluvial floods, and tropical cyclones are discussed within the Asia regional section (12.4.2).
51246	8	9	#REF!	9	Only in China? [Bart Van den Hurk, Netherlands]	NOT APPLICABLE: the text has been completely revised
8940	8	17	8	17	Century has a capital C and throughout the chapter [david Viner, United Kingdom (of Great Britain and Northern Ireland)]	REJECTED: We are not aware of any IPCC style guide requirement to this effect.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
45158	8	18	8	20	I recommend the sentence on Australasian precipitation be changed to the following: Central and north east Australia and THE WEST AND SOUTH OF New Zealand are projected to HAVE INCREASES IN ANNUAL MEAN PRECIPITATION in future, while south western and eastern Australia and THE NORTH AND EAST OF New Zealand are projected to HAVE DECREASES (medium confidence). [I provide more details plus justification in my later comments regarding Page 45 lines 29-31] [David Wratt, New Zealand]	ACCEPTED: this statement has been modified as suggested
9458	8	23	8	23	Insert "to" after "expected". [Klaus Radunsky Radunsky, Austria]	ACCEPTED: This has been corrected throughout.
51248	8	23	#REF!	25	The statement on sea level rise should be associated with a time horizon; when Antarctic ice mass loss is going to become a dominant contributor to SLR that may lead to smaller than average SLR along the Australian coast [Bart Van den Hurk, Netherlands]	NOT APPLICABLE: The executive summary statement for Australian climatic impact driver changes has been completely revised. Mechanisms behind sea level rise (and sources of meltwater) are within the domain of CH9.
41180	8	27	8	35	There is no glacier or cryospheric related hazards assessment for South America in the First Order Draft. The impact of climate change in mountain areas and mainly related to glacier shrinkage and permafrost degradation is assessed globally in SROCC. Among the literature assessed in SROCC, there are a few examples from the Andes. The recently published “The Andean glacier and water atlas: the impact of glacier retreat on water resources” by UNESCO (Schoolmeester et al., 2018) and reference therein, covers in detail many of the possible hazards and challenges related with climate change and the cryosphere in the Andes. Among their key messages, the highlight that; 1) Glacier retreat and volume loss will continue in the future across the whole of the Andes, leading to significant changes in hydrology. This will impact communities and ecosystems; 2) Glacial meltwater is a critical water source at certain times of the year for millions of people – most notably for those living in the Andean highlands of Bolivia, Chile, and Peru; 3) The Andean highlands of Bolivia, northern Chile, and southern Peru are hotspots of water stress, because of their semiarid climate and marked seasonality. With limited hydrological storage capacity in the small upland catchment flows, glacier meltwater has so far acted as an important buffer mechanism; 4) During drought years, glacial meltwater becomes critically important for certain areas; 5) ‘Peak water’ has been reached for many glaciers in the Andes, meaning that meltwater runoff will continue to decrease in the future. Barros et al. (2015), mention that a decrease in snowfall and glacier shrinkages will be one the main impacts of climate change in the Andes of Argentina, possible whit impact on irrigation and hydropower production. In the Andes of Peru, seasonal water scarcity and Glacial Lake Outburst Floods (GLOF) pose a severe threat for highly exposed and vulnerable people (Drenkhan et al., 2019). In the Andes of Bolivia, both the shrinkage of glaciers and the degradation (thawing) of permafrost are supposed to represent future challenges	NOT APPLICABLE: The executive summary statement for Central and South America has been completely revised. Discussion of climatic impact drivers in the Andes is provided within 12.4.4, which includes specific discussions on mass movements, glaciers, and permafrost.
9460	8	32	8	32	Insert "to" after "projected". [Klaus Radunsky Radunsky, Austria]	NOT APPLICABLE: the text has been completely revised
26074	8	32	8	32	… is also projected to decrease … [Arthur Lee, United States of America]	NOT APPLICABLE: the text has been completely revised

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
46062	8	32	8	32	Add the word 'to' between projected and decrease [Shuaib Lwasa, Uganda]	NOT APPLICABLE: the text has been completely revised
51250	8	32	#REF!	32	insert "to" [Bart Van den Hurk, Netherlands]	NOT APPLICABLE: the text has been completely revised
41182	8	37	8	43	There are no hazards or risk assessment related to the shrinkage of glaciers and the degradation of permafrost in mountain areas of Europe. The impact of climate change in mountain areas and mainly related to glacier shrinkage and permafrost degradation is assessed globally in SROCC. Among the literature assessed in SROCC, there are many examples from the Alps. Both the risk of GLOFs or Rain on snow event will increase in Europe. Particularly, the Alpes is maybe the only regions where we could have medium to high confidence that permafrost thawing due to warming temperatures is related to the increase of rock falls and destabilization of mountain slopes. [Lucas Ruiz, Argentina]	NOT APPLICABLE: The executive summary statement for Europe has been completely revised. Discussion of climatic impact drivers in the Alps is provided within 12.4.5, which also includes a discussion of mass movements.
27116	8	37	8	44	A comment on the European Alps (e.g. warming trend, snow reduction and modification of precipitation timing) is missing here while it's highly relevant at European scale (e.g. alps as european water towers) [Edoardo Cremonese, Italy]	NOT APPLICABLE: The executive summary statement for Europe has been completely revised. Discussion of climatic impact drivers in the Alps is provided within 12.4.5.
46064	8	41	8	41	Is it relevance to or the decrease of wind speeds will 'affect' inrrastructure forestry and energy prodiction? [Shuaib Lwasa, Uganda]	NOT APPLICABLE: the text has been completely revised
51252	8	43	#REF!	44	any statements possible on the length of the growing season? [Bart Van den Hurk, Netherlands]	NOT APPLICABLE: The length of the growing season is discussed within the main text, but is too fine grained a topic for the executive summary.
41184	8	46	9	1	There are no hazards or risk assessment related to the shrinkage of glaciers and the degradation of permafrost in mountain areas of North America. The impact of climate change in mountain areas and mainly related to glacier shrinkage and permafrost degradation is assessed globally in SROCC. Among the literature assessed in SROCC, there are many examples from North Amercia. Both the risk of GLOFs or Rain on snow event will increase in North America. [Lucas Ruiz, Argentina]	NOT APPLICABLE: The executive summary text for North America has been changed, but within 12.4.6 and 12.4.9 now includes enhanced discussion of glaciers and mountain permafrost, with reference to the SROCC.
47304	8	47	8	47	spelling error I think. Areal [Siyabusa Mkuhlani, South Africa]	REJECTED: Areal is the word we intended here
43960	8	49	8	54	" Droughts are likely to increase in regions with overall dry trends (Mexico and the US Southwest) and decrease where wet trends are strong (Alaska, Northeast North America), although other regions may see increased episodic drought even where slight wet trends are expected (medium confidence)." Does the conclusion about dry trends need some reconsideration, especially given the almost nonexistent evidence for significant decreases in precipitation in Mexico and the US Southwest in the historical data? Reference: see Fig. 3 of: Knutson, T.R. and F. Zeng, 2018: Model Assessment of Observed Precipitation Trends over Land Regions: Detectable Human Influences and Possible Low Bias in Model Trends. J. Climate, 31, 4617–4637, https://doi.org/10.1175/JCLI-D-17-0672.1 [Thomas Knutson, United States of America]	TAKEN INTO ACCOUNT: The executive summary statement has been completely re-written. We have also further clarified the conversation around dry trends in North America to distinguish between aridity and drought (as well as between meteorological and agricultural drought). Our assessment of future CID changes incorporate observed trend, detection and attribution, model projection (and associated agreement), and theory of the physical mechanisms of change. Assessments in North America include caveats to further contextualize the season, geographical domain, and drought characteristics associated with projected changes.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
42138	9	1		55	Some words written in italic fonts.example: likely can be wriiten as likely [Lubna Alam, Malaysia]	NOT APPLICABLE: the text has been completely revised, however we have utilized IPCC guidelines for italicizing likelihood statements
9192	9	11	9	15	A reconstruction of four centuries of temperature-related coral bleaching in the Great Barrier Reef found higher bleaching in the 1890s and 1750s, confirming that bleaching recovers naturally, though it is still poorly understood. See paper: Reconstruction of Four Centuries of Temperature-Induced Coral Bleaching on the Great Barrier Reef", NA Kamenos & SJ Hennige, Frontiers in Marine Science, Aug 2018, Volume 5, Article 283, doi: 10.3389/fmars.2018.00283 [Jim O'Brien, Ireland]	NOT APPLICABLE: The behaviour of coral reefs following a bleaching event is a measure of their vulnerability and is a topic covered in WGII.
47306	9	11	9	15	there is need for a full stop to separate the sentences 'resources Ocean'; 'ecosystems It' [Siyabusa Mkuhlani, South Africa]	NOT APPLICABLE: the text has been completely revised
49604	9	11		13	the are no punctuation marks at the end of each sentence "Ocean warming and ocean acidification through the 21st century are virtually certain, acting as increasing hazards for marine biodiversity and resources Ocean warming is likely to push temperatures beyond thresholds for the suitability of coral reefs and associated ecosystems" [Cyriaque Rufin Nguimalet, Central African Republic]	ACCEPTED: Punctuation marks have been added
26076	9	13	8	15	…, and very likely that future ocean warming will lead to the decline of ocean oxygen content … [Arthur Lee, United States of America]	NOT APPLICABLE: the text has been completely revised
51254	9	13	#REF!	14	statement is already made at start of paragraph [Bart Van den Hurk, Netherlands]	NOT APPLICABLE: the text has been completely revised and we have sought to remove any duplication.
15442	9	14	9	14	acidification will continue' reads repetitive to the very first sentence in this paragraph. [Ruiqing Miao, United States of America]	NOT APPLICABLE: the text has been completely revised and we have sought to remove any repetition
16092	9	20	9	21	Sea level rise together with storm surges and waves also cause hazards to coastal cities. This should be reflected in the Executive Summary. See Section 12.3.7.2. [SAI MING LEE, China]	REJECTED: The threat of extreme sea level for coastal assets is discussed within 12.3 and 12.4.10 but there are too many specific climatic impact driver/sectoral asset combinations to name or prioritize within the executive summary.
31830	9	27	9	27	Is atmospheric CO2 increase a hazard? This is not consistent with p14, line 39 "CO2 increase will be seen as a benefit for plants". [Anna Sörensson, Argentina]	ACCEPTED: In response to this and similar comments the Hazard indices tables have been completely revamped and the CO2 increase hazard has now been replaced with simply Atmospheric CO2.
50820	9	27	9	34	As in other places above, what do observed trends indicate? Are they attributable? [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	NOT APPLICABLE: the text has been completely revised and past trends are not part of the executive summary now (although they are discussed to a greater extent in the SOD main text sections)

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
15394	9	28	9	28	The coastal erosion is increasing not only on sandy beaches, but on the different types of Arctic shores because of permafrost thawing. The retreat of sea shores of Ushakov Ilsland in the Kara Sea (a glacier island) was up to 100 meter per year and even more. Aleynikov, A., Lipka, O. The degradation of the Ushakov Island ice cover according to the remote sensing data analysis. In: the Earth from Space 9(25) 2018. Co-author. http://zikj.ru/images/25/7.pdf Please add a paragraph into the chapter. Please add the information about such cases too. [Oksana Lipka, Russian Federation]	TAKEN INTO ACCOUNT: As this is an issue that is relevant for all regions in this assessment, the text in 12.4 and 12.5.1 has been modified to reflect that there aren't any global projections for the types of coasts referred to here and that at the present moment we can only say something about sandy coasts due both to known/accepted physics and available projections. We also discuss submarine permafrost and arctic shores.
32994	9	31	9	31	Maybe I would consider drought indices that incorporate soil moisture and evaporation, considering the well known SPEI [Juan Antonio Rivera, Argentina]	REJECTED: it was not possible to go to that level of detail in the ES which must be understandable by the large audience, however within the main text there is a discussion of different types of drought and aridity indices and their relative confidence.
26078	9	31	9	32	This statement needs to have an assessment about the level of confidence. While the observation in the statement says that drought indices that incorporate soil moisture are more likely to show consistent increases, while those that don’t show more regional variation, what is the level of confidence in the observed evidence? [Arthur Lee, United States of America]	NOT APPLICABLE: We have completely revised this executive summary statement. Within the regional sections (12.4) we indicate confidence in various types of climatic impact driver changes and now include caveats noting where confidence is stronger for certain aspects of drought or aridity.
28510	9	31			Some examples of drought indices that incorporate soil moisture would be good. [Kanoksri Sarinnapakorn, Thailand]	NOT APPLICABLE: The executive summary text has been completely revised, however there is a substantial discussion on different measures of aridity and drought (including those focused on representing soil moisture and thermal effects on potential evapotranspiration) within 12.3 and across sections 12.4 and 12.5.
51256	9	32	#REF!	32	sometimes precipitation deficit is interpreted as the difference between precipitation and evaporation, and as such that indicator can be expected to have similar signatures as soil moisture. "Precipitation anomalies" is probably a better term for this [Bart Van den Hurk, Netherlands]	NOT APPLICABLE: We have completely revised this executive summary statement. Our discussion of aridity and drought incorporates many metrics and indices, including P-E, measures of soil moisture change, river flow, etc. (described in Section 12.3). Assessments of trends include look at an aggregate of these changes and considers a variety of indices (as well as their agreement).
31832	9	38	9	39	CO2 concentration in the atmosphere seems then to be useful to describe hazards such as "ocean acidification, pollutants and allergenic matters", but it is not a hazard itself? (see previous comment) [Anna Sörensson, Argentina]	NOT APPLICABLE: the text has been completely revised
8582	9	40	9	43	This sentence is opaque [Robert Kopp, United States of America]	NOT APPLICABLE: the text has been completely revised
47308	9	40	9	43	need a full stop [Siyabusa Mkuhlani, South Africa]	NOT APPLICABLE: the text has been completely revised
15444	9	42	9	42	tail behavior' and 'threshold behavior' should be explained. [Ruiqing Miao, United States of America]	NOT APPLICABLE: the text has been completely revised

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
14848	9	45	9	51	There is an aspiration for co-production, but in practice this is not always implemented. Indices and hazards are still generally defined from a climate/weather perspective rather than from user/impact perspective. [Clare Goodess, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: text revised to reflect that climate services aspire to co-produce but in reality are largely supply-driven.
54032	9	47	9	47	What is the information "beyond climate" that is required? Be more specific, because effective impact assessment cannot be undertaken with climate information alone. Note that many of these issues were raised in earlier IPCC assessment reports, including TAR WG I chapter 13 and WG II Chapter 3; AR4 WG II chapter 2 and AR 5 WG II Ch 21, among others. I also wonder about the implied assumption that impact assessments necessarily require tailored co-production information provided within the context of "climate services", I think it is important to state what is to be understood by the term "climate services" if it is to be used frequently throughout this chapter (I see there is quite a good section on this, so this should be easy to fix). The concept of climate services is very much climate science-led. It is also a commercial activity in some quarters, with all its potential pitfalls. So care is needed not to imply that this is the only conduit for the effective application of climate-related information for impact assessment. [Timothy Carter, Finland]	TAKEN INTO ACCOUNT: Note that the executive summary has bee completely revised
41316	10	1	10	3	In the references to warming or other risks for the 21st in the ES, it is not clear whether this is underpinned by past and current emissions or if under different emission scenarios. It will be helpful to be explicit on this. Where possible, consider providing quantitative information (e.g. instead of saying warming, specify the magnitude). Information for middle and end of the century will be additional value to the ES. [Debra Roberts, South Africa]	TAKEN INTO ACCOUNT: The executive summary statements have been completely revised. The main intent of climatic impact driver change assessments is to note the direction of change that is associated with rising emissions, with RCP8.5 mid-century as a nominal time horizon but all quantitative projections in the main chapter text coupled with a specific RCP/time period.
53830	11	3	13	14	It is good that you make the links to WGII clear. But I think this imortant point can already be made in the first para. [Jan Fuglestvedt, Norway]	TAKEN INTO ACCOUNT: the link is made in the third paragraph.
45824	11	3			the risk framing from CCB1.2 including figure 1 could be in this chapter as a box - other than hazards, this is not a WGI cross cutting theme - chapters 2-11 have very limited, if any, references to risk. [Katja Mintenbeck, Germany]	REJECTED: the framing belongs to Chapter 1
8622	11	5	11	5	"Future climate change has the potential to result in significant societal and environmental damage"The statement is incomplete and Idle. [Ibikunle Olaleru, Nigeria]	TAKEN INTO ACCOUNT: This has been rephrased
41318	11	5	11	5	Perhaps start the current context since are already faced with multiple challenges from climate change. This will help avoid framing the issue as a future problem and not a current one thus downplaying the message around the urgency to act now. [Debra Roberts, South Africa]	TAKEN INTO ACCOUNT: The first sentences now encompass both current and future state of climate
48350	11	5	11	5	Suggest adding "variability and" before "change" which is important for relevance to e.g. the SDGs, Sendai Framework. [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	REJECTED: The mandate of this chapter being (see title) "climate change information", we prefer to focus on climate change.
45822	11	5	11	7	This is the remit for WGII Assessments (impacts, adaptation and vulnerability) - please refer reader to WGII here [Katja Mintenbeck, Germany]	ACCEPTED: we refer to WGII
41320	11	6	11	6	Add 'has and' before 'will lead' [Debra Roberts, South Africa]	ACCEPTED: suggestion added

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
8624	11	8	11	8	"Climate change can also lead to beneficial conditions". The kinds or type of beneficial conditions could as well be included. The statement could as well be merged with the statement in line 5 and recast. [Ibikunle Olaleru, Nigeria]	ACCEPTED: Several comments highlighted that the use of "hazards" as the structural elements of presentation provided an unbalanced view of physical elements driving to impacts. It was recognized that the "propeller diagram" was only part of the story and a new framing and change of vocabulary is now proposed starting in Chapter 1 and propagating here. The physical elements that lead to impacts are now called more neutrally "Climatic impact drivers" which can be hazards or boons depending on sector, regions etc. However it is also recognized that one of the mandate of UNFCCC is to assess in particular elements of the climate system that induce risks, hence a focus in the chapter on hazards.
46066	11	8	11	8	This statement about beneficial conditions of climate change has been written in several reports but not illustrated withe examples. If you have example, please illustrate otherwise rethink this statement. [Shuaib Lwasa, Uganda]	REJECTED: There are many examples of beneficial consequences and we prefer at this point to remain general. These examples are developed in Section 12.3
54034	11	8	11	8	Well at least benefits get a one line mention here! However, this follows three lines on adverse impacts and damage, and is followed by a resumption of the description of hazards. The terminology is really not good for conveying a balanced impression of changes in climate and their relevance for assessing impacts. I can't see how beneficial effects can be considered objectively in this framework. [Timothy Carter, Finland]	ACCEPTED: Several comments highlighted that the use of "hazards" as the structural elements of presentation provided an unbalanced view of physical elements driving to impacts. It was recognized that the "propeller diagram" was only part of the story and a new framing and change of vocabulary is now proposed starting in Chapter 1 and propagating here. The physical elements that lead to impacts are now called more neutrally "Climatic impact drivers" which can be hazards or boons depending on sector, regions etc. However it is also recognized that one of the mandate of UNFCCC is to assess in particular elements of the climate system that induce risks, hence a focus in the chapter on hazards.
48676	11	11	11	13	… and Atlas [Lincoln Alves, Brazil]	ACCEPTED: we added the suggestion
51258	11	12	46	13	A reference to Atlas could be made here as well [Bart Van den Hurk, Netherlands]	REJECTED: the range of pages is too wide to locate where the reviewer suggests to add a citation. References to the Atlas are several along the chapter
26080	11	13	11	13	The word "handshake" here is culturally irrelevant as compared to "handover." It may confuse people of different cultures. It would be prudent to use words such as "linkage." [Arthur Lee, United States of America]	TAKEN INTO ACCOUNT: The sentence is removed to avoid confusion
8584	11	13	11	14	The meaning of this metaphor is unclear [Robert Kopp, United States of America]	TAKEN INTO ACCOUNT: The sentence is removed to avoid confusion

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
8942	11	16	11	22	The concept of dynamic risk is being introduced in WG2 AR6 and the SRCCL, I would suggest that dynamic is used instead of evolution in this section, a paper by Viner et al iis under review in Atmospheric Science Letters. Viner D., Ekstrom M., Hulbert M., Warner N.K., Wreford A., and Zommers Z. 2019 Understanding the dynamic nature of risk in climate change assessments. Atmospheric Science Letters (Submitted) [david Viner, United Kingdom (of Great Britain and Northern Ireland)]	NOTED: CH12 has examined the WGII FOD to understand uses of 'dynamic risk' and linked this to CH12 assessment accordingly.
50822	11	16	11	22	Also mention that hazards might have changed differently in the past than they will in the future [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	ACCEPTED: this has been added
45992	11	20	11	22	Consider also the changing nature of not just multiple but compound events that lead to compound cascading hazards. [Lourdes Tibig, Philippines]	TAKEN INTO ACCOUNT: we have rephrased the sentence
16134	11	21	11	21	The use of the adjective "compound" for multiple hazards seems not appropriate. Within FAQ12.2, the termconcurrent is used which seems more adequate. The term compound is used also somewhere else in the chapter. [Sandro Fuzzi, Italy]	TAKEN INTO ACCOUNT: we have rephrased the sentence
54036	11	24	11	25	Novel - yes, but the religious adherence to the risk framework is to its detriment. I'm worried that this sends a misleading signal that all climate changes of interest for assessing impacts are hazardous - they are not, and the language needs to reflect that. In fact these are climate drivers, that may constitute a hazard when evaluating potential risks of adverse impacts, but also include benign average conditions as well as especially beneficial conditions too. [Timothy Carter, Finland]	ACCEPTED: Several comments highlighted that the use of "hazards" as the structural elements of presentation provided an unbalanced view of physical elements driving to impacts. It was recognized that the "propeller diagram" was only part of the story and a new framing and change of vocabulary is now proposed starting in Chapter 1 and propagating here. The physical elements that lead to impacts are now called more neutrally "Climatic impact drivers" which can be hazards or boons depending on sector, regions etc. However it is also recognized that one of the mandate of UNFCCC is to assess in particular elements of the climate system that induce risks, hence a focus in the chapter on hazards.
8944	11	24	12	39	The relationship between the working groups on risk is very important, this section is welcome, I would also urge the three TSUs to formally convene across Working Group discussion on risk. [david Viner, United Kingdom (of Great Britain and Northern Ireland)]	NOTED: WGI CH12 has led an extensive effort to build a 'handshake' between WGI-WGII in order to ensure that robust and useful climate information is available to be passed into the risk assessment framework (which is itself a joint effort across all three AR6 WGs). In the second order draft we recognize the complex nature of climate change impacts on sectors, which can include both hazards and potential benefits and often combinations of the two given heterogeneity within sectors and across regions.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
39720	11	30	11	32	The fact that risk can change because of changes in vulnerability and exposure conditions is a conclusion from SREX for example and should be also mentioned here. It is important that the chapter introduction includes all of these clarifications. Considering that the chapter assesses climate related hazards independently of the assessment of vulnerability and exposure conditions that will be done by WG2, we need to assure that such division does not alter the understanding of the readers about all of the sources of the risk changes. [Carolina Vera, Argentina]	NOTED: the changing nature of vulnerability and exposure is already mentioned in this section, in another paragraph.
45994	11	30	11	32	Climate-relaed risks arising from adaptation and mitigationpolicies/ strategies could be significant.,. Is there a reason for npt including it in the assessment? [Lourdes Tibig, Philippines]	TAKEN INTO ACCOUNT: This topic is largely beyond the scope of WGI. However an additional small section has been added (12.5.3) with assessment of other externa influences on climatic impact drivers.
51260	11	30	45	31	not only adaptation/mitigation affect changes in climate risk, also (autonomous) socio-economic trends. Is worth mentioning here [Bart Van den Hurk, Netherlands]	ACCEPTED: this has been added
8046	11	32	11	32	"direcly" should be "directly" [Taoyuan Wei, Norway]	EDITORIAL: correction made
26082	11	32	11	32	… directly … [Arthur Lee, United States of America]	EDITORIAL: correction made
48678	11	38	11	41	add some examples [Lincoln Alves, Brazil]	ACCEPTED: examples have been added
15446	11	38	11	44	The two concepts here, i.e., 'Hazard indices' and 'Hazard threshold', should be briefly defined in the executive summary as well. [Ruiqing Miao, United States of America]	ACCEPTED: the concepts are introduced in the Executive summary. Note that "hazards" has now been replaced by "climatic impact driver"
43772	11	38	11	44	Here the definiton of "Hazard Indices" and "Hazard Threshold" have been indicated. Is the definiton an official one in IPCC WGI AR6? It looks to have some fravor of "social" effects, thus it looks to overlap with the contents in WG2. How WG1 should handle such things? [Izuru Takayabu, Japan]	TAKEN INTO ACCOUNT: The term 'hazard' is included in the IPCC glossary, and is also defined in CH1. Put another way, climate variables become hazards when their occurrence or change is related to risk via an overlap with vulnerability and exposure in a given sectoral system. It is not possible to assess risk without vulnerability or exposure assessment (which is the mandate of WGII), however it is the mandate of WGI to provide information about the climatic hazards that can lead to impacts and risk. Coherence and consistency across WGI and WGII treatment of the risk framework is a primary motivation for cross-WG 'Handshake' activities led in part by CH12.
31834	11	43	11	43	Please include "increase": "to create, increase or reduce an impact or risk", to account for all possible options. [Anna Sörensson, Argentina]	ACCEPTED: change introduced
39704	11	46	11	49	The risk approach for the whole report has been introduced already in chapter 1. Check consistency of this explanation driven by Sendai framework with chapter 1 risk framework description. [Carolina Vera, Argentina]	ACCEPTED: the consistency has been checked with Chapter 1
39706	12	1	12	4	Changes in exposure and vulnerability and their influences on related risk changes, were an important part of IPCC SREX SPM [Carolina Vera, Argentina]	ACCEPTED: The IPCC SREX is now cited
42140	12	1		3	limited evidence (or low agreement) can be written in limited evidence (or low agreement) [Lubna Alam, Malaysia]	REJECTED: comment was not understood
8042	12	3	12	3	"more of an effect" could be replaced by "stronger effect" [Taoyuan Wei, Norway]	ACCEPTED: change made

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
46068	12	6	12	6	Which regions are referred to here? important to note that there are various global regional typologies. [Shuaib Lwasa, Uganda]	ACCEPTED: a reference to Chapter 1 is made for the definition of regions
55058	12	6	12	18	Disagree- In the Western Balkans, floods mostly occur in small and medium-sized streams with torrential hydrological regime. During the period 1999 - 2014, a large number of torrential floods were registered in the Danube, Sava and Morava River basins in Serbia. Catastrophic floods of May 2014 due to heavy rainfall hit the Western Balkans (Serbia, Bosnia, Croatia) and historically are the largest one. In some parts of the region, the three-day rainfall exceeded the average monthly volumes for May. The floods have affected about 1.6 million people in western and central Serbia while the flood impact assessment shows that the total damage in 24 affected municipalities was over 1, 525 billion euros.Literature: 1. United Nations, World Bank, European Union (2014): Report on the needs assessment for recovery and rehabilitation of flooded areas (Floods in Serbia in 2014, Belgrade) 2. Grujic G, Stanojković-Sebic A, Petkovic S, Mihic D, Pejic B (2019): Monography - The Impact of Climate Change to Land Degradation in the Republic of Serbia, Oasis, Belgrade [Gordana Grujic, Serbia]	REJECTED: Such specific study cannot be referred to in this paragraph as it is introductory
26084	12	22	12	26	Why not make a separate simple graphic or draw another label, in parallel, or some other notation, to show 'socio-economic development' is also important? [Arthur Lee, United States of America]	REJECTED: The figure needed more important complements, in particular links to WGIII. However we mention that thresholds are can be conditions dependent
8706	12	33	12	37	One difficulty in this figure is that the actual numerical values will vary strongly depending on the local settings. For example, for the groundwater salinization issue, this will depend strongly on the local geology, on precipitations, evapotranspiration at the scale of the aquifer, water pumping, tides, etc. Hence the value (0,5m) would mean very different changes of the hazards depending on the location. May be just mentionning that the salinization hazard increases with sea-level rise, without mentionning specific thresholds, would be appropriate (?) [Goneri Le Cozannet, France]	TAKEN INTO ACCOUNT: we prefer to mention a threshold for giving a better picture, but specified it is a local value
53832	12	33	12	37	Would be good if you could make it more clear that ch12 covers both boxes above. It can easily be read as only the lower box. A color coding or fram around the two boxes would help. [Jan Fuglestvedt, Norway]	ACCEPTED: the figure has been improved
8702	12	38	12	44	This is clear, but may be it is worthwhile to note the different definitions of the term "hazards" accross communities that may eventually confuse some readers. https://www.ipcc.ch/sr15/chapter/glossary/ https://www.unisdr.org/we/inform/terminology#letter-h [Goneri Le Cozannet, France]	NOTED: The definitions are referred here to Chapter 1 and the Glossary
45996	12	42	12	53	The regionalized hazards of the AR6 WG I acknowledges the difficulty faced by governments and practitioners, esecially in areas where there less capacity to assess them. The needed information based on the evolving chnges in the characteristics ofthe climate hazards arising from changes in the global climate drivers and the different temperature levels dictatted by the A/M policies and actions for accurate risk assessments will be a key determinant for achieving climate resilience [Lourdes Tibig, Philippines]	TAKEN INTO ACCOUNT: The connexion between climate impact drivers and the levels of warming is discussed in Section 12.5.2, to be mentioned in the sentence
41322	12	44	13	44	Consider adding 'changes in' after 'as well as' [Debra Roberts, South Africa]	REJECTED: the location of the sentence is erroneous and it was impossible to locate.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
8704	12	50	12	51	This sentence might be misunderstood by those relying on the UNISDR terminology for risks and hazards: in fact, direct human interventions can also reduce the hazards itself, wether induced by climate change or not (e.g;, vegetalization of instable slopes) [Goneri Le Cozannet, France]	TAKEN INTO ACCOUNT. This has been rephrased
32112	12		12		Notwithstanding the difficulties, I suggest it's very important for this chapter to assess the magnitude of potential changes, nor merely their sign. Some bounds on magnitude must be possible and are essential for risk assessment. [Rowan Sutton, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: effort is increased to provide more quantitative statements in sections 12.4-12.5; however Most tables remain qualitative.
41262	12		14		In the listing of hazard categories on p 12-14 the changing intensity of precipitation as well as the increasing amount is an important hazard. While I understand the thinking, I should point out at all the hazards except one are of physical phenomena while the last 'Coastal' is a regional concept. A better title might be combined hazards. This might be followed up by a case study box for each of the regions which like the China one drafted here shows how hazards are often combined to impact our regions. [Leonard Berry, United States of America]	TAKEN INTO ACCOUNT: we changed the categories, and we included a few sentences on compound/combined hazards in section 12.2, but this category is not be included in the tables
42162	12				Elaboration of CORDEX [Lubna Alam, Malaysia]	REJECTED: comment was not understood
53834	13	1	13	5	Figure 12.2: When readers see this with out having read the text, they will not understand "WGII continents". Expanding the text in that box just by a couple of words will help. [Jan Fuglestvedt, Norway]	ACCEPTED: figure edited accordingly.
26644	13	8	13	8	You write "[Placeholder: one or two more case studies expected in the SOD]". For me two case studies are OK and I not add more case studies… [Alessandro Pezzoli, Italy]	ACCEPTED: there is only one and placeholder note is deleted.
26646	13	10	13	10	"The case study". Probably more clear: "This case study" because it is referred to the East China case study that is named in above lines [Alessandro Pezzoli, Italy]	ACCEPTED: text changed
26648	13	12	13	13	"An additional cross-chapter box describes from two case studies…". Better writre (prbably more clear): "An additional cross-chapter box describes from two case studies respectivelt in Europe and Africa, …" [Alessandro Pezzoli, Italy]	ACCEPTED: text revised
15448	13	17	16	8	Section 12.2 reads loose and can be tightened. For instance, page 13, lines 41-49: what is the purpose of this paragraph? Seems like it is disconnected from the previous paragragh. Page 16, lines 1-8: this paragraph reads repetitive and is perhaps misplaced. It could be placed in the placed right below Figure 12.1. [Ruiqing Miao, United States of America]	TAKEN INTO ACCOUNT: text is revised.
43774	13	21	13	25	There the explanation of the difference between CH12 and WG2 has been written. My impression of reading the whole CH12 is that their style of writing is very challenging that they have written many issues related with "social part" in CH12. Is that the position of CH12 in IPCC WG1 ? [Izuru Takayabu, Japan]	TAKEN INTO ACCOUNT: At several places in section 12.1 and 12.2 we make clear that we are the link to WGII and assess climatic impact drivers relevant for regional impact and risk assessment, which includes referring to WGII literature.
46070	13	25	13	25	perhaps the setence need to read exposure and vulnerability assessed by WG Ii [Shuaib Lwasa, Uganda]	ACCEPTED: corrected the wording
48352	13	25	13	25	Suggest adding at the end of the sentence "though the hazards it focuses on are informed by these" to reinforce this point. [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	ACCEPTED: the sentence is revised accordingly.
45826	13	29	3	29	no space in freshwater [Katja Mintenbeck, Germany]	ACCEPTED: text changed

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
26650	13	37	13	37	You write "Chapter 12 also adds an "Energy" sector…". In fact it is not clear from the Table of Contets as well as from the Chapter how and where "Energy" is analyzed probably because this is a cross-chapter topic. If you can add a short sub-paragraph about Energy or if you can add some lines just after line 39 - page 13 where this topic is analyzed, it will be good and will help the reader [Alessandro Pezzoli, Italy]	ACCEPTED: reference to WGIII and other sections is made and text has been extended.
45828	13	37	13	37	reference to WGIII for energy? [Katja Mintenbeck, Germany]	ACCEPTED: reference to WGII is made.
12728	13	37	13	39	Make sure this chapter covers energy efficiency as well as increased energy demand through increased use of cooling appliances as heating continues. For energy efficiency as it pertains to appliances and space cooling, the transition away from high-GWP HFCs provides an opportunity for revising the technologies to further improve energy efficiency. Shah N., et al. (2015) Benefits Of Leapfrogging To Superefficiency And Low Global Warming Potential Refrigerants In Air Conditioning, Ernest Orlando Lawrence Berkeley National Laboratory; IEA (2018) Future of Cooling; Sustainable Energy for All (2018) Chilling Prospects: Providing Sustainable Cooling for All; and Birmingham Energy Institute, University of Birmingham (2018) A Cool World: Defining the Energy Conundrum of Cooling for All. [Kristin Campbell, United States of America]	TAKEN INTO ACCOUNT: same comment as above
12908	13	37	13	39	Make sure this chapter covers energy efficiency as well as increased energy demand through increased use of cooling appliances as heating continues. For energy efficiency as it pertains to appliances and space cooling, the transition away from high-GWP HFCs provides an opportunity for revising the technologies to further improve energy efficiency. Sachar et al. (2018) Solving the Global Cooling Challenge: How to Counter the Climate Threat from Room Air Conditioners. Rocky Mountain Institute; Shah N., et al. (2015) Benefits Of Leapfrogging To Superefficiency And Low Global Warming Potential Refrigerants In Air Conditioning, Ernest Orlando Lawrence Berkeley National Laboratory; IEA (2018) Future of Cooling; Sustainable Energy for All (2018) Chilling Prospects: Providing Sustainable Cooling for All; and Birmingham Energy Institute, University of Birmingham (2018) A Cool World: Defining the Energy Conundrum of Cooling for All. [Durwood Zaelke, United States of America]	TAKEN INTO ACCOUNT: text and reference to WGIII and other section in Ch12 have been made. Section 12.3 covers climatic impact drivers that can effect demand and supply of energy, but in Ch12 we cannot go into detail on the implications of climate change on energy efficiency as this is part of WGII and WGIII assessment.
42372	13	37	13	39	this chapter covers energy efficiency as well as increased energy demand through increased use of cooling appliances as heating continues. For energy efficiency as it pertains to appliances and space cooling, the transition away from high-GWP HFCs provides an opportunity for revising the technologies to further improve energy efficiency. Sachar et al. (2018) Solving the Global Cooling Challenge: How to Counter the Climate Threat from Room Air Conditioners. Rocky Mountain Institute; Shah N., et al. (2015) Benefits Of Leapfrogging To Superefficiency And Low Global Warming Potential Refrigerants In Air Conditioning, Ernest Orlando Lawrence Berkeley National Laboratory; (2018) Future of Cooling; Sustainable Energy for All (2018) Chilling Prospects: Providing Sustainable Cooling for All; and Birmingham Energy Institute, University of Birmingham (2018) A Cool World: Defining the Energy Conundrum of Cooling for All. [Gabrielle Dreyfus, United States of America]	TAKEN INTO ACCOUNT: same comment as above

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
55480	13	39	13	39	ecosystem services versus natures contribution to people, Chapter 1 talks about the IPBES framework which moves away from ecosystem services. This needs discussion across the chapters [Daniela Schmidt, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: We mention now the IPBES framework.
8708	13	41	13	41	Most adaptation practitionners would say that sea-level rise is not a hazard (erosion or flooding would be), but rather a "climate variable" or a "forcing factor". [Goneri Le Cozannet, France]	ACCEPTED: taken care of as we changed hazard to climatic impact driver
39708	13	41	13	45	Hazards can also include extreme and gradual changes in surface water and hydrology, as well as in cryosphere (Chapter 8). [Carolina Vera, Argentina]	ACCEPTED: The text has been rephrased according to new tables
41186	13	41	13	45	As it stated, this sentence implies, differently to the other related hazards that the cryosphere is a hazard by definition. Some phenomena related to the cryosphere, like GLOFs, permafrost thawing or degradation, glacier shrinkage and or rain on snow event are potential hazards and not the cryosphere by itself. [Lucas Ruiz, Argentina]	ACCEPTED: Text changed to "changes in the cryosphere"
8626	13	41	13	49	The statement should be re-casted. Same information repeated at different times. [Ibikunle Olaleru, Nigeria]	ACCEPTED: repetitions were removed.
8952	13	41	13	49	This paragraph introduces the concept of the temporal dimension of hazards, I would recommend using the term acute to describe short term (tornado, hail storm etc) and chronic to describe hazards such as sea level rise. There is a good diagram in Viner D., Rawlins M., Allison I., Howarth C. and Jones A. 2015. Climate Change and Business Survival Mott MacDonald 24pp https://www.mottmac.com/releases/mott-macdonald-and-gsi-make-the-case-for-building-climate-resilience which could be modified to explain this. [david Viner, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: We added a sentence mentioning this terminology/categorization relevant to some sector, but also mention that the categorization in Ch12 is more general. The reference provided cannot be cited, but we provided other reference.
31844	13	45	13	45	"cryosphere" in itself is not a hazard. Change to e.g. "changes in the cryosphere". [Anna Sörensson, Argentina]	ACCEPTED: text revised accordingly
26086	13	46	12	46	… many hazards … [Arthur Lee, United States of America]	ACCEPTED: text changed
8044	13	46	13	46	"witih" should be "with"? [Taoyuan Wei, Norway]	ACCEPTED: text revised accordingly
46072	13	46	13	46	the word within to be edited [Shuaib Lwasa, Uganda]	ACCEPTED: text revised accordingly
46316	13	46	13	46	"witih" should be corrected. [sadegh zeyaeyan, Iran]	ACCEPTED: text revised accordingly
57592	13	46	13	46	"witih" should be corrected. [Sahar Tajbakhsh Mosalman, Iran]	ACCEPTED: text revised accordingly
31838	13	49	13	49	Referencing seems a bit unbalanced: this far Zscheischler et al., 2018 has been cited 2 times, and it is the ONLY paper about hazards that has been cited. I can find many other places where a reference is needed as much as for compound events, as an example the sentence before this one: "Potential changes in the length and characteristics of seasons are also important, as they may shift the timing of many hazard witih broad implications for sectors and regional stakeholders.". [Anna Sörensson, Argentina]	TAKEN INTO ACCOUNT: text on compound events is revised, reference to Chapter 11 is made and new literature is added.
43776	13	51	13	52	"they need careful BA od climate model simulation (CH10)! ==> Have you make deep contact with CH10 ? IS that OK for CH12 to skip on discusisng BA ? To discuss "Hazard thresholds", the absolute value is very important. Some explanation should be done in CH12. [Izuru Takayabu, Japan]	TAKEN INTO ACCOUNT: Ch10 has a BOX on bias adjustment that we refer to and we also extend the text in Ch12 to discuss implication for impact modelling
50824	13	51	14	2	What about the many regions where you do not have reliable observations to make bias adjustments? Cases where you can understand process but not quantify change? [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: revised text on bias adjustment and link to Ch10 Cross-Ch Box10.2 is made; there is already a bit of rewording (see comment 202) to make clear bias adjustment can only be done where sensible, i.e. where observations are available

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
8048	13	52	13	52	"period of time" should be "period"? [Taoyuan Wei, Norway]	REJECTED: We think this is proper English.
52902	13	55			Please state “these need – where sensible – careful bias adjustment”. [Douglas Maraun, Austria]	ACCEPTED: text changed
52900	14	2			This is also discussed in Chapter 10. [Douglas Maraun, Austria]	ACCEPTED: make reference to Ch10
31840	14	4	14	7	Please note that this has already been said, in other words in p11, paragrapg starting at line 46. [Anna Sörensson, Argentina]	ACCEPTED: repetitions are removed
16094	14	5	14	7	There have been discussions about possible increase in local/regional earthquake hazards under the effects of climate change arising from, say, melting of glaciers and massive ice sheets. It may be proper to review the literature or evidence so far and include some discussion in the report. This topic could also be considered as a knowledge gap to encourage more relevant research studies in future. References: - Masih, A., 2018: An Enhanced Seismic Activity Observed Due To Climate Change: Preliminary Results from Alaska. IOP Conf. Ser.: Earth Environ. Sci. 167 012018 (online:https://iopscience.iop.org/article/10.1088/1755-1315/167/1/012018/pdf) - McGuire, B., 2013: Waking the Giant: How a changing climate triggers earthquakes, tsunamis, and volcanoes. Oxford University Press, 320 pp. [SAI MING LEE, China]	TAKEN INTO ACCOUNT: literature on effect of climate change on earthquakes is added in text related to "other" category
8710	14	7	14	7	Note that there is some concern that climate change modifies the liquefaction hazards during earthquakes (e.g., https://www.sciencedirect.com/science/article/pii/S0266114411000069 and probably many others) [Goneri Le Cozannet, France]	TAKEN INTO ACCOUNT: literature on effect of climate change on earthquakes is added in text related to "other" category
31836	14	8	14	10	Instead of saying that you include long term trends to be "in line with the IPCC definition" i think it would be much more useful to include some of the very nice explanations on this from the "Annex VII - Hazard and Extreme Indices". I was actually very confused from here on until I read the Annex, and made comments on the chapter that I than had to erase..... I think that you should include a summary of pieces of the introduction of the Annex, that explains why a hazard is not necesarily related to an extreme event. Many people will go directly to Ch12 instead of reading Ch1 (not to mention the Annex!!). [Anna Sörensson, Argentina]	ACCEPTED: better reference to Annex VII is made and text is revised
31842	14	10	14	10	ECVs has been nemed several times befor this line, please introduce the abbreviation with reference the first time the concept is mentioned. [Anna Sörensson, Argentina]	REJECTED: I see that ECV is introduced as acronym at first occurrence of the essential climate variables in line 10 on page 14.
32996	14	19	14	42	Even when it comprises a larger time scale, permafrost thawing should be included in snow and ice hazard category and not in heat category. Following the rationale used in the chapter, lake and sea ice reduction can be attributed to heat trend too. [Juan Antonio Rivera, Argentina]	ACCEPTED: categories were changed in tables, permafrost is now in "snow and ice"
27400	14	30	14	30	“Wind and storms: hazards associated with decreasing mean winds”. Increasing winds can also generate hazards [Fatima Driouech, Morocco]	TAKEN INTO ACCOUNT: Now there is only one "wind" category and we only assess the wind trend as a "climatic impact driver"
41188	14	33	14	34	One of the principal threat related to the shrinkage of glaciers is Glacial Lake Outburst Floods. Many sad examples have shown that they could cost the lives of many in inhabitants of mountain regions. [Lucas Ruiz, Argentina]	TAKEN INTO ACCOUNT: Glacial Lake Outburst Floods are assessed in section 12.3 as part of glacier melt but are not be explicitly discussed in the methodology section 12.2.
26088	14	39	14	39	… particulate matter … [Arthur Lee, United States of America]	ACCEPTED: text revised accordingly

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
26888	14	39	14	39	"particular matter" should be spelled "particulate matter" [Augustin Colette, France]	ACCEPTED: text revised accordingly
41324	14	39	14	39	particulate? [Debra Roberts, South Africa]	ACCEPTED: text revised accordingly
41326	14	39	14	39	Also consider the implications of the changes for alien invasive [Debra Roberts, South Africa]	Not applicable: categories changed
8586	14	39	14	40	This statement about CO2 decrease is opaque [Robert Kopp, United States of America]	TAKEN INTO ACCOUNT: the categories changed and "CO2 decrease" is not mentioned in table 12.1 anymore
51262	14	41	37	14	typo in deoxygenization [Bart Van den Hurk, Netherlands]	ACCEPTED: text revised accordingly
49606	14	41			read "Ocean deoxygenation" rather than "Ocean deoxygentation" [Cyriaque Rufin Nguimalet, Central African Republic]	ACCEPTED: text revised accordingly
32986	14	47	15	1	The dark and light green colour in this table seem to be reversed [Aimee Slangen, Netherlands]	TAKEN INTO ACCOUNT: the colours in the legend are changed
55746	14	47	15	1	I would ammend Table 12.1 for sand and dust storms: I would remove pressure as secondary ECV (although surface pressure has some effect on dust emission, it is small compared to other factors). Add temperature and surface radiation to the list of secondary ECV's. High temperatures dry the surface fast making it more vulnerable to wind erosion. The more radiation reaching the surface, the more turbulence to the PBL and hence more dust emission. Aerosols is not a major ECV (dust is an aerosol but it does not have a primary effect on its own emission). Finally I would add snow cover a secondary ECV. Snow cover prevents dust emission in relatively high latitudes. [Carlos Perez Garcia-Pando, Spain]	TAKEN INTO ACCOUNT: The Table 12.1 has been revised and several changes have been made.
31846	14	47	15	3	Color key in table: dark gree should be primary ECV and light green secondary ECV. [Anna Sörensson, Argentina]	TAKEN INTO ACCOUNT: colours in table are changed, see also comments above
31848	14	47	15	3	I would make clear in the table that "Ozone" is "Tropospheric Ozone", because if not it could easily be confused with stratospheric ozone (which is way better known by the public as the "ozone hole"). [Anna Sörensson, Argentina]	TAKEN INTO ACCOUNT: in the text we use surface ozone and changed it in the table 12.1

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
31850	14	47	15	3	From this table I my first understanding was that you only want to include the variables that are needed to construct the hazard index, not the variables that contribute to the hazard. I derive this from the fact that under "Warming trend", only "Temperature" is marked but not GHGs, Aerosols, Precipitation (that can mitigate extreme temperatures) etcetc. But looking further at the table I find that this is not consistent among the "Climate Hazards"? For example under "Heat wave": I see in the "Annex VII - Hazard and Extreme Indices" that Humidity and Pressure is included in the calculation of "heat stress index", but I don't see that you use "Wind speed and direction" nor "Surface radiation" in the calculation of any temperature-related index (I do understand that these variables can contribute to the presence or not of a heat wave, but than, to be consistent CO2, Aerosols, etc should be included under "warming trend"). "Snow cover": I directly do not understand why it is included under "heat wave". In the same line: "Wet trend" - why is not only "Precipitation" included here, in symmetry with "Warming trend" and "Temperature"? If variables that determines evapotranspiration rate, such as "Wind speed" and "Humidity" are included, it can be argued that temperature should also be included since it affects atmospheric vater demand. Personally I prefer only to include variables that are used to construct the hazard indeces in the table, but as least there should be a consistency. [Anna Sörensson, Argentina]	TAKEN INTO ACCOUNT: The Table 12.1 has been revised and several changes have been made.
50886	15	0	15	0	Legend in figure/table is incorrect ("primary" and "secondary" are swaped) [Selma Guerreiro, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: colours in legend changed, dark green for primary and light green for secondary
51264	15	1	10	1	the definition of "primary" and "secondary" in the ECV-key is a bit confusing: I would interpret "primary" as more relevant than "secondary", and that is suggested by the color scheme used in the table matrix [Bart Van den Hurk, Netherlands]	TAKEN INTO ACCOUNT: colours in legend changed, dark green for primary and light green for secondary
8712	15	1	15	1	In climate hazards / coastal: suggest to remove "sea level rise" because it appears already in the essential climate variables. I suggest adding: salinization (could be estuaries and aquifers). Flooding gathers different types of hazards: permanent flooding, chronic flooding (e.g., Sweet and Park 2014, Earth Future), flooding during extreme events. Coastal erosion is a hazards as it creates scouring on the basement of coastal infrastructures, but many would consider shoreline changes as a hazard (which may result from erosion or permanent flooding) [Goneri Le Cozannet, France]	REJECTED: Sea level rise in itself could also be a hazard for coastal ecosystems (e.g. mangroves)
14850	15	1	15	1	Key to primary/secondary ECV needs reversing - primary ECVs are dark green [Clare Goodess, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: colours in legend changed, dark green for primary and light green for secondary
15396	15	1	15	1	Please add also ice crust and permafrost thawing into the table [Oksana Lipka, Russian Federation]	REJECTED: Ice crust was not included due to too few articles and permafrost was already in the table

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
26652	15	1	15	1	In the legend of Table we have, probably, an error because the primary ECVs are in light green instead the dark green as wrote in the caption of the table ("primary effect … are indicated in dark green") and the secondary ECVs are in dark green instead in light green as wrote in the caption of the Table ("secondary effect ... are indicated in the light green). In other in the table the primary ECVs are indicated in the dark green so we have a confussion. Please revise and correct the legend... [Alessandro Pezzoli, Italy]	TAKEN INTO ACCOUNT: colours in legend changed, dark green for primary and light green for secondary
45830	15	1	15	1	where is sea surface temperature and ocean deoygenation? [Katja Mintenbeck, Germany]	TAKEN INTO ACCOUNT: this has been included
42142	15	1			include source of table 12.1 [Lubna Alam, Malaysia]	TAKEN INTO ACCOUNT: We made clear in text/caption that the table is based in expert judgement
8050	15	8	15	8	"Setion" should be "Section" [Taoyuan Wei, Norway]	ACCEPTED: text revised accordingly
26090	15	8	15	8	… Section 12.4 … [Arthur Lee, United States of America]	ACCEPTED: text revised accordingly
26092	15	12	15	12	… across the AR6 regions (defined in Chapter 1). [Arthur Lee, United States of America]	ACCEPTED: text revised accordingly
8052	15	13	15	13	"conitnents" should be "continents" [Taoyuan Wei, Norway]	ACCEPTED: text revised accordingly
26094	15	13	15	13	… continents … [Arthur Lee, United States of America]	ACCEPTED: text revised accordingly
40848	15	13		14	The Mediterranean includes also Western Asia (Middle East) [piero lionello, Italy]	ACCEPTED: region is included
26654	15	18	15	18	You write "is indicated may be indicated". You have to choose if use "is indicated" or "may be indicated" [Alessandro Pezzoli, Italy]	ACCEPTED: text revised accordingly
51266	15	18	37	18	delete "is indicated" [Bart Van den Hurk, Netherlands]	ACCEPTED: text revised accordingly
51268	15	19	37	30	Is this climatological information also findable via the Interactive Atlas? Would be good for consistence [Bart Van den Hurk, Netherlands]	NOTED: Most of the climatological information in the chapter is available in the online Atlas.
8054	15	21	15	21	"regionis" should be "regions" [Taoyuan Wei, Norway]	ACCEPTED: text revised accordingly
26656	15	21	15	22	You write "[Placeholder: a white color with an “x” indicates a cell where a given hazard/regionis not yet assessed in the FOD]". Fors sure it is important to add this sentence in the test… [Alessandro Pezzoli, Italy]	REJECTED: just a placeholder text
49608	15	21			read "a given hazard/region is" rather than "a given hazard/regionis" [Cyriaque Rufin Nguimalet, Central African Republic]	ACCEPTED: text revised accordingly
47310	15	29	15	30	there is need for a reference. Other wise the statement should be removed. [Siyabusa Mkuhlani, South Africa]	TAKEN INTO ACCOUNT: link to Annex VII is made
27402	15				- Table 12.1: What about carbon dioxide contribution to air pollution. Also the effect of CO2 concentration on the different hazards listed in this table is not enough illustrated. Please complete as much as possible. [Fatima Driouech, Morocco]	REJECTED: CO2 as secondary factor effecting hazards/CIDs is out of the scope of this chapter.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
14538	16	1	28	47	The changes in climate and extremes have both positive and negative trends in the past and the future, and the possible impacts of the changes on natural and human systems may also have positive and negative aspects. A suggestion is that the trends be given to not only those of hazard relevance, but also those with possible positive impacts. Therefore, some changes such as the downward trends of frost events and cold spells events accompanying climate warming over the last decades and probably over the coming decades could be also summarized and described. All of these are helpful in scientifically assessing the impacts of climate change on natural and human systems in regions and countries. This issue also appears in the following sections including 12.4 Regional information on changing climate which emphasizes more climate hazards. Of course, you could also keep as it was, but the title of this chapter should be changed to "Climate change information for risk assessment". (CUG, Guoyu Ren) [Guoyu Ren, China]	TAKEN INTO ACCOUNT: We have revised our approach to reflect that we are assessing 'climatic impact drivers', which include both trends and changes in extreme events, but do not make broad judgments about the hazardous direction of any trend (see discussion in 12.1). This reflects that the same direction of trend can be hazardous for some assets and beneficial for others. By focusing on the type of change for climatic impact drivers we allow further conversation to look at the array of positive and negative outcomes that result (in sections 12.4, 12.5, and WGII).
26100	16	6	16	6	The WG1 authors here need to coordinate better with the WG2 authors on WG2 Chapter 16, or is it Chapter 16 c ? [Arthur Lee, United States of America]	ACCEPTED: the c) was a typo and is removed
35154	16	11	16	11	This chapter is called "… for key sectors", but it does not focus on these sectors. It focusses on the climate hazards. I suggest, either change the title into "Climate hazard indices", or keep the title and orientate/organize this section on relevant sectors. Especially, for representatives from sectors, the latter option is far more straightforward and understandable. [Janus Willem Schipper, Germany]	TAKEN INTO ACCOUNT: We understand the reviewer to be referring to the title of Section 12.3 (which includes 'for key sectors') rather than the chapter 12 title (which does not). All of CH12 has been reconfigured to use the more neutral 'climatic impact driver' rather than assume a hazard perspective right from the start. This chapter focuses on these climatic impact drivers, including mapping them to key sectors (this section). We considered a sectoral orientation to the sub-sections of 12.3, but this confuses the broader chapter's organization by climatic impact driver. A survey of the sectoral implications of all hazards and benefits is in the mandate of WGII.
48090	16	11	16	11	Section 12.3 identifies hazard indices that are frequently used in the context of climate impacts in the WGII focus sectors (Chapters 2-8). Also, Chapter 12 assesses climate information for impacts and for risk to assets in the 7 main sectors corresponding to Chapters 2-8 of the WGII assessment report. There is a need for coordination between Chapter 12 and WGII. [WGI TSU, France]	TAKEN INTO ACCOUNT: We have added contributing authors from each WGII Sectoral chapter and are building off of WGI-WGII handshake activities from the WGII Kathmandu and WGI Toulouse meetings that will help ensure continuity between working groups.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
26096	16	11	16	33	This entire section is poorly written and lacks the necessary explanations about the gradations of hazards. Likewise, there is no to little explanation about Table 12.2, which lacks a color key about the shade of brown colors inside the table. [Arthur Lee, United States of America]	TAKEN INTO ACCOUNT: We have updated the section to better describe the messages around gradations of hazard, which is also the intent of Figure 12.3 and the surrounding discussion. We have also added the key that was inadvertently left out of Table 12.2 and expanded discussion around that summary table. The aim of Section 12.3 is to establish the relevance of a given climatic impact driver for a sector, as well as to underscore that there are gradations of that relevance even as we leave the projection of climatic impact driver (e.g., hazard) changes to section 12.4 and 12.5 and the discussion of risk (incorporating vulnerability and exposure) to WGII. Graduated levels of hazard are also now a major part of the executive summary message emerging from 12.3.
39716	16	11	16	33	The survey between climate hazards and affected sectors does not seem to build on SRCCL and/or SROCC results, which it is important for consistency across the different reports of the cycle. [Carolina Vera, Argentina]	TAKEN INTO ACCOUNT: We have updated the point of departure to note that the new SRCCL and SROCC reports examine climatic hazards affecting key sectors. Here we take a climatic impact driver approach, mapping them to sectors in 12.3 and then assessing characteristic regional changes in 12.4.
43778	16	11	28	47	It looks that CH12 focuses mainly on natural hazards caused by extreme phenomena. However, when we read those sections, they handle also the phase change of tim emarching of seasons, which causes som edesease to eco-system or agriculture. Is the mechanism of these change caused by climate change discussed somewhere in CH12? [Izuru Takayabu, Japan]	TAKEN INTO ACCOUNT: We emphasize this point as one of the main ways that hazards can change is in their timing. For example, we discuss multiple indices of spring useful for ecosystem function as well as the seasonal timing of frosts (for ecosystems and agriculture), sea/lake ice (e.g., for transportation and algal blooms), heatwaves (e.g., for crops), cold waves (for species and human health) and drought. We also further highlight differential trends by season, which affect seasonal progressions, and note changes in seasonality in the discussion of agricultural pests, diseases, and weeds. The importance of timing shifts is also reinforced with discuss this in FAQ12.2. CH12 therefore assesses trends and projections of shifts in seasonal timing, and the physical mechanisms behind seasonal changes in climate are discussed in CH2, CH4, CH8, and CH11.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
35156	16	13	16	33	Although the first sentence of the sector says "Climate change becomes relevant for regional impact management ...", it does not state anywhere, how large this impact is compared to other major changes (changes in demography, mobility, infrastructure, digitalization etc.). If the title of this section should be called as it is ("... for key sectors"), some evalulation and discussion about the relevance of climate change compared to other changes should be discussed. [Janus Willem Schipper, Germany]	REJECTED: Analysis comparing climate hazards with other hazards and changes in vulnerability and exposure are part of the risk assessment conducted by WGII. CH12 only analyses hazards that are sectorally relevant for this framework
8946	16	18	16	18	The cross referencing with WG2 needs to be confirmed bearing in mind the publication schedules are not in time. [david Viner, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: CH12 cannot refer to AR6 WGII other than to note that it is coming at a later date and has a mandate to cover some issues related to the use of CH12 information.
39714	16	18	16	18	A reference to AR5 WGII or SREX can support this statement instead of "as discussed in WGII". [Carolina Vera, Argentina]	TAKEN INTO ACCOUNT: We intend this to be a reference to the forthcoming AR6 WGII where risk assessment is undertaken. The first order draft included a statement about vulnerability and exposure which needed a reference to the SREX, but this discussion has been concentrated into the introduction of CH12 (Section 12.1) so a direct reference to SREX is provided in the following sentence.
47312	16	25	16	26	need to re-look at the referencing at the end of the sentence. …provided by (Forzieri et al., 2018; Mora et al., 2018). Should be….provided by Forzieri et al., (2018) and Mora et al., (2018) [Siyabusa Mkuhlani, South Africa]	EDITORIAL: Corrected
26990	16	36	17	3	Table 12.2: products and services from forests are completely missing from this table. Please add a row "forests" or "forest resources" to the block "Food, fibre and other ecosystem products". [Joachim Rock, Germany]	ACCEPTED: We have added a row on forestry as an asset category for 'Food, fibre, and other ecosystem products'
16136	16	38	16	39	The table lacks a legend for the three different colours used. [Sandro Fuzzi, Italy]	TAKEN INTO ACCOUNT: Legend added back in
39712	16	38	16	39	The legends explaining the colours of the inner cells are missing [Carolina Vera, Argentina]	TAKEN INTO ACCOUNT: Legend added back in
6229	16	38	17	1	Table 12.2/ Explanation (Legend) for the color needs to be added [Mostafa Jafari, Iran]	TAKEN INTO ACCOUNT: Legend added back in
55748	16	38	17	1	Dust may affect also: coral reef ecosystems (to be further checked with recent literature) and water quality in populated semi-arid regions. It can have an effect on Mountain ecosystems and fresh water species in some regions through deposition on snow (thus melts quicker and sooner than a clean snowpack). This creates problems for the cities, industries, individuals, plants, and animals that rely on a slow-melting snowpack. [Carlos Perez Garcia-Pando, Spain]	TAKEN INTO ACCOUNT: We updated our assessment and now explicitly note connections between dust and sandstorms and ecosystems (including coral) and cities. Additional effects (such as deposition on snowpack affecting snowmelt rate) are secondary/cascading effects (which are not in the purview of CH12) or are small relative to the other direct hazard connections identified here (see discussion in 12.1 and 12.7).

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
8714	17	1	17	1	This table is good: it may be a detail but I think that based on Gattuso et al (2015, Science) and others, ocean warming impacts coastal ecosystems before ocean acidification. Hence I would darken the box connecting coastal ecosystems and ocean warming. Similarly, ocean heat waves, especially in semi-enclosed bassins, are very dangerous for marine species, coral and coastal ecosystems, so I would suggest to darken it. The decrease of coastal sea-ice during winters is already affecting shorelines in the Arctic (AR5WG1Ch18). Hence I would suggest making the link between decrease of sea-ice and the built environment. For energy resources, may be it would be appropriate to distinguish nuclear from non nuclear, because the former have long lifetimes, relevant to the timescales of sea-level rise, whereas the latter have shorter lifetimes and will presumably be replaced as climate mitigation policies are implemented. For Health and wellbeing, may be the 3 cathegories (labor productivity, morbidity and mortality) do not cover all aspects of health and wellbeing (?) (for example, nutrition could be considered as an additional line?). I also suggest reconsidering coastal hazards cathegories (removing sea-level rise, adding salinization). [Goneri Le Cozannet, France]	ACCEPTED: Table 12.2 has been updated to reflect the strong association between coastal ecosystems and mean warming. We have also taken the recommended study into account in our assessment. We separated marine heatwaves into their own climatic impact driver to further accentuate the importance of this phenomenon. The mechanism described here whereby sea ice loss increases coastal erosion is noted under the category of erosion, as it is the loss of shoreline that affects built infrastructure rather than the loss of sea ice itself (note that transportation is directly affected). We have shifted energy production into several asset categories, but discuss thermal power plants under thee energy infrastructure asset category underneath the cities, settlements, and key infrastructure sector; we do not discuss time scales of infrastructure exposure, however, as this is the purview of WGII. We maintained the health sector asset categories as nutrition is a secondary/cascading effect (e.g., of CO2 impacts on food, but there are no clear examples of climatic impact drivers directly affecting nutrition without a secondary choice being made). We have added salinization as a climatic impact driver, particularly for ocean regions; salinity that affects coastal systems, water resources, and other assets is a result of coastal flooding, low river flows from drought, etc, so it is covered there.
8948	17	1	17	1	the diagram is difficult to read, could I suggest that the boxes in the bulk of the table are color coded to match sector colours [david Viner, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: We have re-coloured the sector and climatic impact driver groupings to avoid any potential for confusion with the heat table assessment colours. This is also aided by our including the table legend that was inadvertently left out of the First-order draft
26658	17	1	17	1	What colours of each grid mean? Please add a legend in the Table [Alessandro Pezzoli, Italy]	TAKEN INTO ACCOUNT: Legend added back in
26890	17	1	17	1	Transportation and Fossil Resources are major drivers of air pollution, missing dark brown in the table [Augustin Colette, France]	REJECTED: We have clarified that the aim of Table 12.2 is to identify how climatic impact drivers drive impact on specific sectoral assets. Transportation and fossil resources drive pollution, but this is the opposite direction than what we are focusing on here (that is a subject for WGI CH6, WGII, and WGIII).

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
27118	17	1	17	1	Table 12-2 permafrost thawing is highly relevant for water quality in mountain areas as rock glacier degradation can releases significant amounts of heavy metal in surface water [Edoardo Cremonese, Italy]	TAKEN INTO ACCOUNT: We have adjusted Table 12.2 to note that permafrost thaw can drive climatic impact for water quality, and include several papers on this topic.
27120	17	1	17	1	Table 12-2: the relevance of snow reduction for mountain ecosystems is higher than the relevance of the other snow and ice climate hazards. I suggest using dark brown [Edoardo Cremonese, Italy]	ACCEPTED: We have adjusted Table 12.2 to reflect the strong connection between snow and land ice for mountain ecosystems.
45832	17	1	17	1	Why have land and freshwaters species when the focus is ecosystems. Suggest frshwater ecosystems and land species could be changed to cover other categories of land ecosystems eg tropical forests, temperate/boreal ecosystems… [Katja Mintenbeck, Germany]	TAKEN INTO ACCOUNT: We have revised the asset categories associated Terrestrial and Freshwater Ecosystems to better reflect the array of ecosystem elements within different major biomes (tropical forests; temperature forests; lakes, rivers and wetlands; grasslands and savanna; deserts; mountains; polar)
45834	17	1	17	1	why marine species - this could be open ocean ecosystems [Katja Mintenbeck, Germany]	TAKEN INTO ACCOUNT: We have revised the asset categories associated with Ocean and Coastal Ecosystems to better reflect the array of ecosystem elements within different major biomes (coastal systems, shelf systems, upwelling systems, polar oceans, upper open ocean, deep sea)
45836	17	1	17	1	by water transport do you mean transportation using water eg shipping? [Katja Mintenbeck, Germany]	TAKEN INTO ACCOUNT: We have added descriptions to better define asset categories. We now include 'Land and water transportation' as a broader category that includes shipping.
45838	17	1	17	1	why is marine transportation under poverty etc? [Katja Mintenbeck, Germany]	TAKEN INTO ACCOUNT: We have revised asset categories for Table 12.2 in consultation with WGII lead authors, and now include land and water transportation under 'Cities, settlements, and key infrastructure'
46074	17	1	17	1	Provide a key to the gradation of the table cells [Shuaib Lwasa, Uganda]	TAKEN INTO ACCOUNT: Legend added back in
54670	17	1	17	1	The legend is missing. [Sabine Undorf, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: Legend added back in
55484	17	1	17	1	The table, and the regional examples. is very useful. It should be considered if something like this could be reproduced in WGII in a cross report box type thing. [Daniela Schmidt, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: We have suggested similar tables for WGII at LAM2 in Kathmandu, which are reflected in the WGII First-order draft.
51270	17	1	1	1	table Legend is missing [Bart Van den Hurk, Netherlands]	TAKEN INTO ACCOUNT: Legend added back in
32988	17	1			Key to the table is missing? [Aimee Slangen, Netherlands]	TAKEN INTO ACCOUNT: Legend added back in
42144	17	1			include source of table 12.2 [Lubna Alam, Malaysia]	TAKEN INTO ACCOUNT: In the caption for Table 12.2 we further clarify that 12.2 is a summary of the assessment throughout 12.3 rather than being drawn from a single publication.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
46076	17	4	17	6	Lines 4 - 6 wander between crops and trees. Perhaps exhaust the assessment for crops and then forests and timber or the assessment could focus on plant Production under warming conditions. [Shuaib Lwasa, Uganda]	TAKEN INTO ACCOUNT: This paragraph is organized to include sectoral assets from the food, forestry, and ecosystem services sector, and there is some overlap in the specific assets described from sentence to sentence. The sentences focus on cohesive messages around climatic impact drivers/indices rather than separating by sectoral asset, but we have added the last line in this sequence to note 'crops and ecosystem services' to eliminate the impression of going back and forth between crops and agroforestry/ecosystem services.
45840	17	6	20	9	rather than assess impacts here and picking examples or papers (I assume this is what has been done), please use AR5 and the AR6 special reports as the basis for evidence of relevance [Katja Mintenbeck, Germany]	TAKEN INTO ACCOUNT: CH12 has a clear mandate to assess climate hazards and their connections to sectoral impacts even as the full discussion of impacts and risk themselves (connecting with vulnerability and exposure) are left to WGII. In section 12.3 we note that AR5 WGII and the special reports examined sectoral impacts of hazards but and that we are taking an approach centered around assessing which climatic impact drivers are used for each sector. The following section (12.4) then assesses characteristic changes in each climatic impact driver across continents, which may then be mapped into affected sectors using the information in 12.3. CH12 has also been further connected with WGII approaches building off of handshake activities at WGII LAM2 in Kathmandu and WGI LAM3 in Toulouse.
15450	17	10	17	10	This paragraph needs a leading sentence. [Ruiqing Miao, United States of America]	TAKEN INTO ACCOUNT: We feel that this opening sentence does a good job of leading with the concept of climate information needed to understand sectoral impacts, and this is bolstered by our expansion of the overall introduction of 12.3 (which comes just before this paragraph) that better describes the intent and approach of section 12.3.
15452	17	25	18	1	This paragraph is weak. Could more literature or content be added to it? [Ruiqing Miao, United States of America]	TAKEN INTO ACCOUNT: We are up against space limitations in the chapter so wide expansion of connections between heatwaves and ecosystems is not possible at this time, although we have looked to update/augment literature in our further assessment. We have also noted similarities between ecosystem and agricultural responses to more efficiently use our space and highlight transferable papers and connections.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
47314	17	26	17	26	Put brackets on the reference on the year '2015' [Siyabusa Mkuhlani, South Africa]	EDITORIAL: Corrected
26098	17		17		This entire section is poorly written and lacks the necessary explanations about the gradations of hazards. Likewise, there is no to little explanation about Table 12.2, which lacks a color key about the shade of brown colors inside the table. [Arthur Lee, United States of America]	TAKEN INTO ACCOUNT: We have updated the section to better describe the messages around gradations of hazard, which is also the intent of Figure 12.3 and the surrounding discussion. We have also added the key that was inadvertently left out of Table 12.2 and expanded discussion around that summary table. The aim of Section 12.3 is to establish the relevance of a given climatic impact driver for a sector, as well as to underscore that there are gradations of that relevance even as we leave the projection of climatic impact driver (e.g., hazard) changes to section 12.4 and 12.5 and the discussion of risk (incorporating vulnerability and exposure) to WGII. Graduated levels of hazard are also now a major part of the executive summary message emerging from 12.3.
33356	17				Table 12.2 seems to be missing a key -- what do the different color boxes mean? [Erika Wise, United States of America]	TAKEN INTO ACCOUNT: Legend added back in

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
15454	18	6	18	7	Some recent studies are missing. They are: 1) Schillerberg, Tayler A., Di Tian, and Ruiqing Miao. 2019. "Spatiotemporal patterns of maize and winter wheat yields in the United States: predictability and impact from climate oscillations." Agricultural and Forest Meteorology 275:208-222. 2) Miao, Ruiqing, Madhu Khanna, and Haixiao Huang. 2016. "Responsiveness of Crop Yield and Acreage to Price and Climate." American Journal of Agricultural Economics 98(1): 191-211. 3) Zhang, P. J. Zhang, and M. Chen. 2017. "Economic Impacts of Climate Change on Agriculture: The Importance of Additional Climatic Variables other than Temperature and Precipitation." Journal of Environmental Economics and Management 83:8-31. 4). Chen, Shuai and Chen, Xiaoguang and Xu, Jintao. 2016. Impacts of climate change on agriculture: evidence from China. Journal of Environmental Economics and Management 76: 105-124. [Ruiqing Miao, United States of America]	TAKEN INTO ACCOUNT: We have considered the suggested papers in the CH12 assessment, and find that most would be more appropriate for WGII. Our goal here is not to comprehensively include a comprehensive look at papers examining agroclimatological connections, but to demonstrate the importance of various climatic impact drivers as elements of relevant climate information for impact and risk assessments. 1) This study is focused on climate variability rather than climate change 2) This study examines the effects of price changes and climate change scenarios on yield and acreage, which falls under the mandate of WGII 3) This paper emphasizes the importance of humidity and wind, which we identify as being important to aridity and drought in Section 12.2 and call out specifically in our example of low humidity and wind being important for fruit desiccation and rice cracking (in drought section of 12.3). We also mention the importance of actual/potential evapotranspiration and a variety of drought indices so that agriculture is not only informed by temperature and precipitation. 4) Relationships between agricultural yield and Tmin, Tmax, Precipitation, and Solar radiation are already covered in 12.3
51272	18	6	33	7	For most crops the correlation between mean temperature in the growing season and crop yield is positive; this statement deserves some nuance [Bart Van den Hurk, Netherlands]	TAKEN INTO ACCOUNT: We have reconfigured our discussion to focus on climatic impact drivers and avoid judgments in terms of universal directions of 'hazardous' change. Some clarity is also added here to reflect that many crops respond negatively to warmer conditions in temperate and tropical zones, although there is a big dependence on region and farm system and the magnitude of future temperatures. We also discuss shifts in the geographic range of suitable cultivation for crops, which can be a positive or negative outcome depending on socioeconomic factors. Broader discussion of vulnerability and/or benefit would be provided in WGII.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
47316	18	11	18	12	Has this been published yet? I think you can find published articles for references about similar work? [Siyabusa Mkuhlani, South Africa]	TAKEN INTO ACCOUNT: The Grotjahn chapter was submitted well before the IPCC deadline, so it qualifies for inclusion here. This work is also unique in its breadth of agricultural species covered and specific focus on hazard indices, so there is no clear alternative that is already published. We have replaced/augmented some of the Grotjahn references with alternative references to better represent the contributions in a wide field of research.
15456	18	12	18	12	Grotjahn, submitted' is missing. [Ruiqing Miao, United States of America]	EDITORIAL: We will add submitted reference if not yet published by time of Second Order Draft
54678	18	16	18	17	A relevant reference: Lobell (207). Lobell, D. B. (2007). Changes in diurnal temperature range and national cereal yields. Agricultural and Forest Meteorology, 145(3–4), 229–238. https://doi.org/10.1016/j.agrformet.2007.05.002 [Sabine Undorf, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: We considered the recommended paper as part of the chapter assessment. We agree that this is an important topic, however we already indicate that night-time temperatures have different relevance than daytime temperatures using more recent literature.
55486	18	19	18	19	define wet bulb temperature at first use [Daniela Schmidt, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: We have added a more clear pointer to Technical Annex VII, which describes wet bulb temperature
41190	18	52	19	6	Section 12.3.1.3 on permafrost thawing is based only on examples from the Arctic. Although not so abundant like literature to assess the thawing of Arctic permafrost, there is an increasing source of evidence (literature) that demonstrate that mountain permafrost is also threats by increasing temperature. Chapter 2 of SROCC assess the thawing of mountain permafrost and also section 9.6 of Chapter 9 (AR6). Long term mountain permafrost temperature shows positive trends in the Alps (Biskaborn et al., 2019). Also, mountain permafrost thawing is affecting mountain slope stability (Deline et al., 2015; Magnin et al., 2015). Biskaborn, B. K., Smith, S. L., Noetzli, J., Matthes, H., Vieira, G., Streletskiy, D. A., et al. (2019). Permafrost is warming at a global scale. Nat. Commun. 10, 264. doi:10.1038/s41467-018-08240-4. Deline, P., Gruber, S., Delaloye, R., Fischer, L., Geertsema, M., Giardino, M., et al. (2015). “Ice Loss and Slope Stability in High-Mountain Regions,” in Snow and Ice-Related Hazards, Risks, and Disasters, eds. John F. Shroder, W. Haeberli, and C. Whiteman (Academic Press), 521–561. doi:10.1016/B978-0-12-394849-6.00015-9. Magnin, F., Deline, P., Ravanel, L., Noetzli, J., and Pogliotti, P. (2015). Thermal characteristics of permafrost in the steep alpine rock walls of the Aiguille du Midi (Mont Blanc Massif, 3842 m a.s.l). Cryosph. 9, 109–121. doi:10.5194/tc-9-109-2015. [Lucas Ruiz, Argentina]	TAKEN INTO ACCOUNT: We have added a specific mention of both high-latitude and alpine permafrost , including consideration of the suggested papers. We assess changes in permafrost in sections 12.4 and 12.5 (this section is about making connections to important sectoral assets) and cite several more recent papers to establish the connection between permafrost loss and landslides/rockslides.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
25494	18	52			Section 12.3.1.2 - Most of the references focus on alpine permafrost rather than high latitude/Arctic permafrost. Also most are not very recent. It is suggested that reference is made to Romanovsky et al. (2017 - ref below) and the regional assessments AMAP produced with this report on Adaptation Actions for a Changing Arctic or AACA (includes Barents, Beaufort-Chukchi, Baffin Bay Davis Strait). There is also a Canadian report focussing on Transportation. Links for all these provided below. Romanovsky, V., Isaksen, K., Drozdov, D., Anisimov, O., Instanes, A., Leibman, M., McGuire, A.D., Shiklomanov, N., Smith, S.L., and Walker, D. 2017. Chapter 4, Changing permafrost and its impacts. In Snow, Water, Ice and Permafrost in the Arctic (SWIPA) 2017. Arctic Monitoring and Assessment Program (AMAP) Oslo, Norway. pp. 65-102. https://www.amap.no/documents/doc/snow-water-ice-and-permafrost-in-the-arctic-swipa-2017/1610 Links to AACA reports: Baffin Bay https://www.amap.no/documents/doc/adaptation-actions-for-a-changing-arctic-perspectives-from-the-baffin-baydavis-strait-region/1630; Beaufort https://www.amap.no/documents/doc/adaptation-actions-for-a-changing-arctic-perspectives-from-the-bering-chukchi-beaufort-region/1615; Barents https://www.amap.no/documents/doc/adaptation-actions-for-a-changing-arctic-perspectives-from-the-barents-area/1604; Canadian Transportation report (see Northern Chapter): https://www.nrcan.gc.ca/environment/resources/publications/impacts-adaptation/reports/assessments/2017/19623 [Sharon Smith, Canada]	TAKEN INTO ACCOUNT: We have added a specific mention of both high-latitude and alpine permafrost, including consideration of the suggested papers. This section establishes connection between Climatic Impact Drivers and sectoral assets, whereas regional descriptions are provided in Section 12.4 (many do make use of the AMAP reports).
25496	18	54	19	2	It is thawing of ice-rich permafrost that presents issues for infrastructure (not all permafrost is ice-rich) [Sharon Smith, Canada]	TAKEN INTO ACCOUNT: We have provided increased clarity on different permafrost types and metrics, particularly around infrastructure connections.
27122	19	1	19	1	add rock faces after slopes [Edoardo Cremonese, Italy]	ACCEPTED: We have added 'rock faces' after 'slopes'
35158	19	12	19	14	The sentence starting with "Heat waves are hazardous…" lacks to state that morbidity and mortality is also dependent on the ability to adapt. Therefore, please add after "… Russo et al., 2015)" the sentence "and how well a person is able to adapt by e.g. altering his work and privat life (Kunz-Plapp et al., 2016)." Reference: Kunz-Plapp, T., J. Hackenbruch und J. W. Schipper, 2016: Subjective heat-stress of citizens in a medium-sized city in Western-Europe, Nat. Hazards Earth Syst. Sci., 16, 977-994 pp., DOI: 10.5194/nhess-16-977-2016 [Janus Willem Schipper, Germany]	TAKEN INTO ACCOUNT: We considered the recommended paper as part of the chapter assessment. Chapter 12 can look at connections between climatic impact drivers and health and the changes in particular hazards, but the ability to adapt falls under vulnerability/exposure components of the risk framework. We do already cite several papers to indicate that hazardous thresholds can be population-dependent.
55488	19	13	19	13	not just human health, all organisms on land and in the ocean, consider widening at the intro level [Daniela Schmidt, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: The first paragraph in the discussion on heatwaves is focused on human health connections, and we do mention similar impacts on ecosystem species in a paragraph lower in the same sub-section.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
41328	19	22	19	22	Are there studies that have examined the impact on GDP? [Debra Roberts, South Africa]	REJECTED: WGI CH12 is not considering GDP a single sectoral asset as it is made up of multiple sectors and is affected by many hazards and various non-climate aspects such as vulnerability and exposure that would be better assessed in WGII.
49610	19	22		23	read "(Zhao et al., 2016; Orlov et al., 2019, submitted)" rather than "(Zhao et al., 2016)(Orlov et al., 2019, submitted)" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: corrected
46078	19	27	19	30	Need to reconcile this statement with that on page 18 lines 11-13 on heat stress countered by increase in atmospheric CO2 [Shuaib Lwasa, Uganda]	TAKEN INTO ACCOUNT: We removed the earlier reference to atmospheric CO2 effects on water-use efficiency as it is not our mandate to consider multiple hazards/benefits in combination. CO2 benefits for water retention are noted in section 12.3.7.2, and it is left to WGII to weigh multiple climatic impact drivers to assess overall risk (e.g., in WGII CH5 for agricultural production and food systems).
15460	19	27	19	39	This paragraph reads repetitive to page 18, lines 7-9? [Ruiqing Miao, United States of America]	TAKEN INTO ACCOUNT: We have further clarified distinctions between these two sections. The discussion of crop response in the mean temperature change section references shifts owing to average growing season temperatures, while in the heatwave section we emphasize short-duration exceedances of critical thresholds for plant growth and survival.
49612	19	32		33	read "(Hatfield and Prueger, 2015; Grotjahn, submitted)" rather than "(Hatfield and Prueger, 2015)(Grotjahn, submitted)" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: corrected
51274	19	35	0	35	What do you mean by "elevated"? [Bart Van den Hurk, Netherlands]	TAKEN INTO ACCOUNT: This review comment indicates a broad page range so we are unclear exactly which statement was in question, but we have double-checked use of the word 'elevated' in section 12.3 and found that it makes sense as in its primary meaning of a 'higher level' with one exception where it was unnecessary preceding the indication that canopy temperatures may be more useful than air temperatures for some plant heat stresses (we have swapped this out with the word 'extreme').
15458	19	37	19	39	Because it is for livestock, should this sentence start a new paragraph? [Ruiqing Miao, United States of America]	TAKEN INTO ACCOUNT: We left this paragraph together given that livestock assets are also part of the agricultural sector that was the focus of this paragraph.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
27124	19	42	19	43	Combined heat and drought stress can reduce forest and grasslands primary Productivity". Add grasslands after forest. As a reference consider adding Cremonese et al. 2017 after Ciais et al 2005 (Cremonese, Edoardo, et al. "Heat wave hinders green wave: The impact of climate extreme on the phenology of a mountain grassland." Agricultural and Forest Meteorology 247 (2017): 320-330) [Edoardo Cremonese, Italy]	ACCEPTED: Added 'and grassland' before productivity. We considered the suggested reference in our assessment and added an alternative reference (de Boeck et al., 2018) as it examined experiments of grassland productivity changes with and without water stress and heat stress using a climate change context.
51276	19	44	1	44	It's not only the surface temperature but also the shallow water temperature (where most living organisms are present) that should be used to diagnose a marine heatwave [Bart Van den Hurk, Netherlands]	TAKEN INTO ACCOUNT: We have created a new climatic impact driver category to examine marine heat waves separately from wider heat waves. This is motivated by a recognition that these use different ECVs than terrestrial heat waves. We have also modified the text to refer to water temperatures rather than simply 'SSTs' when introducing marine heatwaves in this section.
26660	19	51	19	51	You write "In cities, heat waves add on top of urban heat islands (Stone, 2007)". Please add the reference : "(Stone, 2012)". Stone B. (2012). The city and the coming climate: Climate Change in the place we live. Cambridge University Press, New York [Alessandro Pezzoli, Italy]	TAKEN INTO ACCOUNT: We considered the recommended paper as part of the chapter assessment, however we include more recent literature that builds upon these works.
55780	19	51	20	1	Impact of extreme heat on human thermal exposure: https://doi.org/10.1016/j.scitotenv.2019.06.085 [Ariane Middel, United States of America]	TAKEN INTO ACCOUNT: We considered the recommended paper as part of the chapter assessment, however it is oriented around adaptation and exposure criteria that are a better fit for WGII.
31852	19	52	20	6	For the SODyou could refer to SROCC Chapter 2 here. [Anna Sörensson, Argentina]	TAKEN INTO ACCOUNT: We have updated our point of departure to include both SRCCL and SROCC. This comment points to a discussion on heat waves, which does not seem like an obvious match for SROCC Chapter 2 (which is on mountain cryosphere). We have added connections for SROCC to the snow and ice climatic impact drivers in 12.3.4, the coastal climatic impact drivers in 12.3.5, and the oceanic climatic impact drivers in 12.3.6. We do mention SROCC CH2 within the chapter, for example in our discussion of snow avalanches.
26590	20	3	20	3	Mention that Heat waves increasing peak cooling means an adverse effect on mitigation, since this requires additional power consumption ? [Thierry Lebel, France]	TAKEN INTO ACCOUNT: We have created a new climatic impact driver category to examine marine heat waves separately from wider heat waves. Discussion of power consumption is beyond the mandate of WGI CH12 but is likely to be covered in WGII and WGIII

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
12730	20	3	20	9	Increased heat waves will also increase demand for air conditioning and the energy that powers it. For energy efficiency as it pertains to appliances and space cooling, the transition away from high-GWP HFCs provides an opportunity for revising the technologies to further improve energy efficiency. IEA (2018) Future of Cooling; Sustainable Energy for All (2018) Chilling Prospects: Providing Sustainable Cooling for All; and Birmingham Energy Institute, University of Birmingham (2018) A Cool World: Defining the Energy Conundrum of Cooling for All; Shah N., et al. (2015) Benefits Of Leapfrogging To Superefficiency And Low Global Warming Potential Refrigerants In Air Conditioning, Ernest Orlando Lawrence Berkeley National Laboratory. Not just heat waves, also any increase in annual ambient temperatures above the cooling set points. New metrics incorporating heat islands, clustered and stacked and improperly installed air conditioning condensers as well as power plant capacity and efficiency impacts of global warming have been developed and deployed (Andersen et al. 2018). Andersen, Stephen O, James Wolf, Yunho Hwang, and Jiazhen Ling. 2018. Life-Cycle Climate Performance Metrics and Room AC Carbon Footprint. ASHRAE Journal, November 2018. http://www.igsd.org/wp-content/uploads/2018/11/Life-Cycle-Climate-Performance-Metrics.pdf. [Kristin Campbell, United States of America]	REJECTED: Discussion of air conditioning demand and consumption needs fall under the domain of WGII and WGIII
12910	20	3	20	9	Increased heat waves will also increase demand for air conditioning and the energy that powers it, and 1.8 to 4.1 billion people may need AC to avoid heat stress under current conditions (no warming or population growth). Meeting this demand would require a 14% increase of current global residential electricity consumption. Mastrucci A., Byers E., Pachauri S., Rao N. D. (2019) Improving the SDG energy poverty targets: Residential cooling needs in the Global South, Energy & Buildings 186:405-415. And increased air conditioning use increases emissions of air pollutants from power plants, in turn worsening air quality and human health impacts. David W. Abel, Tracey Holloway, Monica Harkey, Paul Meier, Doug Ahl, Vijay S. Limaye, Jonathan A. Patz (2018) Air-quality-related health impacts from climate change and from adaptation of cooling demand for buildings in the eastern United States: An interdisciplinary modeling study. https://doi.org/10.1371/journal.pmed.1002599; IEA (2018) Future of Cooling; Sustainable Energy for All (2018) Chilling Prospects: Providing Sustainable Cooling for All; and Birmingham Energy Institute, University of Birmingham (2018) A Cool World: Defining the Energy Conundrum of Cooling for All. [Durwood Zaelke, United States of America]	REJECTED: Discussion of air conditioning demand and consumption needs fall under the domain of WGII and WGIII

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
12912	20	3	20	9	Improving energy efficiency of air conditioners and other cooling equipment and switching to lower GWP refrigerants as required by the Kigali Amendment to the Montreal Protocol could avoid even more warming, up to 100 Gt CO2-eq cumulatively through 2050. Sachar et al. (2018) Solving the Global Cooling Challenge: How to Counter the Climate Threat from Room Air Conditioners. Rocky Mountain Institute, P. 24 ("The 5X solution saves up to 100 gigatons of cumulative emissions by 2050."); Shah et al. (2015), Benefits of Leapfrogging to Superefficiency and Low Global Warming Potential Refrigerants in Room Air Conditioning. Berkeley, CA, USA. ("While there is some uncertainty associated with emissions and growth projections, moving to efficient room air conditioning (~30% more efficient than current technology) in parallel with low-GWP refrigerants in room air conditioning could avoid up to ~25 billion tonnes of CO2 in 2030, ~33billion in 2040, and ~40 billion in 2050, i.e. cumulative savings up to 98 billion tonnes of CO2 by 2050."). [Durwood Zaelke, United States of America]	REJECTED: Discussion of air conditioning demand and consumption needs fall under the domain of WGII and WGIII
12914	20	3	20	9	Hsiang et al. (2017) find in a study of the continental U.S. that: "Total hours of labor supplied declines ~0.11 (±0.004) % per °C in GMST for low-risk workers, who are predominantly not exposed to outdoor temperatures, and 0.53 (±0.01) % per °C for high-risk workers who are exposed (~23% of all employed workers, in sectors such as construction, mining, agriculture, and manufacturing)." S. Hsiang, S., R. Kopp, A. Jina, J. Rising, M. Delgado, S. Mohan, D. J. Rasmussen, R. Muir-Wood, P. Wilson, M. Oppenheimer, K. Larsen, and T. Houser (2017). Estimating economic damage from climate change in the United States. Science 356(6345), 1362–1369. doi: 10.1126/science.aal4369. [Durwood Zaelke, United States of America]	REJECTED: WGI CH12 notes that the ability to have productive outdoor labour is connected to heat extremes, but does efforts to aggregate the net impact of labour reductions and relate these to GMST (which includes multiple hazards, population weighting, regional vulnerability assessment, etc.) is under the mandate of WGII.
12916	20	3	20	9	In 2017, approximately 100 GW of new AC load were connected to the grid compared to 97 GW of added solar generation capacity (Sachar, Sneha, Iain Campbell, and Ankit Kalanki, Solving the Global Cooling Challenge: How to Counter the Climate Threat from Room Air Conditioners. Rocky Mountain Institute, 2018. IEA Future of Cooling (2018) finds that doubling the efficiency of air conditioning under "the Efficient Cooling Scenario greatly reduces the need to build new generation capacity to meet peak demand. Worldwide, the need for additional capacity up to 2050 just to meet the demand from ACs is 1 300 gigawatts (GW) lower in the Efficient Cooling Scenario, the equivalent of all the coal-fired power generation capacity in China and India today. In most countries and regions, the avoided capacity needs are in the form of coal and natural gas… Worldwide, the cumulative savings in the Efficient Cooling Scenario amount to USD 2.9 trillion (United States dollar) over 2017-50 compared with the Baseline Scenario." (p. 12) [Durwood Zaelke, United States of America]	REJECTED: Adaptation and energy efficiency assessment is under the mandate of WGII and WGIII, not WGI CH12.
12918	20	3	20	9	Wenz et al. (2017) project a shift from winter to summer seasonal electricity peaking in 19 countries. Leonie Wenz, Anders Levermann, and Maximilian Auffhammer (2017) North–south polarization of European electricity consumption under future warming, PNAS September 19, 2017 114 (38) E7910-E7918; https://doi.org/10.1073/pnas.1704339114 [Durwood Zaelke, United States of America]	REJECTED: WGI CH12 looks at changes in temperature trends and hazards including their seasonal attributes, but changes in seasonal energy consumption/demand is under the mandate of WGII and WGIII.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
42374	20	3	20	9	Increased heat waves will also increase demand for air conditioning and the energy that powers it, and 1.8 to 4.1 billion people may need AC to avoid heat stress under current conditions (no warming or population growth). Meeting this demand would require a 14% increase of current global residential electricity consumption. Mastrucci A., Byers E., Pachauri S., Rao N. D. (2019) Improving the SDG energy poverty targets: Residential cooling needs in the Global South, Energy & Buildings 186:405-415. And increased air conditioning use increases emissions of air pollutants from power plants, in turn worsening air quality and human health impacts. David W. Abel, Tracey Holloway, Monica Harkey, Paul Meier, Doug Ahl, Vijay S. Limaye, Jonathan A. Patz (2018) Air-quality-related health impacts from climate change and from adaptation of cooling demand for buildings in the eastern United States: An interdisciplinary modeling study. https://doi.org/10.1371/journal.pmed.1002599; IEA (2018) Future of Cooling; Sustainable Energy for All (2018) Chilling Prospects: Providing Sustainable Cooling for All; and Birmingham Energy Institute, University of Birmingham (2018) A Cool World: Defining the Energy Conundrum of Cooling for All. [Gabrielle Dreyfus, United States of America]	REJECTED: Discussion of air conditioning demand and consumption needs fall under the domain of WGII and WGIII
42376	20	3	20	9	Improving energy efficiency of air conditioners and other cooling equipment and switching to lower GWP refrigerants as required by the Kigali Amendment to the Montreal Protocol could avoid even more warming, up to 100 Gt CO2-eq cumulatively through 2050. Sachar et al. (2018) Solving the Global Cooling Challenge: How to Counter the Climate Threat from Room Air Conditioners. Rocky Mountain Institute, P. 24 ("The 5X solution saves up to 100 gigatons of cumulative emissions by 2050."); Shah et al. (2015), Benefits of Leapfrogging to Superefficiency and Low Global Warming Potential Refrigerants in Room Air Conditioning. Berkeley, CA, USA. ("While there is some uncertainty associated with emissions and growth projections, moving to efficient room air conditioning (~30% more efficient than current technology) in parallel with low-GWP refrigerants in room air conditioning could avoid up to ~25 billion tonnes of CO2 in 2030, ~33billion in 2040, and ~40 billion in 2050, i.e. cumulative savings up to 98 billion tonnes of CO2 by 2050."). [Gabrielle Dreyfus, United States of America]	REJECTED: Discussion of air conditioning demand and consumption needs fall under the domain of WGII and WGIII
42378	20	3	20	9	Hsiang et al. (2017) find in a study of the continental U.S. that: "Total hours of labor supplied declines ~0.11 (±0.004) % per °C in GMST for low-risk workers, who are predominantly not exposed to outdoor temperatures, and 0.53 (±0.01) % per °C for high-risk workers who are exposed (~23% of all employed workers, in sectors such as construction, mining, agriculture, and manufacturing)." S. Hsiang, S., R. Kopp, A. Jina, J. Rising, M. Delgado, S. Mohan, D. J. Rasmussen, R. Muir-Wood, P. Wilson, M. Oppenheimer, K. Larsen, and T. Houser (2017). Estimating economic damage from climate change in the United States. Science 356(6345), 1362–1369. doi: 10.1126/science.aal4369. [Gabrielle Dreyfus, United States of America]	REJECTED: WGI CH12 notes that the ability to have productive outdoor labour is connected to heat extremes, but does efforts to aggregate the net impact of labour reductions and relate these to GMST (which includes multiple hazards, population weighting, regional vulnerability assessment, etc.) is under the mandate of WGII.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
42380	20	3	20	9	In 2017, approximately 100 GW of new AC load were connected to the grid compared to 97 GW of added solar generation capacity (Sachar, Sneha, Iain Campbell, and Ankit Kalanki, Solving the Global Cooling Challenge: How to Counter the Climate Threat from Room Air Conditioners. Rocky Mountain Institute, 2018. IEA Future of Cooling (2018) finds that doubling the efficiency of air conditioning under "the Efficient Cooling Scenario greatly reduces the need to build new generation capacity to meet peak demand. Worldwide, the need for additional capacity up to 2050 just to meet the demand from ACs is 1 300 gigawatts (GW) lower in the Efficient Cooling Scenario, the equivalent of all the coal-fired power generation capacity in China and India today. In most countries and regions, the avoided capacity needs are in the form of coal and natural gas… Worldwide, the cumulative savings in the Efficient Cooling Scenario amount to USD 2.9 trillion (United States dollar) over 2017-50 compared with the Baseline Scenario." (p. 12) [Gabrielle Dreyfus, United States of America]	REJECTED: Adaptation and energy efficiency assessment is under the mandate of WGII and WGIII, not WGI CH12.
42382	20	3	20	9	Wenz et al. (2017) project a shift from winter to summer seasonal electricity peaking in 19 countries. Leonie Wenz, Anders Levermann, and Maximilian Auffhammer (2017) North–south polarization of European electricity consumption under future warming, PNAS September 19, 2017 114 (38) E7910-E7918; https://doi.org/10.1073/pnas.1704339114 [Gabrielle Dreyfus, United States of America]	REJECTED: WGI CH12 looks at changes in temperature trends and hazards including their seasonal attributes, but changes in seasonal energy consumption/demand is under the mandate of WGII and WGIII.
45998	20	12	20	21	I suggest you should look at the Dzuds in Mongolia, and use this as an example or a Case Study. [Lourdes Tibig, Philippines]	TAKEN INTO ACCOUNT: We considered this case study, although we are challenged given space limitations and Section 12.3 is not oriented on case studies (but rather on establishing connections between climatic impact drivers and sectoral assets). Mongolia is assessed within the Asia section (12.4.2)
45842	20	12	21	1	rather than assess impacts here and picking examples or papers (I assume this is what has been done), please use AR5 and the AR6 special reports as the basis for evidence of relevance [Katja Mintenbeck, Germany]	TAKEN INTO ACCOUNT: CH12 has a clear mandate to assess climate hazards and their connections to sectoral impacts even as the full discussion of impacts and risk themselves (connecting with vulnerability and exposure) are left to WGII. In section 12.3 we note that AR5 WGII and the special reports examined sectoral impacts of hazards but and that we are taking an approach centered around assessing which climatic impact drivers are used for each sector. The following section (12.4) then assesses characteristic changes in each climatic impact driver across continents, which may then be mapped into affected sectors using the information in 12.3. CH12 has also been further connected with WGII approaches building off of handshake activities at WGII LAM2 in Kathmandu and WGI LAM3 in Toulouse.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
48354	20	14	20	14	Cold spells are also important for killing pests, winter storage of crops (e.g. seed potatoes) which should be included here as well. [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: We augmented text to emphasize connection between cold spells and pests range limitation. Cold requirements for winter crop and caching species storage are also now mentioned with a reference to Sutton et al., 2016.
14852	20	16	20	21	Should mention vernalisation somewhere. 'Cold' can be beneficial - vernalisation and may kill overwintering pests. [Clare Goodess, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: The text now mentions that cold spells are often a necessary component of meeting crop vernalisation requirements. (shifts in vernalisation are also mentioned within the mean warming sub-section above). We have also adjusted the entire presentation of CH12 to shift the hazard-oriented framework toward a more neutral examination of 'climatic impact drivers'. This allows us to more coherently discuss these phenomena as being potentially hazardous to some aspects/degrees and potentially beneficial to others.
49614	20	19		20	read "(Mader et al., 2010; Grotjahn, submitted)" rather than "(Mader et al., 2010) (Grotjahn, submitted)" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: corrected
49616	20	35		36	read "(Wolfe et al., 2018; Grotjahn, submitted)" rather than "(Wolfe et al., 2018)(Grotjahn, submitted)" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: corrected
49618	20	38		39	read "(Cradock-Henry, 2017; Crimp et al., 2016; Mäkinen et al., 2018; Grotjahn, submitted)" rather than "(Cradock-Henry, 2017; Crimp et al., 2016; Mäkinen et al., 2018)(Grotjahn, submitted)" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: corrected
49620	20				"(Grotjahn, submitted)" does not exist among the references! [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: We will add submitted reference if not yet published by time of Second Order Draft
42146	21	1			Source required: figure 12.3 [Lubna Alam, Malaysia]	TAKEN INTO ACCOUNT: We have emphasized that Figure 12.3 is a novel conceptual figure using examples from the 12.3 text to illustrate how the same sector can be affected by graduating levels of hazard that reach different assets and/or lead to more acute changes as conditions become more extreme. We also emphasize that the specific temperatures of these thresholds are not universal but must be an element of the tailored climate information provided for impact and risk analysis.
31854	21	5	21	31	The abbreviation CDD is too easy to confuse with Consequtive Dry Days, it seems to me… [Anna Sörensson, Argentina]	**TAKEN INTO ACCOUNT**: All acronyms and indices now defined in Annex VI

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
45844	21	36	22	43	rather than assess impacts here and picking examples or papers (I assume this is what has been done), please use AR5 and the AR6 special reports as the basis for evidence of relevance [Katja Mintenbeck, Germany]	TAKEN INTO ACCOUNT: CH12 has a clear mandate to assess climate hazards and their connections to sectoral impacts even as the full discussion of impacts and risk themselves (connecting with vulnerability and exposure) are left to WGII. In section 12.3 we note that AR5 WGII and the special reports examined sectoral impacts of hazards but and that we are taking an approach centered around assessing which climatic impact drivers are used for each sector. The following section (12.4) then assesses characteristic changes in each climatic impact driver across continents, which may then be mapped into affected sectors using the information in 12.3. CH12 has also been further connected with WGII approaches building off of handshake activities at WGII LAM2 in Kathmandu and WGI LAM3 in Toulouse.
54676	21	40	22	2	Maybe also of relevance: Orr et al., (2018a, 2018b). Orr, S. A., & Viles, H. (2018). Characterisation of building exposure to wind-driven rain in the UK and evaluation of current standards. Journal of Wind Engineering and Industrial Aerodynamics, 180(July), 88–97. https://doi.org/10.1016/j.jweia.2018.07.013 and Orr, S. A., Young, M., Stelfox, D., Curran, J., & Viles, H. (2018). Wind-driven rain and future risk to built heritage in the United Kingdom: Novel metrics for characterising rain spells. Science of the Total Environment, 640–641, 1098–1111. https://doi.org/10.1016/j.scitotenv.2018.05.354 [Sabine Undorf, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: We have considered the suggested papers in the CH12 assessment and included a reference to the second paper in establishing a connection between pluvial flooding and building damage.
50826	21	45	21	47	Why only projected year? There are many places where an attributable signal in wet hazards has already been observed. North America, Northern Europe, Parts of Asia etc. detailed in chapter 11. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	**TAKEN INTO ACCOUNT**: We have eliminated any discussion of projections or trends in 12.3, as major focus is on establishing a connection to the sectors. Section 12.4 includes discussion of observed trends, theoretical understanding, and model projections
39718	21	49	22	2	References to SRCCL conclusions could be useful to expand the assessment of this subsection [Carolina Vera, Argentina]	TAKEN INTO ACCOUNT: We have expanded this discussion overall and updated our point of departure to include both SRCCL and SROCC, including a specific reference to SRCCL Chapter 5 around mean precipitation changes for agriculture and soil erosion.
49622	21	54		55	read " (Ben-Ari et al., 2018; Mäkinen et al., 2018; Wolfe et al., 2018; Grotjahn, submitted)" rather than " (Ben-Ari et al., 2018; Mäkinen et al., 2018; Wolfe et al., 2018) (Grotjahn, submitted)" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: corrected
14854	21	55	21	57	Wet ground can also be a problem for forestry activities [Clare Goodess, United Kingdom (of Great Britain and Northern Ireland)]	ACCEPTED: We have noted that an changes in mean precipitation can be important for forestry within Table 12.2
49624	21				"(Orlov et al., 2019, submitted)" also does not exist among the references [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: This paper is now published and cited fully.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
49626	22	2			read "(Garrett et al., 2006; Kilroy, 2015; Grotjahn, submitted)" rather than "(Garrett et al., 2006; Kilroy, 2015)(Grotjahn, submitted)" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected
33370	22	7	22	18	Social and economic impacts in flood cities are not mentioned (Urbanization increases exposure to floods). For example consider: Rojas, O .; Mardones, M .; Rojas, C .; Martínez, C .; Flores, L. Urban Growth and Flood Disasters in the Coastal River Basin of South-Central Chile (1943-2011). Sustainability 2017, 9, 195. [Octavio Rojas, Chile]	ACCEPTED: We have noted the importance of floods for cities in Table 12.2 and added the suggested paper in the CH12 assessment.
33372	22	7	22	18	It is important to mention that floods have ecological effects, urban and rural communities. [Octavio Rojas, Chile]	ACCEPTED: We noted connections between flood hazards and ecological, urban, and rural assets in Table 12.2
50870	22	23	22	24	considere adding: Maria Pregnolato; Alistair Ford; Vassilis Glenis; Sean Wilkinson, Richard Dawson (2017) Impact of Climate Change on Disruption to Urban Transport Networks from Pluvial Flooding. Journal of Infrastructure Systems 23(4). DOI: 10.1061/(ASCE)IS.1943-555X.0000372 [Selma Guerreiro, United Kingdom (of Great Britain and Northern Ireland)]	ACCEPTED: We now cite Pregnolato et al. (2017) to underscore the connection between pluvial flooding and urban transportation.
33374	22	23	22	32	It is not entirely clear, the link "river flows within a season, resulting in lower hydropower efficiency" with the process of pluvial flooding. I believe that said aceveración corresponds to the section must go in River flooding. Aspects of urbanization and urban growth are not mentioned in urban water infiltration and management. [Octavio Rojas, Chile]	TAKEN INTO ACCOUNT: We have reduced the prominence of this discussion because it requires a deeper discussion beyond the space limitations and mandate of CH12 (although it may be picked up further in WGII CH4). The original idea was that pluvial floods and river floods can lead to more situations where flow must bypass hydropower generation given dangerously high water levels, but this quickly becomes a discussion around water and energy resource design (e.g., reservoir capacity and average levels) that is better left to WGII. Instead we note that variable river flows must be managed for water resources and hydropower needs. - We do note the prominent relationship between floods and urban areas, but we do not specifically address changes in urbanization or urban growth for water infiltration and management, as these are shifts in exposure and/or vulnerability that will be assessed in WGII.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
43780	22	23	22	32	Here, "damage to infrastructure" has been anticipated. However, as it is related with "human activities", my impression is that these themes are strongly related with WG2. I would like to know the role of CH12 in the whole IPCC AR6 reports ? [Izuru Takayabu, Japan]	TAKEN INTO ACCOUNT: CH12 has a clear mandate to assess climate hazards and their connections to sectoral impacts even as the full discussion of impacts and risk (connecting with vulnerability and exposure) are left to WGII. 12.3 identifies the climatic impact drivers associated with hazards used in more complete impact and risk analyses (which would be assessed in WGII) -- in Section 12.3 we have clarified to underscore that we are noting that these changes have been identified as hazards, even as we do not make any projection of actual damage levels (which would require analysis of vulnerability and exposure)
36518	22	37	22	38	It may dam water flow, forming landslide lakes, such as in the 2008 Wenchuan earthquake (Cui et al. 2009). Landslides collapsing into a reservoir may generate a displacement wave, such as in the case of Vajont, Italy, in 1963 (KAfle et al, 2016). Cui P, Zhu YY, Han YS, Chen XQ, Zhuang JQ. 2009. The 12 May Wenchuan earthquake-induced landslide lakes: distribution and preliminary risk evaluation. Landslides 6(3):209–223. Kafle J, Pokhrel PR, Khattri KB, Kattel P, Tuladhar BM and Pudasaini SP 2016. Landslide-generated tsunami and particle transport inmountain lakes and reservoirs. Annals of Glaciology 57(71):232-244. [Urbano Fra Paleo, Spain]	TAKEN INTO ACCOUNT: We considered the recommended papers in our assessment, however they appear to be more about the dynamics of landslide events rather than their climatic drivers
50828	22	37	22	43	Not only a question for landslide indices but for all, how well do we know from observed landslides and linking them to these indices how well they perform? Are they actually connected with landslides in a strong way, or are they missing lanslides that are caused by diferent events? [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: A full description and evaluation of each index described in CH12 is beyond the chapter's purview, however the text refers readers to the original papers using each index, which should include more complete analysis justifying their selection and performance. In several cases CH12 also points the reader to papers that compare the merits of each index (e.g., for drought).
54674	22	41	22	41	Another reference might be Monsieurs et al. (2019). Monsieurs, E., Dewitte, O., & Demoulin, A. (2019). A susceptibility-based rainfall threshold approach for landslide occurrence. Natural Hazards and Earth System Sciences, 19(4), 775–789. https://doi.org/10.5194/nhess-19-775-2019 [Sabine Undorf, United Kingdom (of Great Britain and Northern Ireland)]	ACCEPTED: We have added the suggested reference in the CH12 assessment to note connections between antecedent moisture levels and rainfall intensity as a trigger for landslides.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
41192	22	41	22	43	This sentence must be re-write. It is inaccurate to say that a landslide could dam a glacier. Maybe there is a confusing with two different origins, but similar phenomenas. One of them are, GLOFs "Glacial Lake Outburst Floods" which are associated with the catatrosphic or suddenly empy or partially empty of glacial lake. If a landslide, rock fall or rock avalanche felt on one of these lakes could trigger a GLOF (partially the aim of Haeberli et al. (2017) paper. Also, a significant number of glacial lakes are dam with unconsolidated glaciogenic sediments (moraines) or for glaciers, which means that by definitions those dams are unstable. The other process and which is the topic of Ruiz-Villanueva et al. (2017) are landslides lake outburst floods (LLOFs), where a mass movements temporarily blocking a drainage system and create a lake, which suddenly could collapse and release a large amount of water. Shortly, landslides are a significant hazards in mountain areas all along the world, they could dam rivers and create lakes, which could suddenly and catastrophically being drainage but also a mass movement falling on a lake (like proglacial or glacial-dammed lake) could also trigger an outburst flood, but in this case it will be known as a GLOF. [Lucas Ruiz, Argentina]	TAKEN INTO ACCOUNT: We have clarified this sentence to refer to glacial meltwater lakes (rather than damming the glacier itself) and have also considered the suggested reference in the CH12 assessment
28214	22	43	22	43	"After Line 43, add: "Storm-triggered landslides (or variously called mudslides or debris flows, Ren 2014), the most frequent and also most destructive type of landslides are predictable now (Iverson 1997; Ren et al. 2011a,b)." [Diandong Ren, Australia]	TAKEN INTO ACCOUNT: We have considered the suggested text; however, it is not the mandate of CH12 to assess predictability and we have more recent studies that link storms to landslides.
45846	22	46	24	6	rather than assess impacts here and picking examples or papers (I assume this is what has been done), please use AR5 and the AR6 special reports as the basis for evidence of relevance [Katja Mintenbeck, Germany]	TAKEN INTO ACCOUNT: CH12 has a clear mandate to assess climate hazards and their connections to sectoral impacts even as the full discussion of impacts and risk themselves (connecting with vulnerability and exposure) are left to WGII. In section 12.3 we note that AR5 WGII and the special reports examined sectoral impacts of hazards but and that we are taking an approach centered around assessing which climatic impact drivers are used for each sector. The following section (12.4) then assesses characteristic changes in each climatic impact driver across continents, which may then be mapped into affected sectors using the information in 12.3. CH12 has also been further connected with WGII approaches building off of handshake activities at WGII LAM2 in Kathmandu and WGI LAM3 in Toulouse.
49628	22	55	23	1	read "(Cook et al., 2014; Feng and Fu, 2013; Sherwood and Fu, 2014; Swann et al., 2016; Grotjahn, submitted)" rather than "(Cook et al., 2014; Feng and Fu, 2013; Sherwood and Fu, 2014; Swann et al., 2016)(Grotjahn, submitted)" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
8920	22		22		An important study linking precipitation and soil moisture trends for landslide risk assessment has been published in Ciabatta et al. (2016). This should be extended on a global scale assessment. A better assessment of the impact of climate changing in landslide risk should be performed. Ciabatta, L., Camici, S., Brocca, L., Ponziani, F., Stelluti, M., Berni, N., Moramarco, T. (2016). Assessing the impact of climate-change scenarios on landslide occurrence in Umbria region, Italy. Journal of Hydrology, 541, 285-295, doi:10.1016/j.jhydrol.2016.02.007 [Luca Brocca, Italy]	TAKEN INTO ACCOUNT: We have expanded our discussion of landslides in the second order draft, including regional assessments in section 12.4, and considered the suggested paper in the CH12 assessment of landslides (this section 12.3 and Section 12.4.5 on Europe include references to Alvioli et al., 2018, which has Dr. Ciabatta as a co-author and also covers climate and landslides in Central Italy).
31856	23	7	23	8	Here you will be able to cite SR of CC and land for the SOD. [Anna Sörensson, Argentina]	ACCEPTED: We have added references to SRCCL in both the mean temperature and aridity portions as we discuss shifts in climatic suitability for agriculture and ecosystems.
48356	23	16	23	16	Suggest modifying the title to "Drought/dryness" as the latter is also important for desert ecosystems, i.e. higher increases of temperature over land lowering relative humidity which enhances evaporation, and thus adding some text on this point. [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: We have updated the list of climatic impact drivers to include both drought and aridity, with the latter also including soil moisture and humidity changes
43782	23	18	23	38	Here they count up only some issues happened through "drought". There may be no meteorological explanation of such phenomena there. Should it be done somewhere in Ch10 ? [Izuru Takayabu, Japan]	TAKEN INTO ACCOUNT: We increased clarity of connections between physical mechanisms underlying hazard definitions and changes in section 12.2, building off of CH10, CH11, and other WGI scientific assessments. Physical explanations and processes are under the purview of WGI CH2-11
50872	23	18	23	38	An important impact of drought is missing: water security - the availability of water for human consumption (made very clear in the last drought in South Africa for example) [Selma Guerreiro, United Kingdom (of Great Britain and Northern Ireland)]	REJECTED: CH12 has a clear mandate to assess climate hazards and their connections to sectoral impacts even as the full discussion of impacts and risk (connecting with vulnerability and exposure) are left to WGII. CH12 can highlight connections between drought and water resources, but the overall balance of impact and risk captured as 'water security' includes vulnerability and exposure assessed by WGII
51278	23	19	8	19	see comment on page 9 line 32 [Bart Van den Hurk, Netherlands]	TAKEN INTO ACCOUNT: We now describe changes in mean precipitation and aridity, noting that there are multiple indices that can focus on different elements of society (water resources, agricultural drought) and elements of the water cycle (soil moisture, precipitation, evapotranspiration, etc.)
31858	23	20	23	20	I would change "runoff" to "river discharge" or "stream flow" since perhaps "runoff" is not such a familiar concept for people outside the land-surface-model community? (sorry if I am wrong, English is not my first language..) [Anna Sörensson, Argentina]	TAKEN INTO ACCOUNT: We now include 'streamflow' as an asset category within the water resources sector, and have replaced references to 'runoff' with '\streamflow'.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
41194	23	25	23	26	Regarding “mega-droughts” you may want to take a look at Garreaud et al. (2017) which describe the recent extreme drought from 2000-2015 (which although with some melioration in 2016 continues to this days) in the Central Andes of Chile and Argentina. Garreaud, R. D., Alvarez-Garreton, C., Barichivich, J., Boisier, J. P., Christie, D., Galleguillos, M., et al. (2017). The 2010–2015 megadrought in central Chile: impacts on regional hydroclimate and vegetation. Hydrol. Earth Syst. Sci. 21, 6307–6327. doi:10.5194/hess-21-6307-2017. [Lucas Ruiz, Argentina]	ACCEPTED: We have added the Garreaud et al. (2017) reference to our discussion of 'mega-droughts'
15462	23	30	23	32	I am not sure how this sentence is related with drought. [Ruiqing Miao, United States of America]	TAKEN INTO ACCOUNT: The low humidity and high windspeed lead to acute evapotranspiration. This is an important climatic impact driver that we felt was worthy of mention and it is positioned best within the episodic drought section even as it would not be broadly classified as a general 'drought'. Recall that all sub-sections/climatic impact driver categories may have multiple phenomena/elements, particularly when connections are established with niche assets such as wine grapes.
51280	23	31	10	31	"inform studies" is a strange phrase here [Bart Van den Hurk, Netherlands]	TAKEN INTO ACCOUNT: We have clarified this phrase in this context, although CH12 has a mandate to look at climate information for impacts and risk assessment, so this phraseology may be appropriate elsewhere in the chapter
49630	23	32			quoted "(Grotjahn, submitted)" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: We have made this accepted manuscript available as it has not been published at time of Second Order Draft
49632	23	36			read "(Prudhomme et al., 2014; Feeley et al., 2008; Schaeffer et al., 2012; van Vliet et al., 2016)" rather than "(Prudhomme et al., 2014).(Feeley et al., 2008; Schaeffer et al., 2012; van Vliet et al., 2016)" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected
35160	23	41	23	55	Although "Wildfire" is strongly connected to drier conditions, it is not a direct effect of it. Please, therefore move section 12.3.4.3 into section "12.3.8 Relevance of other hazards". [Janus Willem Schipper, Germany]	TAKEN INTO ACCOUNT: Rather than being its own climatic impact driver, we now include fire weather as a category of hazard indices often associated with drought and aridity. The occurrence of fire is considered an impact (involving vulnerability, exposure, and potentially adaptation/management) so our focus is on the climatic conditions that are favourable to wildfires, which we classify as fire weather within the aridity/drought climatic impact driver framework.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
15398	23	41	24	6	It is proven, that human was in 95% in charge of the wild fire. Cases with lightnings are very rare. It is good to add also, that the risk of wildfires is increasing as a result of increasing droughts. If use for indices changes in agricultural droughts as a result of climate change, it is possible to assess risks and calculate it in number of days. Lozano, O. M., Salis, M., Ager, A. A., Arca, B., Alcasena, F. J., Monteiro, A. T., ... & Spano, D. (2017). Assessing climate change impacts on wildfire exposure in Mediterranean areas. Risk analysis, 37(10), 1898-1916. Abatzoglou, J. T., & Williams, A. P. (2016). Impact of anthropogenic climate change on wildfire across western US forests. Proceedings of the National Academy of Sciences, 113(42), 11770-11775. [Oksana Lipka, Russian Federation]	TAKEN INTO ACCOUNT: We have improved context of lightning strikes as a 'natural' ignitor of wildfires, while keeping exposure and vulnerability and human ignition causes to WGII. CH12 focuses on the prevailing conditions that form a hazard in the sense of being favourable for wildfire ignition or spread, with fire weather considered as a category of climatic impact driver indices often associated with aridity and drought. We also considered the recommended studies in our assessment (Abatzoglou and Williams, 2016, was already cited elsewhere in this sub-section).
44146	23	51	23	51	Add the following two sentences after the one ending "(… Abatzoglou and Williams, 2016)." "The paleoclimate record indicates that increased vapor pressure deficits associated with high temperatures during the summer-early fall dry season in California now appear to be overwhelming prior wet season moisture delivery as a control on fire activity. Notably, very high (and fatal) fire activity occurred in 2017 following extreme precipitation that threatened major dam integrity during the immediately preceding winter; this combination of extreme wetness followed immediately by extreme fire activity is unprecedented back to at least 1600 (Wahl et al., 2019)." [Citation: Wahl, E., Zorita, E., Trouet, V., and Taylor, A., 2019, "Jet Stream Dynamics, Hydroclimate, and Fire in California: 1600-2000 CE", Proceedings of the National Academy of Science, 116:12, 5393-5398, www.pnas.org/cgi/doi/10.1073/pnas.1815292116.] [Eugene Wahl, United States of America]	TAKEN INTO ACCOUNT: The suggested text considers an important aspect of connected extremes, which we touch upon within CH12 but we are challenged by overall space limitations and cannot cover all concurrent, compound, and sequential hazard combinations as well as their effects on vulnerability, exposure, and the resulting combinations affecting impacts and risk. We considered this example as an indication of changing climatic impact drivers that alter sequential risks in our short discussion on connected extremes at the end of 12.3, although this topic is also discussed in CH11.
46080	23	51	23	52	The reference to Santa Ana in california is the first specific reference to a case in this report. The question is why Sanata Ana when there are many other cases where wind circulation illustrates unpredictability and changes? [Shuaib Lwasa, Uganda]	TAKEN INTO ACCOUNT: There are several examples quoted in this report, as well as several more in-depth case studies. Many wind systems are studied in isolation although the climate information needs are more transferable between wind systems. We worried that regional wind systems/phenomena were not well-known for the average chapter reader and therefore used a specific example so that readers would have a basis to pursue further details (the Santa Ana is one of the most commonly known and studied wind systems)
51282	24	6	33	6	strange setting that changing wind profiles "aid" the design of skyscrapers [Bart Van den Hurk, Netherlands]	TAKEN INTO ACCOUNT: We have rephrased this discussion to clarify that information about shifts in wind profiles is important for engineering design (to avoid hazards)

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
45848	24	33	25	25	rather than assess impacts here and picking examples or papers (I assume this is what has been done), please use AR5 and the AR6 special reports as the basis for evidence of relevance [Katja Mintenbeck, Germany]	TAKEN INTO ACCOUNT: CH12 has a clear mandate to assess climate hazards and their connections to sectoral impacts even as the full discussion of impacts and risk themselves (connecting with vulnerability and exposure) are left to WGII. In section 12.3 we note that AR5 WGII and the special reports examined sectoral impacts of hazards but and that we are taking an approach centered around assessing which climatic impact drivers are used for each sector. The following section (12.4) then assesses characteristic changes in each climatic impact driver across continents, which may then be mapped into affected sectors using the information in 12.3. CH12 has also been further connected with WGII approaches building off of handshake activities at WGII LAM2 in Kathmandu and WGI LAM3 in Toulouse.
9822	24	33			Determination of extreme wind thresholds: Temperature increase in the region may lead to the increase of maximum wind speed (as observed in most of the stations in study region, kouzegaran,2015). Consequently, it is suggested that the extreme wind thresholds and their frequency to be determined. [saeedeh Kouzegaran, Iran]	TAKEN INTO ACCOUNT: In Section 12.3 we note the importance of extreme wind thresholds, but a determination of precise tolerance thresholds for specific sectoral assets is beyond the purview of this assessment. In Section 12.4 we discuss future projections in wind extremes relative to current distributional percentiles, as these are a decent proxy for current tolerance/design criteria. We could not identify the suggested paper, as an internet search for 'kouzegaran 2015 wind speed' did not turn up any applicable results, although we did note that other papers by Kouzegaran have been cited by one of the Chapter 12 Lead Authors and we consider changes in wind speed in Central and West Asia in Section 12.4.2

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
46386	24	33			Determination of extreme wind thresholds: Temperature increase in the region may lead to the increase of maximum wind speed (as observed in most of the stations in study region, kouzegaran,2015). Consequently, it is suggested that the extreme wind thresholds and their frequency to be determined. [sadegh zeyaeyan, Iran]	TAKEN INTO ACCOUNT: In Section 12.3 we note the importance of extreme wind thresholds, but a determination of precise tolerance thresholds for specific sectoral assets is beyond the purview of this assessment. In Section 12.4 we discuss future projections in wind extremes relative to current distributional percentiles, as these are a decent proxy for current tolerance/design criteria. We could not identify the suggested paper, as an internet search for 'kouzegaran 2015 wind speed' did not turn up any applicable results, although we did note that other papers by Kouzegaran have been cited by one of the Chapter 12 Lead Authors and we consider changes in wind speed in Central and West Asia in Section 12.4.2
57662	24	33			Determination of extreme wind thresholds: Temperature increase in the region may lead to the increase of maximum wind speed (as observed in most of the stations in study region, kouzegaran,2015). Consequently, it is suggested that the extreme wind thresholds and their frequency to be determined. [Sahar Tajbakhsh Mosalman, Iran]	TAKEN INTO ACCOUNT: In Section 12.3 we note the importance of extreme wind thresholds, but a determination of precise tolerance thresholds for specific sectoral assets is beyond the purview of this assessment. In Section 12.4 we discuss future projections in wind extremes relative to current distributional percentiles, as these are a decent proxy for current tolerance/design criteria. We could not identify the suggested paper, as an internet search for 'kouzegaran 2015 wind speed' did not turn up any applicable results, although we did note that other papers by Kouzegaran have been cited by one of the Chapter 12 Lead Authors and we consider changes in wind speed in Central and West Asia in Section 12.4.2
8628	24	37	24	38	" plant growth pattern and animal activites could be included in the statement to make it look like this "Changes in prevailing winds can alter the profile of seed dispersal,plant growth pattern, windblown pest, animal activities and disease vectors, and dust dispersal affecting ecosystems, agriculture, and human health" [Ibikunle Olaleru, Nigeria]	ACCEPTED: We have added 'animal activities' to the list of ecosystem aspects affected by changing mean winds.
43786	24	37	24	45	These change in the mean wind would make a severe damage to the birds who migrate in the monsoon regions. For example there is a paper which discussed on migration of Oriental honey-buzzard (Elham et al, 2017) (http://dx.doi.org/10.1098/rspb.2017.0149). It crosses the East China Sea in autum, but the wind condition become not confortable in the future. [Izuru Takayabu, Japan]	ACCEPTED: We now cite the paper by Elham Nourani et al. (2017) in 12.3.3.1 in relation to wind change connections to animal activities (e.g., migration).
43784	24	37	25	25	Here they count up only some issues happened through "wind disasrters". There may be no meteorological explanation of such phenomena there. Should it be done somewhere in Ch10 ? [Izuru Takayabu, Japan]	TAKEN INTO ACCOUNT: We have coordinated with WGI CH11 to request that physical mechanisms are provided in CH11 for all climate hazards shown in CH12

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42148	24	38			Need reference [Lubna Alam, Malaysia]	ACCEPTED: We have removed all placeholders for references
49634	24	42			read "Karnauskas et al., (2018) noted" rather than "Karnauskas et al., 2018 noted" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected
43788	24	50	25	7	Here some specific phenomena should be introduced. For the purpose, PGWD (Pseudo Global Warming Downscaling) method fit well. For example, "Effects of global warming on the impacts of Typhoon Mireille (1991) in the Kyushu and Tohoku regions" Takemi, T, R. Ito and O. Arakawa (https://www.jstage.jst.go.jp/article/hrl/10/3/10_81/_article) showed us the change of the damage to Apple caused by strong wind of Typhoon. It may be a good example showing the linkage between natural hazards and risk-assessment. [Izuru Takayabu, Japan]	REJECTED: Downscaling methods and typhoon dynamics are covered in CH10 and CH11, respectively.
31860	25	6	25	6	"Changes in the profile…", I think you mean "Knowledge of changes in the profile…" [Anna Sörensson, Argentina]	ACCEPTED: We now specify "Information about changes in the profile…"
54660	25	6	25	6	Information on "changes in the profile (…) aid in the design (…)"? (not the changes themselves aid I assume) [Sabine Undorf, United Kingdom (of Great Britain and Northern Ireland)]	ACCEPTED: We now specify "Information about changes in the profile…"
42150	25	7			Reference missing [Lubna Alam, Malaysia]	ACCEPTED: We have removed all placeholders for references
41330	25	9	25	9	Consider adding 'above-ground' electricity infrastructure [Debra Roberts, South Africa]	ACCEPTED: We have specified 'above-ground' electrical transmission lines
32998	25	10	25	10	I'm worried about the references used, which are pre-AR5. I would recommend to include more recent references regarding hail hazards [Juan Antonio Rivera, Argentina]	TAKEN INTO ACCOUNT: We have updated to include more recent hail hazard references and now include 5 references post-AR5
35162	25	10	25	15	Hail is not a hazard connected to wind. Although hail is generated within thunderstorms, which hold a lot of wind gusts, the section "Hail" should therefore be moved into section "12.3.8 Relevance of other hazards". [Janus Willem Schipper, Germany]	TAKEN INTO ACCOUNT: We now include 'hail' as a climatic impact driver under the 'snow and ice' category. The phenomenon that often creates hail is a severe storm, but the damaging aspect is ice itself.
46082	25	12	25	15	This section can potentially be merged with the section on severe storms [Shuaib Lwasa, Uganda]	TAKEN INTO ACCOUNT: We now include 'hail' as a climatic impact driver under the 'snow and ice' category. The phenomenon that often creates hail is a severe storm, but the damaging aspect is ice itself.
50830	25	12	25	15	Similar as to landslides, given that we have hardly observations of hailstroms are there any estimates of how well these infdices perform? I would assume better in some parts of the world than others, but do we have any evidence? Also do the indices miss damage inducing hailstorms? Discussing these aspects would be important for all indices and ideally giving them different lables of usfulness or reliability so readers of this chapters immidiately get an estimate of the level of confidence. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: A full description and evaluation of each index described in CH12 is beyond the chapter's purview, however the text refers readers to the original papers using each index, which should include more complete analysis justifying their selection and performance. Numerous hail indices and studies provide a stronger basis for assessment than would any single study/index, but proxy indices likely miss some events/damage that could be captured by more direct modeling efforts as model resolution and capabilities improve .

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
55750	25	18	25	25	This section needs more detail and consitency with other sections. It would be good to expalin the different types of dust storms and their respective potential damage, how models are able to simulate the different types of storms and in general how difficult is to project dust by the end of the century. Also detail more the diverse impacts of dust storms. In addition to magnitude and duration of event, I would add frequency of occurrence, [Carlos Perez Garcia-Pando, Spain]	TAKEN INTO ACCOUNT: We have enhanced discussion of dust storms (including frequency) to be more commensurate with other sections. This section 12.3 is oriented around establishing connections to sectoral assets and useful indicators, not on uncertainty in projection (this is handled in regional sections within 12.4).
6231	25	20	25	20	Dust and sandstorms frequency may increase by changing climatic factors and induce health, transportation, [Mostafa Jafari, Iran]	TAKEN INTO ACCOUNT: We added connections between dust storms and health/transportation within Table 12.2 as well as with references to air pollution and Valley Fever in the text.
14856	25	20	25	25	Dust and sandstorms are problematic for solar generation and maintenance [Clare Goodess, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: Added connections between dust storms and energy infrastructure within Table 12.2
42152	25	23			Space missing before the references. [Lubna Alam, Malaysia]	EDITORIAL: Space inserted
27132	25	25	25	25	The input of mineral dust from arid regions impacts snow optical properties. The induced albedo reduction generally alters the melting dynamics of the snowpack, resulting in earlier snowmelt thus impact water resources (Di Mauro, Biagio, et al. "Saharan dust events in the European Alps: role in snowmelt and geochemical characterization." The Cryosphere 13.4 (2019): 1147-1165) [Edoardo Cremonese, Italy]	TAKEN INTO ACCOUNT: CH12 notes this type of knock-on effect where one hazard leads to altered physical mechanisms for other hazards, but this mechanistic explanation is not a focus of the chapter even as we include discussion of the ramification of changing snowpack directly (which is a result of multiple anthropogenically-induced changes).
41196	25	28	26	30	Glaciers related hazards due to climate change are missing. Although most glaciers are in remote areas, their hazard impact could have a cascading effect which with a significant impact in low resilience mountain communities. The MRI (Mountain Research Institute) has made a very comprehensive (although not extensible complete) list of recent publications about the hazards and another kind of impact related to the shrinkage of glaciers. Please take a look at: http://www.mountainresearchinitiative.org/index.php/activities/communication-campaigns/vanishingglaciers Chapter 2 and 3 of SROCC assess the hazards related to the shrinkage of glaciers in the high mountain and the arctic regions, respectively. As I mentioned in a comment in the executive summary, a compendium and assessment of evidences of hazards related to the shrinkage of glaciers in the Andes is the recently published Atlas of UNESCO (Schoolmeester et al., 2018). Schoolmeester, T., Johansen, K. S., Alfthan, B., Baker, E., Hesping, M., and Verbist, K. (2018). The Andean glacier and water atlas: the impact of glacier retreat on water resources - UNESCO Biblioteca Digital. , eds. T. Schoolmeester and K. Verbist Arendal, Norway: UNESCO and GRID-Arendal Available at: https://unesdoc.unesco.org/ark:/48223/pf0000265810.locale=es [Accessed January 11, 2019]. [Lucas Ruiz, Argentina]	TAKEN INTO ACCOUNT: We appreciate the reviewer pointing us to this great resource from MRI. We have utilized many of these references in our enhanced assessment of glacial hazards throughout CH12. We have also updated CH12's point of departure to reflect SROCC, including references in the mountain section within 12.4.10 and our discussions of snow and ice hazards in 12.3.4.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
45850	25	28	26	30	rather than assess impacts here and picking examples or papers (I assume this is what has been done), please use AR5 and the AR6 special reports as the basis for evidence of relevance [Katja Mintenbeck, Germany]	TAKEN INTO ACCOUNT: CH12 has a clear mandate to assess climate hazards and their connections to sectoral impacts even as the full discussion of impacts and risk themselves (connecting with vulnerability and exposure) are left to WGII. In section 12.3 we note that AR5 WGII and the special reports examined sectoral impacts of hazards but and that we are taking an approach centered around assessing which climatic impact drivers are used for each sector. The following section (12.4) then assesses characteristic changes in each climatic impact driver across continents, which may then be mapped into affected sectors using the information in 12.3. CH12 has also been further connected with WGII approaches building off of handshake activities at WGII LAM2 in Kathmandu and WGI LAM3 in Toulouse.
48358	25	30	25	30	Should the title just be "Changes in snow" as increases, as there will be in some areas, could lead to increased snow-melt driven flooding hazards. [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: CH12 now includes a climatic impact driver on 'snow and land ice', whose changes can be hazardous or beneficial for a variety of regional sectors
43790	25	32	25	48	Here they introduced nothing related with th echange of resourvour of water, accumulated in the wintertime in mountain area (mountain snowpack for water resources). It has strong influence to crop calendar. [Izuru Takayabu, Japan]	TAKEN INTO ACCOUNT: The topic of mountain snowpack is now covered as the 'cryospheric reservoir, which is an asset for water resources. This also affects agriculture and many other sectors (health, urban areas, infrastructure, industry), which is a topic under the mandate of WGII. We have added text at the end of the introduction to 12.3 (where we describe Table 12.2) to emphasize that we are looking for direct sector x climatic impact driver connections rather than ways in which one sector affects another (e.g., water resource limitations affecting agriculture via irrigation availability).

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
26662	25	39	25	43	A the end of this paragraèh is very important to add a citation for the 100-day rule and the altitude of natural snow-reliablity in Alpine ski areas that it is a reliability index for the snow cover and the snow reduction. The reference is "(Agrawala, 2007)". Agravala S., Ed. (2007). Climate Change in the European Alps. Adapting winter tourism and natural hazards management. OECD Publishing [Alessandro Pezzoli, Italy]	TAKEN INTO ACCOUNT: We considered the suggested reference and its indices related to snow depth and snow cover duration required for successful ski area operation. We stuck with the more recent Wobus et al. (2017) reference rather than the Agrawala (2007) reference (the former uses snow water equivalence, the latter uses snow depth), and focus on the number of days with that snow depth. This is similar to the 100-day rule in that it measures the season of skiing viability, although the 100-day rule is defined using economic criteria and thus is a measure of vulnerability better left to WGII, which would be able to draw upon the change in number of days with sufficient snow depth using Wobus et al. (and similar) analyses.
31862	25	39	25	43	In this sentence it seems like "length of the skiing season" is referring to recreational skiing downhills since artificial snow is mentioned. I don't think that this belongs here since we are talking about hazards. Observe that skiing can also be a fundamental transport for communities (see similar example on same page, lines 53-55). [Anna Sörensson, Argentina]	TAKEN INTO ACCOUNT: We now mention that skiing and snowmobiling affects both recreational and fundamental transportation assets.
49638	25	39			read "Wobus et al., (2017)" rather than "Wobus et al., 2017" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected
51284	25	42	25	42	I don't understand the remark on wet bulb global temperature. Is it a criterion for artificial snow creation? And "global" should be replaced by "globe" [Bart Van den Hurk, Netherlands]	TAKEN INTO ACCOUNT: We clarified that this should be wet-bulb temperature, with reference to Wobus et al. (2017).
31864	25	46	25	47	I don't agree with having "Park and recreation areas may loose appeal" here. It is a very anthropocentric viewpoint where we only see nature as serving us (in this case not even with something essential for our health, but with "nice views"). It is not related with hazards. [Anna Sörensson, Argentina]	REJECTED: There are tremendous societal interests in park and recreation tourism, which makes this an asset worth mentioning. This does not preclude there being other interests and viewpoints including non-anthropocentric interests, which we also represent throughout CH12
41198	25	46	25	48	Recently Bosson et al. (2019) published an analysis of the impact of future glacier shrinkage to UNESCO World Heritage Areas. Here, GLOFs are correctly assessed as hazards. Nevertheless, they are not mentioned at all as snow and ice related hazards. GLOFs are one of the main hazards related to glacier shrinkages in mountain areas, and they deserve a more in deep treatment in this chapter. Bosson, J. -B., Huss, M., and Osipova, E. (2019). Disappearing World Heritage Glaciers as a Keystone of Nature Conservation in a Changing Climate. Earth's Futur., 2018EF001139. doi:10.1029/2018EF001139. [Lucas Ruiz, Argentina]	TAKEN INTO ACCOUNT: We have expanded one of our climatic impact drivers to explicitly include 'snow and land ice', which includes glaciers. This framework allows us to expand our discussion of GLOFs, which is now included within the snow and ice related hazards. We have also considered the suggested study in our assessment, although we noted it does not explicitly mention GLOFs.
25500	25	51			Include river ice in section title and in discussion. [Sharon Smith, Canada]	ACCEPTED: We have expanded our climatic impact driver to include 'Lake, river, and sea ice'

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
25498	25	53	25	55	In addition to accessing communities, winter and ice roads are used to for access to resource development sites in northern Canada for e.g. The length of time that rivers are frozen is also important for ice birdges that are part of the all season road system, for eg. crossing Mackenzie River in NWT Canada. Although shorter ice season means longer barge season on the river it also means shorter operation for the Mackenzie highway in winter - see for example Chapter 3 in Climate Risks & Adaptation Practices for the Canadian Transportation Sector 2016 https://www.nrcan.gc.ca/environment/resources/publications/impacts-adaptation/reports/assessments/2017/19623 and also the following report: Perrin, A., Dion, J., Eng, S., Sawyer, D., Nodleman, J.R., Comer, N., Auld, H., Sparling, E., Harris, M., Nodelman, J.Y.H., and Kinnear, L. 2015. Economic implications of climate change adaptations for mine access roads in northern Canada, Northern Climate ExChange, Yukon Research Centre, Yukon College. https://www.yukoncollege.yk.ca/research/our-research/northern-climate-exchange/economic-implications-of-climate-change-adaptations-for-mine-access-roads-in-northern-canada [Sharon Smith, Canada]	TAKEN INTO ACCOUNT: We have considered the suggested references and expanded attention on ice roads and ice bridges in the assessment. We have also added a reference to the Penddakur 2017 (Chapter 3).
46084	26	1	26	3	Please add the literature on the Arctic that is immense on ths topic. [Shuaib Lwasa, Uganda]	ACCEPTED: We have expanded our assessment of literature on cryospheric hazards, including an updated point of departure from the SROCC (we also cite the SROCC Polar chapter here). We also have elevated a section on changes in climatic impact drivers in polar regions (12.4.9) and expanded our discussion of land ice.
42154	26	3			Space missing before the reference (Wright et al.2013) [Lubna Alam, Malaysia]	NOT APPLICABLE: The sentence with this reference to Wright et al. 2013 has been removed.
35164	26	6	26	10	This section is quite short compared to other hazards, although it can have major impacts on key infrastructures. Can it not be extended to meet up with its impacts. [Janus Willem Schipper, Germany]	ACCEPTED: We are under tight space limitations, but have expanded our discussion of heavy snow and connected it with our discussion of ice storms, resulting in a more complete section.
46086	26	8	26	9	Other critical infrastructure are relevant for this risk. Such as electricity, gas systems, cnetralized heating systems [Shuaib Lwasa, Uganda]	TAKEN INTO ACCOUNT: We have expanded the section on heavy snow and ice storms including connections to energy infrastructure (particularly transmission lines).
54662	26	9	26	9	What about non-heavy snow in urban regions with very low climatological likelihood of any snow (e.g., https://www.metoffice.gov.uk/climate/uk/interesting/february2018-snow)? [Sabine Undorf, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: expanded discussion to recognize that different regions will have different thresholds for what is considered a heavy snow event, owing largely on snow removal infrastructure (which tends to be smaller in places where heavy snow is not common).

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
32356	26	14	26	33	Coastal erosion is considered exclusively from the point of view of soft/sandy coasts, without taking in consideration aspects or metrics relevant for rocky coasts, and particularly soft rocky cliffs or bluffs. Because the risks of coastal erosion in rocky coasts are also relevant, and often more dramatic than in sandy coasts, it is important to consider also these systems in the overall analysis of coastal hazards. [Carlos Loureiro, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: The reviewer is correct that coastal erosion is not exclusive to sandy coastlines. Chapter 12 is limited for space and it is therefore difficult to provide detail on all types of coastlines, and therefore the latest draft of 12.3 does not distinguish between coastal types. In subsequent sections we note the particularly strong effects on sandy beaches and also note the potential for coastal erosion-based landslides and rockfalls in the landslide section.
8184	26	22	26	30	SROCC Chapter 2 has performed a thorough assessment of past and future changes in avalanche activity in mountainous areas. It may be worth using this as a starting point. [Samuel Morin, France]	TAKEN INTO ACCOUNT: We updated references and utilized an updated point of departure from SROCC, and now also cite SROCC CH2 in the snow avalanche section here.
55490	26	24	26	24	net sea level rise is important for every coastal ecosystem many of which are ignored in the random selection of three here. I suggest to indicate that these are examples or add many more such as sea grass, mud flats, rocky shore etc [Daniela Schmidt, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: We augmented discussion to emphasize that these are examples of niche coastal ecosystems, and we also added sea grasses to the list.
43792	26	24	26	30	Here, only "potential forecast" method has been applied. If we use high resolution regiona models, we can say much more on "snow avalanche". For example, if we drove high resolution cloud resolving model, or off-line land surface model, we can estimate the quality change of snow accumulated on land surface, caused by the temperature change. And it is well known that the change of snaw quality add aome risk on the avalanche. [Izuru Takayabu, Japan]	TAKEN INTO ACCOUNT: We added a direct mention of snow quality to our discussion of 'wet snowpack' in the snow avalanche section, and added a reference to Rutty et al. 2017 for snow quality in the land snow section related to recreational skiing. The physical mechanism and downscaling/modeling techniques are beyond the scope of CH12 and will be included in CH9 and CH10 assessment
45852	26	33	27	33	rather than assess impacts here and picking examples or papers (I assume this is what has been done), please use AR5 and the AR6 special reports as the basis for evidence of relevance [Katja Mintenbeck, Germany]	TAKEN INTO ACCOUNT: CH12 has a clear mandate to assess climate hazards and their connections to sectoral impacts even as the full discussion of impacts and risk themselves (connecting with vulnerability and exposure) are left to WGII. In section 12.3 we note that AR5 WGII and the special reports examined sectoral impacts of hazards but and that we are taking an approach centered around assessing which climatic impact drivers are used for each sector. The following section (12.4) then assesses characteristic changes in each climatic impact driver across continents, which may then be mapped into affected sectors using the information in 12.3. CH12 has also been further connected with WGII approaches building off of handshake activities at WGII LAM2 in Kathmandu and WGI LAM3 in Toulouse.

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25502	26	33			Section 12.3.7 - The following regional report may be relevant (and for the Arctic the various AMAP reports mentioned previously) Canada's Marine Coasts in a Changing Climate https://www.nrcan.gc.ca/environment/resources/publications/impacts-adaptation/reports/assessments/2016/18388 [Sharon Smith, Canada]	TAKEN INTO ACCOUNT: We have considered the suggested reference for coastal hazard assessment in Canada, and opted to go with the update to this report (Canada's Changing Climate Chapter 7; Greenan et al., 2019)
8716	26	35	26	49	These paragraphs describe the connections between climate variables, hazards and potential impacts. They can be useful for stakeholders wondering how climate change affects local to regional hazards. In the case of sea-level rise, one possibility would be to consider sea-level rise as a climate variable only, and assess the following hazards: salinization, flooding and erosion, although this classification could be criticized as well as there are many other coastal hazards not included in these cathegories (e.g., scouring due to erosion, debris motions, direct wave schock on infrastructures...) [Goneri Le Cozannet, France]	TAKEN INTO ACCOUNT: Hazards include both extreme events and trends, and each of these often includes many sub-components that we have grouped into representative categories within 12.2 (e.g., fire weather is associated with aridity and drought). We augmented discussion of SLR to indicate these closely-linked hazard components (in collaboration with 12.2) and discuss salinization as a common impact of coastal flooding and sea level rise (each of which puts pressure on water resources and ecosystem waters). We have a separate salinization climatic impact driver for open ocean areas, as this can be a result of current shifts or runoff in coastal areas.
28216	26	35	26	49	At the end of Line 490, add "Sea level rise from ice sheet melting, iceberg calving and retreat of glaciers is of concern (Ren et al. 2013; Ren and Leslie 2011). In particular, the extent to which the larger ice sheets (Greenland and Antarctica) melt and raise global sea levels is both concerning (Ren et al. 2011; Ren et al. 2012) and, as yet, indeterminate. This natural hazard, which likely is linked directly with human-induced greenhouse gas increases and hence to global warming, is a rapidly developing research and observational direction. Again, much further theoretical and modeling studies are required to reduce the current very large spread of possible sea level rise projections." [Diandong Ren, Australia]	TAKEN INTO ACCOUNT: We increased discussion of cryosphere hazards in this second order draft, but the suggested text addresses uncertainties and physical mechanisms for sea level rise that is beyond the purview of CH12. Physical mechanisms and connections between hazards (e.g., heat waves or warming trends contributing to SLR through ice sheet loss) are not a primary focus of CH12 given that they are covered in CH9 and elsewhere in WGI.
55242	26	35		49	Need to add the fnding that anthropogenic increases in CO2 level helps salt marshes resist encroachment from rising seas: http://phys.org/news/2015-12-coastal-marshes-resilient-sea-level-previously.html Excerpt: "...the significant boost in marsh plant productivity associated with elevated levels of atmospheric carbon dioxide will allow marshes to trap more sediment and create more organic soil. This, in turn, will result in increased rates of accretion that will allow marshes to keep up with rising sea levels and may increase the thresholds for marsh drowning by up to 60 percent." Ref: Ratliff et al. (2015), Spatial response of coastal marshes to increased atmospheric CO2. DOI:10.1073/pnas.1516286112 [David Burton, United States of America]	ACCEPTED: We have added Ratliff et al. (2015) as a reference for coastal ecosystem response to CO2 .
8588	26	37	26	40	RSL differs from GMSL also due to GRD (gravitational, rotational, deformational) effects; see ch 9 Box 9.2 [Robert Kopp, United States of America]	TAKEN INTO ACCOUNT: We have added cross-references to CH9 and box 9.2 so that readers can find physical mechanisms and aspects of GMSL including GRD effects

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
12732	26	37	26	49	Rising seas have other implications beyond inundating the land, and the impacts to small islands and how soon these impacts can be felt. Overall, this section could highlight how soon these impacts could happen in other places and that it is far before the full SLR happens. Storlazzi C. D., et al. (2018) Most atolls will be uninhabitable by the mid-21st century because of sea-level rise exacerbating wave-driven flooding, SCIENCE ADVANCES 4(eaap9741):1–9, 1 ("Sea levels are rising, with the highest rates in the tropics, where thousands of low-lying coral atoll islands are located. Most studies on the resilience of these islands to sea-level rise have projected that they will experience minimal inundation impacts until at least the end of the 21st century. However, these have not taken into account the additional hazard of wave-driven overwash or its impact on freshwater availability. We project the impact of sea-level rise and wave-driven flooding on atoll infrastructure and freshwater availability under a variety of climate change scenarios. We show that, on the basis of current greenhouse gas emission rates, the nonlinear interactions between sea-level rise and wave dynamics over reefs will lead to the annual wave-driven overwash of most atoll islands by the mid-21st century. This annual flooding will result in the islands becoming uninhabitable because of frequent damage to infrastructure and the inability of their freshwater aquifers to recover between overwash events. This study provides critical information for understanding the timing and magnitude of climate change impacts on atoll islands that will result in significant, unavoidable geopolitical issues if it becomes necessary to abandon and relocate low-lying island states."). [Kristin Campbell, United States of America]	REJECTED: The overall damage and adaptation/mitigation implications of the CH12 hazards are the purview of WGII
12920	26	37	26	49	Rising seas have other implications beyond inundating the land, and the impacts to small islands and how soon these impacts can be felt. Overall, this section could highlight how soon these impacts could happen in other places and that it is far before the full SLR happens. Storlazzi C. D., et al. (2018) Most atolls will be uninhabitable by the mid-21st century because of sea-level rise exacerbating wave-driven flooding, SCIENCE ADVANCES 4(eaap9741):1–9, 1 ("Sea levels are rising, with the highest rates in the tropics, where thousands of low-lying coral atoll islands are located. Most studies on the resilience of these islands to sea-level rise have projected that they will experience minimal inundation impacts until at least the end of the 21st century. However, these have not taken into account the additional hazard of wave-driven overwash or its impact on freshwater availability. We project the impact of sea-level rise and wave-driven flooding on atoll infrastructure and freshwater availability under a variety of climate change scenarios. We show that, on the basis of current greenhouse gas emission rates, the nonlinear interactions between sea-level rise and wave dynamics over reefs will lead to the annual wave-driven overwash of most atoll islands by the mid-21st century. This annual flooding will result in the islands becoming uninhabitable because of frequent damage to infrastructure and the inability of their freshwater aquifers to recover between overwash events. This study provides critical information for understanding the timing and magnitude of climate change impacts on atoll islands that will result in significant, unavoidable geopolitical issues if it becomes necessary to abandon and relocate low-lying island states."). [Durwood Zaelke, United States of America]	REJECTED: The overall damage and adaptation/mitigation implications of the CH12 hazards are the purview of WGII

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
7460	26	37	27	33	I would suggest that this text is revised following the draft of chapter 9 to reference the relevant sections and ensure consistency [Helene Hewitt, United Kingdom (of Great Britain and Northern Ireland)]	ACCEPTED: We have worked with CH9 authors to ensure that we are consistent in the treatment of physical mechanisms, hazard indices, and projections
41332	26	40	26	40	Refer to sections of the chapter instead of the entire chapter [Debra Roberts, South Africa]	TAKEN INTO ACCOUNT: We now refer to sections of chapters from published assessments (as possible), although we cannot refer to sub-sections of AR6 WGII sections given that these could change after WGI is published.
32990	26	40			Cross-ref to Chapter 9 box 9.2 on key sea level processes [Aimee Slangen, Netherlands]	ACCEPTED: We added a cross-reference to CH9 when discussing sea level processes.
51286	26	47	25	49	Maybe more appropriate for WG-II, but the rate of SLR also affects the ability of societies to implement coastal defense measures: the planning procedure can take longer than the time needed for sea level to exceed the planned defense height [Bart Van den Hurk, Netherlands]	TAKEN INTO ACCOUNT: We have augmented the discussion to also note the importance of the rate of sea level rise as a hazard for urban areas, housing stock, and built infrastructure.
38574	26	52	27	11	There is a new study of extreme storm surge projection based on large ensemble recently. It uses large ensemble of GCM over 5000 years and projected extreme storm surges. It is better to include in this paragraph or other section of in this Chapter (Pacific small islands or Asia), Mori, N., T. Shimura, K. Yoshida, R. Mizuta, Y. Okada, M. Fujita, T. Khujanazarov and E. Nakakita (2019) Future changes in extreme storm surges based on mega-ensemble projection using 60-km resolution atmospheric global circulation model, Coastal Engineering Journal, Taylor & Francis, 13p. doi: 10.1080/21664250.2019.1586290 [Nobuhito Mori, Japan]	TAKEN INTO ACCOUNT: We have considered the suggested reference in the CH12 assessment of coastal flooding, however this study is more about simulation of dynamics (which is assessed in Chapter 11) than about connections between climatic impact drivers and sectoral assets (assessed in Chapter 12).
38576	27	16	27	23	The nation wide projection has conducted targeting to estimate decreasing sandy beaches in Japan. It is nice to include this paragraph. Mori, N., S. Nakajo, S. Iwamura and Y. Shibutani (2018) Projection of decrease in Japanese beaches due to climate change using a geographic database, Coastal Engineering Journal, Taylor & Francis, 8p. doi: 10.1080/21664250.2018.1488513 [Nobuhito Mori, Japan]	TAKEN INTO ACCOUNT: We have considered the suggested reference in assessment of coastlines for the Asia section (12.4.2)
8126	27	18	27	20	This sentence serves as an example of what I feel is excessive self-citation by the lead author of the chapter. I think this is inappropriate. This partticular sentence contains information that has been widely understood for a very long time, so I don't think references are even needed here. [Torbjorn Tornqvist, United States of America]	TAKEN INTO ACCOUNT: We have updated all references and ensured balance across authors (this was expected given placeholder references in the FOD)
42156	27	30			Reference missing [Lubna Alam, Malaysia]	ACCEPTED: We have resolved all notices for placeholder references.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
45854	27	36	27	47	rather than assess impacts here and picking examples or papers (I assume this is what has been done), please use AR5 and the AR6 special reports as the basis for evidence of relevance [Katja Mintenbeck, Germany]	TAKEN INTO ACCOUNT: CH12 has a clear mandate to assess climate hazards and their connections to sectoral impacts even as the full discussion of impacts and risk themselves (connecting with vulnerability and exposure) are left to WGII. In section 12.3 we note that AR5 WGII and the special reports examined sectoral impacts of hazards but and that we are taking an approach centered around assessing which climatic impact drivers are used for each sector. The following section (12.4) then assesses characteristic changes in each climatic impact driver across continents, which may then be mapped into affected sectors using the information in 12.3. CH12 has also been further connected with WGII approaches building off of handshake activities at WGII LAM2 in Kathmandu and WGI LAM3 in Toulouse.
26892	27	40	27	40	add nitrogen dioxide in the list of main air pollutants [Augustin Colette, France]	ACCEPTED: We added nitrogen dioxide to the list of main air pollutants
16138	27	40	27	47	This short paragraph seems too vague. On the one hand reports a lot of different issues, on the other important aspects are forgotten (e.g. no mention of particulate matter is made. Useful reference could be made to chapter 6 to find a more appropriate formulation of this sentence. Also,it would be more appropriate to evidence the WHO tresholds for air pollution, rather than (or in addition to) the fact that limits are different in different countries. [Sandro Fuzzi, Italy]	ACCEPTED: Particulate matter is explicitly mentioned, with specific notes pointing to dust, fires, and pollen. We have also included a cross-reference to WGI CH6, and noted the WHO guidelines in addition to indicating considerable differences across national regulations
43794	27	40	27	47	Here, they also explained the predictability by using only the "potential forecast" method. As air pollution happens near ground where human lives, it strongly related with the structural change of ABL. The strucutre change of ABL would be strongly controlled by climate chnage. We need to use high resolution regional model to estimete it directly. [Izuru Takayabu, Japan]	TAKEN INTO ACCOUNT: We consider the type of model used in studies analysing climate change and air pollution, although a full analysis of strengths and weaknesses of physical process resolution is left for CH6 (which we cross-reference).
50832	27	40	28	25	It would be very helpful to discuss how these other hazards lead to compound hazards in combination with climate related hazards, e.g. in the presence of air-pollution health impacts of heat waves are much stronger. [Friederike Otto, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: A full description of connected hazards is beyond the purview of CH12, but we have noted the importance of not treating all hazards in isolation when performing WGII-like analyses, and have coordinated with CH11 to request that they include a discussion on the physical mechanisms that can lead to connected hazards. We have added a short discussion on connected hazards at the end of 12.3, including a useful way of reading Table 12.2 to understand how climatic impact drivers and/or sectors can interact beyond a more straight-forward climatic impact driver x sectoral asset connection.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
51288	27	46	21	47	Not sure whether "visibility for touristic activities" is a hazard that needs to be assessed by IPCC [Bart Van den Hurk, Netherlands]	REJECTED: There are tremendous societal interests in park and recreation tourism, which makes touristic visibility an asset worth mentioning among the others
35166	27	50	27	50	Shouldn't it be "increase" instead of "decrease"? [Janus Willem Schipper, Germany]	TAKEN INTO ACCOUNT: We have revised CH12 to focus on climatic impact drivers (such as atmospheric CO2 concentration) without trying to make a judgment about the universal direction associated with hazard. CO2 concentration is a great example, as there are extremely complex sectoral responses with many species affected in both positive and negative ways. The overall determination of aggregate risk or benefit is beyond the purview of WGI CH12, which instead notes specific hazard and boon connections and then assesses the change in climatic impact driver (in the case of our example, CO2 concentration is clearly increasing).
16096	27	50	28	13	Higher carbon dioxide concentration can make crops less nutritious. Please consider including the following studies in the discussion. 1. https://www.nature.com/articles/s41558-018-0253-3.epdf 2. https://advances.sciencemag.org/content/4/5/eaaq1012 [SAI MING LEE, China]	ACCEPTED: We cite the suggested references in the CH12 assessment of CO2 concentration changes as a climatic impact driver for agricultural quality
51290	27	50	28	13	this section is only relevant when one can point at areas, periods and mechanisms that will show a CO2 decline. That is quite at odds with the very reason to produce this IPCC report… Also refers to all listings in the regional tables (that generally show a reduction of the hazard anyway) [Bart Van den Hurk, Netherlands]	TAKEN INTO ACCOUNT: We have revised CH12 to focus on climatic impact drivers (such as atmospheric CO2 concentration) without trying to make a judgment about the universal direction associated with hazard. CO2 concentration is a great example, as there are extremely complex sectoral responses with many species affected in both positive and negative ways. The overall determination of aggregate risk or benefit is beyond the purview of WGI CH12, which instead notes specific hazard and boon connections and then assesses the change in climatic impact driver (in the case of our example, CO2 concentration is clearly increasing).

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
28512	27	50			Section 12.3.8.2 is about Atmospheric Carbon Dioxide (CO2) decrease, but the paragraph seems to focus at effect of high CO2 concentration. Note: There is only 1 sentence in the whole paragraph that mentioned about a decline in atmospheric CO2 concentrations. [Kanoksri Sarinnapakorn, Thailand]	TAKEN INTO ACCOUNT: We have revised CH12 to focus on climatic impact drivers (such as atmospheric CO2 concentration) without trying to make a judgment about the universal direction associated with hazard. CO2 concentration is a great example, as there are extremely complex sectoral responses with many species affected in both positive and negative ways. The overall determination of aggregate risk or benefit is beyond the purview of WGI CH12, which instead notes specific hazard and boon connections and then assesses the change in climatic impact driver (in the case of our example, CO2 concentration is clearly increasing).
48360	28	4	28	4	Interesting! Is CO2 really that hetrogenous at the surface that this could be important? I ask because this is not obvious to me (and have not had time to check the references) so I thought I should double-check. [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: The term 'at the surface' was included here to underscore that this is a direct effect of CO2 concentrations on ecosystems and human systems at or near the surface rather than a broader discussion of the overall anthropogenic climate change that is driven in large part by elevated CO2 concentrations throughout the atmosphere. We now specify this in section 12.2 so that the discussion is not confused by this term within 12.3.
31866	28	5	28	13	It is a little problematic that only CO2 decrease is defined as a hazard, while actually half this paragraph is about the impacts of CO2 increase. Some of these impacts might be positive, but others are not: "helps some pests flourish" and "The nutritional density of crops and forage lands is also affected by CO2 concentration". So, it is a bit strange to have this information under the headline "Atmospheric Carbon Dioxide (CO2) decrease" [Anna Sörensson, Argentina]	TAKEN INTO ACCOUNT: We have revised CH12 to focus on climatic impact drivers (such as atmospheric CO2 concentration) without trying to make a judgment about the universal direction associated with hazard. CO2 concentration is a great example, as there are extremely complex sectoral responses with many species affected in both positive and negative ways. The overall determination of aggregate risk or benefit is beyond the purview of WGI CH12, which instead notes specific hazard and boon connections and then assesses the change in climatic impact driver (in the case of our example, CO2 concentration is clearly increasing).

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
31868	28	11	28	12	"The nutritional density of crops and forage lands is also affected by CO2 concentration" - in which way is it affected (decreases/increases)? [Anna Sörensson, Argentina]	TAKEN INTO ACCOUNT: Our overall approach in 12.3 is to note connections between climatic impact drivers and sectoral assets, while leaving the direction and extent of that change to WGII where vulnerability and impact and risk are discussed. The literature indicates that CO2 concentration lowers the nutritional quality of many crops and forage lands, but we leave this to WGII (which discusses this within WGII Chapter 3). Our focus is on defining changes in CO2 as a climatic impact driver rather than on attributing any universal 'hazard' or 'boon' determination.
55492	28	18	28	18	There are too many functions impacted by OA to name here. I suggest avoiding a selection of references and replacing with the relevant part of the SROOC [Daniela Schmidt, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: While there are a large number of functions and systems affected by many of the hazards mentioned in 12.3, we include a select number of high-profile studies that are meant to reinforce the assessment messages that a given hazard is important for a sector. Readers may then find more specific information and follow-on references within these papers and within WGII. We added an improved point of departure to the SROCC.
42158	28	22			Correction CO2 instead of pCO2 [Lubna Alam, Malaysia]	REJECTED: In this case pCO2 stands for the partial pressure of carbon dioxide dissolved in water.
31870	28	23	28	23	"Higher pCO2 concentrations also affect the nutritional quality of phytoplankton at the base of marine food chains"- in which way is it affected (decreases/increases)? [Anna Sörensson, Argentina]	TAKEN INTO ACCOUNT: Our overall approach in 12.3 is to note connections between climatic impact drivers and sectoral assets, while leaving the direction and extent of that change to WGII where vulnerability and impact and risk are discussed. The literature indicates that CO2 concentration lowers the nutritional quality of phytoplankton at the base of marine food chains, but we leave this to WGII (which discusses this within WGII Chapter 3). Our focus is on defining changes in CO2 as a climatic impact driver rather than on attributing any universal 'hazard' or 'boon' determination.
49640	28	40			this citation can be deleted "(Vaquer-Sunyer and Duarte, 2008)" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
35168	28	50	87	14	Although section 12.3 describes the sectors that are affected by changes in climate hazards, the links from the hazards towards the sectors are not described in section 12.4. Please add, at least for some relevant examples per region, these links, as it would fit in the structure that section 12.3 describes the impacts (and relevance) of climate hazards on sectors and section 12.4 describes the specific impacts of these hazard in each region. In this way, section 12.4 would be a clear followup of section 12.3. [Janus Willem Schipper, Germany]	NOTED: An extensive discussion of the many sectoral hazard changes within each region would be beyond the scope (and too long) for Section 12.4, however we have looked to highlight key examples where regional hazard changes are particularly relevant for a given sectoral asset. This is governed by the literature in the region and is constrained by overall space
25504	28	50			Section 12.4 - Should there be references to chapter 11 in this section - it dealt with extremes and should be making similar conclusions. [Sharon Smith, Canada]	ACCEPTED: We have added references to CH11 within 12.4 and have coordinated with CH11 Lead Authors to ensure that there is consistent and coherent treatment of the physical changes in extreme events and the resulting shifts in climatic impact drivers that represent hazards or boons to various regional sectors.
51292	29	10	25	10	insector -> in sector [Bart Van den Hurk, Netherlands]	ACCEPTED: change has been made
48362	29	21	29	21	Strongly suggest reversing the stippling convention so that it obscures regions where there is low agreement instead. [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	**ACCEPTED**: we followed the general stippling/hatching method for the whole report, which includes what is proposed
51294	29	26	29	27	Not for all regions these additional hazard maps are already included in the Atlas in this FOD [Bart Van den Hurk, Netherlands]	NOT APPLICABLE: this is a comment for the Atlas
33000	29	45	29	47	"a positive precipitation trend is indicated as a “wet trend” hazard increase (red) and as a “dry trend” hazard decrease (blue)" this is unintuitive from a common sense perspective. Why not using red-green? [Juan Antonio Rivera, Argentina]	ACCEPTED: We have now revamped our hazard categories and consequently all Hazard assessment tables (incl colour schemes).
7982	29	51	35	1	"Climate Change Impacts in North Africa (North West Africa and North East Africa) are now completely ignored in the document; Many researchers involved in the topic of climat change in North of Africa, produced a vast literature, It is recommended taking into account the most important findings of prior publications." [Abdelkader Hamlat, Algeria]	REJECTED: This chapter does not look at climate change impacts. We are dealing with climate change information for regional impact and risk assessment. North Africa is assessed.
33018	29	51	77	6	The description of Climate hazards for each of the regions are quite different. Apparently the idea is to frame AR5 results as starting point. In the case of Asia you just have 2 sentences about it, while for Africa you have 3 paragraphs. I would suggest to find homogeneity in this aspect [Juan Antonio Rivera, Argentina]	TAKEN INTO ACCOUNT: Section 12.4 now treats regions more homogeneously
8630	29	53	30	1	This statement requires references [Ibikunle Olaleru, Nigeria]	TAKEN INTO ACCOUNT: Reference added.
14858	29	53	30	21	This opening section on Africa has a good structure which could be more closely followed for other regions. The final paragraph on CORDEX is particularly useful - would be good to have something similar for all regions. [Clare Goodess, United Kingdom (of Great Britain and Northern Ireland)]	NOTED: Sections are now homogenized
50902	30	1	30	1	References is needed here, to support the statement of various ocean basin teleconnecting to Africa. The Indian Ocean Dipole (IOD), subtropical South Indian Ocean dipole and Southern Annular Mode (SAM) also need to be mentioned here. [Francois Engelbrecht, South Africa]	REJECTED: This is an introductory paragraph and it is not meant to assess how these features are influencing the climate.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
50904	30	3	30	3	References are needed when describing the rainfall producing systems of the African continent. This paragraph should also refer to tropical-temperate troughs, tropical lows and cyclones and the West and East African monsoon systems. [Francois Engelbrecht, South Africa]	NOTED: We are not describing the rainfall producing systems, we are just mentioning them as mean for opening the section. However tropical-temperate troughs, tropical lows are added.
27408	30	5	30	10	There is a great agreement (among models and studies) about the projected decrease of precipitation in the Mediterranean region which includes a part from North Africa. Please specify what is projected in terms of precipitation in this part of the continent where there is a high agreement regarding precipitation amounts and drought evolutions. [Fatima Driouech, Morocco]	ACCEPTED: Assessment is also done for North Africa
50906	30	6	30	6	"Projected rainfall changes were assessed as uncertain, except in areas of high or complex topography where they were found to be likely increasing by the end of the 21st century.". This is a mispresentation of previous IPCC Assessments in terms of rainfall patterns over Africa. For example, AR4, AR5 and SR1,5 have all assessed that rainfall decreases are likely over southern Africa and Mediterranean North Africa. High confidence statments have also been made in terms of East African rainfall increases for certain seasons. This paragraph should be rewritten to correctly reflect previous assessments of projected changes in rainfall in Africa. [Francois Engelbrecht, South Africa]	TAKEN INTO ACCOUNT: We thank the reviewer for the comment, the text has been revised.
50908	30	9	30	9	"medium confidence that drought will intensify in Eastern Africa". The term "Eastern Africa" is not generally used, rather, the authors should refer to the geographical reagion of "East Africa". There is also no reference in SR1.5 Chapter 3, or in the Africa Chapter of AR5 (Niang et al., 2014), of "medium confidence" in drought increasing over East Africa. The authors need to carefully revise this paragraph to correctly reflect the AR5 and SR1.5 assessments for East Africa. [Francois Engelbrecht, South Africa]	TAKEN INTO ACCOUNT: We thank the reviewer for the comment, the text has been revised.
50910	30	9	30	9	"in Eastern and Southern Africa and low confidence that heavy 10 precipitation will amplify towards the end of the century and in 2 ºC global warming". Once again, this is a wrong portrayal of the AR5 assessment of Niang et al. (2014) - the Africa Chapter of AR5, which found "high confidence" in future increases in extreme precipitation over East Africa. [Francois Engelbrecht, South Africa]	TAKEN INTO ACCOUNT: We thank the reviewer for the comment, the text has been revised
50912	30	9	30	9	"in Eastern and Southern Africa and low confidence that heavy 10 precipitation will amplify towards the end of the century and in 2 ºC global warming". The authors should not use "end of 21st century" and "2 degrees C of global warming" as equivalent statements - this is a gross error. Under low mitigation futures, the 2 degree C threshold may well be exceeded by mid-century, as the authors should know. [Francois Engelbrecht, South Africa]	TAKEN INTO ACCOUNT: We thank the reviewer for the comment, the text has been revised
27410	30	12	30	21	Assessment for north Africa is missing here [Fatima Driouech, Morocco]	ACCEPTED: Assessment is also done for North Africa in the rest of the section
50916	30	15	30	21	References are needed to back-up these statements on model evaluation. [Francois Engelbrecht, South Africa]	REJECTED: Model assessment is taken from the Atlas. This is mentioned at page 30 line 15
50914	30	17	30	19	Replace "Eastern Africa" with "East Africa" and "Western Africa" with "West Africa". [Francois Engelbrecht, South Africa]	ACCEPTED: Replacements have been done.
51296	30	18	41	18	typo in "displacemet" [Bart Van den Hurk, Netherlands]	ACCEPTED: This is corrected.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
45102	30	22	30	23	CORDEX MENA region also covers more than half of Africa and adding the results from that region can improve the GCM/RCM matrix for the area. CORDEX MENA is worth a mention :) Zittis, G., Hadjinicolaou, P., 2017. The effect of radiation parameterization schemes on surface temperature in regional climate simulations over the MENA-CORDEX domain. Int. J. Climatol. 37 (10), 3847–3862. Zittis, G., Hadjinicolaou, P., Lelieveld, J., 2014. Comparison of WRF model physics parameterizations over the MENA-CORDEX domain. Am. J. Clim. Chang. 3, 490–511. T. Ozturk, M. T. Turp, M. Turkes, and M. L. Kurnaz, “Future Projections of Temperature and Precipitation Climatology for CORDEX-MENA Domain Using RegCM4.4”, Atmospheric Research 206, 87-107 (2018). Almazroui, M., 2016. RegCM4 in climate simulation over CORDEX-MENA/Arab domain: selection of suitable domain, convection and land-surface schemes. Int. J. Climatol. 36, 236–251. http://dx.doi.org/10.1002/joc.4340. Almazroui, M., Islam, M.N., Al-Khalaf, A.K., Saeed, F., 2015. Best convective parametrization scheme within RegCM4 to downscale CMIP5 multi-model data for the CORDEX-MENA/Arab domain. Theor. Appl. Climatol. 124, 807–823. Almazroui, M., Islam, M.N., Alkhalaf, A.K., Saeed, F., Dambul, R., Rahman, M.A., 2016. Simulation of temperature and precipitation climatology for the CORDEX-MENA/Arab domain using RegCM4. Arab. J. Geosci. 9 (1), 1–13. Bucchignani, E., Cattaneo, L., Panitz, H.J., Mercogliano, P., 2016. Sensitivity analysis with the regional climate model COSMO-CLM over the CORDEX-MENA domain. Meteorog. Atmos. Phys. 128, 73–95. [Levent Kurnaz, Turkey]	REJECTED: Most of the references suggested here are not relevant for our assessment. The only relevant one (i.e. Ozturk, M. T. Turp, M. Turkes, and M. L. Kurnaz, “Future Projections of Temperature and Precipitation Climatology for CORDEX-MENA Domain Using RegCM4.4) is assessed.
42164	31	1		55	The word likely can be written in normal font instead of italic. [Lubna Alam, Malaysia]	REJECTED: This is a requirement for the calibrated language.
41334	31	3	31	30	Is it possible to contrast RCP8.5 with 2.6? [Debra Roberts, South Africa]	TAKEN INTO ACCOUNT: New figures now focus on RCP8.5 and RCP2.6
50918	31	5	31	9	The authors here provide an understatement of what is known about future temperature increases in Africa. For the very low temperature thresholds (e.g. 2 degrees C) mentioned by the authors to be exceeded by the end of the 21st century under RCP8.5, the level of confidence should be "virtually certain", not "likely". Rather, the authors should make use of the CORDEX and CMIP6 projections to provide the projected temperature range over different regions in Africa, which will be more than 4 degrees C under RCP8.5/SSP8.5, and they should assign an appropriate level of confidence for that range. [Francois Engelbrecht, South Africa]	Taken into account. We thank the reviewer for the comment, the text has been revised.
50920	31	5	31	9	The authors are here providing statements of temperature increases relative to "20th century climate". The should here, and consistently across the chapter, rather express changes in terms of the AR6-agreed historical baseline period - or, alternatively, they should express changes in terms of the pre-industrial baseline. [Francois Engelbrecht, South Africa]	REJECTED: Information are taken from the literature. We don't do new research here. So we assessed what is available in the literature.
51300	31	13	37	13	does this mean that both onset and termination of monsoon season is delayed? [Bart Van den Hurk, Netherlands]	REJECTED: We do not understand to what part of the report the comment refers to
49642	31	19			read "Russo et al., (2016) projected" rather than "Russo et al., 2016 projected" [Cyriaque Rufin Nguimalet, Central African Republic]	ACCEPTED: This is corrected.
51302	31	24	39	25	not clear what is implied here with an increase showing a trend … [Bart Van den Hurk, Netherlands]	REJECTED: We do not understand to what part of the report the comment refers to

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
8718	31	26	31	30	I wonder if a more quantitative statement could be provided here: "likely" is extremely precise, but "more probable" is not and does not informs about the severity of the problem and wether this should be considered as a major issue. [Goneri Le Cozannet, France]	REJECTED: We have to used IPCC language in this case (very likely, likely, etc.). "More probable" is not part of it.
50922	31	26	31	30	In this paragraph on heat stress, human health and mortaility in Africa, the authors may also want to consider the paper by Garland et al. (2015): [Francois Engelbrecht, South Africa]	REJECTED: We here focus on RCP scenarios. Garlan et al. (2015) considered A2 scenario.
43962	31	30	31	30	Suggest to add: "A regional trend analysis of historical Wet Bulb Globe Temperature (1973-2012) finds over much of Africa evidence of detectable anthropogenic increases in summertime WBGT--at least in the African regions with sufficient data available for the trend analysis (Knutson and Ploshay 2016)." Reference: for regional details of where this detection/attribution result applies in Africa and surrounding regions, see Fig. 5 of: Knutson, T.R. & Ploshay, J.J. (2016) Detection of anthropogenic influence on a summertime heat stress index. Climatic Change 138: 25. https://doi.org/10.1007/s10584-016-1708-z. [Thomas Knutson, United States of America]	TAKEN INTO ACCOUNT: Reference assessed and added.
50924	31	38	31	38	The Kruger and Nxumalo is not dated. [Francois Engelbrecht, South Africa]	ACCEPTED: This is corrected.
7984	31	38			"Kruger and Nxumalo" should read "Kruger and Nxumalo 2017" [Abdelkader Hamlat, Algeria]	ACCEPTED: This is corrected.
46088	31	41	31	43	need to also include assessment of cold hazards in specific highland areas accros Africa including East Africa. [Shuaib Lwasa, Uganda]	NOTED: The new version has a cold spell and frost sub- section now
26576	31	51	31	53	A reference to Roehrig et al. (2013) would be welcome here. They showed that "CMIP5 models have not yet reached a degree of maturity which makes it possible to rely directly on them to anticipate climate changes and their impacts, especially with regards to rainfall"; Annual rainfall over a Sahel box may vary by a factor 10 across models, interannual variability and decadal variability being also very different form one model to the other. Ref: Roehrig, R., Bouniol, D., Guichard, F., Hourdin, F. and Redelsperger, J.-L. The present and future of the west african monsoon: a process oriented assessment of CMIP5 simulations along the AMMA transect. J. Climate, 26.17, 6471-6505 [Thierry Lebel, France]	ACCEPTED: The paragraph has been revised.
50926	31	51	31	53	"Observed and projected magnitudes and signs of changes of mean annual and seasonal precipitation in 52 Africa have a large uncertainty for both global and regional scale projections (Aloysius et al., 2016; Dosio 53 and Panitz) (see also Figure 12.5d)". This statement is problematic. The IPCC has in three consecutive assessments, AR4 (Christensen et al., 2007 - the Africa chapter), AR5 (Niang et al., 2014 - the Africa Chapter) and in SR1.5 (Chapter3) assesed that decreases in precipitation are likely over southern Africa and mediterranean North Africa under low mitigation futures. The authors should as a starting point for their assessment correctly portray these findings. Then, if they do want to make the statement that there is a general uncertainty in terms of African rainfall futures, they need to provide convincing evidence why the previous three assessments got it wrong. More likely, the authors statement is too strong, and they should not attempt to make general statements relevant to the entire African continent. [Francois Engelbrecht, South Africa]	TAKEN INTO ACCOUNT: We thank the reviewer for the comment, the text has been revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
26574	31	51	32	35	All the comments below refer to the section "Wet Hazards" in Africa. There is an obvious linkage to make between this section of Chapter 12 with Section 8.4.2.3.2 of chapter 8 on the water cycle. Consistency between these two parts of the WG1 report is an important issue. Linkages with the sections of the future WG2 report on impacts that will deal with Africa should also be considered [Thierry Lebel, France]	TAKEN INTO ACCOUNT: We thank the reviewer for the comment, the text has been revised.
57756	31	51	32	35	All this section seems to me mainly based on CORDEX results. Please check consistency with Ch10.4.3.2.1 where CMIP5 results are assessed; for instance the drying of Western Africa (lines 5-7) is somehow in contrast with CMIP5 results. You may also want to include the study by Dosio, A., Jones, R., Jack, C., Lennard, C., Nikulin, G., and Hewitson, B. (2019). What can we know about future precipitation in Africa? Robustness, significance and added value of projections from a large ensemble of regional climate models. Clim. Dyn. doi:Submitted. who directly compared precipitation future characteristics in Africa from the large CORDEX ensemble with the results of the driving GCMs. [Alessandro Dosio, Italy]	TAKEN INTO ACCOUNT: We thank the reviewer for the comment, the text has been revised.
7986	31	52		53	"Dosio and Panitz" should read "Dosio and Panitz 2015" [Abdelkader Hamlat, Algeria]	ACCEPTED: This is corrected.
57754	31	53	31	53	The exact reference for Dosio and Panitz is Dosio, A., and Panitz, H.-J. (2016). Climate change projections for CORDEX-Africa with COSMO-CLM regional climate model and differences with the driving global climate models. Clim. Dyn. 46, 1599–1625. doi:10.1007/s00382-015-2664-4. [Alessandro Dosio, Italy]	ACCEPTED: Reference corrected.
26580	31	55	32	7	There is an overall impression of confusion stemming from the different pieces assembled in this paragraph: "Increasing precipitation in Central and Eastern Sahel" (line 55 p 12-31); "wet signal getting stronger and more extended for a 3°C and 4°C warmer world" (line 4-5 p 12-32); "a drying of about 10% is projected by the end of the century for the RCP 8.5 in West Africa" (line 5-6 p 12-32). Sources and nature of uncertainty are different for the various regions mentioned (see above comment for West Africa). This reflects the fact that there is no agreement between models on this long/hot debated issue on how will evolve the annual rainfall in West Africa and/or on the contours of areas where it might increase and where it might decrease. I would suggest to clarify this [Thierry Lebel, France]	TAKEN INTO ACCOUNT: We thank the reviewer for the comment, the text has been revised for more clarity.
50928	31	55	32	7	The authors should use as the baseline for their discussion the CMIP6 ensemble, which at this point in time is not mentioned at all. They should show Figures on the projected changes in rainfall and rainfall extremes over Africa based on the CMIP6 ensemble, or at least refer to Figures from other Chapters, for example Chapter 11 on extremes. From the CMIP6 baseline, the authors can then supplement the discussion with the set of CORDEX papers they are already referring to. [Francois Engelbrecht, South Africa]	TAKEN INTO ACCOUNT: CMIP6 is there now.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
27412	31		31		Wet hazards part: Please introduce assessment in the case of north-Africa where there is great agreement (at least for the north-west) about future evolutions of precipitation amounts. These evolutions are projected to severely impact agriculture and water resources (Please see: RICCAR assessment report and references included (https://www.unescwa.org/publications/riccar-arab-climate-change-assessment-report), IRD (2016) The Mediterranean Region under Climate Change (and references included), Betts et al. (2016), Döll et al. (2018) among many others) [Fatima Driouech, Morocco]	ACCEPTED: Assessment is provided for the North Africa region.
26578	32	3	32	3	Given the uncertainty and lack of convergence among forcing GCMs in monosoon regions (such as West Africa), the confidence to be given to CORDEX simulations should be questionned (see for instance Hourdin et al., 2010 on this topic). A well known bias of GCMs over the WAM area relates to wrong SSTs simulations over the Guinea Gulf, limiting the northward migration of the ITCZ. Diallo et al. (2017) mention that "Even with prescribed sea surface temperature, large biases remain on the position of the zonal jets and ITCZ". Given the topic ("climate change information") of this chapter and the intrinsic forcing biaises in Cordex simulations over sub-saharan Africa, I would be extremly reluctant to advise any African government to make stringent adaptation decisions based on Cordex simulations (ie changing agricultural practices, replacing one culture by another, building water resources planing on the assumption that annual rainfall would increase or decrease at any given level ...) Refs: Hourdin, F. and co-authors, 2010, AMMA model intercomparision project, Bull. Amer. Meteor. Soc., 91, 95_104 F.B. Diallo, F. Hourdin, C. Rio, A.-K. Traore, L. Mellul, F. Guichard and L. Kergoat, 2017, The surface energy budget computed at the grid-scale of a climate model challenged by station data in West Africa, JAMES, 9(7), 2710-2738, https://doi.org/10.1002/2017MS001081, 2017 [Thierry Lebel, France]	NOTED: Note sure what revision is required here but we would like to recall that the assessment is based in available literature and the information therein.
42166	32	3			Elaboration of GCM [Lubna Alam, Malaysia]	ACCEPTED: GCM elaborated as Global Climate Model.
26584	32	9	32	11	It should be mentioned here that intensification is already detected in the West-African Sahel, has depicted in Panthou et al. (2018). Ref. : Panthou G., Lebel T., Vischel T., Quantin G., Ba A., Sane Y., Ndiaye O., Diongue-Niang A., Diopkane M, 2018. Rainfall intensification in tropical semi-arid regions: the Sahelian case. Environmental Research Letters, 13 (6), 064013. [Thierry Lebel, France]	TAKEN INTO ACCOUNT: We thank the reviewer for the comment, the text has been revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
26586	32	9	32	11	A recent paper by Kendon et al. (2019) underlines that high resolution (4.5 km grid-spacing), convection-permitting simulations shows future increases in dry spell length during the wet season over western and central Africa, weaker or not apparent in simulations carried out with a convection-parameterised 25 km grid-spacing model. Rainfall extremes are mentionned in line 40 page 12-33; more consideration should be paid to this issue in this "Wet hazards section". Ref. : E. J. Kendon, R. A. Stratton, S. Tucker, J. H. Marsham, S. Berthou, D. P. Rowell & C. A. Senior (2019). Enhanced future changes in wet and dry extremes over Africa at convection-permitting scale. Nature Communications 10, Article number: 1794 (2019). https://doi.org/10.1038/s41467-019-09776-9. [Thierry Lebel, France]	TAKEN INTO ACCOUNT: Reference added.
26582	32	13	32	16	By contrast to the uncertainty regarding the evolution of the annual rainfall totals there is a much stronger agreement on two meaningfull evolutions in terms of impacts and risks: 1) Change in seasonality as mentioned here (ref to Lebel and Ali, 2009, and to Monerie et al. , 2012, would be welcome in this respect) 2) Deepening of the dipole between the Western and the Central / Estearn Sahel (e.g. same refs as above, different authors having mentioned this since these early publications). I would thus suggest to better distinguish what is highly uncertain (such as annual rainfall evolution) from what makes more consensus (seasonality and dipole) Refs: Lebel, T. and Ali, A., 2009. Recent trends in the Central and Western Sahel rainfall regime (1990 - 2007). J. Hydrol., 375(1-2), 52-64 Monerie, P.A., B. Fontaine and P. Rocou (2012). Expected future changes in the African monsoon between 2030 and 2070 using some CMIP3 and CMIP5 models under a medium-low RCP scenario. [Thierry Lebel, France]	REJECTED: Suggested references are considered old. We consider references after AR5.
50930	32	18	32	22	The authors need to refer to the extreme precipitation and streamflow of Chapter 3 of SR1.5, which reports negative tendencies for these quantities in several African regions. [Francois Engelbrecht, South Africa]	NOTED: the SR1.5 is considered as point of departure so it is used in the opening of the section if relevant. In the main text only new literature is reported.
26588	32	18	32	27	Hydrological scenarios are uncertain, but it would be worth mentioning here that trends are already detected in the hydrological extremes in the Senegal and Niger Rivers. Ref. : Wilcox, C., Vsichel, T., Panthou, G., Bodian, A. et al., 2018. Trends in hydrological extremes in the Senegal and Niger rivers. J. Hydrol., 566, 531-545 [Thierry Lebel, France]	**NOTED:** The reference was unfortunately not assessed, by mistake
14860	32	18	32	35	In these examples, details are given of the number of climate/impact models used. This is generally not done for other examples. Would be useful to have some consistency across the chapter on how or whether such information is reported. [Clare Goodess, United Kingdom (of Great Britain and Northern Ireland)]	ACCEPTED: This is removed.
33002	32	24	32	24	Typically, the low flow quantile is the Q90 (flow which was equalled or exceeded for 90% of the specified term) instead of the Q10 [Juan Antonio Rivera, Argentina]	TAKEN INTO ACCOUNT: We thank the reviewer for the comment, the text has been revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
50932	32	29	32	35	The authors may want to consider a "box" on the Idai Tropical cyclone floods in Mozambique in March 2019, the biggest flood disaster in recorded history in southern Africa - and the second largest flood disaster in recorded history in the Southern Hemisphere. [Francois Engelbrecht, South Africa]	NOTED: But not much literature is available for this. For space reasons we will not add a box
50934	32	29	32	35	The authors should refer in more detail to some of the process-based studies on flood hazards in Africa. Some exampes are: Engelbrecht C.J., Engelbrecht F.A. and Dyson L.L. (2013). High-resolution model-projected changes in mid-tropospheric closed-lows and extreme rainfall events over southern Africa. International Journal of Climatology 33 173-187. DOI: 10/1002/joc.3420; Malherbe J., Engelbrecht F.A. and Landman W.A. (2013). Projected changes in tropical cyclone climatology and landfall in the Southwest Indian Ocean region under enhanced anthropogenic forcing. Climate Dynamics 40 1267-1286. DOI 10.1007/s00382-012-1635-2; Muthige M., Malherbe J., Engelbrecht F., Grab S., Beraki A., Maisha R., Van Der Merwe J. (2018). Projected changes in tropical cyclones over the South West Indian Ocean under different extents of global warming. Env. Res. Letters 104541.R1. [Francois Engelbrecht, South Africa]	NOTED: The two last papers are assessed and added.
42168	32	33			no space required before degree celsius [Lubna Alam, Malaysia]	ACCEPTED: Space is removed.
43964	32	40	32	42	Suggest to add: "A gridpoint based precipitation trend analysis for 1901-2010 for the limited African regions with sufficient data for trend analysis over this period finds little evidence for detectable decreasing trends in southern Africa but some regions with detectable anthropogenic decreases in northern tropical Africa and the African Mediterranean region (Knutson and Zeng 2018). This precipitation trend finding supports projections of increasing drought in parts of northern tropical Africa and the Mediterranean region, but not elsewhere in Africa. Of note, the decreasing precipitation trends in northern tropical Africa and the Mediterranean region appear to be the most prominent examples of large-scale detectable anthropogenic precipitation decreases (drying trends) over the past century anywhere in the world, although some smaller regions such as southwest Australia, also have very pronounced drying trends." Reference: see Fig. 3 of: Knutson, T.R. and F. Zeng, 2018: Model Assessment of Observed Precipitation Trends over Land Regions: Detectable Human Influences and Possible Low Bias in Model Trends. J. Climate, 31, 4617–4637, https://doi.org/10.1175/JCLI-D-17-0672.1 [Thomas Knutson, United States of America]	ACCEPTED: Reference added.
50936	32	40	32	42	SR1.5 Chapter 3, SREX and AR5 assigned only low confidence in existing trends indicating increases in drought in Africa, and those statements were largely confined to Africa. The authors need to start this section by referring to these assessments, and from that basis they need to motivate their stronger statement (medium confidence) of increases in drought over larger parts of the African continent, [Francois Engelbrecht, South Africa]	TAKEN INTO ACCOUNT: We thank the reviewer for the comment, the text has been revised.
49644	32	42			read "(Dai, 2013; Thomas and Nigam, 2018)" rather than "(Dai, 2013)(Thomas and Nigam, 2018)" [Cyriaque Rufin Nguimalet, Central African Republic]	ACCEPTED: This corrected.
50938	33	1	33	6	When referring to drought in the southwestern Cape in South Africa, the authors may also want to refer to the paper by Naik and Babatunde (2019) "Projected changes in drought characteristics over Western Cape, South Africa", in Meteorological Applications. [Francois Engelbrecht, South Africa]	ACCEPTED: Reference added.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
13246	33	1	72	55	The term of "wind power" and "wind energy" used together (mixed) in "Wind and storm hazards in *REGION*". This word should be unified as "wind energy". [Masamichi Ohba, Japan]	REJECTED: These wind terms are not mentioned in the Africa section.
51304	33	4	37	4	delete "is" [Bart Van den Hurk, Netherlands]	ACCEPTED: "is" deleted.
41336	33	4	33	4	Delete 'is' [Debra Roberts, South Africa]	ACCEPTED: "is" deleted.
43966	33	11	33	26	Comment: Some of the high confidence in future drought increase is for regions (e.g., southern Africa) where CMIP5 models simulated a decreasing rainfall trend over 1901-2010, but there was little evidence for a detectable decrease in observed precipitation (and in fact there were nominal increases in precipitation across much of the region (Knutson and Zeng 2018). If there is no evidence of decreasing trend in precipitation over 110 year period, I do not have high confidence there will be an increase in coming decades even if models tend to agree. Without a precipitation decrease driving the drought decrease one is relying on a temperature mechanism, but I'm not convinced that is strong enough to overcome even a minor precipitation increasing trend. Per Milly and Dunne (2016) inferences based on offline drought metrics (e.g., PDSI) are likely not reliable. So I suggest this is not a high confidence projection of drought increase in cases where there is no clearly detectable decreasing trend in rainfall or soil moisture. References: see Fig. 3 of: Knutson, T.R. and F. Zeng, 2018: Model Assessment of Observed Precipitation Trends over Land Regions: Detectable Human Influences and Possible Low Bias in Model Trends. J. Climate, 31, 4617–4637, https://doi.org/10.1175/JCLI-D-17-0672.1 Milly, P. C. D., and Dunne, K. A. (2016). Potential evapotranspiration and continental drying. Nat. Clim. Chang. 6, 25 946–949. doi:10.1038/nclimate3046. [Thomas Knutson, United States of America]	NOTED: Not sure what is required here.
50940	33	11	33	26	The authors correctly discuss the effects of rapidly rising temperatures in Africa on reduces soil-moisture, in addition to the reductions in rainfall projected for southern Africa. The authors may in this regard also want to refer to the papers by Engelbrecht F., Adegoke J., Bopape M-J., Naidoo M., Garland R., Thatcher M., McGregor J., Katzfey J., Werner M., Ichoku C. and Gatebe C. (2015). Projections of rapidly rising surface temperatures over Africa under low mitigation. Env. Res. Letters. 10 085004 and Babatunde et al. (2018) Future projection of droughts over major river basins in Southern Africa at specific global warming levels. Theoretical and applied climatology. [Francois Engelbrecht, South Africa]	REJECTED: This reference is not added because it is not specific to RCP4.5 and/or RCP8.5
42170	33	21			PDSI (elaboration) [Lubna Alam, Malaysia]	ACCEPTED: PDSI has been elaborated as Palmer Drought Severity Index.
51306	33	44	37	4	ironic that in 2019 two hurricanes hit Madagascar and Mozambique within a period of 6 weeks [Bart Van den Hurk, Netherlands]	NOTED: Information about these are not available in literature to our knowledge
14862	33	44	33	46	What about changes in other parts of the region? Is there no evidence or no evidence of changes? There are dangers in citing 'odd' studies like this with no broader context/assessment. [Clare Goodess, United Kingdom (of Great Britain and Northern Ireland)]	ACCEPTED: Other parts of Africa are mentioned that there is no evidence of such hazards occurrence in available literature.
14864	33	48	33	49	Also consequences for solar generation and maintenance. [Clare Goodess, United Kingdom (of Great Britain and Northern Ireland)]	ACCEPTED: This is added.
55752	33	48	34	4	Need to add additional studies (on health impacts and trends) and perhaps refine confidence estimates. [Carlos Perez Garcia-Pando, Spain]	REJECTED: Assessing health impacts is not our mandate.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
41338	34	4	34	4	Suggest deleting 'for some reasons' of the reasons are not provided. [Debra Roberts, South Africa]	ACCEPTED: "For some reasons" has been deleted.
8720	34	7	34	19	This paragraph (sea level rise impacts in Africa) could apply in many other places, so this could result in some repetitions accross regional sections. May be it is possible to say a word about how african coasts are more or less vulnerable to some of the major hazards induced by sea-level rise. Without having the big picture myself, I would say that due to water scarcity in Morocco and Egypt, this is an additional constraint to water pumping and agriculture. I would also mention that erosion in the gulf of Guinea can be exacerbated by the absence of sediment management plans (e.g. by-pass in harbours)... Otherwize the risk is to deliver very generic information that does not highlight the reasons for concerns in each region (?). [Goneri Le Cozannet, France]	NOTED: Not sure what revision is needed here.
32358	34	7	34	21	A more significant effort needs to be placed in addressing the section on coastal hazards in Africa. While there is in fact limited work on regional projections of coastal change, significant work has been developed on shoreline evolution over the past decades in some coastal sections (e.g. Anthony et al., 2019, Continental Shelf Research, DOI: 10.1016/j.csr.2018.12.006; Cabral et al., Internationa Journal of Disaster Risk Reduction, DOI: 10.1016/j.ijdrr.2017.04.002; Palalane et al., Journal of Coastal Research, DOI:10.2112/JCOASTRES-D-14-00020.1) and recent extreme coastal flooding events (tropical cyclones Idaí and Kenneth) have demonstrated that while modellling studies may suggest a decrease in tropical cyclones making landfall in SE Africa (Muthige et al., 2019 - already in the chapter references) the observational record suggest intensification of tropical cyclones (Fitchett, J.M., 2018. Recent emergence of CAT5 tropical cyclones in the South Indian Ocean. South African Journal of Science 114 (11/12), 4426, 6 p.). For areas without detailed information the works of Luijendijk et al. (2018) and Mentaschi et al., (2018) provide first order approximations and can be used for Africa just as they have been used for other continents in this chapter. [Carlos Loureiro, United Kingdom (of Great Britain and Northern Ireland)]	REJECTED: too much WGII reference not relevant for this section
46090	34	9	34	19	Include lietrature in assessment about different coastal areas like Cape Town, Mombasa, Alxendria etc [Shuaib Lwasa, Uganda]	NOTED: We have assessed what is available and have included any new literature in this matter if available.
42172	34	9		11	no space required before degree celsius [Lubna Alam, Malaysia]	ACCEPTED: Space is removed.
51308	34	31	45	31	would be good to provide some meta-information on this table: time range, RCP, global temperature change? Table is very useful [Bart Van den Hurk, Netherlands]	ACCEPTED: Table caption is revised.
14866	35	1	35	1	The format of these summary tables is very nice and clear. Very useful. [Clare Goodess, United Kingdom (of Great Britain and Northern Ireland)]	NOTED: Thank you for this positive comment
43968	35	1	35	3	A map showing the definitions of the different African regions in table 12.3 and the main text is needed for context. [Thomas Knutson, United States of America]	TAKE INTO ACCOUNT: Regions are defined in the Atlas
42174	35	1			Source of table 12.3 [Lubna Alam, Malaysia]	TAKEN INTO ACCOUNT: Table 12.3 is made up as a n expert judgment based on the assessment. This is specified in the caption

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
9998	35	6	35	6	Authors should definitely refer to the recent HIMAP assessment report: Wester P., Mishra A., Mukherji A., Shrestha A. (eds) The Hindu Kush Himalaya Assessment. Springer, Cham - see https://link.springer.com/book/10.1007/978-3-319-92288-1 [Valerio Lucarini, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account -Reference added
43796	35	6	45	12	Almost all references explaining the climate hazards in East Asia comes form China. And a bit more from Korean Peninsular. Some issues happened around Japan Islands should be added here. [Izuru Takayabu, Japan]	TAKEN INTO ACCOUNT- Text is revised to add more material regarding climate change in Japan and Korea in the chapter.
14540	35	6	45	16	More publications on Asian change in extreme climate are available. Mainland China and East Asia are much more under-representative in this version of the chapter draft, considering the thousands of publications for the regions in both English and Chinese. I would suggest that the authors search for and read those published in languages other rather English and those as special issues of international English journals. For example, there are a series of special issues on mean and extreme climate change over mainland China, East Asia, and Hindu Kush Himalaya in journals like Climate Research, Climate Change, Advance in Climate Change Research, and Climate and Environmental Research (in Chinese). Besides, further attention could be given to a few of highly sensitive areas including East Asian monsoon region, Hindu Kush Himalayan region or the Qinghai-Tibetan Plateau, South Asian monsoon region, and Central Asia. (CUG, Guoyu Ren) [Guoyu Ren, China]	TAKEN INTO ACCOUNT - We have revised the text to include in the assessment additional literature (not only in English) on mainland China, East Asia, and the "highly sensitive areas" as suggested by the reviewer.
26216	35	8	35	12	Most of the summary here rely on Shen et al. (2018) paper. This paper clusters countries based on natural disasters that include geo-hazards such as volcanoes and tsunami, and also epidemics. Therefore, volcano and tsunami affected countries are biased to be clustered as such, neglecting weather and climate related hazards. For example, Japan and Indonesia are classfied as high fatality due to Tsunami. Some other considerations may be needed. [Akio Kitoh, Japan]	Accepted - The introductory summary about the climatic impact factors in Asia is revised.
6215	35	10	35	10	sand-dust storms and also flooding in West Asia [Mostafa Jafari, Iran]	Accepted-text revised.
16098	35	10	35	10	Please replace “typhoons and tropical cyclones” by “tropical cyclones”. [SAI MING LEE, China]	Accepted-text revised.
7658	36	6	36	8	Add literature for more evidence. Hong and Hong (2016) Changes in the Seoul metropolitan area urban heat environment with residential redevelopment, Journal of Applied Meteorology and Climatology, 55, 1091-1106 [Jinkyu Hong, Republic of Korea]	REJECTED- Suggested reference is more on the urban effect on temperature than long-term background warming. References may already be enough but open to adding more relevant ones. (Comment is same as Comment 36832).
36832	36	6	36	8	Add literature for more evidence. Hong and Hong (2016) Changes in the Seoul metropolitan area urban heat environment with residential redevelopment, Journal of Applied Meteorology and Climatology, 55, 1091-1106 [Jinkyu Hong, Republic of Korea]	REJECTED- Suggested reference is more on the urban effect on temperature than long-term background warming. References may already be enough but open to adding more relevant ones.
28138	36	9	36	10	An Asia2k project of PAGES2k is suggested to be cited and was achieved to reconstruct the Asian temperature ion over the past millennium by a multi-proxy approach (Shi et al., 2015, climatic change), which supports the late 20th century was the warmest period in Asia over the past millennium, but the temperatures in some regions during the 11th, 12th and 13th are comparable to levels in the 20th century. This project includes some precious historical documentary data from eastern China. [Feng SHI, China]	**TAKEN INTO ACCOUNT**: More supports based on literature is used to confirm if the late 20th century was the warmest period in Asia over the past millennium.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
35354	36	12	36	14	Re-citation/overlap with chapter Atlas (Page 41, Line 37-39) for rapid increase in minimum temperatures in Asia (Cheong et al., 2018). Same reference is used in Chapter 12. [Mehwish Ramzan, Pakistan]	Accepted - Coordination is done with the Atlas to reduce redundant texts and ensure consistencies. But the reference can stay in CH12 too
7660	36	17	36	27	We should mention that heat wave in East Asia is closely related to rapid urbanization in this area. Here is new study to support this. Hong et al. (2019) Evolution of the urban heat island over half a century in the Seoul metropolitan area, Korea: Impact of the economic climate and urbanization, Environment Pollution, in revision. [Jinkyu Hong, Republic of Korea]	Accepted -Text has been revised with additional references.
43836	36	18	36	18	Please add Imada et al. (2017, BAMS) which analysed the historical change in heat wave frequency in Asia. Imada, Y., H. Shiogama, C. Takahashi, M. Watanabe, M. Mori, Y. Kamae, and S. Maeda, 2018: Climate change increased the likelihood of the 2016 heat extremes in Asia. Bull. Amer. Meteor. Soc., DOI:10.1175/BAMS-D-17-0109.1. [Izuru Takayabu, Japan]	Taken into account -Reference added
44138	36	19	36	27	Suggest to add to end of paragraph: "A regional trend analysis of historical summertime Wet Bulb Globe Temperature (WBGT) for the period 1973-2012 finds extensive regions of Asia with detectable anthropogenic increases in this heat stress index that includes both temperature and moisture influences (Knutson and Ploshay 2016). Trend analysis for temperature only since 1901 shows detectable anthropogenic influence on temperature in the region over the past century (Knutson et al. 2013). " References: Knutson, T.R. & Ploshay, J.J. (2016) Detection of anthropogenic influence on a summertime heat stress index. Climatic Change 138: 25. https://doi.org/10.1007/s10584-016-1708-z. and Knutson, T.R., F. Zeng, and A.T. Wittenberg, 2013: Multimodel Assessment of Regional Surface Temperature Trends: CMIP3 and CMIP5 Twentieth-Century Simulations. J. Climate, 26, 8709–8743, https://doi.org/10.1175/JCLI-D-12-00567.1 " [Thomas Knutson, United States of America]	Accepted - Text has been revised with additional references.
13102	36	25	36	25	Providing full citations here: [(Lee et al., 2018b; Shin et al., 2018; Wang et al., 2019; You et al., 2017; Zhou and Wang, 2016).] Reference: Zhou, C., and Wang, K., (2016). Coldest temperature extreme monotonically increased and hottest extreme oscillated over northern hemisphere land during last 114 years. Sci. Rep., 6, 25721. doi: 10.1038/srep25721. [Zhou Chunlüe, United States of America]	Taken into account -Reference added
6217	36	34	36	34	According to all reports in different scales temperature of Astara region in the north west of Iran , in last half century has been increased. Astara location is included in both of Central Asia and West Asia subregions in IPCC AR4. Projection for temperature change in Central Asia subregion is not in agreement with national and local downscaling results (Jafari, 2013) [Mostafa Jafari, Iran]	Noted
35352	36	35	36	35	Central Asia show an increase between °C and about 7°C on average, (Missing the temperature value indicated with bolded text) SEP [Mehwish Ramzan, Pakistan]	ACCEPTED - Text revised.
41340	36	35	36	35	The value for the first part of the temperature range is missing [Debra Roberts, South Africa]	Taken into Account - see response to Comment 35352
45114	36	35	36	35	Sentence should read "… between 3 oC and about 7 oC..." [Levent Kurnaz, Turkey]	Taken into Account - see response to Comment 35352

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
46318	36	35	36	35	lower temperature value should be noted. [sadegh zeyaeyan, Iran]	Taken into Account - see response to Comment 35352
55282	36	35	36	35	Please mention number with unit of temperature [Muhammad Amjad, Pakistan]	Taken into Account - see response to Comment 35352
57594	36	35	36	35	lower temperature value should be noted. [Sahar Tajbakhsh Mosalman, Iran]	Taken into Account - see response to Comment 35352
45104	36	37	36	37	CORDEX MENA region also covers the Middle East region and adding the results from that region can improve presentation. Especially Mansour's work on Arabian Peninsula should not be ignored. Zittis, G., Hadjinicolaou, P., 2017. The effect of radiation parameterization schemes on surface temperature in regional climate simulations over the MENA-CORDEX domain. Int. J. Climatol. 37 (10), 3847–3862. Zittis, G., Hadjinicolaou, P., Lelieveld, J., 2014. Comparison of WRF model physics parameterizations over the MENA-CORDEX domain. Am. J. Clim. Chang. 3, 490–511. T. Ozturk, M. T. Turp, M. Turkes, and M. L. Kurnaz, "Future Projections of Temperature and Precipitation Climatology for CORDEX-MENA Domain Using RegCM4.4", Atmospheric Research 206, 87-107 (2018). Almazroui, M., 2016. RegCM4 in climate simulation over CORDEX-MENA/Arab domain: selection of suitable domain, convection and land-surface schemes. Int. J. Climatol. 36, 236–251. http://dx.doi.org/10.1002/joc.4340. Almazroui, M., Islam, M.N., Al-Khalaf, A.K., Saeed, F., 2015. Best convective parametrization scheme within RegCM4 to downscale CMIP5 multi-model data for the CORDEX-MENA/Arab domain. Theor. Appl. Climatol. 124, 807–823. Almazroui, M., Islam, M.N., Alkhalaf, A.K., Saeed, F., Dambul, R., Rahman, M.A., 2016. Simulation of temperature and precipitation climatology for the CORDEX-MENA/Arab domain using RegCM4. Arab. J. Geosci. 9 (1), 1–13. Bucchignani, E., Cattaneo, L., Panitz, H.J., Mercogliano, P., 2016. Sensitivity analysis with the regional climate model COSMO-CLM over the CORDEX-MENA domain. Meteorog. Atmos. Phys. 128, 73–95. [Levent Kurnaz, Turkey]	Taken into account -Some Reference added
7664	36	41	36	43	Here is new study to support increase of heat wave in Korea that will be published soon. Hong et al. (2019) Evolution of the urban heat island over half a century in the Seoul metropolitan area, Korea: Impact of the economic climate and urbanization, Environment Pollution, in revision." [Jinkyu Hong, Republic of Korea]	Taken into account - see response to Comment 7660
35356	36	41	36	43	Re-citation/overlap with chapter Atlas (Page 48, Line 35-36) for increasing trend of heat waves over Pakistan (Saeed et al., 2017). [Mehwish Ramzan, Pakistan]	Accepted-text revised.
42176	37	1			space required before (high confidence) [Lubna Alam, Malaysia]	ACCEPTED - Text is revised.
42178	37	10			space required before (medium confidence) [Lubna Alam, Malaysia]	ACCEPTED - Text is revised.
43838	37	18	37	18	Over Japan, occurrence of extremely hot days will be expected to increase by 1.4 times and 1.8 times under 1.5 degC and 2.0 degC warmer worlds, respectively (Imada et al. 2019). Imada, Y., M. Watanabe, H. Kawase, H. Shiogama, and M. Arai, 2019: The July 2018 High Temperature Event in Japan Could Not Have Happened without Human-Induced Global Warming. SOLA, 15A, 8-12, https://doi.org/10.2151/sola.15A-002. [Izuru Takayabu, Japan]	Accepted - Text is revised to include literature on other countries in East Asia.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
25508	37	19	37	19	it is more correct to say "permfrost is warming (rather than thawing)" which is implied by the changes in permafrost temperature mentioned in the paragraph. Changes in active layer thickness are mentioned in references mentioned above and also in ch 2 and 9 so you could say something about this and thawing of shallow permafrost [Sharon Smith, Canada]	REJECTED - The term warming instead of thawing is not changed in this section to keep the consistency within this chapter.
25506	37	19	37	22	Make link to Chapter 2 (2.3.2.5) which discusses permafrost temperature trends (also refer to Ch 9). Biskaborn et al. only looks at a decade so reference should be made to AMAP document Romanovsky et al. (2017 - ref and link provided earlier in Ch 12 comments) as well as most recent state of climate reports (Romanovsky et al. 2018 and Noetzli et al 2018 - updates for these should be released later in summer) which considers longer time series and is more up to date with respect to time series used. Refs: Romanovsky VE, Smith SL, Isaksen K, Shiklomanov NI, Streletskiy DA, Kholodov AL, Christiansen HH, Drozdov DS, Malkova GV, Marchenko SS (2018) [Arctic] Terrestrial Permafrost [in "State of the Climate in 2017"]. Bulletin of the American Meteorological Society (supplement) 99 (9):S161-S165. doi:10.1175 /2018BAMSStateoftheClimate.1; Noetzli J, Christiansen HH, Deline P, Guglielmin M, Isaksen K, Romanovsky VE, Smith SL, Zhao L, Streletskiy DA (2018) [Global Climate] Permafrost Thermal State [in "State of the Climate in 2016"]. Bulletin of the American Meteorological Society (supplement) 99 (9):S20-S22. doi:10.1175 /2018BAMSStateoftheClimate.1 [Sharon Smith, Canada]	Accepted-text revised.
25510	37	22	37	24	Biskaborn et al. (2019) is incorrect reference for this statement [Sharon Smith, Canada]	Accepted-text revised. Replace reference with correct one.
33004	37	22	37	24	The assessment of freezing rain or freezing drizzle should be placed in the cold hazards section [Juan Antonio Rivera, Argentina]	Accepted - Text (on freezing rain) to be moved under Section 12.4.2.6 (Snow and Ice hazards in Asia)
46000	37	27	37	36	Same comment as above [Lourdes Tibig, Philippines]	Noted.
43840	37	29	37	36	Mori et al. (2014 Nature Geosci., 2019 Nature Climate Change) pointed that there is a cooling trend in the central Eurasia and it is attributable to enhanced melting of Arctic sea ice. They also pointed that general AGCMs underestimates atmospheric responses to Arctic sea ice variability. Mori, M., M. Watanabe, H. Shiogama, J. Inoue, and M. Kimoto, 2014: Robust Arctic sea-ice influence on the frequent Eurasian cold winters in past decades. Nat. Geosci. 7, 869–873. Mori, M., Y. Kosaka, M. Watanabe, H. Nakamura, and M. Kimoto, 2019: A reconciled estimate of the influence of Arctic sea-ice loss on recent Eurasian cooling. Nature Climate Change, 9, 123-129. [Izuru Takayabu, Japan]	Not applicable - This is now related to the arctic region and European Russian
42180	37	32			space required before citation [Lubna Alam, Malaysia]	ACCEPTED - Text is revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
16100	37	34	37	36	The author should also consider including relevant references on arctic amplifications and cold waves (e.g. Francis and Skific, 2015; Overland and Wang, 2018) References : - Francis Jennifer and Skific Natasa, 2015 : Evidence linking rapid Arctic warming to mid-latitude weather patterns, Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences, 373 (2045), https://doi.org/10.1098/rsta.2014.0170 - James E. Overland, Muyin Wang, 2018 : Arctic-midlatitude weather linkages in North America, Polar Science, Volume 16, Pages 1-9, ISSN 1873-9652, https://doi.org/10.1016/j.polar.2018.02.001. [SAI MING LEE, China]	Not applicable - This is now related to the arctic region and European Russian
43972	37	39	40	6	The series of statements in the wet hazard and dry hazards sections can seem confusing. Having a map analysis showing the observed and historical run trends and assessment (detection, attribution, consistency) for 1901-2010 trends and 1951-2010 trends would be a way of making this all clearer. In any case, I suggest the following overall summary for decreasing precipitation trends for Asia: "Some detectable anthropogenic decreasing precipitation trends (1901-2010) were found in Asia in a gridpoint-based trend analysis (Knutson and Zeng, 2018), including most prominently the eastern Mediterranean regions, along with some gridboxes in Japan and South Asia, southeast Asia and the Maritime Continent. However, many regions, particular in South Asia show no significant precipitation trends." Reference: see Fig. 3 of: Knutson, T.R. and F. Zeng, 2018: Model Assessment of Observed Precipitation Trends over Land Regions: Detectable Human Influences and Possible Low Bias in Model Trends. J. Climate, 31, 4617–4637, https://doi.org/10.1175/JCLI-D-17-0672.1 [Thomas Knutson, United States of America]	TAKEN INTO ACCOUNT - Text is revised and reference added.
50374	37	41	37	51	In Asia - epecially the Hindukush Himalayas have been experiencing cascading events resulting from a multi-hazard environment with upstream-downstream linkages, having significant transboundary impacts. This aspect needs more emphasis. Sample reference - Vaidya R.A. et al. (2019) Disaster Risk Reduction and Building Resilience in the Hindu Kush Himalaya. In: Wester P., Mishra A., Mukherji A., Shrestha A. (eds) The Hindu Kush Himalaya Assessment. Springer, Cham [Sejuti Basu, India]	Not applicable - Removed as this is more related to impacts and risks (WGII)
49646	37	44		45	read "(Chen et al., 2016b; Dong et al., 2018; Li et al., 2017; Wan et al., 2015; Xu et al., 2019; Rahimi and Fatemi, 2019)" rather than "(Chen et al., 2016b; Dong et al., 2018; Li et al., 2017; Wan et al., 2015; Xu et al., 2019)(Rahimi and Fatemi, 2019)" [Cyriaque Rufin Nguimalet, Central African Republic]	ACCEPTED - Text is revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
43970	37	45	37	45	Suggest to add: "A gridpoint based precipitation trend analysis for 1901-2010 for Asian regions with sufficient data for trend analysis finds strong detectable anthropogenic increasing precipitation trends, particularly in mid- to high latitudes, although coverage is rather scattered (Knutson and Zeng 2018). Some detectable anthropogenic decreasing trends were found in a few regions including near the Mediterranean and a few gridboxes in Japan and south or southeast Asia." Reference: see Fig. 3 of: Knutson, T.R. and F. Zeng, 2018: Model Assessment of Observed Precipitation Trends over Land Regions: Detectable Human Influences and Possible Low Bias in Model Trends. J. Climate, 31, 4617–4637, https://doi.org/10.1175/JCLI-D-17-0672.1 [Thomas Knutson, United States of America]	TAKEN INTO ACCOUNT: Reference has been added in the aridity and drought section now
6219	37	48	37	48	Most part of Iran in current year - 2019, were faced with heavy rain and disastrous flooding. [Mostafa Jafari, Iran]	Noted.
6221	37	48	37	48	Most part of Iran in current year - 2019, were faced with heavy rain and disastrous flooding. In some places rain in few days was equal to one year normal rainfall. Huge damages and casualties. [Mostafa Jafari, Iran]	Noted.
7662	38	22	38	34	There is an evidence to show increase in heavy and intensive rainfall recently in Korea. Kim, et al (2009). Bayesian changepoint analysis of the annual maximum of daily and subdaily precipitation over South Korea. Journal of Climate, 22(24), 6741-6757. [Jinkyu Hong, Republic of Korea]	Noted. Since the suggested reference is before 2013, more recent literature have been added in the assessment.
13242	38	22	38	34	12.4.2.3 Wet hazards in Asia: about Heavy rainfall Future climate extreme rainfall in East Asia (Japan) is also discussed in the following paper by using state-of-the-art climate model simulation. Extreme rainfall will increase 4~10% by 1 degree C warming in East Asia (Ohba and Sugimoto 2019). Spatial distribution of the changes in heavy precipitation can be non-uniform because of the difference in the sensitivity of the cause (weather condition) to the global warming. Please consider my proposal to add the following reference. Ohba, M., and S. Sugimoto 2019: Differences in climate change impacts between weather patterns: possible effects on spatial heterogeneous changes of future extreme rainfall, Climate Dynamics, 52, 4177–4191. doi:10.1007/s00382-018-4374-1 [Masamichi Ohba, Japan]	TAKEN INTO ACCOUNT - Text is revised and reference added.
50854	38	36	38	37	While dicussing Indian monssoons, it is critical to note the observed shift in distribution of extreme events during the monsoon, as well as the observed negative trends in wet spell durations and positive trends in dry spell durations over the last half century. Sample reference - Vinnarasi, R., and C. T. Dhanya (2016), Changing characteristics of extreme wet and dry spells of Indian monsoon rainfall, J. Geophys. Res. Atmos., 121, 2146–2160, doi:10.1002/2015JD024310. [Sejuti Basu, India]	REJECTED - The goal of Chapter 12 is to focus on the extreme events and trends rather than the dynamics that may be behind those changes. Our focus is therefore on discussing dry trends, wet spell changes, etc., rather than monsoon dynamics.
8186	39	6	39	6	It is suprising to see a reference to a retracted article (note that it has now been republished in Nature, but with new references, so that the 2019 reference should be quoted instead). Also note, in this part, that SROCC has assessed the impacts of changes in glacier and snow melt on water resources. [Samuel Morin, France]	Accepted. Reference is updated and text is revised to consider findings from SROCC.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
15464	39	11	39	11	Reference needed for the first sentence. [Ruiqing Miao, United States of America]	TAKEN INTO ACCOUNT - This reference is added: Yang, T., Zhou, X., Yu, Z., Krysanova, V., & Wang, B. (2015). Drought projection based on a hybrid drought index using Artificial Neural Networks. Hydrological Processes, 29(11), 2635-2648
33006	39	19	39	21	Even when the drying trend seems to be connected to a decrease in the duration of extreme heavy rainfall events, I would suggest to assess the two results according to different hazards. [Juan Antonio Rivera, Argentina]	TAKEN INTO ACCOUNT - More literature material has been added for assessing the connection between the drying trend and the decrease in the duration of extreme heavy rainfall events.
46314	39	33	39	33	Droughts can also create new local dust sources. For example, over the past few years, a significant part of the dust problems in southwestern parts of Iran has been produced by local centers. This is one of the examples that a climate hazard can exacerbate another climate hazard. [sadegh zeyaeyan, Iran]	Rejected - This topic is outside the scope of this chapter.
57590	39	33	39	33	Droughts can also create new local dust sources. For example, over the past few years, a significant part of the dust problems in southwestern parts of Iran has been produced by local centers. This is one of the examples that a climate hazard can exacerbate another climate hazard. [Sahar Tajbakhsh Mosalman, Iran]	Rejected - This topic is outside the scope of this chapter. (Comment is the same as Comment 46314)
45108	39	43	39	44	Drying trends are also observed in Ozturk et al 2017. T. Ozturk, M. T. Turp, M. Turkes, and M. L. Kurnaz, “Projected Changes in Temperature and Precipitation Climatology of Central Asia CORDEX Region 8 by Using RegCM4.3.5”, Atmospheric Research 183, 296-307 (2017). T. Ozturk, H. Altinsoy, M. Turkes and M. L. Kurnaz, “Simulation of Temperature and Precipitation Climatology for the Central Asia Cordex Domain by Using RegCM 4.0” Climate Research 52, 63-76 (2012). [Levent Kurnaz, Turkey]	Accepted- The 2017 reference has been added but not the 2012 reference as it is pre-AR5.
45106	39	54	39	54	CORDEX MENA region also covers the Middle East region and adding the results from that region can improve presentation. Especially Mansour’s work on Arabian Peninsula should not be ignored. Zittis, G., Hadjinicolaou, P., 2017. The effect of radiation parameterization schemes on surface temperature in regional climate simulations over the MENA-CORDEX domain. Int. J. Climatol. 37 (10), 3847–3862. Zittis, G., Hadjinicolaou, P., Lelieveld, J., 2014. Comparison of WRF model physics parameterizations over the MENA-CORDEX domain. Am. J. Clim. Chang. 3, 490–511. T. Ozturk, M. T. Turp, M. Turkes, and M. L. Kurnaz, “Future Projections of Temperature and Precipitation Climatology for CORDEX-MENA Domain Using RegCM4.4”, Atmospheric Research 206, 87-107 (2018). Almazroui, M., 2016. RegCM4 in climate simulation over CORDEX-MENA/Arab domain: selection of suitable domain, convection and land-surface schemes. Int. J. Climatol. 36, 236–251. http://dx.doi.org/10.1002/joc.4340. Almazroui, M., Islam, M.N., Al-Khalaf, A.K., Saeed, F., 2015. Best convective parametrization scheme within RegCM4 to downscale CMIP5 multi-model data for the CORDEX-MENA/Arab domain. Theor. Appl. Climatol. 124, 807–823. Almazroui, M., Islam, M.N., Alkhalaf, A.K., Saeed, F., Dambul, R., Rahman, M.A., 2016. Simulation of temperature and precipitation climatology for the CORDEX-MENA/Arab domain using RegCM4. Arab. J. Geosci. 9 (1), 1–13. Bucchignani, E., Cattaneo, L., Panitz, H.J., Mercogliano, P., 2016. Sensitivity analysis with the regional climate model COSMO-CLM over the CORDEX-MENA domain. Meteorog. Atmos. Phys. 128, 73–95. [Levent Kurnaz, Turkey]	ACCEPTED - Some of the references suggested have been added in the Africa section where more appropriate.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
42182	40	1	40	2	Check citation style for multiple citation within single bracket () [Lubna Alam, Malaysia]	NOTED: Citation style is revised.
49648	40	1		2	read "(Xu et al., 2019; Shi et al. 2015; Chen and Sun, 2017)" rather than "(Xu et al., 2019)(Shi et al. 2015)(Chen and Sun, 2017)" [Cyriaque Rufin Nguimalet, Central African Republic]	ACCEPTED - Text is revised.
39432	40	9	40	29	Decreasing trend of TCs over the Indochina Peninsula was showed. The trend corresponded to the rainfall trend. Ref. Takahashi, H.G., and T. Yasunari, 2008: Decreasing trend in rainfall over Indochina during the late summer monsoon: Impact of tropical cyclones. J. Meteor. Soc. Japan, 86, 429-438, doi:10.2151/jmsj.86.429. Takahashi, H.G., T. Yoshikane, M. Hara and T. Yasunari, 2009: High-resolution regional climate simulations of the long-term decrease in September rainfall over Indochina, Atmos. Sci. Lett., 10, 14-18, doi:10.1002/asl.203. Takahashi, H.G., 2011: Long-term changes in rainfall and tropical cyclone activity over South and Southeast Asia. Adv. Geosci., 30, 17-22, doi:10.5194/adgeo-30-17-2011. [Hiroshi Takahashi, Japan]	ACCEPTED - More recent publications citing these suggested references have been considered and added.
9824	40	9			Determination of extreme wind thresholds along with dust and reduction of min horizontal visibility: wind speed increase, temperature increase, and precipitation reduction which are the consequences of climate change, have caused soil moisture reduction and dryness of superficial soils. In vast areas, these could become the sources of dust. In the east of the Middle East, along with wind speed increase, the min horizontal visibility reduction and dust events have also been increased. It is suggested to determine the extreme wind indices along with min horizontal visibility reduction and dust events [saeedeh Kouzegaran, Iran]	NOTED: text has been revised and the section is very different now
46388	40	9			Determination of extreme wind thresholds along with dust and reduction of min horizontal visibility: wind speed increase, temperature increase, and precipitation reduction which are the consequences of climate change, have caused soil moisture reduction and dryness of superficial soils. In vast areas, these could become the sources of dust. In the east of the Middle East, along with wind speed increase, the min horizontal visibility reduction and dust events have also been increased. It is suggested to determine the extreme wind indices along with min horizontal visibility reduction and dust events [sadegh zeyaeyan, Iran]	NOT APPLICABLE: text has been revised and the section is very different now
57664	40	9			Determination of extreme wind thresholds along with dust and reduction of min horizontal visibility: wind speed increase, temperature increase, and precipitation reduction which are the consequences of climate change, have caused soil moisture reduction and dryness of superficial soils. In vast areas, these could become the sources of dust. In the east of the Middle East, along with wind speed increase, the min horizontal visibility reduction and dust events have also been increased. It is suggested to determine the extreme wind indices along with min horizontal visibility reduction and dust events [Sahar Tajbakhsh Mosalman, Iran]	NOTED: text has been revised and the section is very different now
55754	40	11	40	17	There is clear evidence that during the last drought in the Middle East (~2001 - ~2011), dust levels increased by a factor ~2. There is also some evidence that the drought was exhacerbated due to global warming. [Carlos Perez Garcia-Pando, Spain]	Rejected - No references were provided or could be found

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
49650	40	11		12	read "in Western Asia. Nabavi et al., (2016) identified permanent" rather than "in Western Asia (Nabavi et al., 2016). identified permanent" [Cyriaque Rufin Nguimalet, Central African Republic]	ACCEPTED - Text is revised.
46312	40	18	40	18	It should be noted that dust has a lot of negative effects, especially on the electricity production and transmission infrastructure. In 2017, the combination of high dust and humidity in Khuzestan, Iran caused severe problems in electricity transmission lines and major power outages. [sadegh zeyaeyan, Iran]	Rejected - Chapter 12 focuses on climate hazard, but wind power potential is not related to hazard. More related to WGII.
57588	40	18	40	18	It should be noted that dust has a lot of negative effects, especially on the electricity production and transmission infrastructure. In 2017, the combination of high dust and humidity in Khuzestan, Iran caused severe problems in electricity transmission lines and major power outages. [Sahar Tajbakhsh Mosalman, Iran]	Rejected - More related to WGII. (Comment is same as Comment 46312)
16104	40	19	40	21	The authors should consider beefing up the TC frequency trend review with the following latest findings/references : Existing four best track datasets (RSMC-Tokyo, CMA, HKO and JTWC) continue to show significant interdecadal variations in basin wide TC frequency and intensity in the western North Pacific. While most of the best track datasets depicted a decreasing trend in basin wide TC frequency, the observed trend and its statistical significance are still highly depending on which best track dataset is used, on the analysis period chosen and other analysis details (e.g. Lee et al., 2012; Walsh et al., 2016). [Update frequency trend will also be available from the Third Assessment Report of UN WMO/ESCAP Typhoon Committee which will likely be available in 2020] References : - Walsh, K. J.E., McBride, J. L., Klotzbach, P. J., Balachandran, S., Camargo, S. J., Holland, G., Knutson, T. R., Kossin, J. P., Lee, T.-C., Sobel, A. and Sugi, M. (2016), Tropical cyclones and climate change. WIREs Clim Change, 7: 65–89. doi:10.1002/wcc.371 - Lee, T. C., T. R. Knutson, H. Kamahori, and, M. Ying, 2012: Impacts of Climate Change on Tropical Cyclones in the Western North Pacific Basin. Part I : Past Observations. Tropical Cyclone Res. Rev. 1, 213-230. [SAI MING LEE, China]	ACCEPTED - Walsh et al 2016 reference has been considered.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
43974	40	19	40	29	This Asian impacts section on TCs is confusing, as it is not clear what the confidence levels are referring to: confidence in the sign of a trend? Confidence in detection of a trend? Confidence in attribution of a trend to anthropogenic influence? This is all very vague here. It needs to be coordinated with TC/climate material elsewhere in the report. The new WMO report on TC detection/attribution (Knutson et al. 2019) would be a good source and useful reference to use and coordinate with. It reviews and assesses a number of TC detection/attribution case studies related to the northwest Pacific and North Indian Ocean (Arabian Sea) basins bordering on Asia, which may be of interest (confidence in detection/attribution is low, but there is at least a suggestion of anthropogenic influence emerging in some cases. Those cases and references are generally not mentioned here yet. Reference: Knutson, T., S.J. Camargo, J.C. Chan, K. Emanuel, C. Ho, J. Kossin, M. Mohapatra, M. Satoh, M. Sugi, K. Walsh, and L. Wu, 2019: Tropical Cyclones and Climate Change Assessment: Part I. Detection and Attribution. Bull. Amer. Meteor. Soc., 0, https://doi.org/10.1175/BAMS-D-18-0189.1 (in press) [Thomas Knutson, United States of America]	NOTED: the section has been fully revised and many more references are added now.
16102	40	19	40	41	General comment: In this paragraph, the review of past and future trends of tropical cyclone activities in the western North Pacific (including the Asia region) is far from adequate. The authors are strongly requested to conduct a more thorough literature review on these topics and substantially revise this paragraph. In particular, reference should be made to the review reports/publications of the 8th and 9th International Workshop on Tropical Cyclones (IWTC-8 and IWTC-9) and the Expert Team assessment of the UN WMO/ESCAP Typhoon Committee. Moreover, the Third Assessment Report of UN WMO/ESCAP Typhoon Committee will likely be available in 2020. References : - Walsh, K. J.E., McBride, J. L., Klotzbach, P. J., Balachandran, S., Camargo, S. J., Holland, G., Knutson, T. R., Kossin, J. P., Lee, T.-C., Sobel, A. and Sugi, M. (2016), Tropical cyclones and climate change. WIREs Clim Change, 7: 65–89. doi:10.1002/wcc.371 - Lee, T. C., T. R. Knutson, H. Kamahori, and, M. Ying, 2012: Impacts of Climate Change on Tropical Cyclones in the Western North Pacific Basin. Part I : Past Observations. Tropical Cyclone Res. Rev. 1, 213-230. - Ying, M., T. R. Knutson, H. Kamahori, and T. C. Lee, 2012: Impacts of Climate Change on Tropical Cyclones in the Western North Pacific Basin. Part II: Late 21st Century Projections. Tropical Cyclone Res. Rev. 1, 231-241. - Kevin J.E. Walsh, et al., 2018 : Tropical cyclone and climate change, Rapporteur Report of Topic 7.1, 9th International Workshop on Tropical Cyclone, Hawaii, USA, 3-7 Dec 2018 https://www.wmo.int/pages/prog/arep/wwrp/tmr/documents/IWTC-9_Subtopic_7-1.pdf [SAI MING LEE, China]	Accepted. Text revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
16106	40	25	40	29	The authors should consider beefing up the TC intensity/related metrics trend in the western North Pacific in this paragraph with the following latest findings/references : Since AR5, there was noticeable progress in improving the consensus between best track datasets and increasing use of homogenized ADT-HURSAT to investigate intensity trends. An increase in the number and intensification rate for intense TCs, such as Cat. 4-5, in western North Pacific (WNP) since mid-1980s was reported by a number of studies using various statistical methods to reduce the uncertainty in intensity assessment among best track datasets. Moreover, spatial and cluster analysis of TC intensity depicted inhomogenous trends in different regions of the WNP. (e.g. Kang and Elsner, 2012; Park et al., 2013; 2014; Zhao et al., 2018; Kishtawal et al., 2012) References : - Kang, N. Y. and J.B. Elsner, 2012 : Consensus on climate trends in western North Pacific tropical cyclones, Journal of Climate, 25, 7564-7573. - Park, D.S.R., C.H. Ho, and J.H. Kim, 2014 : Growing threat of intense tropical cyclones to East Asia over the period 1977-2010, Environmental Research Letter, 9, 014008. - Park, D.S.R., J.H. Kim, and H.S. Kim, 2013 : Spatially inhomogeneous trends of tropical cyclone intensity over the western North Pacific for 1977-2010, Journal of Climate, 26, 5088-5101. - Zhao, H.K., X.Y. Duan, G.B. Raga, P.J. Klotzbach, 2018 : Changes in characteristics of rapidly intensifying Western North Pacific tropical cyclones related to climate regime shifts, Journal of Climate, 31, 8163-8179. - Kishtawal, C.M., N. Jaiswal, R. Singh, and D. Niyogi, 2012 : Tropical cyclone intensification trends during satellite era (1986-2010), Geophysical Research Letters, 39, L10810. [SAI MING LEE, China]	ACCEPTED - Text revise and the reference after 2014 have been added.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
16108	40	25	40	29	The authors should also discuss the observed TC track / exposure changes in western North Pacific (WNP) in this paragraph with the following latest findings/references : (i) Significant northwestward shift in TC tracks and poleward shift in the average latitude where TCs reach their peak intensity in the WNP have also been reported since 1980s. The prevailing track changes also resulted in an increase in the exposure of TC passage and landfalling in some regions, including East China, Japan, and Korean Peninsula in last few decades (e.g. Zhao and Wu, 2014; Park et al., 2014; Kossin et al. 2016; Li et al., 2017; Liu and Chan, 2019) (ii) Significant decreasing trend of TC translation speed in the WNP (e.g. Chu et al. 2012; Kossin, 2018; Li et al., 2017) References: - Chu, P.-S., J.-H. Kim, and Y.R. Chen, 2012: Have steering flows in the western North Pacific and the South China Sea changed over the last 50 years? Geophys. Res. Lett., 39, L100704. - Kossin, J. P., K. A. Emanuel, and S. J. Camargo, 2016: Past and projected changes in western North Pacific tropical cyclone exposure. Journal of Climate, 29, 5725-5739. - Kossin, J.P., 2018 : A global slowndown of tropical cyclone translation speed, Nature, 558, 104-107. - Zhao, H.K. and Liguang Wu, 2014 : Inter-decadal shift of the prevailing tropical cyclone tracks over the western North Pacific and its mechanism study, Meteorol. Atmos. Phys. 125, 89-101. - Liu, KS, J.C.L Chan, 2019 : Inter-decadal variability of the location of maximum intensity of category 4–5 typhoons and its implication on landfall intensity in East Asia. International Journal of Climatology, 39, 1839-1852. https://doi.org/10.1002/joc.5919 - Li, C.Y., W. Zhou, C.M. Shun and T.C. Lee, 2017 : Change in Destructiveness of	Accepted - Text revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
16110	40	31	40	41	An obvious missing part in this paragraph is a thorough review of a number of available studies on the projections of TC activities (frequency, intensity, track, rainfall, storm surge, etc.) in western North Pacific (WNP). The authors are strongly requested to revisit the whole topic and revise this part. Reference and alignment should also be made with the robust findings in Chapter 11.7.1.5. Below are some key references of which the authors should consider : - Colbert, A.J., B.J. Soden, and B.P. Kirtman, 2015: The Impact of Natural and Anthropogenic Climate Change on Western North Pacific Tropical Cyclone Tracks. J. Climate, 28, 1806− 1823. - Kanada, S., A. Wada, and M. Sugi, 2013: Future Changes in Structures of Extremely Intense Tropical Cyclones Using a 2-km Mesh Nonhydrostatic Model. J. Climate, 26, 9986−10005. - Kossin, J. P., K. A. Emanuel, and S. J. Camargo, 2016: Past and Projected Changes in Western North Pacific Tropical Cyclone Exposure. J. climate, 29, 5725−5739. - Knutson, T. R., J. J. Sirutis, M. Zhao, R. E. Tuleya, M. Bender, G. A. Vecchi, G. Villarini, and D. Chavas, 2015: Global Projections of Intense Tropical Cyclone Activity for the Late Twenty-First Century from Dynamical Downscaling of CMIP5/RCP4.5 Scenarios. J. Climate, 28, 7203−7224. - Knutson, T., Camargo, S. J., Chan, J. C. L., Emanuel, K., Ho, C., Mohapatra, M., et al. (2019b). Tropical Cyclones and Climate Change Assessment : Part II. Late 21st Century Projections. Bull. Am. Meteorol. Soc. in review - Lok, C. C. F., and Chan, J. C. L., 2017: Simulating seasonal tropical cyclone intensities at landfall along the South China coast. Clim. Dyn. Adv., 50, 2661−2672. - Manganello, J. V., K. I. Hodges, B. Dirmeyer, J. L. Kinter III, B. A. Cash, L. Marx, T. Jung, D. Achuthavatier, J. M. Adams, E. L. Altshuler, B. Huang, E. K. Jin, P. Towers, and N. Wedi, 2014: Future Changes in the Western North Pacific Tropical Cyclone Activity Projected by a Multidecadal Simulation with a 16-km Global Atmospheric GCM. J. Climate, 27(20), 7622−7646.	Accepted -Text revised and some of the newest refences are added
43976	40	31	40	41	Note that a new WMO assessment report which reviews a number of studies making TC projections for each basin, including the western North Pacific and North Indian Oceans, is now in review at BAMS and should be available soon. A draft version can be provided to the IPCC authors of this chapter if they would like to have it. Three authors on the WMO report are also either lead authors (Kossin, Satoh) or review editor (Chan) for Ch. 11 of this IPCC draft. [Thomas Knutson, United States of America]	NOTED: Text in the section has been fully revised and hopefully the result are not closer the WMO report
13244	40	43	40	55	12.4.2.5 Wind and storm hazards in Asia Changes in wind power potential should be written in this section same as the other regions. Wind energy potential will reduced in East Asia including Japan (Ohba, 2019) as is expected to decrease in East Asia (Karnauskas et al., 2018). Ohba, M., 2019: The Impact of Global Warming on Wind Energy Resources and Ramp Events in Japan. Atmosphere, 10, 265, doi.org/10.3390/atmos10050265. [Masamichi Ohba, Japan]	Accepted- Changes in wind power potential has been added to this part, considering how this topic was discussed/assessed for the other regions.
49652	41	16			read "Kraaijenbrink et al., (2017) have reported " rather than "(Kraaijenbrink et al., 2017) have reported" [Cyriaque Rufin Nguimalet, Central African Republic]	ACCEPTED - Text revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
49654	41	24			read "There is medium confidence " rather than "There ismedium confidence" [Cyriaque Rufin Nguimalet, Central African Republic]	ACCEPTED - Text revised.
26218	41	40	41	46	Following text may be added in this paragraph. "The central Japan is one of the heaviest snowfall areas in the world with more than 5 m of snow depth due to the existence of the Japan Sea. Global warming will reduec total winter snowfall amount, but the heavy snowfall occurring at a frequency of every 10 years or less will be enhanced there due to changes in moisture content and circulation changes (Kawase et al., 2016)." Kawase, H., Murata, A., Mizuta, R., Sasaki, H., Nosaka, M., Ishii, M., and Takayabu, I. (2016). Enahncement of heavy daily snowfall in central Japan due to global warming as projected by large ensemble of regional climate simulations. Climatic Change, 139, 265-278, doi:10.1007/s10584-016-1781-3. [Akio Kitoh, Japan]	ACCEPTED - Text revised. Reference added
43842	41	40	41	46	Kawase et al. (2016) showed that the extremely heavy snowfall is enhanced in central Japan where the total winter snowfall amount decreases significantly under 4 degC warmer climate. Kawase, H., A. Murata, R. Mizuta, H. Sasaki, M. Nosaka, and I. Takayabu, 2016: Enhancement of heavy daily snowfall in central Japan due to global warming as projected by large ensemble of regional climate simulations. Climatic Change, 139, 265-278. [Izuru Takayabu, Japan]	ACCEPTED - Text revised.
45110	41	47	41	47	Demiroglu et al have investigated the snow reliability using RCP4.5 pathway for the near future in the Western Caucasus. They have determined that reliable snow depth for ski tourism will be declining. O. C. Demiroğlu, M. T. Turp, T. Ozturk, and M. L. Kurnaz, “Impact of Climate Change on Natural Snow Reliability, Snowmaking Capacities, and Wind Conditions of Ski Resorts in Northeast Turkey: A Dynamical Downscaling Approach”, Atmosphere 7, UNSP52 (2016). [Levent Kurnaz, Turkey]	ACCEPTED - Text revised. Some of the references added
8722	41	49	42	18	May be it would be worthwhile to mention that one key aspect of sea-level rise related hazards in East Asia is the fact that many cities are affected by ground subsidence due to water pumping. [Goneri Le Cozannet, France]	NOTED: in this chapter only the climate change effect on Climate impact driver is assessed. This suggestion is more relevant to WGII.
46002	41	49	42	18	Since this subsection is on coastal hazards in Asia, it is missing the hazards from. extreme winds and storm surge with flooding associated with intense tropical cyclones, both observed and projected.. [Lourdes Tibig, Philippines]	TAKEN INTO ACCOUNT: Assessment of coastal flooding due to storm surge is improved now. Discussion on extreme winds and tropical cyclones can be found in Section 12.4.7.3.
8130	41	51	41	52	Sections like these that focus on an entire continent should not open with information about one very specific locality. Please start with the big picture, then zoom in on key regions. [Torbjorn Tornqvist, United States of America]	ACCEPTED - Text revised.
8128	41	51	42	18	In my view, this section misses what is arguably the largest coastal hazard in Asia: the high rates of RSLR in large deltas and coastal plains with megacities (Shanghai, Bangkok, Manila, Tokyo, and so on), due to human-induced subsidence. For example, plans were recently announced to move the Indonesian government away from Jakarta for this very reason. [Torbjorn Tornqvist, United States of America]	Accepted. RSLR is now included

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
43978	42	1	42	18	See this reference, which assesses the Murakami et al. Arabian Sea Tropical Cyclone anthropogenic influence paper in Nature Climate Change. Both the Murakami et al. paper and our assessment of it may be of interest here. References: Hiroyuki Murakami, Gabriel A. Vecchi, Seth Underwood. Increasing frequency of extremely severe cyclonic storms over the Arabian Sea. Nature Climate Change, 2017; 7 (12): 885 DOI: 10.1038/s41558-017-0008-6. and Knutson, T., S.J. Camargo, J.C. Chan, K. Emanuel, C. Ho, J. Kossin, M. Mohapatra, M. Satoh, M. Sugi, K. Walsh, and L. Wu, 2019: Tropical Cyclones and Climate Change Assessment: Part I. Detection and Attribution. Bull. Amer. Meteor. Soc., 0, https://doi.org/10.1175/BAMS-D-18-0189.1 (in press) [Thomas Knutson, United States of America]	Taken into account - References have been added in section 12.4.7.3
42184	42	5	42	6	Include space before and after of (Pramanik et al. 2015) [Lubna Alam, Malaysia]	Editorial - Spaces have been added in the appropriate places.
16140	42	21	42	21	Why no mention is made here of air pollution as for most of the other regions? Chapter 6 may be helpful in this regard. [Sandro Fuzzi, Italy]	ACCEPTED - Air pollution hazard has also been assessed now for Asia.
55284	42	23	42	25	Repeated statements [Muhammad Amjad, Pakistan]	ACCEPTED - Text revised.
7666	42	23	42	31	With increases in heat wave, global warming, and urban heat island in East Asia, we have more chance to have massive blackout. Hong and Kim (2015) Weather impact on electrical power load: Partial phase synchronization analysis, Meteorological Applications, 22, 811-816. [Jinkyu Hong, Republic of Korea]	Rejected. Related to WGII.
35358	42	28	42	30	Repeated statement as used in start of paragraph (Chapter 12, Page42, Lines23-25). [Mehwish Ramzan, Pakistan]	ACCEPTED - Text revised.
46004	42	42	43	3	Table on directional changes of climate hazards in Asia (and in the other regions) with confidence level assessed foreach iwill bea vital tool in decision making for risk assessment. [Lourdes Tibig, Philippines]	ACCEPTED: This is what CH12 has in the regional assessment table. Table 12.4 is for Asia
42186	43	1			Include source of table 12.4 [Lubna Alam, Malaysia]	Noted - Table is original and was based on the assessed literature to summarize the section.
51310	43	3	37	3	typo in populationand [Bart Van den Hurk, Netherlands]	NOTED: not sure where the comment is referred to
46006	43	6	45	14	Excellent cross-chapter box ,but it is too long. Some of the discussion could be shortened /revised to make it more concise and tight. [Lourdes Tibig, Philippines]	ACCEPTED - Text revised.
14868	43	8	45	13	This is a good choice of case study but it needs strengthening. And more focused on East China and the specific event itself. There is too much information on other parts of East China which confuses the box. [Clare Goodess, United Kingdom (of Great Britain and Northern Ireland)]	ACCEPTED - Text revised.
51312	43	14	41	14	a 1 in 5 event may be severe but it surely is not extreme, as it it fairly frequent [Bart Van den Hurk, Netherlands]	NOTED: not sure where the comment is referred to
51314	43	19	45	19	did the heatwave extend to North China? Why then is it called "East China heatwave"? [Bart Van den Hurk, Netherlands]	ACCEPTED - Text revised.
49656	43	23			read "Zhang et al., (2016a) estimated that " rather than "(Zhang et al., 2016a) estimated that" [Cyriaque Rufin Nguimalet, Central African Republic]	ACCEPTED - Text revised.
16112	43		43		For Table 12.4, the confidence levels for the “severe storms” should be re-assessed based on the revised paragraphs in Chapter 12.4.2.5 [SAI MING LEE, China]	Taken into account - The confidence levels for the severe storms have been reassessed based on the revised text.
15466	44	2	44	4	This sentence is not grammatical. [Ruiqing Miao, United States of America]	Editorial - Text is revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
14870	44	11	44	22	This should only focus on East China. Can something be said about the size of population affected. How long was the event? What about linkages with air pollution/quality? [Clare Goodess, United Kingdom (of Great Britain and Northern Ireland)]	ACCEPTED - Text revised.
43844	44	11	44	33	In 2013, severe heat wave also occurred in Korea and Japan due to the enhanced Tibettan High and the Pacific subtropical High. Because the background atmospheric circulation patterns are the same as the case of East China, not only the East China case but also the case in Korea and Japan should also be covered equally. In the Japanese case, the 1036 deaths from heat strokes are reported in 2013, and the global warming increased the event probability of the heat in 2013 by more than 7 times (Imada et al. 2014 BAMS). In the Korean case, extreme hot summer temperatures in 2013 have become 10 times more likely due to human influence (Min et al. 2014 BAMS). Imada, Y., H. Shiogama, M. Watanabe, M. Mori, M. Ishii, and M. Kimoto, 2014: The contribution of anthropogenic forcing to the Japanese heat waves of 2013. Bull. Amer. Meteor. Soc., 95 (9), S52-S54. Min, S.-K., Y.-H. Kim, M.-K. Kim, and C. Park, 2014: ASSESSING HUMAN CONTRIBUTION TO THE SUMMER 2013 KOREAN HEAT WAVE. Bull. Amer. Meteor. Soc., 95 (9), S48-S51. [Izuru Takayabu, Japan]	ACCEPTED: now the box focus on East ASIA.
15468	44	12	44	14	Should these two bullet points combined into one? [Ruiqing Miao, United States of America]	ACCEPTED - Text revised.
14872	44	14			In in 5 does not seem such a rare event. [Clare Goodess, United Kingdom (of Great Britain and Northern Ireland)]	ACCEPTED - Text revised.
15470	44	17	44	18	Could you please provide some specific numbers? [Ruiqing Miao, United States of America]	ACCEPTED - Text revised
16142	44	26	44	33	It is not clear what Human influences mean in this context. The first sentence says: " Both antrhropogenic and natural factors..." What is specific about China? This is true everywhere, as also the fact that human influence causes heat waves. Also, from this sentence one would have the impression that heat waves are only affected by regional factors, which is, of course, not true. The whole sentence should be re-formulated or even deleted, since it does not add anything to the whole box. [Sandro Fuzzi, Italy]	Taken into account - This paragraph is revised to discuss attribution (not just human influences).
43980	44	27	44	33	Suggest to add to end of paragraph: "A regional trend analysis of historical summertime Wet Bulb Globe Temperature (WBGT) over the period 1973-2012 over the globe finds regions of eastern China with detectable anthropogenic increases in this heat stress index that includes both temperature and moisture influences (Knutson and Ploshay 2016). Trend analysis for temperature only since 1901 shows detectable anthropogenic influence on temperature in the region over the past century (Knutson et al. 2013). " References: Knutson, T.R. & Ploshay, J.J. (2016) Detection of anthropogenic influence on a summertime heat stress index. Climatic Change 138: 25. https://doi.org/10.1007/s10584-016-1708-z. and Knutson, T.R., F. Zeng, and A.T. Wittenberg, 2013: Multimodel Assessment of Regional Surface Temperature Trends: CMIP3 and CMIP5 Twentieth-Century Simulations. J. Climate, 26, 8709–8743, https://doi.org/10.1175/JCLI-D-12-00567.1" [Thomas Knutson, United States of America]	NOT APPLICABLE : section has been substantially changed.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
48364	44	27	44	33	Suggest including a reference to the Sparrow et al attribution study here, i.e. Sparrow, S.N., et al 2018, Attributing human influence on the July 2017 Chinese heatwave: the influence of sea-surface temperatures, Environ. Res. Lett. https://doi.org/10.1088/1748-9326/aae356 [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	REJECTED - In cross-box 12.1, we focus on East China 2013 heatwave. This reference can be considered if we discuss attribution.
14874	44	29	44	29	What is meant by dynamics? [Clare Goodess, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable - This part of box removed. So no Action needed.
42188	44	30			Check citation style for multiple citation within single bracket () [Lubna Alam, Malaysia]	ACCEPTED: Text is revised.
49658	44	30			read "(Freychet et al., 2017; Yin et al., 2017). Sun et al., (2014b) more specifically connect" rather than "(Freychet et al., 2017)(Yin et al., 2017). (Sun et al., 2014b) more specifically connect" [Cyriaque Rufin Nguimalet, Central African Republic]	ACCEPTED: Text is revised.
12734	44	36	44	50	Increased heat waves will also increase demand for air conditioning and the energy that powers it. For energy efficiency as it pertains to appliances and space cooling, the transition away from high-GWP HFCs provides an opportunity for revising the technologies to further improve energy efficiency. IEA (2018) Future of Cooling; Sustainable Energy for All (2018) Chilling Prospects: Providing Sustainable Cooling for All; and Birmingham Energy Institute, University of Birmingham (2018) A Cool World: Defining the Energy Conundrum of Cooling for All; Shah N., et al. (2015) Benefits Of Leapfrogging To Superefficiency And Low Global Warming Potential Refrigerants In Air Conditioning, Ernest Orlando Lawrence Berkeley National Laboratory. Not just heat waves, also any increase in annual ambient temperatures above the cooling set points. New metrics incorporating heat islands, clustered and stacked and improperly installed air conditioning condensers as well as power plant capacity and efficiency impacts of global warming have been developed and deployed (Andersen et al. 2018). Andersen, Stephen O, James Wolf, Yunho Hwang, and Jiazhen Ling. 2018. Life-Cycle Climate Performance Metrics and Room AC Carbon Footprint. ASHRAE Journal, November 2018. http://www.igsd.org/wp-content/uploads/2018/11/Life-Cycle-Climate-Performance-Metrics.pdf. [Kristin Campbell, United States of America]	REJECTED Beyond mandate of Chapter 12 which does not assess impacts.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
12922	44	36	44	50	Increased heat waves will also increase demand for air conditioning and refrigeration and the peak energy that powers it. For energy efficiency as it pertains to appliances and space cooling, the transition away from high-GWP HFCs provides an opportunity for revising the technologies to further improve energy efficiency. IEA Future of Cooling (2018) projects that electricity demand for air conditioning in China will more than double to 960 TWh under baseline scenario. IEA (2018), "Future of Cooling". IEA (2018) Future of Cooling; Sustainable Energy for All (2018) Chilling Prospects: Providing Sustainable Cooling for All; and Birmingham Energy Institute, University of Birmingham (2018) A Cool World: Defining the Energy Conundrum of Cooling for All; Shah N., et al. (2015) Benefits Of Leapfrogging To Superefficiency And Low Global Warming Potential Refrigerants In Air Conditioning, Ernest Orlando Lawrence Berkeley National Laboratory. Not just heat waves, also any increase in annual ambient temperatures above the cooling set points. New metrics incorporating heat islands, clustered and stacked and improperly installed air conditioning condensers as well as power plant capacity and efficiency impacts of global warming have been developed and deployed (Andersen et al. 2018). Andersen, Stephen O, James Wolf, Yunho Hwang, and Jiazhen Ling. 2018. Life-Cycle Climate Performance Metrics and Room AC Carbon Footprint. ASHRAE Journal, November 2018. http://www.igsd.org/wp-content/uploads/2018/11/Life-Cycle-Climate-Performance-Metrics.pdf. In 2017, approximately 100 GW of new AC load were connected to the grid compared to 97 GW of added solar generation capacity (Sachar, Sneha, Iain Campbell, and Ankit Kalanki, Solving the Global Cooling Challenge: How to Counter the Climate Threat from Room Air Conditioners. Rocky Mountain Institute, 2018. www.rmi.org/insight/solving_the_global_cooling_challenge). IEA Future of Cooling (2018) finds that doubling the efficiency of air conditioning under "the Efficient Cooling Scenario greatly reduces the need to build new generation capacity to meet peak demand. Worldwide, the need for additional capacity up to 2050 just to	REJECTED Too detailed for Ch12. More related to WGII

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
42384	44	36	44	50	Increased heat waves will also increase demand for air conditioning and refrigeration and the peak energy that powers it. For energy efficiency as it pertains to appliances and space cooling, the transition away from high-GWP HFCs provides an opportunity for revising the technologies to further improve energy efficiency. IEA Future of Cooling (2018) projects that electricity demand for air conditioning in China will more than double to 960 TWh under baseline scenario. IEA (2018), “Future of Cooling”. IEA (2018) Future of Cooling; Sustainable Energy for All (2018) Chilling Prospects: Providing Sustainable Cooling for All; and Birmingham Energy Institute, University of Birmingham (2018) A Cool World: Defining the Energy Conundrum of Cooling for All; Shah N., et al. (2015) Benefits Of Leapfrogging To Superefficiency And Low Global Warming Potential Refrigerants In Air Conditioning, Ernest Orlando Lawrence Berkeley National Laboratory. Not just heat waves, also any increase in annual ambient temperatures above the cooling set points. New metrics incorporating heat islands, clustered and stacked and improperly installed air conditioning condensers as well as power plant capacity and efficiency impacts of global warming have been developed and deployed (Andersen et al. 2018). Andersen, Stephen O, James Wolf, Yunho Hwang, and Jiazhen Ling. 2018. Life-Cycle Climate Performance Metrics and Room AC Carbon Footprint. ASHRAE Journal, November 2018. http://www.igsd.org/wp-content/uploads/2018/11/Life-Cycle-Climate-Performance-Metrics.pdf. In 2017, approximately 100 GW of new AC load were connected to the grid compared to 97 GW of added solar generation capacity (Sachar, Sneha, Iain Campbell, and Ankit Kalanki, Solving the Global Cooling Challenge: How to Counter the Climate Threat from Room Air Conditioners. Rocky Mountain Institute, 2018. www.rmi.org/insight/solving_the_global_cooling_challenge). IEA Future of Cooling (2018) finds that doubling the efficiency of air conditioning under “the Efficient Cooling Scenario greatly reduces the need to build new generation capacity to meet peak demand. Worldwide, the need for additional capacity up to 2050 just to	REJECTED- Related to WGII - Too detailed for Ch12.
15472	44	37	44	37	change the first 'an' into 'in'. [Ruiqing Miao, United States of America]	Editorial - Text is revised.
49660	44	37			read "of heat waves increase an accelerating manner" rather than "of heat waves increase an an accelerating manner" [Cyriaque Rufin Nguimalet, Central African Republic]	ACCEPTED: Text is revised.
14876	44	41			Is this increase in uncertainty due to uncertainty in emission scenarios? [Clare Goodess, United Kingdom (of Great Britain and Northern Ireland)]	NOT APPLICABLE: text is not longer there
49662	44	45		46	read "Sun et al., (2014b) used CMIP5 models" rather than "(Sun et al., 2014b) used CMIP5 models" [Cyriaque Rufin Nguimalet, Central African Republic]	ACCEPTED: Text is revised.
51316	44	46	41	47	this 60-fold increase is not very clear: does it refer to any type of heatwaves, or the type that is discussed in this text box? [Bart Van den Hurk, Netherlands]	NOTED: not clear to which text is referred to.
42190	44	48			include a space before the word "Also" [Lubna Alam, Malaysia]	ACCEPTED - Text is revised.
14878	45	2	45	2	This statement about the event already being a 1in5 year event in 2013 raises questions about the estimation of recurrence intervals in a non-stationary climate. [Clare Goodess, United Kingdom (of Great Britain and Northern Ireland)]	NOT APPLICABLE: text is not longer included.
15474	45	8	45	8	The following paper should be cited about temperature and labor capacity: Zhang, Peng, Olivier Deschenes, Kyle Meng, Junjie Zhang. 2018. "Temperature Effects on Productivity and Factor Reallocation: Evidence from a Half Million Chinese Manufacturing Plants", Journal of Environmental Economics and Management, 88(3): 1-17. [Ruiqing Miao, United States of America]	REJECTED - Related to WGII.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
45160	45	17	52	5	The main reference provided in your draft both for observed trends and for projections for New Zealand is "Ministry for the Environment & Stats NZ, 2017". While this "State of the Environment" report is a good reference for observed trends, the best reference for Projections is: "Ministry fior the Environment (2018). Climate Change Projections for New Zealand: Atmosphere Projections based on Simulations from the IPCC Fifth Assessment, 2nd Edition". The work done for this 2018 report is where the projections in "MfE and Stats NZ, 2017" report came from. The 2018 report provides the background and detail and should be used as the primary reference. [David Wratt, New Zealand]	ACCEPTED: Recommended reference has been changed throughout as appropriate
45162	45	17	52	5	Regarding my recommendations for using Ministry for the Environment (2018) as the primary reference for New Zealand projections: You can download a pdf of this report from: https://www.mfe.govt.nz/sites/default/files/media/Climate%20Change/Climate-change-projections-2nd-edition-final.pdf [David Wratt, New Zealand]	ACCEPTED: Recommended reference has been changed throughout as appropriate
42192	45	22	45	23	Make it more clear. Confusing. [Lubna Alam, Malaysia]	ACCEPTED: Sentences rephrased to " The IPCC Special report on 1.5°C warming (Hoegh-Guldberg et al., 2018) projects very likely (high confidence) increases in the intensity and frequency of warm days and warm nights and decreases in the intensity and frequency of cold days and cold nights in Australasia. Furthermore, a likely (high confidence) increase in the frequency and duration of warm spells is also projected for Australia.
45164	45	29	45	31	I recommend this sentence be changed to the following: "Central and north east Australia and THE WEST AND SOUTH OF New Zealand are projected to HAVE INCREASES IN ANNUAL MEAN PRECIPITATION in future, while south western and eastern Australia and THE NORTH AND EAST OF New Zealand are projected to HAVE DECREASES (medium confidence)". Reasons: For New Zealand this is consistent with the projections in Ministry for the Environment (2018). And I suggest the wording should refer to ANNUAL MEAN PRECIPITATION rather than just using terms such as being wetter or becoming dryer since (a) These projected changes ARE for annual precipitation and projected changes in seasonal precipitation may be differeny and (b) "dryness" and "wetness" may depend on evaporation as well as rainfall, and your current wording might be seen as contradicting your statements about predicted changes in drought frequency. [David Wratt, New Zealand]	ACCEPTED: Sentence modified as suggested, but paragraph has been moved to end of 12.4.3 as part of Chapter-wide restructuring
33008	46	7	46	16	Most of this assessment is based only on technical reports. Is it possible to include any other scientific publications? [Juan Antonio Rivera, Argentina]	TAKEN INTO ACCOUNT: This comment likely refers to the CSIRO and BOM and the MfE&Stats reports that have been cited in 12.4.3 (among dozens of individual journal papers). These reports are rigorous assessments produced by highly reputable national organisations in Australia and NZ and are internally and externally peer reviewed as a matter of course. WGII Chapter 11 also exclusively uses these reports in their assessments.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
43982	46	12	46	12	Suggest to add: "Nonetheless, a number of regions in Australia were assessed as having detectable anthropogenic increases in summertime wet bulb globe temperature (WBGT)--an index of heat stress including moisture influence--over the period 1973-2012 (Knutson and Ploshay 2016)." Ref: See fig 5a of this article for details. We find that increases in WBGT are more detectable than temperature alone in many regions: Knutson, T.R. & Ploshay, J.J. (2016) Detection of anthropogenic influence on a summertime heat stress index. Climatic Change 138: 25. https://doi.org/10.1007/s10584-016-1708-z. [Thomas Knutson, United States of America]	ACCEPTED: Sentence added as suggested, but most of the para containing this sentence has moved to the Atlas as part of the Chapter-wide re-structure
45166	46	26	46	27	Change the reference from "Ministry for the Environment and Stats NZ (2017)" to "Ministry for the Environment (2018)" - which is the primary reference for these projections. [David Wratt, New Zealand]	ACCEPTED: Reference has been changed as suggested
45168	47	19	47	19	Change the reference from "Ministry for the Environment and Stats NZ (2017)" to "Ministry for the Environment (2018)" - which is the primary reference for these projections. [David Wratt, New Zealand]	ACCEPTED: Reference has been changed as suggested
45170	47	41	47	42	Change the reference from "Ministry for the Environment and Stats NZ (2017)" to "Ministry for the Environment (2018)" - which is the primary reference for these projections. [David Wratt, New Zealand]	ACCEPTED: Reference has been changed as suggested
43984	47	51	47	51	Suggest to add: "Detectable anthropogenic increases in precipitation in Australia were reported particularly for the north central Australia and for a few regions along the south central coast for the period 1901-2010 (Knutson and Zeng 2018)." Note: could also mention that the increase precipitation in northern Australia is qualitatively consistent with increased streamflow there reported on p. 48 line 8. Reference: see Fig. 3 and 4 of: Knutson, T.R. and F. Zeng, 2018: Model Assessment of Observed Precipitation Trends over Land Regions: Detectable Human Influences and Possible Low Bias in Model Trends. J. Climate, 31, 4617–4637, https://doi.org/10.1175/JCLI-D-17-0672.1 [Thomas Knutson, United States of America]	ACCEPTED: Sentence added as suggested
45172	47	53	47	53	I recommend this sentence be changed to the following: "Central and north east Australia and THE WEST AND SOUTH OF New Zealand are projected to HAVE INCREASES IN ANNUAL MEAN PRECIPITATION in future, while south western and eastern Australia and THE NORTH AND EAST OF New Zealand are projected to HAVE DECREASES (medium confidence)". Reasons: For New Zealand this is consistent with the projections in Ministry for the Environment (2018). And I suggest the wording should refer to ANNUAL MEAN PRECIPITATION rather than just using terms such as being wetter or becoming dryer since (a) These projected changes ARE for annual precipitation and projected changes in seasonal precipitation may be differeny and (b) "dryness" and "wetness" may depend on evaporation as well as rainfall, and your current wording might be seen as contradicting your statements about predicted changes in drought frequency. [David Wratt, New Zealand]	ACCEPTED: Sentence modified as suggested

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
45174	48	1	48	3	I recommend this sentence be changed to : " In New Zealand, CHANGES IN MEAN PRECIPITATION ARE EXPECTED TO VARY AROUND THE COUNTRY AND WITH SEASON. PROJECTED PATTERNS IN ANNUALPRECIPITATION EXHIBIT INCREASES IN THE WEST AND SOUTH OF NEW ZEALAND AND DECREASES IN THE NORTH AND EAST (MINISTRY FROR THE ENVIRONMENT 2018)". Reason: This suggested wording is consistent with the latest NZ rainfall prediction modelling, as documented in Ministry for the Environment 2018. [David Wratt, New Zealand]	ACCEPTED: The discussion on mean precipitation has been mostly moved to the Atlas as part of WGI chapter re-structure. However, part of the suggested statement is also reproduced in 12.4.3 with a citation to the Atlas
49664	48	3			read "Liu et al., (2018a) project that" rather than "(Liu et al., 2018a) project that" [Cyriaque Rufin Nguimalet, Central African Republic]	ACCEPTED: Brackets have been fixed
42194	48	11			Include space before citation [Lubna Alam, Malaysia]	ACCEPTED: Space added as suggested
49666	48	16			read "Ishak et al., (2013) found negative" rather than "(Ishak et al., 2013) found negative" [Cyriaque Rufin Nguimalet, Central African Republic]	ACCEPTED: Brackets have been fixed
33010	48	23	48	28	"Projections given by CSIRO and Bureau of Meteorology (2015) indicate a decrease of mean runoff in southern Australia by 2090 of 0% to -30% and 0% to -60% under RCP4.5 and RCP8.5, respectively. Median projections for the Rangelands, Eastern Australia, and Northern Australia are similar with a range of around +10 to -40% for RCP4.5 and +30 to -70% for RCP8.5). Decreases in mean runoff are projected for southern Australia, south western Western Australia, and far south-eastern Australia with at least medium confidence." This should be moved to section 12.4.3.4 Dry Hazards [Juan Antonio Rivera, Argentina]	NOT APPLICABLE: Discussion of mean runoff has been deleted due to space limitations and chapter wide re-structure
49668	49	1		17	About this sub-title "12.4.3.4 Dry hazards in Australasia", it seems that both first paragraphs (lines 1-17) are not well placed because related to precipitation/rainfall. To remove! [Cyriaque Rufin Nguimalet, Central African Republic]	REJECTED: These sentences are exclusively about decreases in precipitation. Furthermore this text now comes under the section 12.4.3.2 Wet and Dry as per Chapter-wide re-structure.
43986	49	7	49	7	Suggest to add: "Detectable anthropogenic decreases in precipitation over the past century have been reported for southwest Australia by Delworth and Zeng (2014) and Knutson and Zeng (2018), with the latter study also finding detectable anthropogenic decreases in and near parts of Tasmania. Delworth and Zeng relate southwest Australian rainfall decline to both stratospheric ozone and greenhouse gas influences." See Fig. 3c and 4c of Knutson and Zeng--zoom in on their pdf figure if you need to for detail. Figure 4c shows results for 1951-2010 trends indicating detectable anthropogenic decreases also extending from Tasmania into extreme southeast Australia. References: Delworth, T. L. and F. Zeng (2014): Regional rainfall decline in Australia attributed to anthropogenic greenhouse gases and ozone levels. Nature Geoscience, volume 7, pages 583–587. and Knutson, T.R. and F. Zeng, 2018: Model Assessment of Observed Precipitation Trends over Land Regions: Detectable Human Influences and Possible Low Bias in Model Trends. J. Climate, 31, 4617–4637, https://doi.org/10.1175/JCLI-D-17-0672.1 [Thomas Knutson, United States of America]	ACCEPTED: Sentences added as suggested
42196	49	12			After by 2065; a apce is required [Lubna Alam, Malaysia]	ACCEPTED: Space added as suggested
42198	49	14			Check citation style for multiple citation within single bracket () [Lubna Alam, Malaysia]	ACCEPTED: Brackets have been fixed

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
33012	49	19	49	20	Any new references to support this statement? Which is the historical period? [Juan Antonio Rivera, Argentina]	ACCEPTED: In consultation with WGII Ch 11 (Australasia) this sentence has been replaced by: "With respect to droughts, below average rainfall has occurred in 17 of the last 20 April to October periods since 1999 in southern Australia (CSIRO and BOM, 2018). There is low confidence in a historical decline in number, duration and intensity of droughts in northwest (Chapter 11). In south west Australia an increase in drought intensity has been observed (low confidence), while in parts of south east Australia an increase in the length of droughts have been observed (low confidence) (Chapter 11). In New Zealand, since 1972/73, soils at 7 of 30 monitored sites became drier, while the 2012–13 drought was one of the most extreme in the previous 41 years (Ministry for the Environment & Stats NZ, 2017)."
42200	49	25			Space needed before citation [Lubna Alam, Malaysia]	ACCEPTED: Space added as suggested
49670	49	25			read "Ferguson et al., (2018) project" rather than "(Ferguson et al., 2018) project" [Cyriaque Rufin Nguimalet, Central African Republic]	ACCEPTED: Brackets have been fixed
45176	49	30	49	34	I recommend this sentence be changed to: "Projections given by MINISTRY FOR THE ENVIRONMENT (2018) indicate that drought severity, expressed as potential evapotranspiration deficit, in New Zealand WILL INCREASE IN SEVERITY AND FREQUENCY, WITH INCREASES MOST MARKED IN ALREADY DRY AREAS (see also Figure 12.7f)" Reason: Consistency with the latest NZ projections, as described in Ministry for the Environment (2018). [David Wratt, New Zealand]	ACCEPTED: Sentence modified as suggested
49672	49	37			read "and Dowdy (2018) found that" rather than "and (Dowdy, 2018) found that" [Cyriaque Rufin Nguimalet, Central African Republic]	ACCEPTED: Brackets have been fixed
49674	49	45		46	read "Clarke et al. (2016) and Clarke and Evans (2018) project a" rather than "(Clarke et al., 2016; Clarke and Evans, 2018) project a" [Cyriaque Rufin Nguimalet, Central African Republic]	ACCEPTED: Brackets have been fixed
45178	50	13	50	14	Change the reference to "Ministry for the Environment (2018). Reason: This is the primary reference for these projections. [David Wratt, New Zealand]	ACCEPTED: Reference has been changed as suggested

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
43988	50	16	50	22	See discussion of the Callaghan and Power (2011) study and the Holland and Bruyere proportion of Cat 4-5 study in Knutson et al. (2019). While we assessed these both as only low confidence for detection of anthropogenic influence, if one "lowers the bar" to avoid Type II errors (overlooking or understating anthropogenic influence or detection of anthropogenic influence) then we assessed the Callaghan and Power paper as suggesting (to a balance of evidence level) a detectable decrease in intense landfalling TCs in eastern Australia but without attribution to human influence, and we assess Holland and Bruyere's study as suggesting (to a balance of evidence level) a detectable anthropogenic increase in proportion of TCs reaching Cat 4-5 levels globally (no assessment given for the Australia region in isolation). Reference: Knutson, T., S.J. Camargo, J.C. Chan, K. Emanuel, C. Ho, J. Kossin, M. Mohapatra, M. Satoh, M. Sugi, K. Walsh, and L. Wu, 2019: Tropical Cyclones and Climate Change Assessment: Part I. Detection and Attribution. Bull. Amer. Meteor. Soc., 0, https://doi.org/10.1175/BAMS-D-18-0189.1 (in press) [Thomas Knutson, United States of America]	TAKEN INTO ACCOUNT: In response to this and other comments, and in consultation with WGII Chapter 11 (Australasia) the paragraph in question has now been modified to " At regional scale, the number of TCs has declined since 1982 , but this trend has not been observed in the proportion of intense TCs (medium confidence) (CSIRO and BOM, 2018; Holland and Bruyère, 2014; Kuleshov et al., 2010). However the frequency of intense TCs that make landfall in north eastern Australia has declined significantly since the 19th century (Callaghan and Power, 2011). No trend in the frequency of East Coast Lows has been observed (Pepler et al., 2014).
45982	50	48	50	53	There are now studies on the possible changes in the characteristics of ENSO, and these must be considered when assessing future drought trends. In some countries, droughts are linked to ENSO, brought about by rainfall anomalies; thus, the need for updating of the knowledge. [Lourdes Tibig, Philippines]	NOTED: no textual changes affected as no clear request has been made nor references provided
8590	51	5	51	8	A whole continent is a broad area across which to take sea-level trends. What is the range of rates? [Robert Kopp, United States of America]	ACCEPTED: This whole paragraph has now been replaced with WGI Ch9 projections
42202	51	15			A spcae is needed in 0.05m. It can be written as 0.05 m. [Lubna Alam, Malaysia]	ACCEPTED: This whole paragraph has now been replaced with WGI Ch9 projections
49676	51	24		25	read "reported by Vousdoukas et al. (2018)" rather than "reported by (Vousdoukas et al., 2018) [Cyriaque Rufin Nguimalet, Central African Republic]	ACCEPTED: Brackets have been fixed
8592	51	28	51	38	Sync with chapter 9 with chapter 9 ESL projections are available [Robert Kopp, United States of America]	ACCEPTED: Text has been modified to reflect Ch 9 projections of ESL change where applicable
33014	51	40	51	40	Consider to remove the Bruun (1962) reference [Juan Antonio Rivera, Argentina]	REJECTED: Bruun (1962) is the seminal reference with respect to SLR driven coastline recession and hence is retained.
42204	51	44			A spcae is needed in 0.2m/yr. It can be written as 0.2 m/yr. [Lubna Alam, Malaysia]	ACCEPTED: Corrected as suggested
9354	52	1	52	6	It now appears that part of the chapter summary (page 07 lines 46-47) is actually taken from lines 01-02 on page 52. The point here is that, according to dictionaries, a summary is " a comprehensive and usually brief abstract, recapitulation, or compendium of previously stated facts or statements". In the present case, the previously stated facts or statements (§11.6.1) make no mention of the various drought definitions given in the summary; they do not comment either, of course, on the way these definitions affect assessments regarding their changes. In case distinguishing these definitions of drought is seen as important, then the text should discuss them; otherwise the summary should be modified to better match the text! [philippe waldteufel, France]	NOT APPLICABLE: This comment doesn't appear to be relevant to 12.4.3. Line numbers mentioned in comment are not consistent with line numbers in 12.4.3.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
43990	52	10	52	17	Comment: The problem with projecting changes in extreme high water levels is that while it is clear that SLR will increase mean water levels and the occurrence of common (nuisance) flooding, the 100, 500, 1000-year type events depend on occurrence of an extreme storm (e.g., TC) event and these events could even decrease for a region depending on how future storm frequency, tracks, and intensity will change for a given region. [Thomas Knutson, United States of America]	NOTED: no textual changes affected as no clear request has been made nor references provided
55756	52	55	53	1	There are are dust storms in Australia and the decadal variability is sensitive to ENSO through precipitation and vegetation changes, I would not say it is not relevant. [Carlos Perez Garcia-Pando, Spain]	NOTED: no textual changes affected as no references are provided nor could be found
45180	53	1	53	3	Table 12.5: I am not aware of any evidence for a "Medium confidence of hazard decrease" for "mean wind decrease" in New Zealand. In fact Ministry for the Environment (2018) projects "strengthened westerlies in Winter"and also projects an increase in extreme wind speeds of up to 10% or more in parts of the country.I suggest changing the first of the four column headings under "Wind and storms" to "Mean wind" (ie remove the word "decrease", and changing the assessment for New Zealand in this column to "medium confidence of hazard increase". [David Wratt, New Zealand]	TAKEN INTO ACCOUNT: In response to this and similar comments the previous Hazard indices tables have been completely revamped and the top level hazard index (now referred to as CIDs) is now simply Wind with sub indices Mean wind speed, Severe wind storm, and Dust and sandstorm
33022	53	6	53	6	For the Southern-South America region (in particular La Plata Basin), you should consider the following studies: Carril A.F., Cavalcanti I.F.A., Menéndez C.G., Sörensson A., López-Franca N., Rivera J.A., Robledo F., Zaninelli P.G., Ambrizzi T., Penalba O.C., da Rocha R.P., Sánchez E., Bettolli M.L., Pessacg N., Renom M., Ruscica R., Solman S., Tencer B., Grimm A., Rusticucci M., Cherchi A., Tedeschi R., Zamboni L. 2016. Extreme events in La Plata basin: a retrospective analysis of what we have learned during CLARIS-LPB project. Climate Research 68: 95-116. Cavalcanti I.F.A., Carril A., Penalba O., Grimm A.M., Menendez C., Sánchez E., Cherchi A., Sörensson A., Robledo F., Rivera J., Pántano V., Bettolli M.L., Zaninelli P., Zamboni L., Tedeschi R.G., Dominguez M., Ruscica R., Flach R. 2015. Precipitation extremes over La Plata Basin - Review and new results from observations and climate simulations. Journal of Hydrology 523: 211-230. [Juan Antonio Rivera, Argentina]	ACCEPTED: The articles by Carril et al. (2016) and Cavalcanti et al. (2015) are now part of the assessment.
39724	53	6	58	11	Chapter 12 of WG2 includes a subsection of climatic hazards for each subregion of central and south America. It is important to check consistency and coherency between the two assessments. [Carolina Vera, Argentina]	NOTED :We are interacting with WG2 to ensure consistency and coherency between WG1 and WG2 assessments. Regional harmonization is also being ensured among the different chapters of WGI AR6.
31882	53	6	58	19	This section on South America has some overlaps with the Atlas section on South America as to content on temperature and precipitation, but differs in the literature that is used. Coordination will be necessary to check that everything at least is coherent. I also recommend for this section to do a more intergrated and complete litterature assessment. There are some statements that are based on only one single-model publication (e.g. Kitoh et al. 2011), their model does not represent well the present day precipitation pattern, so how can it be used to make statements in IPCC report on changes in precipitation extremes? I would recommend to work with the LA of Atlas responsible for South America to coordinate. Perhaps you can also involve CAs from South America in the section? [Anna Sörensson, Argentina]	NOTED: Following this and other comments, a major coordination effort among Ch 11-12-Atlas was undertaken, resulting in a significant re-arrangement of material covered in each chapter.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
33016	53	8	53	11	The sub-regions considered are barely mentioned later in the assessment, which focus more in countries or regions within countries. Moreover, the regions are not depicted in a map. Thus, I would consider to remove the description of this sub-regions [Juan Antonio Rivera, Argentina]	ACCEPTED: The opening sentences of the CSA assessment were modified to be homogeneous and consistent with all regional sections. The text now refers to Atlas figure of AR6 regions in section 12.1 and in introduction to 12.4 so that readers can understand the geographic extent of regions in CH12 tables and figures.
14880	53	8	53	25	There needs to be more consistency in the structure/content of the opening sections for each region. In this case I find the information in the second part of the paragraph on sectoral issues/requirements quite informative and useful. [Clare Goodess, United Kingdom (of Great Britain and Northern Ireland)]	ACCEPTED: The opening sentences of the CSA assessment were modified to be homogeneous and consistent with all regional sections.
48746	53	16	53	16	Should not confuse the model projections with what is expected, which should be based on additional evidence, including underlying mechansims, observed trends, assessement of specific relevant model biases, etc. I proposed replacing "are expected" by "are projected by the models". [Ken Takahashi, Peru]	NOT APPLICABLE: text has been replaced
39722	53	18	53	25	Stakeholders from disaster risk management and urban planning are also main actors requiring climate informatin in the region [Carolina Vera, Argentina]	NOT APPLICABLE: text has been replaced
49296	54	14	55	14	Please review adittional paper like this; López-Franca N, Zaninelli PG, Carril AF, Menéndez CG, Sánchez E (2016) Changes in temperature extremes for 21st century scenarios over South America derived from a multi-model ensemble of regional climate models. Clim Res 68:151-167. https://doi.org/10.3354/cr01393 [Juan Bazo, Peru]	ACCEPTED: The article by López-Franca et al. (2016) is now part of the assessment.
39736	54	14	55	20	References that could be useful for this assessment: DOI: 10.5194/nhess-16-821-2016, DOI: 10.3354/cr01393 [Carolina Vera, Argentina]	ACCEPTED: The articles by López-Franca et al. (2016) and Ceccherini et al. (2016) are now part of the assessment.
49300	54	14	57	28	I will suggest checking this; María Fernanda Cabré, Silvina Solman, Mario Núñez, Regional climate change scenarios over southern South America for future climate (2080-2099) using the MM5 Model. Mean, interannual variability and uncertainties, Atmósfera, Volume 29, Issue 1, 2016, Pages 35-60,ISSN 0187-6236, https://doi.org/10.20937/ATM.2016.29.01.04. [Juan Bazo, Peru]	ACCEPTED: The article by Cabré et al. (2016) is now part of the assessment.
14882	54	16	54	40	This paragraph could be shortened. [Clare Goodess, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: this section has been reshape to meet the page constrain
39726	54	16	54	40	The discussion about the observed extreme temperature changes in SES region is missing here although there is available literature, for example: Rusticucci, M., Barrucand, M., & Collazo, S. (2017). Temperature extremes in the Argentina central region and their monthly relationship with the mean circulation and ENSO phases. International Journal of Climatology, 37(6), 29 3003-3017. doi:10.1002/joc.4895 Wu, Y., & Polvani, L. M. (2017). Recent trends in extreme precipitation and temperature over Southeastern South America: The dominant role of stratospheric ozone depletion in the CESM large ensemble. Journal of Climate, 63 30(16), 6433-6441. doi:10.1175/JCLI-D-17-0124.1 [Carolina Vera, Argentina]	TAKEN INTO ACCOUNT: Articles by Rusticucci et al. (2017) and Wu & Polvani (2017) are now included in the assessment.
48680	54	18	54	20	add reference [Lincoln Alves, Brazil]	NOT APPLICABLE: text has been replaced
48748	54	37	54	39	This is too vague. Need to specify what is the nature of the changes observed in temperatures in Peru. [Ken Takahashi, Peru]	TAKEN INTO ACCOUNT: text has been reshaped

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
43992	54	40	54	40	Suggest to add: "A detectable anthropogenic increase in summertime wet bulb globe temperature (WBGT), an index of heat stress, has been reported for the period 1973-2012 over much of Central and South America--at least in areas with adequate data coverage (Knutson and Ploshay 2016). This is mainly a temperature driven increase, and this detection/attribution result is consistent with earlier studies for surface temperature using longer period records." Reference: see fig. 5a of: Knutson, T.R. & Ploshay, J.J. (2016) Detection of anthropogenic influence on a summertime heat stress index. Climatic Change 138: 25. https://doi.org/10.1007/s10584-016-1708-z. [Thomas Knutson, United States of America]	TAKEN INTO ACCOUNT: text has been reshaped and reference added
42206	54	43			A space needed (veryhigh confidence) [Lubna Alam, Malaysia]	NOT APPLICABLE: text has been replaced
48750	54	54	54	56	It is unclear what this statement implies about the southern cone and the Andes, but it is unlikely that the Andes would not experience warming. The confidence in whatever this is meant to convey should also be assessed and references provided. [Ken Takahashi, Peru]	TAKEN INTO ACCOUNT: text has been reshaped and more reference added
49678	54	54			read "(see Figure 12.10c)." rather than "(see Figure 12.10c." [Cyriaque Rufin Nguimalet, Central African Republic]	NOT APPLICABLE: text has been replaced
49680	55	2			read "Diffenbaugh and Giorgi (2012) point to" rather than "(Diffenbaugh and Giorgi, 2012) point to" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Text is revised.
49682	55	8		9	read "Orlowsky and Seneviratne (2012) project a " rather than "(Orlowsky and Seneviratne, 2012) project a " [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Text is revised.
33028	55	21	55	21	I find that there is no single paper about trends in streamflow along this subsection. The Marengo and Espinoza (2016) paper assessed for the dry hazards can be used to cover this aspect. I provide more examples: Mernild, S.H., G.E. Liston, C.A. Hiemstra, J.C. Yde, and G. Casassa, 2018: Annual River Runoff Variations and Trends for the Andes Cordillera. J. Hydrometeor., 19, 1167–1189, https://doi.org/10.1175/JHM-D-17-0094.1. Rivera J.A., Penalba O.C., 2017. Spatio-temporal assessment of streamflow droughts over Southern South America: 1961-2006. Theoretical and Applied Climatology 133(3-4): 1021-1033. Fernanda Maciel, Alvaro Díaz & Rafael Terra (2013) Multi-annual variability of streamflow in La Plata Basin. Part I: observations and links to global climate, International Journal of River Basin Management, 11:4, 345-360, DOI: 10.1080/15715124.2013.847843. Carmona, A.M. & Poveda, G. Climatic Change (2014) 123: 301. https://doi.org/10.1007/s10584-013-1046-3 [Juan Antonio Rivera, Argentina]	ACCEPTED: The articles by Mernild et al. (2018), Rivera and Penalba (2017), Maciel et al. (2013), and Carmona and Poveda (2014) are now part of the assessment.
33026	55	21	57	28	The Sanchez et al. (2015) paper was assessed for temperature but not for wet and dry hazards. I suggest its inclusion given that it covers South America [Juan Antonio Rivera, Argentina]	ACCEPTED: The article by Sanchez et al. (2015) is now part of the assessment.
49298	55	21	57	28	I will suggest checking this; Penalba, O. C. and Rivera, J. A. (2016), Regional aspects of future precipitation and meteorological drought characteristics over Southern South America projected by a CMIP5 multi-model ensemble. Int. J. Climatol., 36: 974-986. doi:10.1002/joc.4398 [Juan Bazo, Peru]	ACCEPTED: The article by Penalba and Rivera (2016) is now part of the assessment. Penalba, O. C. and Rivera, J. A. (2016).

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
39732	55	23	55	28	References that could be useful for this assessment: DOI: 10.1016/j.wace.2015.07.001, DOI: 10.1007/s00477-018-1557-6, DOI: 10.1175/JCLI-D-12-00412.1, DOI: 10.1073/pnas.1421010112, DOI: 10.1002/joc.4153, DOI: 10.1007/s00382-018-4225-0, DOI: 10.4236/ajcc.2014.35043, DOI: 10.1088/1748-9326/11/11/114029, DOI: 10.1175/JCLI-D-16-0287.1, DOI: 10.1016/J.GLOPLACHA.2018.06.008, DOI: 10.3354/cr01396, DOI: 10.3354/cr01374, DOI: 10.1002/joc.5312 [Carolina Vera, Argentina]	ACCEPTED: Text is revised.
39728	55	23	55	46	There is more literature available than that included here and not all of the 8 subregions are well covered. Useful articles could be: Saurral, R. I., Camilloni, I. A., & Barros, V. R. (2017). Low-frequency variability and trends in centennial precipitation stations in southern South America. International Journal of Climatology, 37(4), 1774-1793. doi:10.1002/joc.4810 Vera, C. S., & Díaz, L. (2015). Anthropogenic influence on summer precipitation trends over South America in CMIP5 models. International Journal of Climatology, 35(10), 3172-3177. doi:10.1002/joc.4153 [Carolina Vera, Argentina]	ACCEPTED: The articles by Saurral et al. (2017) and Vera and Díaz (2015) are now part of the assessment.
39730	55	23	56	23	Regarding the assessment of SES region, check consistency and coherency with the assessment made in the case study of the SES summer wetting in chapter 10 [Carolina Vera, Argentina]	NOTED: Regional harmonization is being ensured among the different chapters of WGI AR6.
43994	55	27	55	27	Suggest to add: "Parts of southern South America stand out as a coherent region of detectable anthropogenic increases in annual precipitation according to the 1901-2010 trend assessment of Knutson and Zeng (2018). The observed increase there has been significantly stronger than that simulated in CMIP5 historical runs, suggesting that CMIP5 model projections could underestimate future precipitation increases in this region." Reference: see Fig. 3 and 4 of: Knutson, T.R. and F. Zeng, 2018: Model Assessment of Observed Precipitation Trends over Land Regions: Detectable Human Influences and Possible Low Bias in Model Trends. J. Climate, 31, 4617–4637, https://doi.org/10.1175/JCLI-D-17-0672.1 [Thomas Knutson, United States of America]	NOT APPLICABLE : section has been substantially changed.
48752	55	27	55	46	The trend assessments discussed correspond to periods shorter than 50 years and South America is subjected to internal decadal variability from the Pacific and Atlantic, which could confound the climate change signal. This caveat to the interpretation should be explicitly indicated. [Ken Takahashi, Peru]	REJECTED: This statement is outside the scope of Chapter 12. Climate variability and dynamics are covered in the Atlas.
31872	55	30	55	32	"In South America, annual rainfall amounts showed increasing trends of about 26.4 and 16.1 mm/decade over SES and AMZ, respectively, which were accompanied by non-significant decreases in NEB and the western part of the continent." Reference for this statement, as well as the period of these trends, are missing. [Anna Sörensson, Argentina]	Taken into account - Text has been revised.
48682	55	30	55	34	See Alves et al (2017) Sensitivity of Amazon Regional Climate to Deforestation. American Journal of Climate Change, 6, 75-98.https://doi.org/10.4236/ajcc.2017.61005 [Lincoln Alves, Brazil]	Rejected - This statement is outside the scope of Chapter 12. Feedback mechanisms and main drivers are covered in the Atlas.
31874	55	38	55	39	"The largest increases in rainfall amounts were observed in annual maximum 5-day and 1-day rainfall amounts, particularly over AMZ and SES." Reference is missing for this statement. [Anna Sörensson, Argentina]	Taken into account - The reference was added
31876	55	43	55	43	To cite Skansi et al correcly "eastern" should be changed to "south eastern". Note that the most eastern part of South America is Northeastern Brasil. [Anna Sörensson, Argentina]	ACCEPTED: text revised

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
48754	55	51	55	51	The southeastern tropical Pacific has a strong wet bias associated with the long-standing double ITCZ syndrome, whose strength is due to ocean-atmosphere couling, although even correcting for this, the trend persists. I propose inserting the following: "The projected increase in NWS remains even after correcting for the wet bias in this region in climate models (Jauregui and Takahashi, 2017)". Reference: doi:10.1007/s00382-017-3745-3 [Ken Takahashi, Peru]	Rejected - This statement is outside the scope of Chapter 12. Feedback mechanisms and main drivers are covered in the Atlas.
48756	55	51	55	51	Please insert: "Frequency of strong Eastern Pacific El Niño events that produce extreme rainfall in NWS, such as in 1983 and 1998, is expected to increase (Cai et al, 2018).". Reference: doi:10.1038/s41586-018-0776-9 [Ken Takahashi, Peru]	Taken into account:- The reference was added
49684	55	51			read "of the SES sub-region. Hidalgo et al. (2017) project wetter " rather than "of the SES sub-region]. (Hidalgo et al., 2017) project wetter" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Text is revised.
49686	55	53			read "Kitoh et al. (2011) project increases in" rather than "(Kitoh et al., 2011) project increases in" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Text is revised.
49688	55	55	56	1	read "Orlowsky and Seneviratne (2012) also point to" rather than "Orlowsky and Seneviratne, 2012) also point to" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Text is revised.
49690	56	2			read "Kitoh et al. (2011) suggest increases in" rather than "(Kitoh et al., 2011) suggest increases in" [Cyriaque Rufin Nguimalet, Central African Republic]	Editorial - Text is revised.
31880	56	3	56	8	Here there are some papers that I have not cited in 10.4.2.2.4 and 10.4.3.2.4, I will check on that for the SOD. Please see my comment on lines 6-7 on having attribution statement here. [Anna Sörensson, Argentina]	NOTED: Consistency among WGI chapters has been much improved
49692	56	3			read "Chou et al. (2014) suggest increases" rather than "(Chou et al., 2014) suggest increases" [Cyriaque Rufin Nguimalet, Central African Republic]	Editorial - Text is revised.
42208	56	4	56	5	revise the sencetence in line with citation and also check citation style. [Lubna Alam, Malaysia]	EDITORIAL: Text is revised.
49694	56	4			read "Teichmann et al. (2013) project" rather than "(Teichmann et al. 2013) project" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Text is revised.
49696	56	5		6	read "Coppola et al. (2014a), Giorgi et al. (2014b) and Llopart et al. (2014) all agree on" rather than "(Coppola et al., 2014a; Giorgi et al., 2014b; Llopart et al., 2014) all agree on" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Text is revised.
31878	56	6	56	7	"This precipitation increase in SES is connected with an increase in the occurrence of ENSO-like events in both near- and long-term GCM and RCM projections (da Rocha et al., 2014)." Please note that Chapter 10 section 10.4 includes a full regional attribution and projection assessment of the SESA rainfall increase. Please see sections 10.4.2.2.4 and 10.4.3.2.4. You will notice that there is much more to this issue than only the paper of da Rocha. Perhaps it is better here to refer to section 10.4.3.2.4 instead of making attribution statements, we must be coherent among chapters. I will check on the da Rocha paper again to eventually include it in 10.4.3.2.4. [Anna Sörensson, Argentina]	TAKEN INTO ACCOUNT: text has been revised
31884	56	10	56	23	This is a clear example of when more litterature is needed. For projected increases in extreme precipitation there is only three papers cited. As I said before Atlas has done a more complete assessment. [Anna Sörensson, Argentina]	TAKEN INTO ACCOUNT: text has been revised and more reference added

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
49698	56	17		18	read "Chou et al. (2014) suggested" rather than "The study by (Chou et al., 2014) suggested" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Text is revised.
49700	56	19			read "Also Giorgi et al. (2014) project predominant " rather than "The work by (Giorgi, et al., 2014) projects predominant " [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Text is revised.
39742	56	25	56	25	Reference that could be useful for this assessment: DOI: 10.1002/joc.5505 [Carolina Vera, Argentina]	ACCEPTED: Text is revised.
33020	56	28	56	28	I believe that the megadrought over the Central Andes of Argentina and Chile should be considered in the assessment. See for example: Rivera J.A., Penalba O.C., Villalba R., Araneo D.C. 2017. Spatio-temporal patterns of the 2010-2015 extreme hydrological drought across the Central Andes, Argentina. Water 9(9): 652. https://doi.org/10.3390/w9090652. Garreaud, R. D., Alvarez-Garreton, C., Barichivich, J., Boisier, J. P., Christie, D., Galleguillos, M., LeQuesne, C., McPhee, J., and Zambrano-Bigiarini, M.: The 2010–2015 megadrought in central Chile: impacts on regional hydroclimate and vegetation, Hydrol. Earth Syst. Sci., 21, 6307-6327, https://doi.org/10.5194/hess-21-6307-2017, 2017. [Juan Antonio Rivera, Argentina]	ACCEPTED: Text revised and reference included
33024	56	28	56	28	Penalba and Rivera (2016) assessed future changes of drought characteristics south of 20°S, finding a significant increase in the number of drought events for most of the 21st century analyzed periods, based on RCP4.5 and RCP8.5 scenarios. These drought events are projected to have shorter durations, with non-significant changes in drought severity. Maybe would worth to include this information in the assessment. Penalba O.C., Rivera J.A. 2016. Regional aspects of future precipitation and meteorological drought characteristics over Southern South America projected by a CMIP5 multi-model ensemble. International Journal of Climatology 36: 974-986. In particular, for La Plata Basin, you can check Carril et al. (2016) for future drought projections. [Juan Antonio Rivera, Argentina]	ACCEPTED: Text revised and reference included
39738	56	28	57	28	References that could be useful for this assessment: DOI: 10.3390/cli2040264, DOI: 10.1525/elementa.328, doi: 10.3389/fenvs.2019.00087 [Carolina Vera, Argentina]	ACCEPTED: Reference has been changed as suggested
49702	56	31		32	read "Coppola et al. (2014a), Giorgi et al. (2014b)and Llopart et al. (2014) also point to " rather than "The works by (Coppola et al., 2014a; Giorgi et al., 2014b; Llopart et al., 2014) also point to " [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Text is revised.
48684	56	33	56	33	in particular over southern Amazonia. [Lincoln Alves, Brazil]	TAKEN INTO ACCOUNT: text has been revised
49704	56	34		35	read "with some suggestions on a decrease in precipitation in the tropical region (Teichmann et al., 2013)." rather than "with the suggestions by (Teichmann et al. 2013) on a decrease in precipitation in the tropical region." [Cyriaque Rufin Nguimalet, Central African Republic]	TAKEN INTO ACCOUNT: text has been reshaped

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
43996	56	35	56	35	Suggest to add: "A regional precipitation trend assessment for 1901-2010 (Knutson and Zeng 2018) shows limited evidence for significant long-term drying trends in the central and South American region except for parts of Chile and the Falkland Islands, which had detectable anthropogenic drying trends according to their assessment." Reference: See fig. 3c of: Knutson, T.R. and F. Zeng, 2018: Model Assessment of Observed Precipitation Trends over Land Regions: Detectable Human Influences and Possible Low Bias in Model Trends. J. Climate, 31, 4617–4637, https://doi.org/10.1175/JCLI-D-17-0672.1 [Thomas Knutson, United States of America]	NOT APPLICABLE: mean trends are now assessed in the Atlas
48686	56	36	56	37	add more refereces [Lincoln Alves, Brazil]	TAKEN INTO ACCOUNT: text has been revised and more reference added
49706	56	38			read "Fuentes-Franco et al. (2015) argue that " rather than "(Fuentes-Franco et al., 2015) argue that " [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Text is revised.
49708	56	39			read "the findings by Hidalgo et al. (2017)" rather than "the findings by (Hidalgo et al., 2017)" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Text is revised.
43998	56	47	57	28	Comment: There is so little evidence for long-term significant negative precipitation trends in the region over the past century that I question the confidence in projections of future drying, unless this is somehow related to Amazon deforestation that is not being capturedyet in historical trend analysis. As mentioned in my earlier comment, an analysis of precipitation trends over 1901-2010 (Knutson and Zeng 2018) shows little evidence for significant decreasing precipitation trends in the region with the exception of a few small regions of Chile, Falkland Islands and one gridbox in northeast South America. With so little evidence of widespread decreasing precipitation trends, I question whether projections of future drying from models are reliable here. Reference: see Fig. 3 and 4 of: Knutson, T.R. and F. Zeng, 2018: Model Assessment of Observed Precipitation Trends over Land Regions: Detectable Human Influences and Possible Low Bias in Model Trends. J. Climate, 31, 4617–4637, https://doi.org/10.1175/JCLI-D-17-0672.1 [Thomas Knutson, United States of America]	REJECTED: there is consistency across ensembles for drying
49710	56	48		49	read "Hidalgo et al. (2017) point to future" rather than "(Hidalgo et al., 2017) point to future" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Text is revised.
49712	56	53		54	read "Chou et al. (2014) point to" rather than " (Chou et al., 2014) point to" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Text is revised.
49714	57	1			read "Kitoh et al. (2011) suggest decreases" rather than "(Kitoh et al., 2011) suggest decreases" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Text is revised.
49716	57	5			read "Chou et al. (2014) also indicate potential" rather than "(Chou et al., 2014) also indicate potential" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Text is revised.
49718	57	11		12	read "considered/recognized by Giorgi et al. (2014), who identified" rather than "identified in the work by (Giorgi et al., 2014), who identified" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Text is revised.
49720	57	18			read "Arnell and Gosling (2013) point to a " rather than "(Arnell and Gosling, 2013) point to a " [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Text is revised.
49722	57	21			read "with suggestions of Marengo (2014) and Marengo et al. (2015) who have" rather than "with suggestions by (Marengo, 2014; Marengo et al., 2015) who have" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Text is revised.
49724	57	26			read "Marengo et al. (2016) point to a" rather than "(Marengo et al., 2016) point to a" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Text is revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
49726	57	27			read "Alfieri et al. (2017) project decreases" rather than "(Alfieri et al., 2017) project decreases" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Text is revised.
48758	57	30	57	30	The feedbacks between vegetation and dry trends in the Amazon, which could result in savannization, should be discussed together with the associated uncertainties. [Ken Takahashi, Peru]	Rejected - This statement is outside the scope of Chapter 12. Feedback mechanisms and main drivers are covered in the Atlas.
33034	57	33	57	33	You might consider this study for the assessment of wind trends in South America: E. Bianchi, A. Solarte, T.M. Guozden. Large scale climate drivers for wind resource in Southern South America.Renew Energy, 114 (2017), pp. 708-715 [Juan Antonio Rivera, Argentina]	REJECTED: the paper is not dealing with any climate projection
39734	57	35	57	46	Reference that could be useful for this assessment: DOI: 10.1007/s10584-018-2174-6, [Carolina Vera, Argentina]	ACCEPTED: The article by Augusto Sanabria and Carril (2018) is now part of the assessment.
33032	57	48	57	48	I'm sure that results from the RELAMPAGO field campaign will be published shortly, relevant to the storm and hail hazards [Juan Antonio Rivera, Argentina]	NOTED: RELAMPAGO results can be included in future versions of this assessment when they are published publicly.
33030	57	51	57	51	Here is a study you should consider for snow trends in South America: Mernild, S. H., Liston, G. E., Hiemstra, C. A., Malmros, J. K., Yde, J. C. and McPhee, J. (2017), The Andes Cordillera. Part I: snow distribution, properties, and trends (1979–2014). Int. J. Climatol., 37: 1680-1698. doi:10.1002/joc.4804 [Juan Antonio Rivera, Argentina]	ACCEPTED: The article by Mernild et al. (2017) is now part of the assessment.
41200	57	51	57	53	Copy and paste my coment in the executive summury about the glaciers and permafrost related hazards in South America. There is no glacier or cryospheric related hazards assessment for South America in the First Order Draft. The impact of climate change in mountain areas and mainly related to glacier shrinkage and permafrost degradation is assessed globally in SROCC. Among the literature assessed in SROCC, there are a few examples from the Andes. The recently published “The Andean glacier and water atlas: the impact of glacier retreat on water resources” by UNESCO (Schoolmeester et al., 2018) and reference therein, covers in detail many of the possible hazards and challenges related with climate change and the cryosphere in the Andes. Among their key messages, the highlight that; 1) Glacier retreat and volume loss will continue in the future across the whole of the Andes, leading to significant changes in hydrology. This will impact communities and ecosystems; 2) Glacial meltwater is a critical water source at certain times of the year for millions of people – most notably for those living in the Andean highlands of Bolivia, Chile, and Peru; 3) The Andean highlands of Bolivia, northern Chile, and southern Peru are hotspots of water stress, because of their semiarid climate and marked seasonality. With limited hydrological storage capacity in the small upland catchment flows, glacier meltwater has so far acted as an important buffer mechanism; 4) During drought years, glacial meltwater becomes critically important for certain areas; 5) ‘Peak water’ has been reached for many glaciers in the Andes, meaning that meltwater runoff will continue to decrease in the future. Barros et al. (2015), mention that a decrease in snowfall and glacier shrinkages will be one the main impacts of climate change in the Andes of Argentina, possible whit impact on irrigation and hydropower production. In the Andes of Peru, seasonal water scarcity and Glacial Lake Outburst Floods (GLOF) pose a severe threat for highly exposed and vulnerable people (Drenkhan et al., 2019). In the Andes of Bolivia, both the shrinkage of glaciers and the	ACCEPTED: text has been revised accordingly

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
39740	58	1	58	5	Reference that could be useful for this assessment: DOI: DOI: https://doi.org/10.1525/elementa.31 [Carolina Vera, Argentina]	TAKEN INTO ACCOUNT: The article by Bhattachan et al. (2018) is now part of the assessment.
33376	58	3	58	3	Storm or extreme wave events shows the positive trend in central Chile. That extreme events have increased from an average of 5 per year in the middle of last century to roughly 20 per year in the 21st century (Martínez et al., 2018). C. Martínez, M. Contreras-López, P. Winckler, H. Hidalgo, E. Godoy, R. Agredano. (2018). Coastal erosion in central Chile: a new hazard?. Ocean Coast Manag., 156 (2018), pp. 141-155, 10.1016/j.ocecoaman.2017.07.011 [Octavio Rojas, Chile]	ACCEPTED: reference cited
33378	58	8	58	8	In Chile since the second half of the 20th century, there has been an increase in catastrophic river floods linked to nivoglacial processes, for example GLOFs (Glacial Lake Outburst Flood), changes that may be associated with an increase in the documentary record or climatic trends (1). However, the evidence shows an increase in glacial lakes in the Central Andes, Northern and Southern Patagonia between 1986-2016, possibly due to the retreat of the glaciers and the increase in temperature (2, 3): References: (1), Rojas, O., Mardones, M., Arumí, J., & Aguayo, M. (2014). Una revisión de inundaciones fluviales en Chile, período 1574-2012: causas, recurrencia y efectos geográficos. Revista de Geografía Norte Grande, 57, 177–192. (2), Masiokas, M.H., Rivera, A., Espizua, L.E., Villalba, R., Delgado, S., & Aravena, J.C. (2009). Glacier fluctuations in extratropical South America during the past 1000 years. Palaeogeography, Palaeoclimatology, Palaeoecology, 281(3-4), 242-268. (3) Wilson, R., Glasser, N. F., Reynolds, J. M., Harrison, S., Iribarren, P., Schaefer, M., & Shannon, S. (2018). Glacial lakes of the Central and Patagonian Andes. Global and Planetary Change, 162(January), 275–291. [Octavio Rojas, Chile]	ACCEPTED: text has been revised
48688	58	16	58	16	Table 12.6 must be cosistent with Atlas 5.5 [Lincoln Alves, Brazil]	TAKEN INTO ACCOUNT: Table is consistent with the Atlas
14884	58	24	59	29	The opening section for this region also has a nice structure - so could be used as a model for other regions - see also comments on Africa and South America. [Clare Goodess, United Kingdom (of Great Britain and Northern Ireland)]	NOTED: Thank you for this positive comment
40892	59	1			In the list of initiatives that have contributed and are contributing to the regional climate research also MedCLIVAR should be mentioned (https://doi.org/10.1029/2012EO100001) [piero lionello, Italy]	REJECTED: The MedCLIVAR is more intended for a user community and the paper suggested is 2012. The community doesn't produce papers at the moment, so it is not supported by the peer-reviewed literature.
30244	59	2	59	2	"Baltic Experiment" should be "Baltic Sea Experiment". Note also that BALTEX ended in 2013 and was followed by "Baltic Earth". See www.baltic-earth.eu [Ole B. Christensen, Denmark]	NOT APPLICABLE: the text has been removed due to space constraints
30238	59	2			"Baltic Experiment" should be "Baltic Sea Experiment". Note also that BALTEX ended in 2013 and was followed by "Baltic Earth". See www.baltic-earth.eu [Ole B. Christensen, Denmark]	ACCEPTED: text revised
51328	59	6	41	6	insert "mean" after "global" [Bart Van den Hurk, Netherlands]	NOT APPLICABLE: the referred page and line are wrong
51320	59	6	41	19	Some duplication with contents of Atlas.5.6.2.2 but is a useful summary here [Bart Van den Hurk, Netherlands]	**NOTED:** taken into account and after Toulouse all the overlaps is clarified
51318	59	7	39	7	"all these three" -> "these" [Bart Van den Hurk, Netherlands]	NOT APPLICABLE: the text has been removed due to space constrain

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14886	59	11			Does this systematic bias occur when models are forced by reanalysis and/or GCMs? [Clare Goodess, United Kingdom (of Great Britain and Northern Ireland)]	NOT APPLICABLE: the text has been removed due to space constrain
42210	59	16			Elaborate 'RCM' [Lubna Alam, Malaysia]	NOTED: the acronym has been included in the glossary
51322	59	28	46	29	Not all material is already included in the Atlas FOD [Bart Van den Hurk, Netherlands]	NOTED: it is our understanding that the Atlas should have this material in their the SOD
27134	59	38	59	38	Regarding b) and c) It's the change in the number of days compared to present or is the absolute number of days? [Edoardo Cremonese, Italy]	NOTED: It is the change of number of days compared to the present. It is specified at the beginning of the figure caption.
40866	60	1	61	34	Here I find very little information on the frequency of temperature extremes such as warm/cold nights and warm/cold days [piero lionello, Italy]	REJECTED: this is beyond the mandate of CH12 because CH11 includes these.
54680	60	4	61	10	What about changes in minimum temperature, maximum temperature, and diurnal temperature change - mentioned for North America (placeholder on page 12-68) but not for Europe. [Sabine Undorf, United Kingdom (of Great Britain and Northern Ireland)]	REJECTED: because these are all simple extreme indicators it should be in CH11 I think.
40860	60	4		13	I think that "virtually certain" and "high confidence" should be added to the statements on mean temperature increase [piero lionello, Italy]	ACCEPTED: confidence statements are now added.
14888	60	6			For all regions, it would be good to comment on the relationship between the regional and global warming trends. [Clare Goodess, United Kingdom (of Great Britain and Northern Ireland)]	**TAKEN INTO ACCOUNT**: In all regions, interpretations of all CIDs for various global warming levels is done (not only mean temperature). Note that more details are available in the Atlas chapter regarding mean regional warming.
44000	60	11	60	11	Suggest to add here: "A detectable anthropogenic increase in a summertime heat stress index over Europe has been identified based on wet bulb globe temperature (WBGT) index trends for 1973-2012 (Knutson and Ploshay 2016). WBGT considers both temperature and moisure effect on human heat stress and the inclusion of moisure makes trends even more detectable than for temperature alone, although the upward trends in WBGT are driven by strong recent summertime warming over Europe." Reference: See Fig. 5 of: Knutson, T.R. & Ploshay, J.J. (2016) Detection of anthropogenic influence on a summertime heat stress index. Climatic Change 138: 25. [Thomas Knutson, United States of America]	ACCEPTED: Text revised and reference included
49728	60	15			read "different temperature thresholds favouring habitat suitability" rathar than "different temperature thresholds favouringhabitat suitability" [Cyriaque Rufin Nguimalet, Central African Republic]	NOT APPLICABLE: the text has been removed due to space constrain

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
12736	60	22	60	24	Increased heat waves will also increase demand for air conditioning and the energy that powers it. For energy efficiency as it pertains to appliances and space cooling, the transition away from high-GWP HFCs provides an opportunity for revising the technologies to further improve energy efficiency. IEA (2018) Future of Cooling; Sustainable Energy for All (2018) Chilling Prospects: Providing Sustainable Cooling for All; and Birmingham Energy Institute, University of Birmingham (2018) A Cool World: Defining the Energy Conundrum of Cooling for All; Shah N., et al. (2015) Benefits Of Leapfrogging To Superefficiency And Low Global Warming Potential Refrigerants In Air Conditioning, Ernest Orlando Lawrence Berkeley National Laboratory. Not just heat waves, also any increase in annual ambient temperatures above the cooling set points. New metrics incorporating heat islands, clustered and stacked and improperly installed air conditioning condensers as well as power plant capacity and efficiency impacts of global warming have been developed and deployed (Andersen et al. 2018). Andersen, Stephen O, James Wolf, Yunho Hwang, and Jiazhen Ling. 2018. Life-Cycle Climate Performance Metrics and Room AC Carbon Footprint. ASHRAE Journal, November 2018. http://www.igsd.org/wp-content/uploads/2018/11/Life-Cycle-Climate-Performance-Metrics.pdf. [Kristin Campbell, United States of America]	see response #12734
12924	60	22	60	24	Increased heat waves will also increase demand for air conditioning and the energy that powers it, and 1.8 to 4.1 billion people may need AC to avoid heat stress under current conditions (no warming or population growth). Meeting this demand would require a 14% increase of current global residential electricity consumption. Mastrucci A., Byers E., Pachauri S., Rao N. D. (2019) Improving the SDG energy poverty targets: Residential cooling needs in the Global South, Energy & Buildings 186:405-415. And increased air conditioning use increases emissions of air pollutants from power plants, in turn worsening air quality and human health impacts. David W. Abel, Tracey Holloway, Monica Harkey, Paul Meier, Doug Ahl, Vijay S. Limaye, Jonathan A. Patz (2018) Air-quality-related health impacts from climate change and from adaptation of cooling demand for buildings in the eastern United States: An interdisciplinary modeling study. https://doi.org/10.1371/journal.pmed.1002599; IEA (2018) Future of Cooling; Sustainable Energy for All (2018) Chilling Prospects: Providing Sustainable Cooling for All; and Birmingham Energy Institute, University of Birmingham (2018) A Cool World: Defining the Energy Conundrum of Cooling for All; See also Y. T. Eunice Lo, et al., Increasing mitigation ambition to meet the Paris Agreement's temperature goal avoids substantial heat-related mortality in U.S. cities Science Advances 05 Jun 2019: Vol. 5, no. 6, eaau4373, DOI: 10.1126/sciadv.aau4373. [Durwood Zaelke, United States of America]	REJECTED: This is too much WG2 material and it is beyond the mandate of WGI report.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
12926	60	22	60	24	Improving energy efficiency of air conditioners and other cooling equipment and switching to lower GWP refrigerants as required by the Kigali Amendment to the Montreal Protocol could avoid even more warming, up to 100 Gt CO2-eq cumulatively through 2050. Sachar et al. (2018) Solving the Global Cooling Challenge: How to Counter the Climate Threat from Room Air Conditioners. Rocky Mountain Institute, P. 24 ("The 5X solution saves up to 100 gigatons of cumulative emissions by 2050."); Shah et al. (2015), Benefits of Leapfrogging to Superefficiency and Low Global Warming Potential Refrigerants in Room Air Conditioning. Berkeley, CA, USA. ("While there is some uncertainty associated with emissions and growth projections, moving to efficient room air conditioning (~30% more efficient than current technology) in parallel with low-GWP refrigerants in room air conditioning could avoid up to ~25 billion tonnes of CO2 in 2030, ~33billion in 2040, and ~40 billion in 2050, i.e. cumulative savings up to 98 billion tonnes of CO2 by 2050."). [Durwood Zaelke, United States of America]	REJECTED: This is too much WG2 material and it is beyond the mandate of WGI report.
12928	60	22	60	24	Hsiang et al. (2017) find in a study of the continental U.S. that: "Total hours of labor supplied declines ~0.11 (±0.004) % per °C in GMST for low-risk workers, who are predominantly not exposed to outdoor temperatures, and 0.53 (±0.01) % per °C for high-risk workers who are exposed (~23% of all employed workers, in sectors such as construction, mining, agriculture, and manufacturing)." S. Hsiang, S., R. Kopp, A. Jina, J. Rising, M. Delgado, S. Mohan, D. J. Rasmussen, R. Muir-Wood, P. Wilson, M. Oppenheimer, K. Larsen, and T. Houser (2017). Estimating economic damage from climate change in the United States. Science 356(6345), 1362–1369. doi: 10.1126/science.aal4369. [Durwood Zaelke, United States of America]	REJECTED: This is too much WG2 material and it is beyond the mandate of WGI report.
12930	60	22	60	24	In 2017, approximately 100 GW of new AC load were connected to the grid compared to 97 GW of added solar generation capacity (Sachar, Sneha, Iain Campbell, and Ankit Kalanki, Solving the Global Cooling Challenge: How to Counter the Climate Threat from Room Air Conditioners. Rocky Mountain Institute, 2018. IEA Future of Cooling (2018) finds that doubling the efficiency of air conditioning under "the Efficient Cooling Scenario greatly reduces the need to build new generation capacity to meet peak demand. Worldwide, the need for additional capacity up to 2050 just to meet the demand from ACs is 1 300 gigawatts (GW) lower in the Efficient Cooling Scenario, the equivalent of all the coal-fired power generation capacity in China and India today. In most countries and regions, the avoided capacity needs are in the form of coal and natural gas… Worldwide, the cumulative savings in the Efficient Cooling Scenario amount to USD 2.9 trillion (United States dollar) over 2017-50 compared with the Baseline Scenario." (p. 12) [Durwood Zaelke, United States of America]	REJECTED: This is too much WG2 material and it is beyond the mandate of WGI report.
12932	60	22	60	24	Wenz et al. (2017) project a shift from winter to summer seasonal electricity peaking in 19 countries. Leonie Wenz, Anders Levermann, and Maximilian Auffhammer (2017) North–south polarization of European electricity consumption under future warming, PNAS September 19, 2017 114 (38) E7910-E7918; https://doi.org/10.1073/pnas.1704339114 [Durwood Zaelke, United States of America]	REJECTED: This is too much WG2 material and it is beyond the mandate of WGI report.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
42386	60	22	60	24	Wenz et al. (2017) project a shift from winter to summer seasonal electricity peaking in 19 countries. Leonie Wenz, Anders Levermann, and Maximilian Auffhammer (2017) North–south polarization of European electricity consumption under future warming, PNAS September 19, 2017 114 (38) E7910-E7918; https://doi.org/10.1073/pnas.1704339114 [Gabrielle Dreyfus, United States of America]	REJECTED: This is too much WG2 material and it is beyond the mandate of WGI report.
42388	60	22	60	24	Improving energy efficiency of air conditioners and other cooling equipment and switching to lower GWP refrigerants as required by the Kigali Amendment to the Montreal Protocol could avoid even more warming, up to 100 Gt CO2-eq cumulatively through 2050. Sachar et al. (2018) Solving the Global Cooling Challenge: How to Counter the Climate Threat from Room Air Conditioners. Rocky Mountain Institute, P. 24 ("The 5X solution saves up to 100 gigatons of cumulative emissions by 2050."); Shah et al. (2015), Benefits of Leapfrogging to Superefficiency and Low Global Warming Potential Refrigerants in Room Air Conditioning. Berkeley, CA, USA. ("While there is some uncertainty associated with emissions and growth projections, moving to efficient room air conditioning (~30% more efficient than current technology) in parallel with low-GWP refrigerants in room air conditioning could avoid up to ~25 billion tonnes of CO2 in 2030, ~33billion in 2040, and ~40 billion in 2050, i.e. cumulative savings up to 98 billion tonnes of CO2 by 2050."). [Gabrielle Dreyfus, United States of America]	REJECTED: This is too much WG2 material and it is beyond the mandate of WGI report. We may suggest WG2 climate scientist to take it
42390	60	22	60	24	In 2017, approximately 100 GW of new AC load were connected to the grid compared to 97 GW of added solar generation capacity (Sachar, Sneha, Iain Campbell, and Ankit Kalanki, Solving the Global Cooling Challenge: How to Counter the Climate Threat from Room Air Conditioners. Rocky Mountain Institute, 2018. IEA Future of Cooling (2018) finds that doubling the efficiency of air conditioning under "the Efficient Cooling Scenario greatly reduces the need to build new generation capacity to meet peak demand. Worldwide, the need for additional capacity up to 2050 just to meet the demand from ACs is 1 300 gigawatts (GW) lower in the Efficient Cooling Scenario, the equivalent of all the coal-fired power generation capacity in China and India today. In most countries and regions, the avoided capacity needs are in the form of coal and natural gas… Worldwide, the cumulative savings in the Efficient Cooling Scenario amount to USD 2.9 trillion (United States dollar) over 2017-50 compared with the Baseline Scenario." (p. 12) [Gabrielle Dreyfus, United States of America]	REJECTED: This is too much WG2 material and it is beyond the mandate of WGI report.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
42392	60	22	60	24	Increased heat waves will also increase demand for air conditioning and the energy that powers it, and 1.8 to 4.1 billion people may need AC to avoid heat stress under current conditions (no warming or population growth). Meeting this demand would require a 14% increase of current global residential electricity consumption. Mastrucci A., Byers E., Pachauri S., Rao N. D. (2019) Improving the SDG energy poverty targets: Residential cooling needs in the Global South, Energy & Buildings 186:405-415. And increased air conditioning use increases emissions of air pollutants from power plants, in turn worsening air quality and human health impacts. David W. Abel, Tracey Holloway, Monica Harkey, Paul Meier, Doug Ahl, Vijay S. Limaye, Jonathan A. Patz (2018) Air-quality-related health impacts from climate change and from adaptation of cooling demand for buildings in the eastern United States: An interdisciplinary modeling study. https://doi.org/10.1371/journal.pmed.1002599; IEA (2018) Future of Cooling; Sustainable Energy for All (2018) Chilling Prospects: Providing Sustainable Cooling for All; and Birmingham Energy Institute, University of Birmingham (2018) A Cool World: Defining the Energy Conundrum of Cooling for All. [Gabrielle Dreyfus, United States of America]	repeated comment. See response 42384
51330	60	24	46	24	this CDD information is not yet included in the FOD Atlas [Bart Van den Hurk, Netherlands]	NOTED: it is our understanding that the Atlas should have this material in their the SOD
50874	60	26	60	35	Southern Europe will see the biggest increases in the number of heat-wave days while Central Europe will see the biggest increases of maximum heat-wave temperatures (Guerreiro et al 2018, Fischer and Schar, 2010) Guerreiro, S.B., Dawson, R.J., Kilsby, C., Lewis, E. and Ford, A. (2018) 'Future changes in heat-waves, droughts and floods in every European city', Environmental Research Letters, 13(3), p. 034009. Fischer EM and Schar C 2010 Consistent geographical patterns of changes in high-impact European heat-waves Nat. Geosci. 3. 398–403 [Selma Guerreiro, United Kingdom (of Great Britain and Northern Ireland)]	ACCEPTED: text revised and the 2018 reference added. The 2010 are already considered by previous reports
40862	60	26			please specify whether the heat wave increase refers to frequency, duration, intensity or all of them [piero lionello, Italy]	NOTED: the statement is referred to the frequency of heat wave as it is written in line 27.
40850	60	33			specify which events [piero lionello, Italy]	NOT APPLICABLE: the text has been removed due to space constraints

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
12738	60	37	60	40	Increased heat waves will also increase demand for air conditioning and the energy that powers it. For energy efficiency as it pertains to appliances and space cooling, the transition away from high-GWP HFCs provides an opportunity for revising the technologies to further improve energy efficiency. IEA (2018) Future of Cooling; Sustainable Energy for All (2018) Chilling Prospects: Providing Sustainable Cooling for All; and Birmingham Energy Institute, University of Birmingham (2018) A Cool World: Defining the Energy Conundrum of Cooling for All; Shah N., et al. (2015) Benefits Of Leapfrogging To Superefficiency And Low Global Warming Potential Refrigerants In Air Conditioning, Ernest Orlando Lawrence Berkeley National Laboratory. Not just heat waves, also any increase in annual ambient temperatures above the cooling set points. New metrics incorporating heat islands, clustered and stacked and improperly installed air conditioning condensers as well as power plant capacity and efficiency impacts of global warming have been developed and deployed (Andersen et al. 2018). Andersen, Stephen O, James Wolf, Yunho Hwang, and Jiazhen Ling. 2018. Life-Cycle Climate Performance Metrics and Room AC Carbon Footprint. ASHRAE Journal, November 2018. http://www.igsd.org/wp-content/uploads/2018/11/Life-Cycle-Climate-Performance-Metrics.pdf. [Kristin Campbell, United States of America]	see response #12734
12934	60	37	60	40	Increased heat waves will also increase demand for air conditioning and the energy that powers it, and 1.8 to 4.1 billion people may need AC to avoid heat stress under current conditions (no warming or population growth). Meeting this demand would require a 14% increase of current global residential electricity consumption. Mastrucci A., Byers E., Pachauri S., Rao N. D. (2019) Improving the SDG energy poverty targets: Residential cooling needs in the Global South, Energy & Buildings 186:405-415. And increased air conditioning use increases emissions of air pollutants from power plants, in turn worsening air quality and human health impacts. David W. Abel, Tracey Holloway, Monica Harkey, Paul Meier, Doug Ahl, Vijay S. Limaye, Jonathan A. Patz (2018) Air-quality-related health impacts from climate change and from adaptation of cooling demand for buildings in the eastern United States: An interdisciplinary modeling study. https://doi.org/10.1371/journal.pmed.1002599; IEA (2018) Future of Cooling; Sustainable Energy for All (2018) Chilling Prospects: Providing Sustainable Cooling for All; and Birmingham Energy Institute, University of Birmingham (2018) A Cool World: Defining the Energy Conundrum of Cooling for All; See also Y. T. Eunice Lo, et al., Increasing mitigation ambition to meet the Paris Agreement's temperature goal avoids substantial heat-related mortality in U.S. cities Science Advances 05 Jun 2019: Vol. 5, no. 6, eaau4373, DOI: 10.1126/sciadv.aau4373. [Durwood Zaelke, United States of America]	repeated comment -- see response 12924

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
12936	60	37	60	40	Improving energy efficiency of air conditioners and other cooling equipment and switching to lower GWP refrigerants as required by the Kigali Amendment to the Montreal Protocol could avoid even more warming, up to 100 Gt CO2-eq cumulatively through 2050. Sachar et al. (2018) Solving the Global Cooling Challenge: How to Counter the Climate Threat from Room Air Conditioners. Rocky Mountain Institute, P. 24 ("The 5X solution saves up to 100 gigatons of cumulative emissions by 2050."); Shah et al. (2015), Benefits of Leapfrogging to Superefficiency and Low Global Warming Potential Refrigerants in Room Air Conditioning. Berkeley, CA, USA. ("While there is some uncertainty associated with emissions and growth projections, moving to efficient room air conditioning (~30% more efficient than current technology) in parallel with low-GWP refrigerants in room air conditioning could avoid up to ~25 billion tonnes of CO2 in 2030, ~33billion in 2040, and ~40 billion in 2050, i.e. cumulative savings up to 98 billion tonnes of CO2 by 2050."). [Durwood Zaelke, United States of America]	repeated comment. See response 12926
12938	60	37	60	40	Hsiang et al. (2017) find in a study of the continental U.S. that: "Total hours of labor supplied declines ~0.11 (±0.004) % per °C in GMST for low-risk workers, who are predominantly not exposed to outdoor temperatures, and 0.53 (±0.01) % per °C for high-risk workers who are exposed (~23% of all employed workers, in sectors such as construction, mining, agriculture, and manufacturing)." S. Hsiang, S., R. Kopp, A. Jina, J. Rising, M. Delgado, S. Mohan, D. J. Rasmussen, R. Muir-Wood, P. Wilson, M. Oppenheimer, K. Larsen, and T. Houser (2017). Estimating economic damage from climate change in the United States. Science 356(6345), 1362–1369. doi: 10.1126/science.aal4369. [Durwood Zaelke, United States of America]	repeated comment -- see response 12914
12940	60	37	60	40	In 2017, approximately 100 GW of new AC load were connected to the grid compared to 97 GW of added solar generation capacity (Sachar, Sneha, Iain Campbell, and Ankit Kalanki, Solving the Global Cooling Challenge: How to Counter the Climate Threat from Room Air Conditioners. Rocky Mountain Institute, 2018. IEA Future of Cooling (2018) finds that doubling the efficiency of air conditioning under "the Efficient Cooling Scenario greatly reduces the need to build new generation capacity to meet peak demand. Worldwide, the need for additional capacity up to 2050 just to meet the demand from ACs is 1 300 gigawatts (GW) lower in the Efficient Cooling Scenario, the equivalent of all the coal-fired power generation capacity in China and India today. In most countries and regions, the avoided capacity needs are in the form of coal and natural gas… Worldwide, the cumulative savings in the Efficient Cooling Scenario amount to USD 2.9 trillion (United States dollar) over 2017-50 compared with the Baseline Scenario." (p. 12) [Durwood Zaelke, United States of America]	repeated. See response 12916
12942	60	37	60	40	Wenz et al. (2017) project a shift from winter to summer seasonal electricity peaking in 19 countries. Leonie Wenz, Anders Levermann, and Maximilian Auffhammer (2017) North–south polarization of European electricity consumption under future warming, PNAS September 19, 2017 114 (38) E7910-E7918; https://doi.org/10.1073/pnas.1704339114 [Durwood Zaelke, United States of America]	repeated comment -- see response 12918

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42394	60	37	60	40	Improving energy efficiency of air conditioners and other cooling equipment and switching to lower GWP refrigerants as required by the Kigali Amendment to the Montreal Protocol could avoid even more warming, up to 100 Gt CO2-eq cumulatively through 2050. Sachar et al. (2018) Solving the Global Cooling Challenge: How to Counter the Climate Threat from Room Air Conditioners. Rocky Mountain Institute, P. 24 ("The 5X solution saves up to 100 gigatons of cumulative emissions by 2050."); Shah et al. (2015), Benefits of Leapfrogging to Superefficiency and Low Global Warming Potential Refrigerants in Room Air Conditioning. Berkeley, CA, USA. ("While there is some uncertainty associated with emissions and growth projections, moving to efficient room air conditioning (~30% more efficient than current technology) in parallel with low-GWP refrigerants in room air conditioning could avoid up to ~25 billion tonnes of CO2 in 2030, ~33billion in 2040, and ~40 billion in 2050, i.e. cumulative savings up to 98 billion tonnes of CO2 by 2050."). [Gabrielle Dreyfus, United States of America]	repeated comment -- see response 42388
42396	60	37	60	40	Hsiang et al. (2017) find in a study of the continental U.S. that: "Total hours of labor supplied declines ~0.11 (±0.004) % per °C in GMST for low-risk workers, who are predominantly not exposed to outdoor temperatures, and 0.53 (±0.01) % per °C for high-risk workers who are exposed (~23% of all employed workers, in sectors such as construction, mining, agriculture, and manufacturing)." S. Hsiang, S., R. Kopp, A. Jina, J. Rising, M. Delgado, S. Mohan, D. J. Rasmussen, R. Muir-Wood, P. Wilson, M. Oppenheimer, K. Larsen, and T. Houser (2017). Estimating economic damage from climate change in the United States. Science 356(6345), 1362–1369. doi: 10.1126/science.aal4369. [Gabrielle Dreyfus, United States of America]	repeated comment -- see response 12914
42398	60	37	60	40	In 2017, approximately 100 GW of new AC load were connected to the grid compared to 97 GW of added solar generation capacity (Sachar, Sneha, Iain Campbell, and Ankit Kalanki, Solving the Global Cooling Challenge: How to Counter the Climate Threat from Room Air Conditioners. Rocky Mountain Institute, 2018. IEA Future of Cooling (2018) finds that doubling the efficiency of air conditioning under "the Efficient Cooling Scenario greatly reduces the need to build new generation capacity to meet peak demand. Worldwide, the need for additional capacity up to 2050 just to meet the demand from ACs is 1 300 gigawatts (GW) lower in the Efficient Cooling Scenario, the equivalent of all the coal-fired power generation capacity in China and India today. In most countries and regions, the avoided capacity needs are in the form of coal and natural gas… Worldwide, the cumulative savings in the Efficient Cooling Scenario amount to USD 2.9 trillion (United States dollar) over 2017-50 compared with the Baseline Scenario." (p. 12) [Gabrielle Dreyfus, United States of America]	repeated. See response 12916
42400	60	37	60	40	Wenz et al. (2017) project a shift from winter to summer seasonal electricity peaking in 19 countries. Leonie Wenz, Anders Levermann, and Maximilian Auffhammer (2017) North–south polarization of European electricity consumption under future warming, PNAS September 19, 2017 114 (38) E7910-E7918; https://doi.org/10.1073/pnas.1704339114 [Gabrielle Dreyfus, United States of America]	repeated comment -- see response 12918

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
40864	60	37	61	24	these statements refer to impacts of climate change. Do they belong tothischapter? or they are a duplication with respect to WGII chapter 13 Europe? [piero lionello, Italy]	NOTED: A minimum overlap is foreseen with WGII. These information belong to CH12 too.
51334	60	39	51	39	The Atlas does not yet have this information included [Bart Van den Hurk, Netherlands]	NOTED: it is our understanding that the Atlas should have this material in their the SOD
8724	60	42	60	46	I understand that this section will be updated significantly in the 2nd order draft, but may be (if feasible) some more quantitative information on the potential for heat waves to exceed some morbidity or mortability thresholds over time would be useful here. [Goneri Le Cozannet, France]	NOTED: This chapter only shows change of the threshold that is relevant for morbidity or mortality. This information is already now in the panel c of figure 12.11 where we use as an example WBGT>31. We do not show the information for all the thresholds.
51336	60	43	49	44	What do you mean with "plains under RCP8.5"? [Bart Van den Hurk, Netherlands]	ACCEPTED: text revised
15400	60	48	60	49	Permafrost in Europe is also on Arctic islands, like Svalbard, Novaya Zemlia and Iceland. Please add. [Oksana Lipka, Russian Federation]	ACCEPTED: text has been revised accordingly
8632	60	48	60	55	The statement should be recasted and rearranged, reference should also be included. [Ibikunle Olaleru, Nigeria]	ACCEPTED: The new version has been recasted and rearranged to make the statement more focused. Also references have been added
25512	60	48	61	10	For trends in permafrost conditions - See Noetzli et al. (2018) for European permafrost and Romanovsky et al. (2018 - for info Nordic region of Europe) state of climate report - refs provided in previous Ch 12 comments. Also make ref to Ch 2 and 9. Also relevant are:Marcer M, Serrano C, Brenning A, Bodin X, Goetz J, Schoeneich P (2019) Evaluating the destabilization susceptibility of active rock glaciers in the French Alps. The Cryosphere 13:141-155. doi:0.5194/tc-13-141-2019 Eriksen HO, Rouyet L, Lauknes TR, Berthling I, Isaksen K, Hindberg H, Larsen Y, Corner GD (2018) Recent acceleration of a rock glacier complex, Ádjet, Norway, documented by 62 years of remote sensing observations. Geophysical Research Letters 45. doi:10.1029/2018GL077605 [Sharon Smith, Canada]	NOTED: A link to Noetzli et al. (2018) and Romanovsky (2018) has be added. The other papers that are cited are either methodological and of local relevance (Marcer et al., 2019) or a local case study (Eriksen et al., 2018). While interesting, one may wonder whether the results contained therein are valid for the larger study regions in which they were realized. I would not therefore add them.
40852	60	48		54	missing bibliographic ref on permafrost thawing [piero lionello, Italy]	ACCEPTED: one more reference has been added (Biskaborn et al. (2019; NCOMM)
42212	61	1			Elaborate 'ENSEMBLE' [Lubna Alam, Malaysia]	NOT APPLICABLE: the text has been removed due to space constrain
51338	61	5	41	5	strange to refer to processes that will disappear [Bart Van den Hurk, Netherlands]	NOTED: but we think this is informative since is due to climate change
49730	61	8			read "longer particularly in summer" rather than "longer in particularly in summer" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: done
42214	61	18			A Space is needed before citation (Christiansen et al, 2018) [Lubna Alam, Malaysia]	EDITORIAL: done
40854	61	20			"(low confidence)" is misplaced [piero lionello, Italy]	NOTED: but it is not clear where it is misplced
51340	61	25	51	26	The Atlas does not yet have this information included [Bart Van den Hurk, Netherlands]	NOTED: it is our understanding that the Atlas should have this material in their the SOD
42216	61	25			A space is needed after the citation. [Lubna Alam, Malaysia]	EDITORIAL: done
40868	61	28		34	same as comment 10 [piero lionello, Italy]	NOT APPLICABLE: not clear what comment 10 is

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
14890	61	30	61	34	This seems a bit contradictory. It is said that the trends are weaker in southern Europe but the % projections are larger for Southern Europe. [Clare Goodess, United Kingdom (of Great Britain and Northern Ireland)]	NOTED: the sentence refers to the heating degree day index and the observed trend from Spinoni 2015 is indeed weaker in southern Europe or not significant
40856	61	31			"with enhancement over Northern Europe and a weaker trend in Southern " seems to contradict the following lines. Not clear phrasing [piero lionello, Italy]	NOTED: enhancement is referred to the decreasing trend that will continue in the future. So the sentence is correct as it is.
41344	61	32	61	34	Might be useful to also provide value for RCP2.6 [Debra Roberts, South Africa]	NOTED: It is included in the text if available in the literature, if not it can be based on CH12 or Atlas plots.
44002	61	44	61	45	I disagree with this statement: " However precipitation trends are noisy and significance in trends can only be obtained when considering large subregions (Chapter 10)." We find significant precipitation trends at 2.5x2.5 degree gridpoint scale, forming a relative coherent region without additional smoothing spatially, even over much of western and eastern Europe (1901-2010) though not in central Europe. Suggest to replace the above sentence with the following: "Detectable anthropogenic increasing trends in precipitation over 1901-2010 have been identified for much of western Europe and eastern Europe--though not over central Europe or Mediterranean region--based on gridpoint-based univariate detection/attribution analysis (Knutson and Zeng 2018). Over much of this region, the increasing trends over 1901-2010 are significantly stronger than in CMIP5 historical runs, suggesting that CMIP5 models may be underestimating future increasing trends in these regions." Reference: Fig. 3c and 4c of: Knutson, T.R. and F. Zeng, 2018: Model Assessment of Observed Precipitation Trends over Land Regions: Detectable Human Influences and Possible Low Bias in Model Trends. J. Climate, 31, 4617–4637, https://doi.org/10.1175/JCLI-D-17-0672.1 [Thomas Knutson, United States of America]	NOTED: This paper is only based on CMIP5 and for what I can see in Figure 3c and 4c most of Europe is grey that means non detectable trends, except few blue points (positive) in the very north and far east, and few red points over Greece. The sentence can stay as it is and the reference has been added in the beginning of the paragraph.
51342	61	47	55	47	I don't understand the "despite" in this sentence [Bart Van den Hurk, Netherlands]	NOTED: despite is used here to indicate that even if the simulations have a wet bias, there is nevertheless an increase confidence in precipitation change projection, mean and extremes.
40858	61	49			https://doi.org/10.1007/s10113-018-1290-1 shows contrasting trends of precipitation across the Mediterranean region and specifically the decrease of precipitation with global warming in southern Europe [piero lionello, Italy]	NOTED: to our understanding the paper confirm a precipitation decrease in the Mediterranean basin so it can be added as a reference.
44004	62	6	62	7	Comment: Just to add to concerns about future flooding increase in Europe, it appears that CMIP5 historical runs have underestimated the 1901-2010 increasing trends in precipitation in the region in observed data, suggesting these same models could be underestimating future increases with climate warming. If true, the models could be understating future flood risk, although flooding is admitedly a complicated phenomenon. Reference to cite if you want to bring up this issue: Fig. 3c of: Knutson, T.R. and F. Zeng, 2018: Model Assessment of Observed Precipitation Trends over Land Regions: Detectable Human Influences and Possible Low Bias in Model Trends. J. Climate, 31, 4617–4637, https://doi.org/10.1175/JCLI-D-17-0672.1 [Thomas Knutson, United States of America]	REJECTED: as the reviewer says the flood is a complicated issue and it is not necessary directly and linearly linked with precipitation only. So this speculation is beyond the scope of this chapter and we prefer to assess what is discussed in the literature.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
50876	62	6	62	21	Changes in river flooding in Europe are strongly affected by the driving GCM; they range from worsening occurring only in north-western Europe to increases in all of Europe except the Mediterranean area. The British Isles have some of the worst overall flood projections but using outputs from some CMIP5 GCMs the severe increase in river flooding extends to the north of Iberia (Guerreiro et al 2018). Guerreiro, S.B., Dawson, R.J., Kilsby, C., Lewis, E. and Ford, A. (2018) 'Future changes in heat-waves, droughts and floods in every European city', Environmental Research Letters, 13(3), p. 034009. [Selma Guerreiro, United Kingdom (of Great Britain and Northern Ireland)]	NOT APPLICABLE: We don't find in this paper any indication on flood uncertainty due to the driving GCM. It may be the wrong paper
40876	62	6		32	Again: these statements refer to impacts of climate change. Do they belong here or they are a duplication with respect to WGII chapter 13 Europe? [piero lionello, Italy]	NOTED: these statement can stay in CH12 and a minimum overlap can be present n WGII
49732	62	6			read "SR1.5 and Alfieri et al. (2017) show" rather than "SR1.5 and Alfieri et al., 2017 show" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: done
51344	62	17	5	17	A decrease in return period implies and increase in intensity at a given return period. Is that what you mean to say? [Bart Van den Hurk, Netherlands]	NOTED: yes this is the meaning, but the sentence can stay as it is
49734	62	20			read "is also found by Thober et al. (2018) in" rather than "is also found by (Thober et al., 2018) in" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: done
14892	62	24	62	27	This could be better explained. In particular, what is meant here by 'urban development'? [Clare Goodess, United Kingdom (of Great Britain and Northern Ireland)]	ACCEPTED: for urban development is meant expansion of urban areas. In the paper that is cited they compare the climate change effect and the urban expansion effect on pluvial flooding due to extreme precipitation. Text is revised now.
51346	62	26	5	26	"I" -> "in". The entire paragraph needs a bit of text editing [Bart Van den Hurk, Netherlands]	EDITORIAL: done
49736	62	26		27	not clear "an increase I pluvial flooding mainly due" [Cyriaque Rufin Nguimalet, Central African Republic]	ACCEPTED: text revised

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
14894	62	29	62	32	What causes these spatial differences - does this relate to present day or to projections? Seems to contradict what is said on lines 51-55 in terms of drought. [Clare Goodess, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: The paper is based on observed data and is not done with any projections. From the papers there is the explanation " This was the result of the interplay of estimated rainfall intensity which was higher for central Europe and the Mediterranean, modulated by urban topography and flow paths occurring during floods." The method is based on simple regression of 10 years return period of hourly precipitation. The paper is cited to put the previous projections in the context of an "observed trend", the two are switched now in the text. It also needs to be put in a broader context if possible with new literature. Regarding the comments for line 51-55, I believe that pluvial flooding is quite different from stream flood flooding or drought. Pluvial flooding is related to a temporal and spatial scale much shorter and smaller compared to streamflow drought.
50878	62	29	62	32	The referred paper does not present the values shown here (which I assume were estimated from a map shown there). I propose the following sentence has a replacement: In a pan European study using an urban flood model and estimated 10 year return hourly rainfall, Guerreiro et al. (2017) showed that cities in central Europe and Mediterranean have a higher percentage of city area affected by pluvial flooding than Northern and Western coastal cities. This was the result of the interplay of estimated rainfall intensity which was higher for central Europe and the Mediterranean, modulated by urban topography and flow paths occurring during floods. [Selma Guerreiro, United Kingdom (of Great Britain and Northern Ireland)]	NOTED: the reviewer is right, but those number are easy to estimate from the Figure 8 of the paper.
15476	62	37	62	37	Here by 'next century' do you mean the 21st century or 22nd century? Please clarify. [Ruiqing Miao, United States of America]	NOTED: the whole report and chapter is all about projections for the 21 century, so I think there is no need to specify it

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
50880	62	37	62	49	Using 12-month rainfall based, Drought Severity Index, Guerreiro et al 2018 showed that drought conditions are expected to intensify in southern Europe under all CMIP5 GCMs, while in mid and northern latitudes the projections are GCM-dependent. Comparing 2051-2100 with 1951-2000, using rainfall from some GCMs leads to areas of Southern Europe having more than 70% probability that the worse historical period drought will be exceeded in any given month, and may experience droughts up to 14 times worse than the worst drought in the historical period. Guerreiro et al 2017 showed that for Iberia, climate model future drought projections are neither related to their performance in simulating historical drought nor to their large-scale circulation patterns. All CMIP5 models project an intensification of drought conditions for Iberia; some project small increases but most project extreme multi-year droughts by the end of the century. Guerreiro, S.B., Dawson, R.J., Kilsby, C., Lewis, E. and Ford, A. (2018) 'Future changes in heat-waves, droughts and floods in every European city', Environmental Research Letters, 13(3), p. 034009 Guerreiro, S.B., Kilsby, C. and Fowler, H.J. (2017) 'Assessing the threat of future megadrought in Iberia', International Journal of Climatology, 37(15). [Selma Guerreiro, United Kingdom (of Great Britain and Northern Ireland)]	ACCEPTED: we thank the reviewer for highlighting the 2018 paper relevant for the section. Text is now included. The second suggestion is redundant since the information is already included in the first.
40880	62	37			I find no information on past trends of droughts in southern Europe [piero lionello, Italy]	ACCEPTED: text revised with reference to CH11
51332	62	38	51	38	Alse the publication of Vogel et al would be relevant here: Vogel MM, Zscheischler J, Wartenburger R, Dee D, Seneviratne SI. Concurrent 2018 hot extremes across Northern Hemisphere due to human-induced climate change. Earth's Future, 2019 (in review) [Bart Van den Hurk, Netherlands]	NOTED: the paper is about hot extremes, in this paragraph we are assessing droughts. It can be use in the Heat section.
44006	62	40	62	40	Suggest to add: "This is supported by a gridpoint-based analysis of precipitation trends over 1901-2010 showing detectable anthropogenic decreases over the Mediterranean region (Knutson and Zeng). The Mediterranean region (along with parts of northern tropical Africa) shows some of the strongest evidence anywhere in the world for large-scale decreasing precipitation trends over 1901-2010, considering regions with adequate data coverage over this period." Reference: Fig. 3c of: Knutson, T.R. and F. Zeng, 2018: Model Assessment of Observed Precipitation Trends over Land Regions: Detectable Human Influences and Possible Low Bias in Model Trends. J. Climate, 31, 4617–4637, https://doi.org/10.1175/JCLI-D-17-0672.1 [Thomas Knutson, United States of America]	ACCEPTED: we thank the reviewer. Reference and text is included.
51348	62	43	8	43	How do we fit 100 additional stress years in a period shorter than a century? [Bart Van den Hurk, Netherlands]	NOT APPLICABLE: the text has been removed due to space constrain
49738	62	45			read "are used in Spinoni et al. (2014) and" rather than "are used in (Spinoni et al., 2014) and" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: done
49740	62	47			read "and 8.5 scenario (Spinoni et al., 2019)." rather than "and 8.5 scenario.(Spinoni et al., 2019)." [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: done

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
49742	63	3		5	read "Agro-climatic indicators connected to extreme weather events were used to derive 11 agro-climatic indices (based on Tmax, Tmin, Tdaily, Pdaily, ET and soil moisture condition thresholds) to quantify the possible effect of climate change by 2060 on European wheat production (Trnka et al., 2014)." rather than "In the work by Trnka et al., (2014) agro-climatic indicators connected to extreme weather events were used to derive 11 agro-climatic indices (based on Tmax, Tmin, Tdaily, Pdaily, ET and soil moisture condition thresholds) to quantify the possible effect of climate change by 2060 on European wheat production." [Cyriaque Rufin Nguimalet, Central African Republic]	NOT APPLICABLE: the text has been removed due to space constrain
14896	63	6			It is not very informative to just refer to changes in risk - can you be more specific here? [Clare Goodess, United Kingdom (of Great Britain and Northern Ireland)]	NOT APPLICABLE: the text has been removed due to space constrain
49744	63	9		10	raed "has been detected with significant impact on ecosystems and society (Vautard et al., 2007)." rather than "has been detected (Vautard et al., 2007) with significant impact on ecosystems and society. " [Cyriaque Rufin Nguimalet, Central African Republic]	NOT APPLICABLE: the text has been removed due to space constrain
14898	63	15	63	19	What is the potential explanation for a reduction in severe wildfire risk in southern Europe? This seems counterintuitive given projected changes in drought. And the final sentence of the paragraph refers to an increase in risk. Why these different findings? [Clare Goodess, United Kingdom (of Great Britain and Northern Ireland)]	NOTED: the point the reviewer raised is exactly the message we want to pass about fire hazard. The literature doesn't show a consensus on this at the moment but is very much case dependent. This justify the low confidence statement.
49746	63	16			raed "very extreme wildfire events (Forzieri et al., 2016)." rather than "very extreme wildfire events. (Forzieri et al., 2016)." [Cyriaque Rufin Nguimalet, Central African Republic]	ACCEPTED: text has been revised
42218	63	18			A space is needed after the citation. [Lubna Alam, Malaysia]	ACCEPTED: text has been revised
51350	63	35	7	35	What is "wind time variability"? [Bart Van den Hurk, Netherlands]	ACCEPTED: text has been revised
40882	63	42			https://doi.org/10.3402/tellusa.v68.29391: Results show significant negative trends of cyclone frequency in spring and positive trends in summer, whose contrasting effects compensate each other at annual scale, so that there is no significant long-term trend in total cyclone numbers in the Mediterranean basin in the 1979–2008 period. [piero lionello, Italy]	ACCEPTED: text has been revised
49748	63	43			read "(Smits et al., 2005; Vautard et al., ESD, in press)" rather than "(Smits et al., 2005 Vautard et al., ESD, in press)" [Cyriaque Rufin Nguimalet, Central African Republic]	ACCEPTED: text has been revised
42220	63	44	63	46	Unit correction ms-1 [Lubna Alam, Malaysia]	EDITORIAL: done
51352	63	51	64	7	Would be good to put a placeholder here for outcome of HighResMIP results that will probably also assess the impact of high resolution models on extreme wind conditions [Bart Van den Hurk, Netherlands]	**NOTED:** HiResMIP projections considered in the final version
48082	64	22	64	22	Too many adjectives accompanying term ?evidence? (some of them are redundant or not very precise): no clear, limited, conflicting, sufficient, sufficiently strong. Unlike in other chapters, these terms do not appear in italics in many places along Chapter 12. [WGI TSU, France]	ACCEPTED: It is not clear if the comment is referred to the "insufficient evidence" text or is general for CH12. If the latter not clear why pg64 line 22 is indicated. If the former , text has been revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
15402	64	28	65	12	Snow and ice hazards in Khibiny (near Scandinavia) and Caucasus mountains are missed. They are famous by avalanches, for example. Turchaninova, A. S., Seliverstov, Y. G., & Sokratov, S. A. (2019). About the numerical modeling of snow avalanches in the Russian Arctic. In Solving the puzzles from cryosphere (pp. 118-119). Komarov, A., Seliverstov, Y., Sokratov, S., Glazovskaya, T., & Turchaniniva, A. (2017, April). Avalanche risk assessment in Russia. In EGU General Assembly Conference Abstracts (Vol. 19, p. 9104). [Oksana Lipka, Russian Federation]	REJECTED The Turchaninova paper is in Russian and from the available English abstract is a methodological paper as much as it is the Komarov paper and they are both not showing results in a climate change context.
29892	64	33	64	33	Widespread and accelerated decrease of snowdepth (Fontrodona Bach et al., 2018) and snow water equivalent (doi: 10.1175/JHM-D-16-0188.1) are currently observed in Europe. [Christoph Marty, Switzerland]	ACCEPTED: text has been revised
41202	64	36	64	37	It is essential to mention the period (1970-2015) for which this rate was obtained. Also, Klein et al. (2016) founded a great yearly variability that is worth to mention. [Lucas Ruiz, Argentina]	ACCEPTED: text has been revised
42222	64	36			A space is needed before uniit m (1000-2500m) [Lubna Alam, Malaysia]	EDITORIAL: done
25514	64	49	64	49	Reference to Ch 9 should probably be made here. [Sharon Smith, Canada]	ACCEPTED: text has been revised
41204	64	49	64	50	Although this section is about Europe, the authors are mention all mountain regions in the world, please use this sentence in more general context or re-write it just for Europe. Regarding the author's assessment, literature assessed in chapter 9, suggest that very likely that glaciers will continue to lose mass throughout the 21st century. Please cite the proper section of Chapter 9 (9.5.2.5) [Lucas Ruiz, Argentina]	ACCEPTED: text has been revised
42224	64	55			CO2 (2 needed to be subscript) [Lubna Alam, Malaysia]	EDITORIAL: done
42226	65	1	65	12	Space required before citation [Lubna Alam, Malaysia]	EDITORIAL: done
51356	65	15	8	54	Lots of typos in this section [Bart Van den Hurk, Netherlands]	EDITORIALS: text has been revised
40894	65	17			Venice is avery important example. Concerning observed trends https://doi.org/10.1016/j.pce.2010.10.002 shows that increased floods are caused by increased realtive sea level (and not to increased storminess), https://doi.org/10.1002/joc.5066 shows a decrease of extreme wave heights and increaseof events in the middle range [piero lionello, Italy]	REJECTED: both suggestion are very local study that are beyond the scope of the section given the limited page length.
51354	65	21	7	21	Is the phrase starting with "The Baltic" actually the start of a new sentence? [Bart Van den Hurk, Netherlands]	EDITORIAL: text has been revised
40884	65	23			I think that Gualdi et al made an estimate of the steric component only. This excludes any mass contributions and it ignores the link to the East Atlatic sea level [piero lionello, Italy]	NOTED: The paper is used only to confirm the finding from also other papers, so I think the details of the "steric component" is probably irrelevant here.
40886	65	25			https://doi.org/10.1016/j.sbspro.2014.02.087 shows a future decrease of storm surges along the Mediterranean (southern Europe) coastline. Consequently confidence on trends of extreme surges is low in the Mediterranean [piero lionello, Italy]	NOTED: The sentence in question refers to Extreme sea levels (ESL) which is a combination of mean sea level, tide, surge and wave setup. This comment refers only to surge which is one component of ESL
42228	65	27			Space needed after the citation [Lubna Alam, Malaysia]	EDITORIAL: done
49750	65	27			read "only available in Vousdoukas et al. (2018) and" rather than "only available in (Vousdoukas et al., 2018)and" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: done
49752	65	28			read "Both studies disagree on the" rather than "The two studies disagree on the" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: done

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
49754	65	37			read "Vitousek et al. (2017) indicate the European" rather than "(Vitousek, et al., 2017) indicate the European" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: done
40888	65	39			https://doi.org/10.1016/j.gloplacha.2016.06.012 shows that mass addition across the Gibraltar Strait to the Mediterranean Sea will likely become the dominant factor and it will determine an increase of the maximum water level along most of the coastline (in spite of the decreasing storminess) [piero lionello, Italy]	ACCEPTED: text is revised
42230	65	41			It can be written as the same report is used in the report Forzieri et al. (2016)….. [Lubna Alam, Malaysia]	REJECTED: not sure why we need the word "report". Doesn't make the English fluid.
51358	65	43	10	43	would be good to indicate which area of Eastern Europe are meant here [Bart Van den Hurk, Netherlands]	ACCEPTED: text has been revised
54664	65	45	65	47	Monioudi et al. (2017) only study beaches in the Aegean archipelago, not all beaches [Sabine Undorf, United Kingdom (of Great Britain and Northern Ireland)]	ACCEPTED: comment well taken. text revised.
32360	65	45	65	54	To focus exclusively on beaches and open sandy coasts is again a significant simplification of coastal hazards in Europe (and elsewhere for that matter). While limited in spatial scope and modelling complexity, various other studies have explored changes in coastal hazards with rising sea levels for geologically-constrained beaches (e.g. Bon de Sousa, et al., 2018. Applied Geography, DOI: 10.1016/j.apgeog.2018.07.023) or soft rock cliffs (e.g. Brooks et al., 2012. Geomorphology, DOI: 10.1016/j.geomorph.2012.02.007) and there is a vast body of literature on coastal hazards under a changing climate for estuaries, lagoons and saltmarshes. [Carlos Loureiro, United Kingdom (of Great Britain and Northern Ireland)]	ACCEPTED: Bon se Sousa References have been added.
51360	65	46	19	46	What is a complete erosion? All sand to disappear? [Bart Van den Hurk, Netherlands]	NOTED: In the paper that is referred to they compared the length of the erosion with the maximum width of the beach and when the two are equal it means complete erosion.
42232	65	51	65	52	can be written as, Le Cozannet et al. (2019) showed….. [Lubna Alam, Malaysia]	EDITORIAL: done
49756	65	51		52	read "Le Cozannet et al. (2019) show shoreline projection " rather than "(Le Cozannet et al. 2019)shows shoreline projection " [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: done
55832	65	52		53	there are a couple of typos:)shows (needs a space) and the word strong [Emilia Guisado-Pintado, Spain]	EDITORIAL: done
8732	65	53	65	54	suggested rephrasing: "but they do not find a strong increase of shoreline erosion before the 2050". (add "increase of") [Goneri Le Cozannet, France]	NOT APPLICABLE: the text has been removed due to space constrain
49758	65	53			read "not find a strong shoreline" rather than "not find a srtong shoreline" [Cyriaque Rufin Nguimalet, Central African Republic]	NOT APPLICABLE: the text has been removed due to space constrain
54668	66	14	66	15	Should the statement that the lack of a recent ozone decrease makes its projected increase more relevant be explained? [Sabine Undorf, United Kingdom (of Great Britain and Northern Ireland)]	NOTED: The meaning of the sentence already highlight the relevance of the increase due to the ozone decrease.
8734	66	25	66	30	I think this is a very relevant result but I don't understand what dominates at the end, assuming constant PM10 emissions: is this the effect on atmospheric circulation favouring accumulation of PM10 close to the emission areas, or is this the warming of temperatures favouring the dispersion of PM10? [Goneri Le Cozannet, France]	NOTED: from the text, the PM10 decrease is attributed to the nitrate volatilization.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
16144	66	25	66	30	This paragraph is entirely correct, but it is not specific for Europe. In all regions these data are true, with minor differences (see Chapter 6). One suggestion could be to avoid mentioning air pollution issues for all regions and report this text in a more generalised way in the introduction of the section for all regions. Text and references could be borrowed from Chapter 6. [Sandro Fuzzi, Italy]	ACCEPTED: the text is specific for Europe because it refers to EU studies. Reference to CH6 is included now for broader context.
51362	66	27	30	27	What is "impacting the aerosol concentration"? [Bart Van den Hurk, Netherlands]	NOTED: The sentence means that temperature impacts the aerosol concentration.
54682	66	33	66	38	Maybe this could be linked to the discussion of diurnal temperature range; relevant references are e.g. Wild, M., Ohmura, A., & Makowski, K. (2007). Impact of global dimming and brightening on global warming. Geophysical Research Letters, 34(4), 1–4. https://doi.org/10.1029/2006GL028031 and Makowski, K., Wild, M., & Ohmura, A. (2008). Diurnal temperature range over Europe between 1950 and 2005. Atmospheric Chemistry and Physics Discussions, 8(2), 7051–7084. https://doi.org/10.5194/acpd-8-7051-2008 and Makowski, K., Jaeger, E. B., Chiacchio, M., Wild, M., Ewen, T., & Ohmura, A. (2009). On the relationship between diurnal temperature range and surface solar radiation in Europe. Journal of Geophysical Research Atmospheres, 114(7), 1–16. https://doi.org/10.1029/2008JD011104 and Undorf, S., Bollasina, M. A., & Hegerl, G. C. (2018). Impacts of the 1900-1974 increase in anthropogenic aerosol emissions from North America and Europe on Eurasian summer climate. Journal of Climate. https://doi.org/10.1175/JCLI-D-17-0850.1 [Sabine Undorf, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT We agree the phenomena are linked but DTR evolution is a consequence, so it is not mentioned here. However the fact that RCMs and GCMs behave differently possibly due to aerosols is mentioned now, and a reference to more papers is now given. Since there are other mechanisms in place it is hard to however conclude with a robust sign on future evolutions of radiation.
41284	66	45	67	2	I wonder if it is possible to have a similar assessment table for the different types of compound events discussed in chapter 11 and per region as you do here. I am referring to Europe, but the same could be interesting for the other regions too. [Veruska Muccione, Switzerland]	**REJECTED:** We do not think enough literature is available to include compound event assessments in each region
26894	66	47	67	1	the column "air pollution" should be differentiated in 2 parts: there is high confidence of hazard increase for ozone air pollution (p66 L11-15), and low confidence in hazard decrease for aerosol pollution (see p66 L25-30) [Augustin Colette, France]	ACCEPTED: this is now specified in the CID table.
8726	67	1	67	1	For sea-level rise, one issue is that in Scandinavia, sea-level is dropping due to post-glacial rebound. In these regions, coastal hazards will decrease (although constant accretions of shorelines can be seen as a hazards for navigation operations). [Goneri Le Cozannet, France]	TAKEN INTO ACCOUNT: Projections of sea level rise and extreme sea level include post-glacial rebound, local sediment accretion, and local subsidence where those data exist. We have focused our discussion on relative sea level rise (ocean level compared to local land level) and readers are now referred to a broader discussion of these physical processes and topics in CH9. Our analysis of Polar Northern Europe notes relative sea level declines around the Baltic Sea.
14934	67	1			I am somewhat surprised that wildfire hazard is not shown as increasing in Southern Europe. Medium confidence in increases in hail hazard does not seem fully justified by the text. [Clare Goodess, United Kingdom (of Great Britain and Northern Ireland)]	**ACCEPTED**: Fire weather in the Mediterranean region is now assessed as increasing with high confidence

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
25522	67	5			Section 12.4.6 - The recently released Canada's Changing Climate Report may be relevant to this section for regional information. Link to report https://www.nrcan.gc.ca/environment/impacts-adaptation/21177 [Sharon Smith, Canada]	TAKEN INTO ACCOUNT: We now include material drawn from the Canada's Changing Climate Report, which helps us considerably in the assessment of climatic impact drivers for Canada.
42782	67	11	67	12	Is it possible to plot *observed* trends from recent historical data in a way similar to the projected trends shown in Fig 12.13? Evidence for some regional trends in observations is discussed in the text, and a more global view of observed climate change is presented in Ch 2. It would be phenomenally useful for WG2 assessments to have graphics showing observed changes in much the same way as depicted in Fig. 12.13, even (maybe especially) if regions with insufficient data are explicitly depicted [David Gutzler, United States of America]	TAKEN INTO ACCOUNT: We consider observed trends in the assessment and have substantially increased the discussion of observations throughout Chapter 12, but a more complete presentation of maps does not fit in CH12 given space requirements. We are also working with the interactive Atlas to include capabilities to create hazard index maps from observational datasets.
42778	67	16	67	33	This figure is awesome!! Both for the selection of variables and for its inclusion of Mexico in North America. I think this figure provides a wonderful template for the WG1-WG2 handshake. I'll make a couple of 'substance' comments separately. [David Gutzler, United States of America]	NOTED: No action needed, and we continue to work closely with WGII CH14 around this section.
42780	67	16	67	33	Is it possible to add near-coastal ocean temperature trends -- or a metric pertaining to marine heat waves --plotted similarly to panel (i)? [David Gutzler, United States of America]	TAKEN INTO ACCOUNT: We included coastal areas for hazards as possible, although we are limited by a lack of observational data beyond land areas for hazard indices requiring bias-adjustment. We are also adding a figure on Marine Heatwaves in 12.4.9, and refer the reader to a Cross-Chapter box on marine heatwaves that is located in Chapter 9.
44008	68	11	68	11	Suggest to add here: "According to the U.S. Climate Science Special Report (Vose et al. 2019) detectable anthropogenic warming since 1901 has occurred over the western and northern regions of the contiguous United States (medium confidence), although over the southeastern United States there has been no detectable warming trend since 1901. A detectable anthropogenic increase in a summertime heat stress index over much or North America has been reported based on wet bulb globe temperature (WBGT) index trends for 1973-2012 (Knutson and Ploshay 2016). WBGT considers both temperature and moisure effect on human heat stress, and the inclusion of moisure makes trends even more detectable than for temperature alone. However, in the continental U.S. the strong warm episode in the 1930s lowers confidence in detection/attribution findings that are based on records beginning in the 1970s, which do not include the 1930s warm period." References: See Fig. 5 of: Knutson, T.R. & Ploshay, J.J. (2016) Detection of anthropogenic influence on a summertime heat stress index. Climatic Change 138: 25. See also Vose et al. 2019, Fig. 6.6 and related discussion. [Thomas Knutson, United States of America]	TAKEN INTO ACCOUNT: We have added further material from Vose et al. (and the US National CLIMATE Assessment), and also note increases in heat stress over the continent even in places where some temperature trends are not as clear using a more recent reference (Grotjahn and Huynh, 2018)

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
6223	68	17	68	17	indicator species [Mostafa Jafari, Iran]	REJECTED: We interpret this review comment to recommend the inclusion of a more detailed discussion of prominent species affected by annual and seasonal warming trends. Chapter 12 refers the reader to WGII and prominent studies for further analysis not permitted by its limited space.
39400	68	17	69	42	Althought within the conceptual framework the assesment of the chapter was conceived as a "handshake" instead of a "handover" between WGI and WGII, the authors in the section referring to this comment (12.4.6.1), did few emphasis on the description of climatic hazards. On the contrary, the assesment was mainly based on the impact of climatic hazards on different sectors, which is the main objective of the WGII [Noemi Chacón, Venezuela]	TAKEN INTO ACCOUNT: Text of Section 12.4.6 has been revised to ensure that focus remains on changes to climatic impact drivers and associated hazard index changes without discussing impact and risk implications. This also reflects enhanced engagement with WGII CH14 to ensure consistency and coherence across WGs.
49760	68	25		26	read "Hill et al. (2014) found that stream" rather than "(Hill et al., 2014) found that stream" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected
42234	68	32			need space at the word verylikely [Lubna Alam, Malaysia]	EDITORIAL: Corrected
49762	68	34			read "Jacobs et al. (2015) projected that" rather than "Jacobs et al., 2015 projected that" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected
49764	68	40			read "Lee and Sumner (2015) classified climate" rather than "(Lee and Sumner, 2015) classified climate" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected
49766	68	44			read "Allstadt et al. (2015) calculated growing" rather than "Allstadt et al., 2015 calculated growing" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected
25516	68	49	68	53	This section is poorly written. There seems to be some confusion regarding perennially frozen permafrost and seasonally frozen active layer. [Sharon Smith, Canada]	TAKEN INTO ACCOUNT: We have provided increased clarity on different permafrost types including perennially frozen permafrost and seasonally-frozen active layer
41206	68	49	68	53	The results of Melvin et al. (2017) are partially wrong interpreted in this sentence. A reduction (-0.5m) of the active layer indicates an increase of the permafrost thick. e.i. the top of permafrost is closer to the surface due to a decrease in surface temperature. Nevertheless, what Melvin et al. (2017) shown in their "Supporting Information Fig. S1" is that negative change of active layer means areas where near-surface permafrost is projected to be lost because of climate changes. Please, use the published results in the meaning of the author (lost of near-surface permafrost) and not to express their results as a reduction of permafrost active layer thickness, which give the wrong impression of a permafrost thickening. [Lucas Ruiz, Argentina]	ACCEPTED: Text clarified to focus on Melvin et al. (2017) finding that permafrost is lost over much of Alaska rather than on precise Active Layer thickness changes.
25518	68	51	68	52	It is thawing of ice-rich permafrost that presents issues for infrastructure (not all permafrost is ice-rich) and also for landscape stability (ground settlement, thaw slumps, active layer detatchments). It is better to say "changes in permafrost conditions" rather than changes in permafrost thawing" (thawing is the change). Also there are better references that say more about infrastructure impact - see refs for AMAP SWIPA (Romanovsky et al. 2017), AMAP AACA reports and Canadian Transportation report mentioned in earlier comments on chapter 12. [Sharon Smith, Canada]	TAKEN INTO ACCOUNT: We have provided increased clarity on different permafrost types including distinguishing ice-rich permafrost. We also have updated our point of departure to reflect SROCC findings and consider the suggested references in the updated assessment.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
25520	68	52	68	53	Reduction in active layer thickness?? Are you referring to the depth of seasonal freezing which could decrease with warming while seasonal thawing increases. Perhaps you could be more clear here. [Sharon Smith, Canada]	TAKEN INTO ACCOUNT: Text clarified to reflect Melvin et al. (2017) finding that permafrost is lost across many portions of Alaska and that other areas see an increase in Active Layer Thickness.
49768	68	52			read "Melvin et al. (2017) projected more " rather than "Melvin et al., 2017 projected more " [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected
15478	69	9	69	9	The first 5 words in this line are unclear. [Ruiqing Miao, United States of America]	TAKEN INTO ACCOUNT: 'Hazardous heat wave hazard thresholds' has been replaced with 'Hazardous heatwave thresholds' in 12.4.6.1
49770	69	10		11	read "Maxwell et al. (2018) identified regional " rather than "(Maxwell et al., 2018) identified regional " [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected
42236	69	10		12	Its preferable to write Maxwell et al. (2018), Oleson et al. (2018), [Lubna Alam, Malaysia]	EDITORIAL: Corrected
49772	69	12			read "Oleson et al. (2018) identified increased" rather than "(Oleson et al., 2018) identified increased" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected
49774	69	18			read "Schauberger et al. (2017) tracked increases" rather than "Schauberger et al., 2017 tracked increases" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected
49776	69	20		21	read " (Hatfield and Prueger, 2015; Kerr et al., 2018; Schlenker and Roberts, 2009; Grotjahn, submitted)." rather than " (Hatfield and Prueger, 2015; Kerr et al., 2018; Schlenker and Roberts, 2009)Grotjahn, submitted)." [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected
42238	69	21			Need space before citation Gourdji et al., 2013. It can be written Gourdji et al., (2013) [Lubna Alam, Malaysia]	EDITORIAL: Corrected
49778	69	21			read "Gourdji et al. (2013) noted that" rather than "(Gourdji et al., 2013) noted that" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected
15480	69	25	69	28	Should these four lines be a new paragraph? They are about energy instead of crops. [Ruiqing Miao, United States of America]	REJECTED: In this case a discussion of multiple sectoral thresholds (crops, air transportation, energy infrastructure) is included in the same paragraph on high temperature indices, so the organization is by climatic impact driver rather than by sector (splitting each sector/climatic impact driver into its own paragraph would be too disjointed given the large number of combinations in Table 12.2).
51298	69	30	25	30	global -> globe [Bart Van den Hurk, Netherlands]	EDITORIAL: now reads 'wet bulb globe temperature'
49780	69	32		33	read "(see also Wuebbles et al., 2014; Zhao et al., 2015b)." rather than "(see also (Wuebbles et al., 2014; Zhao et al., 2015b)." [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected
42240	69	33			Need space before citation Key et al., 2013. It can be written Key et al., (2013) [Lubna Alam, Malaysia]	EDITORIAL: Corrected
49782	69	33			read "Key et al. (2014) also applied" rather than "(Key et al., 2014) also applied" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected
49784	69	37			read "Heron et al. (2016) used" rather than " (Heron et al., 2016) used" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected
42242	69	40			(Frieler et al., 2013) can be written as Frier et al (2013). [Lubna Alam, Malaysia]	EDITORIAL: Corrected

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
49786	69	40			read "Frieler et al. (2013) used a similar" rather than "(Frieler et al., 2013) used a similar" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected
42244	69	42			2 ºC should written as 2ºC [Lubna Alam, Malaysia]	EDITORIAL: space removed between numbers and °C
44010	70	19	70	22	I recommend replacing the first two sentences of the section (lines 19-22) with the following: "An analysis of observed regional precipitation trends since 1901 over North America (Knutson and Zeng 2018) finds detectable positive trends--over central, north central and northeastern United States and south central Canada--that are attributable at least in part to anthropogenic forcing. The observed positive trends over much of these regions are significantly stronger than simulated in CMIP5 historical runs. Positive observed precipitation trends in the south central U.S. are significant, but were not attributable to anthropogenic influence, since CMIP5 historical runs simulate a decreasing trend in this region since 1901. Significant positive precipitation trends in these North American regions were also found in IPCC AR5." Rationale for this recommendation: The only reference cited was Easterling et al. 2017. The assessment and summary on lines 19-22 is not a correct characterization of Easterling et al 2017. What Easterling et al. (2017) actually said was: "Based on current evidence, it is concluded that detectable but not attributable increases in mean precipitation have occurred over parts of the central United States. " The lack of a finding of attribution for mean precipitation in Easterling et al. was due to lack of studies on this topic, but this is out of date as there is now a new study available focusing on regional attribution of mean precipitation trends (Knutson and Zeng 2018). In Easterling et al., the mention of low confidence was actually referring to trends in extreme precipitation and not mean precipitation. Here is what they said (about extreme precipitation): "Formal detection-attribution studies indicate a human contribution to extreme precipitation increases over the continental United States, but confidence is low based on those studies alone due to the short observational period, high natural variability, and model uncertainty." Reference: Fig. 3c of: Knutson, T.R. and F. Zeng, 2018: Model Assessment of Observed Precipitation Trends over Land Regions: Detectable Human Influences and Possible Low Bias in Model Trends. J. Climate, 31, 4617–4637, https://doi.org/10.1175/JCLI-D-17-0672.1	TAKEN INTO ACCOUNT: In the second order draft assessment of mean precipitation trends are assessed by the Atlas. We have expanded on their assessment here to indicate the emerging literature providing more certainty around precipitation trends in North America, citing Knutson and Zeng (2018) and pointing also to an enhanced figure comparing observations and models with/without natural variability in Chapter 10 (Figure 10.17).
49788	70	20			read "Easterling et al. (2017) noted increasing trends" rather than "(Easterling et al., 2017) noted increasing trends" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected
44012	70	27	70	27	Suggest to add here: "Observed increasing precipitation trends over much of the central and northeastern US and south central Canada over 1901-2010 were found to be significantly stronger than simulated in CMIP5 historical runs, suggesting that these models could also be underestimating future increases in precipitation in these regions (Knutson and Zeng 2018)." Reference: Fig. 3c of: Knutson, T.R. and F. Zeng, 2018: Model Assessment of Observed Precipitation Trends over Land Regions: Detectable Human Influences and Possible Low Bias in Model Trends. J. Climate, 31, 4617–4637, https://doi.org/10.1175/JCLI-D-17-0672.1 [Thomas Knutson, United States of America]	TAKEN INTO ACCOUNT: We added a note citing Knutson and Zeng (2018) to indicate that wet trends may be higher than CMIP5 projections given historical trend biases.
49790	70	31		32	read "Mallakpour and Villarini (2015) found little evidence " rather than "(Mallakpour and Villarini, 2015) found little evidence " [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
49792	70	33			read "Slater and Villarini (2016) found significant" rather than "(Slater and Villarini, 2016) found significant" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected
49794	70	36			read "Wuebbles et al. (2014) projected that" rather than "(Wuebbles et al., 2014) projected that" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected
49796	70	41			read "(FEMA, 2016; Vahedifard et al., 2017)" rather than "(FEMA, 2016) (Vahedifard et al., 2017)". Also "(FEMA, 2016)" does not exist in the references. [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected
44014	70	48	70	48	Recommend to add here: "Easterling et al. (2017) concluded that while detection-attribution studies suggested some anthropogenic influence on extreme preciptation increases over the continental United States, although 'confidence is low based on those studies alone due to the short observational period, high natural variability, and model uncertainty'." [Thomas Knutson, United States of America]	TAKEN INTO ACCOUNT: The updated discussion better discusses model uncertainty, natural variability, and short observational period while also referencing a focus figure in Chapter 10 (Figure 10.17)
49798	70	55			read "Maxwell et al. (2018) identified regional " rather than "(Maxwell et al., 2018) identified regional " [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected
44016	71	14	71	14	Suggest to insert here: "There was little evidence of significant or detectable decreasing precipitation annual trends anywhere in North America over the period 1901-2010 in the analysis of Knutson and Zeng (2018), at least over continental regions with sufficient data for their trend analysis." Reference: Fig. 3c of: Knutson, T.R. and F. Zeng, 2018: Model Assessment of Observed Precipitation Trends over Land Regions: Detectable Human Influences and Possible Low Bias in Model Trends. J. Climate, 31, 4617–4637, https://doi.org/10.1175/JCLI-D-17-0672.1 [Thomas Knutson, United States of America]	TAKEN INTO ACCOUNT: For the second order draft the main assessment of precipitation trends is now conducted by the WGI Atlas, but we have compared against the suggested text/reference for consistency in our assessment.
42246	71	14		19	(Easterling et al., 2017) can be wriiten as Easterling et al. (2017) [Lubna Alam, Malaysia]	EDITORIAL: Corrected
49800	71	14			read "Easterling et al. (2017) found a stronger" rather than "(Easterling et al., 2017) found a stronger" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected
49802	71	19		20	read "End-of-century RCP8.5 projections indicate precipitation decreases reach 30% in southwest Mexico in winter (Easterling et al., 2017)," rather than "(Easterling et al., 2017) end-of-century RCP8.5 projections indicate precipitation decreases reach 30% in southwest Mexico in winter," [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected
9356	71	33	71	41	What is meant by "intensification" in this summary paragraph? One would like to interpret this word in terms of quantitative information (area covered, energy, duration, rain...). In the text, intensification is quoted only once, page 69 line 2, when talking about storm-track, and I fail to understand what that means. [philippe waldteufel, France]	TAKEN INTO ACCOUNT: The review comment page and line numbers did not include the word 'intensification', but we understand the reviewer comment to be referring to the phrase 'a more rapid intensification speed also heightens the tropical cyclone hazard'. In this case we have clarified to refer to TCs more rapidly progressing in terms of hurricane wind speeds and overall destructive power (e.g., as associated with the Saffir-Simpson hurricane scale). A reference to Bhatia et al., 2019, also helps the reader track down the meaning here.
42248	71	34			(Park Williams et al., 2013) can be written as Park Williams et al. (2013) [Lubna Alam, Malaysia]	EDITORIAL: Corrected

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
49804	71	34			read "Park Williams et al. (2013) project that" rther than "(Park Williams et al., 2013) project that" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected
49806	71	49			read "(Easterling et al., 2017). Multiple studies" rather than "(Easterling et al., 2017), Multiple studies" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected
49808	71	52			read "Serinaldi (2016) warns against bivariate" rather than "(Serinaldi, 2016) warns against bivariate" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected
49810	72	1		2	read "Abatzoglou and Williams (2016) found a climate" rather than "(Abatzoglou and Williams, 2016) found a climate" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected
42250	72	7			95th… th should be upper script. [Lubna Alam, Malaysia]	EDITORIAL: 95th now uses superscript for 'th'
49812	72	9			read "Prestemon et al. (2016) found more conducive" rather than " (Prestemon et al., 2016) found more conducive" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected
49816	72	17		18	read "Karnauskas et al. (2018) found a reduction " rather than "(Karnauskas et al., 2018) found a reduction " [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected
49814	72	17			read "Mean winds are projected to decline" rather than "Mean winds are projectedto decline" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected
49818	72	37			read "Vose et al. (2014) found no conclusive" rather than "(Vose et al., 2014) found no conclusive" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected
49820	72	41			read "however Seeley and Romps (2015) projected springtime" rather than "however (Seeley and Romps, 2015) projected springtime" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected
49822	72	51			read "Brimelow et al. (2017) project a decrease " rather than "(Brimelow et al., 2017) project a decrease " [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected
55758	73	1	73	5	I can help further refining this section. Please see NCA box on dust storms in North America: Major mineral dust sources are located in the Southwest and the High Plains (Ginoux et al., 2012). Projections of future dust activity are uncertain (e.g. Brahney et al. 2013). The projected intensification of drought in the Southwest (Melillo et al., 2014) could increase the wind erosion potential in alluvium and dry-playa sources due to a reduction of soil moisture or vegetation die-off (Reheis et al., 2006; Munson et al., 2011). Paradoxically, summer rain storms can enhance dust emission through sediment mobilized by runoff or through direct emission by convective winds (Reheis et al., 2011), and the less common wet-playa sources can become primary sources during high-rainfall years (Reheis and Kihl, 1995; Reheis et al., 2006, 2011). In addition to drought, wind erosion potential can be exacerbated by human activities that disturb the soil, including cropping, livestock grazing, recreation and suburbanization, and water diversion for irrigation (Gill, 1996; Gillette, 1999; Munson et al., 2011; Belnap et al., 2014). A good example is the 1930s “Dust Bowl” in the High Plains, where poor agricultural land management practices and the duration of the drought led to strong wind erosion and dust storms on an unprecedented scale (Chepil, 1957). [Carlos Perez Garcia-Pando, Spain]	**NOTED:** The proposed text/literature was considered but the text needed to be strongly reduced
49824	73	3			read "although Pu and Ginoux (2017) project about" rather than "although (Pu and Ginoux, 2017) project about" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
41208	73	8	74	11	Throughout this section, there is not any mention at all to glacier hazards in North America. SROCC chapters 2 and 3 assesses different glacier-related hazards, and show some examples from North America. As another example, Carrivick and Tweed (2016) give a comprehensive, although still incomplete assessment of the societal impacts of GLOFs. Finally, there are some examples of GLOFs for North America, particularly in Alaska ;(Wilcox et al., 2014). Carrivick, J. L., and Tweed, F. S. (2016). A global assessment of the societal impacts of glacier outburst floods. Glob. Planet. Change 144, 1–16. doi:10.1016/J.GLOPLACHA.2016.07.001. Wilcox, A. C., Wade, A. A., and Evans, E. G. (2014). Drainage events from a glacier-dammed lake, Bear Glacier, Alaska: Remote sensing and field observations. Geomorphology 220, 41–49. doi:10.1016/J.GEOMORPH.2014.05.025. [Lucas Ruiz, Argentina]	TAKEN INTO ACCOUNT: CH12 now includes a stronger treatment of glaciers and other cryosphere hazards. We have added a climatic impact driver for snow and land ice (which includes glaciers), and also added the Carrivick and Tweed reference to note outburst floods in Canada and Alaska.
49826	73	16			read "Kunkel et al. (2009) identified declining" rather than "(Kunkel et al., 2009) identified declining" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected
49828	73	22			read "Pierce and Cayan (2013) find that " rather than "(Pierce and Cayan, 2013) find that " [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected
49830	73	24			read "O'Gorman (2014) simulated a shift " rather than "(O'Gorman, 2014) simulated a shift " [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected
33358	73	37	73	40	Found the wording of this sentence to be confusing -- suggest rephrasing to "…Pacific Northwest and declines in the heaviest snow events in the Southeast US." [Erika Wise, United States of America]	ACCEPTED: text revised as suggested.
49832	73	38			read "Kluver and Leathers (2015) noted a " rather than "(Kluver and Leathers, 2015) noted a " [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected
49834	73	44		45	read "Changnon (2018) examined extreme" rather than "(Changnon, 2018) examined extreme" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected
49836	73	49		50	read "Ning and Bradley (2015) project that" rather than "(Ning and Bradley, 2015) project that" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected
48092	74	14	74	14	Section 12.4.6.7 (Open and deep ocean) assesses key hazards in open and deep ocean which can be linked with sectoral and regional vulnerability and exposure for WGII impact and risk assessments. There is a need for coordination between Chapter 12 and WGII. [WGI TSU, France]	TAKEN INTO ACCOUNT: The specific line of this comment does not seem to refer to the topic mentioned, but building off connections with WGII (particularly CH3) established at WGII LAM2 in Kathmandu, as well as WGI CH9 and the recent SROCC, CH12 now includes more oceanic climatic impact drivers and has added a section on open ocean. We also assess climatic impact drivers associated with 'deep sea systems' as a category of marine ecosystem in Table 12.2 (which will connect with WGII CH3).

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
8132	74	21	74	23	One reference that might be considered here is Love et al. (2016, Earth's Future 4: 440) which provides RSL projections for the North American Atlantic and Gulf coasts (including the main cities along these shorelines) by 2100 CE. [Torbjorn Tornqvist, United States of America]	TAKEN INTO ACCOUNT: We considered the suggested Love et al. reference but decided to stick with the National Climate Assessment as the primary reference here considering it allows us to touch on all regions. Adding detailed references for the Gulf Coast would suggest that we should find them for all regions, which is beyond our purview (this reference may make more sense in Chapter 9 or in WGII Chapter 14).
49838	74	27			read "Sweet and Park (2014) suggested a" rather than "Sweet and Park, 2014 suggested a" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected
49840	74	40		41	read "under RCP8.5, Ghanbari et al. (2019) and Sweet et al. (2017) projected major flooding" rather than "under RCP8.5 by(Ghanbari et al., 2019; Sweet et al., 2017) projected major flooding" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected
8134	74	49	74	49	I am not a morphodynamic modeler, but the Bruun Rule is rather contentious within that community, so I suggest it is used with caution (if at all). At the very minimum, consideration should be given to studies that have demonstrated the limitations of the Bruun Rule, such as Wolinsky & Murray (2009, JGR-ES, 114: F01009). [Torbjorn Tornqvist, United States of America]	ACCEPTED: We have replaced the Bruun reference with updated literature
33036	74	49	74	49	Consider to remove the Bruun (1962) reference [Juan Antonio Rivera, Argentina]	ACCEPTED: We have replaced the Bruun reference with updated literature
49842	75	1		2	read "Erikson et al. (2015) also project a" rather than "(Erikson et al., 2015) also project a" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected
42252	75	3			correction near citation. Editional Bracket (eed to be deleted. [Lubna Alam, Malaysia]	EDITORIAL: extra '(' removed
16146	75	11	75	13	Again, for North America a different format and type of information are used to inform about air pollution. The format should be as consistent as possible for all regions. [Sandro Fuzzi, Italy]	TAKEN INTO ACCOUNT: We have updated to increase clarity and consistency for air pollution hazards across all of CH12. This includes an update to the definition of air pollution hazards in 12.2 to underscore that we are focused on meteorological hazards and direct changes caused by climate (e.g., wildfires) rather than emissions policy.
49844	75	35		36	read "Ekstrom et al. (2015) mapped out " rather than "(Ekstrom et al., 2015) mapped out " [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected
49846	75	41			read "Altieri and Gedan (2015) highlight the ways" rather than "(Altieri and Gedan, 2015) highlight the ways" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Corrected

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
25524	76	1			Table 12.8. There are some issues with the regions and also the assessment of hazards.Why isn't Alaska part of Northwestern North America (which would also include the western Canadian Arctic) which most certainly will have permafrost issues. Also what about North central North America as this would include part of northern Canada which would also have permafrost issues (it isn't clear if Northwestern North America and North eastern North America includes entire Canadian Arctic). Maybe there should be reconsideration of the regions and a separate category for north of 60 for North America and subdivide that into west, central and east and not have separate Alaska region. [Sharon Smith, Canada]	TAKEN INTO ACCOUNT: - The region formerly called 'Alaska' has been renamed to Northwest North America be inclusive of NW Canada. - We now remind readers of the AR6 sub-regions in the caption for both the figure and table in 12.4.6 and point to the sub-regional map in Chapter 1 so that readers can better understand maps and tables. - We now have a section on polar regions (12.4.9) that includes a similar heat table focusing on climatic impact drivers focusing on the polar portions of the northern North American regions. - We suggested adding regions in consultation with Atlas and wider AR6 regions group, but the final determination was set with recognition that number of regions is already high in North America. Further detail and sub-regional analysis is provided in some of the text statements and will also be provided in WGII Chapter 14, for example.
26896	76	3	76	5	from P75 L11-22 I would say that there is high confidence for hazard increase for air pollution in the table [Augustin Colette, France]	TAKEN INTO ACCOUNT: We updated literature and clarified the definition of air pollution in 12.2 so that we could make a more confident statement for air pollution in Table 12.8. It is important to note that we are assessing the meteorological conditions for air pollution and factors like wildfire aerosols, which we underscore are likely small compared to the effect of broader emissions policy which are trending downward but are beyond our mandate. While recent trends in air pollution over North America are confounded by large shifts in aerosol emissions as a result of policy changes, literature suggests that there are increases in warm conditions susceptible to air pollution creation from aerosol precursors, shifts in stagnation days, and higher wildfire aerosol emissions. The new assessment is therefore largely uncertain for Canada and Mexico, but medium confidence in air pollution increase over Western, Central, and Eastern North America (corresponding to the contiguous US) even as we highlight some regions where stagnation days and wildfire emissions may not follow the broader pattern.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
42254	76				Table 12.8 (Source missing) [Lubna Alam, Malaysia]	TAKEN INTO ACCOUNT: We have added text in the introduction to section 12.4 that clarifies that these regional tables are a summary of assessments through the regional sub-sections and are not deriving from a single reference.
48084	77	16	77	16	In several places along the chapter, the text makes reference to statistically significant results, but no information about the level of significance is given. [WGI TSU, France]	Not applicable. After revision, text no longer makes reference to results that are "statistically significant".
44020	77	20	77	20	Suggest to add here: "A detectable anthropogenic increase in a summertime heat stress index has been identified over a number of island regions in the Caribbean, western tropical Pacific, and tropical Indian Ocean, based on wet bulb globe temperature (WBGT) index trends for 1973-2012 (Knutson and Ploshay 2016). WBGT considers both temperature and moisure effect on human heat stress. The relative short period analyzed (40 years) may be too short for confident detection in the Caribbean owing to strong Atlantic multidecadal variability there, although their method did use model-generated internal variability to attempt to address this issue. " Reference: See Fig. 5 of: Knutson, T.R. & Ploshay, J.J. (2016) Detection of anthropogenic influence on a summertime heat stress index. Climatic Change 138: 25. [Thomas Knutson, United States of America]	Accepted. The first sentence of the suggested text has been added to the section under "Extreme heat". However, the last sentence in the suggested edit was replaced by a statement of "medium confidence" to express the limitation of the relatively short time period used in their analysis. The suggested reference has also been added.
14900	77	22	77	39	SIDS were particularly influential in originally pushing the 1.5C target - so it would be good to report some of the underlying studies here and refer to SR1.5. [Clare Goodess, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Key findings from SR1.5 report (Hoegh-Guldberg et al., 2018) have been added to this section.
44018	77	44	77	45	Suggested modification to wording: " Observation datasets have revealed no significant long-term trends in Caribbean rainfall over 1901-2012, when analyzed seasonally and for grouped data grouped into large subregions of the Caribbean, with inter decadal variability shown in wetter and drier conditions (Jones et al., 2016b). In contrast, a gridpoint based annual precipitation trend analysis for gridpoints with available data over 1901-2010 in the Caribbean region does indicate some gridboxes with detectable decreasing trends (Knutson and Zeng, 2108), which were attributable in part to anthropogenic forcing. The regions included south of Cuba, in the northern Bahamas, and in the Windward Islands. These findings did not hold over the shorter time intervals they analyzed (1951-2010 and 1981-2010)." Reference: Reference: Fig. 3c of: Knutson, T.R. and F. Zeng, 2018: Model Assessment of Observed Precipitation Trends over Land Regions: Detectable Human Influences and Possible Low Bias in Model Trends. J. Climate, 31, 4617–4637, https://doi.org/10.1175/JCLI-D-17-0672.1 [Thomas Knutson, United States of America]	Not applicable. Text was revised according to the reviewer's suggestion with the suggested reference added, but the text has been moved from Chapter 12 to the Atlas (Atlas 5.8.1).
14902	77	46	77	51	I would round these numbers to the nearest % rather than giving two decimal places. [Clare Goodess, United Kingdom (of Great Britain and Northern Ireland)]	Editorial. Percentage values with two decimal places have been rounded off.
33038	78	26	78	29	Which basins are you considering with these results? Apparently you are referring to a specific portion of the small islands given the 2013-2016 drought event you are considering [Juan Antonio Rivera, Argentina]	Not applicable. After revision, the text has been removed and now refers to Box 11.5 where the reference is cited.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
14904	78	26			Specify the location of these records/trends [Clare Goodess, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Text has been edited to indicate that these records and trends are observed in the Caribbean.
49848	78	27		28	read "from the mid 1990s – 2010 (Beharry et al., 2015; Stephenson et al., 2014)." rather than "from the mid 1990s – 2010. (Beharry et al., 2015; Stephenson et al., 2014)." [Cyriaque Rufin Nguimalet, Central African Republic]	Editorial. Extra period is removed.
49850	78	38		40	from line 38 "A projected decrease in annual… up to line 40 (Cantet et al., 2014)." and from line 42 "Seasonal rainfall… to 47' (Timm et al., 2015).", all have to insert above in paragraphs related to "Wet hazards" because not well placed here. [Cyriaque Rufin Nguimalet, Central African Republic]	Not applicable. Following other comments our main hazard categories (now called Climatic Impact Drivers) have been significantly overhauled and the SOD now follows the "Wet and dry" category.
33040	79	1	79	3	I would consider to update this with at least CMIP5 results [Juan Antonio Rivera, Argentina]	Not applicable. After revision, the text has been removed and now refers to AR6 WGI Chapter 11 and more recent literature for updated results on tropical cyclone projections.
12740	79	48	80	2	Rising seas have other implications beyond inundating the land, and the impacts to small islands and how soon these impacts can be felt. Overall, this section could highlight how soon these impacts could happen in other places and that it is far before the full SLR happens. Storlazzi C. D., et al. (2018) Most atolls will be uninhabitable by the mid-21st century because of sea-level rise exacerbating wave-driven flooding, SCIENCE ADVANCES 4(eaap9741):1–9, 1 (“Sea levels are rising, with the highest rates in the tropics, where thousands of low-lying coral atoll islands are located. Most studies on the resilience of these islands to sea-level rise have projected that they will experience minimal inundation impacts until at least the end of the 21st century. However, these have not taken into account the additional hazard of wave-driven overwash or its impact on freshwater availability. We project the impact of sea-level rise and wave-driven flooding on atoll infrastructure and freshwater availability under a variety of climate change scenarios. We show that, on the basis of current greenhouse gas emission rates, the nonlinear interactions between sea-level rise and wave dynamics over reefs will lead to the annual wave-driven overwash of most atoll islands by the mid-21st century. This annual flooding will result in the islands becoming uninhabitable because of frequent damage to infrastructure and the inability of their freshwater aquifers to recover between overwash events. This study provides critical information for understanding the timing and magnitude of climate change impacts on atoll islands that will result in significant, unavoidable geopolitical issues if it becomes necessary to abandon and relocate low-lying island states.”). [Kristin Campbell, United States of America]	Taken into account. The discussion on projections on coastal inundation in this section has been revised.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
12944	79	48	80	2	Rising seas have other implications beyond inundating the land, and the impacts to small islands and how soon these impacts can be felt. Overall, this section could highlight how soon these impacts could happen in other places and that it is far before the full SLR happens. Storlazzi C. D., et al. (2018) Most atolls will be uninhabitable by the mid-21st century because of sea-level rise exacerbating wave-driven flooding, SCIENCE ADVANCES 4(eaap9741):1–9, 1 ("Sea levels are rising, with the highest rates in the tropics, where thousands of low-lying coral atoll islands are located. Most studies on the resilience of these islands to sea-level rise have projected that they will experience minimal inundation impacts until at least the end of the 21st century. However, these have not taken into account the additional hazard of wave-driven overwash or its impact on freshwater availability. We project the impact of sea-level rise and wave-driven flooding on atoll infrastructure and freshwater availability under a variety of climate change scenarios. We show that, on the basis of current greenhouse gas emission rates, the nonlinear interactions between sea-level rise and wave dynamics over reefs will lead to the annual wave-driven overwash of most atoll islands by the mid-21st century. This annual flooding will result in the islands becoming uninhabitable because of frequent damage to infrastructure and the inability of their freshwater aquifers to recover between overwash events. This study provides critical information for understanding the timing and magnitude of climate change impacts on atoll islands that will result in significant, unavoidable geopolitical issues if it becomes necessary to abandon and relocate low-lying island states."). [Durwood Zaelke, United States of America]	Taken into account. The discussion on projections on coastal inundation in this section has been revised.
7464	79				reference to SROCC chapter 4 would be useful in discussion of small islands [Helene Hewitt, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Key findings from SROCC report have been added in this section, as well as reference to AR6 WGI Chapter 9 for updated information on coastal hazards.
45904	80	14	80	27	I observed that coastal erosion provides serious impacts on the life and economy, particularly of islands country. Infrastructure such as port, airport and road connection are located along the coastline. Once road connection is cut off by the erosion of road and town and villages are isolated and distribution of relief supply is delayed. In the case of Cyclone Pam in April 2015, many road were destroyed and people were disconnected (P13-14, http://www.taifu.dpri.kyoto-u.ac.jp/wp-content/uploads/2015/05/DPRI-VMGD-survey-first-report-Final.pdf) and it takes long time for full restoration even though emergency restoration is done soon. In January 2017. Still full restoration has not been done yet. Damage on infrastructure, particularly road transport in islands country provides negative impact for many years. So it is better to call attention as an impact of climate change in island countries. [Takashi Hongo, Japan]	Taken into account. The discussion on coastal erosion has been improved, including information on projections. However, the impacts of coastal erosion on different sectors are outside the scope of this section.
55494	80	31	82	52	These sections feel a bit repetitive after the regional sections. They might benefit from case studies, developed in collaboration with WGII on specific examples for each along the lines of the very good box 12/1 or regional examples as in the arid section following [Daniela Schmidt, United Kingdom (of Great Britain and Northern Ireland)]	**TAKEN INTO ACCOUNT**: to avoid repetitions, we shortened considerably the summaries of specific zones as used in WGII (and hotspots in SR15), but elevated "Polar regions" and "Open and deep ocean" at the same level as the continents as they are not covered as such. However, case studies can be found in Chapter 10.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
46042	80	31	87	14	Not sure how the categories were chosen for impacts by specific zones, however could wildfire impact in temperate forests be included? It certainly is a large one in California. [Isaac Pearlman, United States of America]	**REJECTED**: The structure of the section was mirroring the specific zones used in WGII. Temperate forests are not among the specific zones, and wildfires are covered in the continental sections 12.4.1-12.4.7
45858	81	7			what about marine biodiversity hotspots? [Katja Mintenbeck, Germany]	**TAKEN INTO ACCOUNT**: marine biodiversity hotspots are considered
45860	81	7			rather than assess impacts here and picking examples or papers (I assume this is what has been done), please use AR5 and the AR6 special reports as the basis for evidence of relevance [Katja Mintenbeck, Germany]	**ACCEPTED:** the AR5 and AR6 reports have been taken as a basis for evidence of relevance
45856	81	9	81	10	please be consistent with deiftion of hotspots for biodiversity in WGII cross chapter paper 1 "biodiversity hotspots are geographic areas or locations that contain a high species richness, usually with high endemism, and in some classifications are under significant threat from anthropogenic activity" [Katja Mintenbeck, Germany]	**ACCEPTED:** we have replaced the definition with that used in WGII AR6.
49852	81	12			read "Myers et al. (2000) identified 8 leading " rather than "Myers et al., 2000 identified 8 leading " [Cyriaque Rufin Nguimalet, Central African Republic]	**EDITORIAL:** change made
6225	81	24	81	24	and may caused species upward migration [Mostafa Jafari, Iran]	**REJECTED:** assessment of migrations of species is not in our CH12 mandate.
14906	81	33	81	36	Elsewhere it is suggested that these trends are not projected for the Mediterranean. [Clare Goodess, United Kingdom (of Great Britain and Northern Ireland)]	**NOTED:** we checked consistency in assessment of trends in "fire weather". However projections of fire risk depends strongly on non climatic effects.
49854	81	34			read "Jolly et al. (2015) have shown that" rather than "(Jolly et al., 2015)have shown that" [Cyriaque Rufin Nguimalet, Central African Republic]	**EDITORIAL:** change made
7466	81	41	82	49	Maybe a map of cities with the greatest exp[osure to climate change and magnitude of affected population might be useful [Helene Hewitt, United Kingdom (of Great Britain and Northern Ireland)]	**REJECTED:** Exposure assessment is rather in the mandate of WGII
45862	81	41			ather than assess impacts here and picking examples or papers (I assume this is what has been done), please use AR5 and the AR6 special reports as the basis for evidence of relevance [Katja Mintenbeck, Germany]	**ACCEPTED:** the AR5 and AR6 reports have been taken as a basis for evidence of relevance
36520	81	43	81	44	4% of the total world's population lives in coastal megacities and, although some projections indicate they will start to stabilize, they are developing very rapidly, so their environmental impact is increasing (Sekovski et al, 2012). Improved and integrated weather, environment and climate monitoring systems (Baklanov et al, 2016, Mills et al, 2010) is needed. Sekovski, I., Newton, A. and Dennison, W.C. (2012) Megacities in the coastal zone: Using a driver-pressure-state-impact-response framework to address complex environmental problems. Estuarine, Coastal and Shelf Science 96: 48–59. Baklanov A, Molina LT, Gauss M. 2016. Megacities, air quality and climate. Atmospheric Environment, 126: 235-249. Mills G, Cleugh H, Emmanuel R, Endlicher EE, McGranahanG, Ng E, Nickson A, Rosenthal J, Steemer K. 2010. Climate information for improved planning and management of megacities (needs perspective). Proc. Environ. Sci.1: 228 – 246. [Urbano Fra Paleo, Spain]	**TAKEN INTO ACCOUNT**: the introduction has been modified, also accounting from previous reports as a point of departure.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
14908	81	47	81	49	Need to be a little careful here. In some cities, such as London, the UHI has 'stabilized' i.e. when estimated as the average relative difference between urban/rural areas. [Clare Goodess, United Kingdom (of Great Britain and Northern Ireland)]	**TAKEN INTO ACCOUNT**: This is now phrased carefully
14542	81	54	82	3	Yang et al. (2018) reported a significant correlation of Short-Duration Intense Rainfall (SDIR) with Urban Heat Island Intensity (UHII) in Beijing urban areas. Higher frequencies (amounts) of the SDIR events are found in or near the central urban area, and most of the SDIR events begin to appear in late evening and nighttime, but tend to end in late night and early morning. The spatial and temporal patterns of regional SDIR events show the good relationship with those of the UHII in the urban areas, indicating an obvious influence of urbanization on extremely intense rainfall in the city (Yang, P., Ren, G. Y., Yan, P. C., 2017a. Evidence for a strong association of short-duration intense rainfall with urbanization in the Beijing urban area. J. Climate. 30, 5851-5870.Doi: 10.1175/JCLI-D-16-0671.1). (CUG, Guoyu Ren) [Guoyu Ren, China]	**TAKEN INTO ACCOUNT**: We now increase the literature assessment on this point and include the suggested references
42256	82	6			A single space before citation is needed [Lubna Alam, Malaysia]	**EDITORIAL:** change made
26900	82	9	82	14	disagree on referencing the San José et al. 2016 study that does not rely on state of the art approach in climate impact modelling by comparing single years (2030, 2050, 2100 versus 2011) rather than multi-annual averages to minimize interannual variability. This paper was published in "Journal of Computational and Applied Mathematics", it is very unlikely that it would have passed peer review in an Environment/Atmosphere/Climate journal [Augustin Colette, France]	**ACCEPTED:** the reference ha been removed because the uncertainty was not assessed properly in this paper and multi-model multi-year experiments are needed.
26898	82	12	83	12	add precursors in "due to reductions of emissions of primary pollutants and precursors" [Augustin Colette, France]	**NOT APPLICABLE:** discussion of air pollution has been deleted
8058	82	29	82	29	".." should be "." [Taoyuan Wei, Norway]	**EDITORIAL:** change made
55834	82	39		41	I suggest to add a reference (Fraile-Jurado, P., Álvarez-Francoso, J.I., Guisado-Pintado, E., Sánchez-Carnero, N., Ojeda-Zújar, J., Leatherman, S.P. (2017). Mapping inundation probability due to increasing sea level rise along El Puerto de Santa María (SW Spain). Natural Hazards, Volume 87, Issue 2, 1 June 2017, Pages 581-598) regarding the studies of flooding due to sea level rise based on the probability of ocurrence and the diferent local scenarios in Europe. The authors proposed a method to account and map the full range of probabilities, associated with each scenario of sea level rise, and thus offering a more realistic view of the probability of inundation in southwest Spain. [Emilia Guisado-Pintado, Spain]	**REJECTED:** the study is too specific
45864	82	52			ather than assess impacts here and picking examples or papers (I assume this is what has been done), please use AR5 and the AR6 special reports as the basis for evidence of relevance [Katja Mintenbeck, Germany]	**TAKEN INTO ACCOUNT**: AR5 and AR6 special reports have been taken as the basis
14910	82	54	84	6	This whole section is a bit muddled. Need to be clearer in definitions of arid/semi-arid/hyper-arid/desert etc. And distinguish between changes in exising "arid" regions and spatial extension/expansion of such regions. Additional suggested reference: Park et al (2018) Keeping global warming within 1.5C constrains emergence of aridification. Nature Climate Change 8, 70-74. https://www.nature.com/articles/s41558-017-0034-4 [Clare Goodess, United Kingdom (of Great Britain and Northern Ireland)]	**TAKEN INTO ACCOUNT**: We now increase the literature assessment on this point and include the suggested references
42258	82	55			A single space before citation is needed [Lubna Alam, Malaysia]	**EDITORIAL:** change made

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
6227	83	45	83	45	Deserts and semi-arid areas under climate change impats are more prone to dust storms, which have impacts on human health as well as several other sectors [Mostafa Jafari, Iran]	**TAKEN INTO ACCOUNT**: We now increase the literature assessment on this point
55760	83	46	83	49	I would delete the following text (not relevant for the discussion): "Dust aerosol can also cause surface cooling over arid and semi-arid regions. The cooling effects of dust aerosol are larger in the Northern Hemisphere (NH) than in the Southern Hemisphere (SH). This asymmetric cooling leads to a severer reduction in evaporation over the low latitudes of the NH compared with their counterpart areas in the SH (Zhao et al., 2015a)." [Carlos Perez Garcia-Pando, Spain]	**ACCEPTED:** text deleted
14544	84	9	84	12	A special issue on Hindu Kush Himalayan climate change in Advance in Climate Change Research, and a chapter on climate change (Unravelling Climate Change in the Hindu Kush Himalaya: Rapid Warming in the Mountains and Increasing Extremes) in The Hindu Kush Himalaya Assessment report edited by P. Wester et al. (2019), could be referred in this subsection. (CUG, Guoyu Ren) [Guoyu Ren, China]	**ACCEPTED:** The Hindu-Kush regional report is now cited in Section 12.4
46092	84	9	84	21	need to also include assessment of cold hazards in specific highland areas accros Africa including East Africa. [Shuaib Lwasa, Uganda]	**TAKEN INTO ACCOUNT**: cold hazards are added in the Africa section and repeated here for mountains
46094	84	9	84	21	It is important to include IPCC assessment from Cryosphere special report [Shuaib Lwasa, Uganda]	**TAKEN INTO ACCOUNT**: mountain areas now take SROCC as a starting point for the assessment
45866	84	21			ather than assess impacts here and picking examples or papers (I assume this is what has been done), please use AR5 and the AR6 special reports as the basis for evidence of relevance [Katja Mintenbeck, Germany]	**ACCEPTED:** the AR5 and AR6 special reports have been taken as a basis for evidence of relevance
48088	85	13	85	13	Section 12.4.8.7, which assesses key hazards in open and deep ocean, can be linked with sectoral and regional vulnerability and exposure for WGII impact and risk assessments (ocean warming, marine heatwaves, ocean acidification, de-oxygenation, etc.). [WGI TSU, France]	NOTED: key hazards assessment of open and deep ocean is already linked with sectoral vulnerability and exposure of WGII risks assessment
45868	85	13			ather than assess impacts here and picking examples or papers (I assume this is what has been done), please use AR5 and the AR6 special reports as the basis for evidence of relevance [Katja Mintenbeck, Germany]	**ACCEPTED:** the AR5 and AR6 special reports have been taken as a basis for evidence of relevance
49856	85	23			read "Henson et al. (2017) projected that" rather than "(Henson et al., 2017) projected that" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL :corrected
49858	85	26			read "This section assesses key hazards in open" rather than "This section assesseskey hazards in open" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: change made
49860	85	32			read "and high agreement that ocean" rather than "and high agreementthat ocean" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: change made
49862	85	34			read "Fossheim et al. (2015) noted that " rather than "(Fossheim et al., 2015) noted that " [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: change made
14546	85	41	85	54	Two papers (Li, Yan et al. 2018-2019) on oceanic heat waves in the Yellow Sea and East China Sea could be read and cited here. They reported the increased oceanic heat waves frequency in the seas and a abnormally strong oceanic heat wave event in 2017 in the Yellow Sea. (CUG, Guoyu Ren) [Guoyu Ren, China]	**TAKEN INTO ACCOUNT**: The marine heat waves are treated and assessed in more detail in Box 9.2 (Ch9), in particular Li et al. 2019 is cited.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
7468	85	41	85	55	The section on marine heartwaves has text which repeats the content of the cross-chapter box. I think it is only the assessment of coral bleaching that is needed to be in the chapter 12 text [Helene Hewitt, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: repeated contents of the cross chapter box 9.1 has been removed.
42260	85	43			a single space after the sign > is needed ... typically > 90th… 90th th should be upperscript [Lubna Alam, Malaysia]	EDITORIAL: change made
55496	86	1	86	27	The summative text here for the ocean is not going to the same level of depth as other sections are [Daniela Schmidt, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: summative text of this section has been revised
42262	86	1			A single space is needed after CO2 [Lubna Alam, Malaysia]	EDITORIAL: change made
49864	86	4			read "the anthropogenic CO2 emitted during " rather than "the anthropogenic CO2emitted during " [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: change made
49866	86	13			read "Deoxygenation" rather than "De-oxygenation" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: change made
49868	86	24			read "Oschlies et al. (2012) projected that future" rather than "(Oschlies et al., 2012) projected that future" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: change made
25526	86	29			Section 12.4.8.7.5 - reference should be made to appropriate sections of chapter 2 and 9 which assess trends in Arctic sea ice conditions. [Sharon Smith, Canada]	TAKEN INTO ACCOUNT: text revised by making reference to Chapter 9. Also note this section has been moved up to12.4.9.5 "Snow and Ice" in Polar Terrestrial Regions.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
12742	86	30	86	42	Decreased sea ice allows for greater warming in the region that begets further loss of the ice (Pistone et al 2014), and an ice-free Arctic could happen within the next couple decades (Overland and Wang 2013); the ice that is already lost will allow additional transport within the region, which will be further increased as the ice becomes more and more diminished. Pistone K., et al. (2014) Observational Determination of Albedo Decrease Caused by Vanishing Arctic Sea Ice, PROC. NAT'L. ACAD. SCI. 111(9):3322–3326; Overland and Wang (2013) When will the summer Arctic be nearly sea ice free?, GEOPHYSICAL RESEARCH LETTERS 40:2097–2101, 2097 ("Time horizons for a nearly sea ice-free summer for these three approaches [for estimating future ice loss covered in the study] are roughly 2020 or earlier, 2030 ± 10 years, and 2040 or later."). Shipping routes through the Arctic risk additional pollution, especially of short-lived climate forcers that can amplify warming in the region and accelerate localized warming. With increased transit within the Arctic, there will be increased localized pollution, including of climate-warming agents like black carbon that can further amplify warming by decreasing the albedo of the snow and ice surfaces it settles upon; reducing/eliminating sources of black carbon (e.g., the heavy fuel oil utilized in the shipping industry) are crucial to protecting the region. Stephenson S. R., et al. (2018) Climatic responses to future trans-Arctic shipping, GEOPHYSICAL RESEARCH LETTERS 45:9898–9908; Arctic Monitoring and Assessment Programme (AMAP) (2017) ADAPTATION ACTIONS FOR A CHANGING ARCTIC: PERSPECTIVES FROM THE BARENTS AREA; Arctic Council Secretariat (2017) EXPERT GROUP ON BLACK CARBON AND METHANE: SUMMARY OF PROGRESS AND RECOMMENDATIONS 2017; Sand M., et al. (2013) Arctic surface temperature change to emissions of black carbon within Arctic or midlatitudes, J. GEOPHYSICAL RESEARCH 118(14):7788–7798; see also Stohl A., et al. (2013) Black carbon in the Arctic: the underestimated role of gas flaring and residential combustion emissions, ATMOS. CHEM. PHYS. 13:8833–8855. [Kristin Campbell, United States of America]	TAKEN INTO ACCOUNT: The reviewer raises several points that we address within the chapter or that are addressed elsewhere in WGI or WGII. Mechanisms behind arctic amplification and sea ice loss (which would include the black carbon feedbacks) are assessed in CH4 and CH9. The importance of ice-free conditions in the arctic for the prospect of future oceanic ship traffic is addressed in 12.3. Projections of an ice-free arctic are assessed within 12.4.6, 12.4.8, and 12.4.9 using more recent references than the Pistone et al. and Overland and Wang references suggested here. This includes several wide-ranging independent assessments such as the AMAP 2017 report which the reviewer recommended and we include here. The mechanisms by which an ice-free arctic could affect local emissions of black carbon by increased ship traffic) are examples of a larger category of secondary effects of a climatic impact driver change which can lead to sectoral changes and feedbacks. These types of secondary effects are noted in 12.3 and also within a new section focused on secondary hazard changes caused by adaptation and mitigation measures within 12.5.3.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
12946	86	30	86	42	Decreased sea ice allows for greater warming in the region that begets further loss of the ice (Pistone et al 2014), and an ice-free Arctic could happen within the next couple decades (Overland and Wang 2013); the ice that is already lost will allow additional transport within the region, which will be further increased as the ice becomes more and more diminished. Pistone K., et al. (2014) Observational Determination of Albedo Decrease Caused by Vanishing Arctic Sea Ice, PROC. NAT'L. ACAD. SCI. 111(9):3322–3326; Overland and Wang (2013) When will the summer Arctic be nearly sea ice free?, GEOPHYSICAL RESEARCH LETTERS 40:2097–2101, 2097 ("Time horizons for a nearly sea ice-free summer for these three approaches [for estimating future ice loss covered in the study] are roughly 2020 or earlier, 2030 ± 10 years, and 2040 or later."). Shipping routes through the Arctic risk additional pollution, especially of short-lived climate forcers that can amplify warming in the region and accelerate localized warming. With increased transit within the Arctic, there will be increased localized pollution, including of climate-warming agents like black carbon that can further amplify warming by decreasing the albedo of the snow and ice surfaces it settles upon; reducing/eliminating sources of black carbon (e.g., the heavy fuel oil utilized in the shipping industry) are crucial to protecting the region. Stephenson S. R., et al. (2018) Climatic responses to future trans-Arctic shipping, GEOPHYSICAL RESEARCH LETTERS 45:9898–9908; Arctic Monitoring and Assessment Programme (AMAP) (2017) ADAPTATION ACTIONS FOR A CHANGING ARCTIC: PERSPECTIVES FROM THE BARENTS AREA; Arctic Council Secretariat (2017) EXPERT GROUP ON BLACK CARBON AND METHANE: SUMMARY OF PROGRESS AND RECOMMENDATIONS 2017; Sand M., et al. (2013) Arctic surface temperature change to emissions of black carbon within Arctic or midlatitudes, J. GEOPHYSICAL RESEARCH 118(14):7788–7798; see also Stohl A., et al. (2013) Black carbon in the Arctic: the underestimated role of gas flaring and residential combustion emissions, ATMOS. CHEM. PHYS. 13:8833–8855. [Durwood Zaelke, United States of America]	TAKEN INTO ACCOUNT: The reviewer raises several points that we address within the chapter or that are addressed elsewhere in WGI or WGII. Mechanisms behind arctic amplification and sea ice loss (which would include the black carbon feedbacks) are assessed in CH4 and CH9. The importance of ice-free conditions in the arctic for the prospect of future oceanic ship traffic is addressed in 12.3. Projections of an ice-free arctic are assessed within 12.4.6, 12.4.8, and 12.4.9 using more recent references than the Pistone et al. and Overland and Wang references suggested here. This includes several wide-ranging independent assessments such as the AMAP 2017 report which the reviewer recommended and we include here. The mechanisms by which an ice-free arctic could affect local emissions of black carbon by increased ship traffic) are examples of a larger category of secondary effects of a climatic impact driver change which can lead to sectoral changes and feedbacks. These types of secondary effects are noted in 12.3 and also within a new section focused on secondary hazard changes caused by adaptation and mitigation measures within 12.5.3.
8056	86	32	86	32	"a significant trends" should be "a significant trend" [Taoyuan Wei, Norway]	EDITORIAL: change made
42808	86	33	86	34	need rewording for clear meaning [Xiao Cunde, China]	ACCEPTED- text revised
42264	86	35			A single space is required before citation. [Lubna Alam, Malaysia]	EDITORIAL: change made
42266	86	40			Check citation input. All of the citations should be in the single bracket (A , B , C , D). [Lubna Alam, Malaysia]	EDITORIAL: change made
49870	86	49			read "Shakhova et al. (2015) also noted that" rather than "(Shakhova et al., 2015) also noted that" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: change made
49872	87	9			read "Bakun (2017) project that climate" rather than "(Bakun, 2017) project that climate " [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: change made
49874	87	12			read "Wang et al. (2015a) projected that" rather than "(Wang et al., 2015a) projected that" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: change made
55498	87	18	90	16	The text feels repetitive from earlier sections and needs some refocussing to consider what the messages are. Keeping this text succinct may provide the focus on the key take home message [Daniela Schmidt, United Kingdom (of Great Britain and Northern Ireland)]	ACCEPTED: Text in this section has been modified to remove redundancies
42268	87	23	87	24	Elaborattion of the terms QUEST QUEST-GSI , ISIMIP, BRACE and HAPPI needed [Lubna Alam, Malaysia]	Not applicable. After revision, the sentence has been removed
51364	87	27	21	27	strange formulation in "for driving" [Bart Van den Hurk, Netherlands]	EDITORIAL: corrected

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
8634	87	28	87	33	The statement is too long, kindly break up. [Ibikunle Olaleru, Nigeria]	EDITORIAL. Most of the sentence is actually made up of references therefore we left it unchanged.
51366	87	45	24	45	check reference to content in Atlas on hazard indices and their changes [Bart Van den Hurk, Netherlands]	Not applicable. After revision, the paragraph has been removed
7668	87	52	88	19	A consensus exists for the fact that UHI becomes stronger with progress of urbanization, but its regional scale impact and interaction with HW are currently disagreeing. In perspective of heat wave and urbanization, Zhao et al. (2018) reported synergy effects between UHI and HW based on cities in the US. On the other hand, Scott et al. (2018) found that UHI became weaker in case of HW events in North America. Scott et al.., 2018. Reduced urban heat island intensity under warmer conditions. Environ. Res. Lett. 13, 064003. Zhao et al., 2018. Interactions between urban heat islands and heat waves. Environ. Res. Lett. 13, 034003. [Jinkyu Hong, Republic of Korea]	Not Applicable: after revision UHI is no longer discussed
9524	87		97		Section 12.5 I believe that this section would be importantly enriched if it includes a subsection discussing indices that characterize the performance of infrastructure and societal systems. These indices include (among others) resilience, robustness, and vulnerability. Since they have been initially proposed for water systems analyses by [Hashimoto et al., 1982] they have been refined applied in other sectors to account for climate change risks (see for example: [Moy et al., 1986; Jinno, 1995; Kundzewicz and Laski, 1995; Kjeldsen and Rosbjerg, 2004; Jain and Bhunya, 2008; Basupi and Kapelan, 2015; Brown et al., 2015; Herman et al., 2015, Pimm, 1984; Fowler et al., 2003; Wang and Blackmore, 2009; Folke et al., 2010]. As these indices (or preferably referred to as metrics) have gained popularity to examine climate risks, this section would be highly enriched by discussing them. This discussion would nicely fit with what is already presented in Chapter 9, Section 10.5.1 [Paltan Homero, United Kingdom (of Great Britain and Northern Ireland)]	REJECTED These mostly refer to WGII impacts. We have emphasised that the chapter concentrates on indicators of hazard/resource change, not on socio-economic impacts
15482	88	2	88	2	Here 'summer temperatures' is vague. Do you mean average, max, or min temperature? [Ruiqing Miao, United States of America]	ACCEPTED: we have now included the definition from the Lehner et al paper
42270	88	15			) can be removed after the citation [Lubna Alam, Malaysia]	EDITORIAL: corrected
49876	88	16			read "(Matthews et al., 2017)." rather than "(e.g. (Matthews et al., 2017)." [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: corrected
49878	88	53			read "Lin et al. (2018a) showed a decrease" rather than "(Lin et al., 2018a) showed a decrease" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: corrected
49880	88	55	89	1	read "Naumann et al. (2018) for example" rather than "Naumann et al., 2018 for example" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: corrected
27422	88				- Uncertainty language is very important. But it should be build using IPCC principles. Some cases are based on one paper (i.e in 12.5.1.2). [Fatima Driouech, Morocco]	**ACCEPTED:** IPCC uncertainty language now used properly
42272	89	1			Elaboration of SPEI [Lubna Alam, Malaysia]	ACCEPTED: we have added an explanation of what SPEI represents
57758	89	7	89	7	There is a paper on global projections of droughts (SPI and SPEI) based on all available CORDEX runs worldwide: Spinoni, J., Barbosa, P.,[…], Dosio, A.: Future global meteorological drought hotspots. A study based on CORDEX data, Journal of Climate, submitted [Alessandro Dosio, Italy]	NOTED: we will include this study, if it is accepted, in the final draft

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
49882	89	9			read "Abatzoglou et al. (2019) showed that" rather than "Abatzoglou et al., 2019 showed that" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: corrected
55836	89	30		31	Regarding the net global change and the occurrence and impact of extra-tropical storms, I suggest to add a reference of studies leading with the fact that impact of these events depend not only on the future changes in storm tracks but also, and more important, in the environmental characteristics of the site and the event itself such as duration, coastal orientation, path as well as the concurrence/synchornicity with other forcing factors such as high tide. This aspect can instead be added to page 27 line 28 when explaining coastal erosion indexes and coastal response. The reference is Guisado-Pintado, E. and Jackson, D.W.T. 2018. Multi-scale variability of storm Ophelia 2017: The importance of synchronised environmental variables in coastal impact. Science of the Total Environment. Volume 630, 15 July 2018, Pages 287-301. [Emilia Guisado-Pintado, Spain]	NOTED: useful comments: section has been revised accordingly
45116	89	40	89	40	People dealing with ski tourism have been doing extensive work on future snow avaliability in ski resorts globally. Their literature may be worth mentioning here. O. C. Demiroğlu, M. T. Turp, T. Ozturk, and M. L. Kurnaz, “Impact of Climate Change on Natural Snow Reliability, Snowmaking Capacities, and Wind Conditions of Ski Resorts in Northeast Turkey: A Dynamical Downscaling Approach”, Atmosphere 7, UNSP52 (2016). [Levent Kurnaz, Turkey]	NOTED: The comment recommends a paper which is very local: this would be best described in the regional section.
38572	89	45	90	7	The impact of extratropical cyclone and tropical cyclone on extreme sea level has been discussed in the North Western Pacific region. It is better to add to this paragraph. e.g. Mori, N. and T. Takemi (2016) Impact assessment of coastal hazards due to future changes of tropical cyclones in the North Pacific Ocean, Weather and Climate Extremes (review paper), Vol.11, pp.53-69. [Nobuhito Mori, Japan]	NOTED: This has been addressed in the Asia regional section
49884	90	4			read "to those made by Vousdoukas et al. (2018), " rather than "to those made by (Vousdoukas et al., 2018), " [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL : corrected
42274	90	6			30cm can be written as 30 cm [Lubna Alam, Malaysia]	EDITORIAL: corrected
8594	90	9	90	13	Why only likely adverse? [Robert Kopp, United States of America]	NOTED: almost all of the impacts are in an adverse direction. There are some exceptions, which we will include once we review the latest papers
42276	90	9			some words written in italic fonts.example: likely can be wriiten as likely. [Lubna Alam, Malaysia]	EDITORIAL: corrected
49886	90	19			"The dashed" or "The shaded"? [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: corrected
53836	90	39	96	33	re 12.5.2 Climate hazards at different levels of changing global signals: this section is important. It has a clear a good stucture that will be important for the Reasons for Concern figures. Looking forward to further development after more input from the other chapters. [Jan Fuglestvedt, Norway]	NOTED: Our thanks to the reviewer for the positive feedback!
53838	90	48	91	16	Coordination across chapters is needed on choice of temperature definition (GMST vs GSAT) [Jan Fuglestvedt, Norway]	TAKEN INTO ACCOUNT: On the basis of the outcome of the discussion on this issue GSAT is going to be used, and the text has been changed accordingly throughout.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
49888	90	56			read "expressed as changes " rather than "expressedas changes " [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: corrected
51370	91	10	1	10	reference made to Atlas database, where hazards are calculated per degree global warming (not implemented in Atlas chapter yet) [Bart Van den Hurk, Netherlands]	ACCEPTED: Text revised to refer to the database/interactive or to the chapter accordingly when relevant.
51372	91	21	1	21	Provide a key to the RFCs in the Table caption [Bart Van den Hurk, Netherlands]	ACCEPTED: Table caption edited.
25528	91	21			Table 12.10 - For erosion/deposition/methane release the indicator is land area with permafrost. Surely this is not the most appropropriate indicator for what is essentially a landscape change that may not necessarily be associated with permafrost. Changes in landcover are probably more appropriate here as indicator that might be used for identifying erosion and deposition. (note also the ECVs for permafrost are permafrost thermal state and active layer thickness). [Sharon Smith, Canada]	REJECTED: This comment ensues from a misunderstanding of the entry in the now second (formerly first) column of the table as a Point Of Departure. In fact, "permafrost" is the focus here, and "Erosion, Deposition and Methane Emissions" are those coming specifically from permafrost thawing. So we have slightly modified the content of the last column to suggest more clearly that permafrost is our focus, not erosion/deposition in general. If the latter was the case we agree with the reviewer that many other processes could be responsible. In our case the threats are by definition driven by permafrost thawing. Also note that the Table has been modified and has now an additional column at front.
8962	91	22	91	22	as with previous comment my recommendation would be to characterise the types of events as chronic and acute to fit in with a wider audience, which will be made up of practitioners e.g., consulting engineers etc [david Viner, United Kingdom (of Great Britain and Northern Ireland)]	REJECTED: The audience of this section is actually identified as the authors in WGII in charge of relating risks to various warming levels in the context of the RFCs and national/international policymakers looking for a deeper understanding of these concerns. The global scale of our assessment in this section would make it very difficult for practitioners to use this information directly, so wee do not see a need to make this distinction for the reason argued by the reviewer. We would absolutely agree if this section had the same purpose and audience as the regional sections in our chapter.
15484	91	22	91	22	Blue background makes it difficult to read the black words. [Ruiqing Miao, United States of America]	ACCEPTED: Table headings are now over light blue

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
45870	91	28	96	9	rather than asess risks to ecosystems and human systems, please refer to AR5 material and AR6 special reports [Katja Mintenbeck, Germany]	NOT APPLICABLE: CH12 has a clear mandate to understand the hazard component of risk, which includes a connection between essential climate variables and sectoral response, even as the full risk assessment (including vulnerability and exposure) is provided in WGII. We have undertaken a substantial effort to build the WGI-WGII 'handshake' for consistent and coherent assessment, and will use AR6 WGII prominently as a point of departure, together with AR5 WGII. We won't assess risks here but provide information relevant to that assessment for impact scientists/WGII authors
25530	91	38	91	39	See various Arctic syntheses mentioned earlier in Ch 12 comments, including AMAP SWIPA 2017, AACA regional reports, Canadian syntheses for more up to date and more comprehensive references for this section. [Sharon Smith, Canada]	**NOTED:** This discussion now draws from the assessment of other chapters, including references therein.
49890	91	38			read "(Bell et al., 2013; Ellison, 2015; Vousdoukas et al., 2018);" rather than "(Bell et al., 2013; Ellison, 2015)(Vousdoukas et al., 2018);" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: corrected
42278	91	44		45	Elaboration of SROCC, SRCCL and also needed reference citation [Lubna Alam, Malaysia]	ACCEPTED: Text revised by adding the extended names of the reports and correct citations.
51374	92	9	92	9	Make distinction between Atlas chapter and Atlas interactive data analysis hub [Bart Van den Hurk, Netherlands]	TAKEN INTO ACCOUNT: combined with previous comment about the Atlas database vs. the Atlas chapter.
51376	92	15	5	16	Although this statement is correct, it is also a bit trivial, since the SST is a key ingredient in the GMST [Bart Van den Hurk, Netherlands]	NOTED: However the triviality is there only if the warming ratio between land and ocean remains constant across warming levels, which is not a given (and in fact it is true only in a transient simulation as opposed to what would happen along a stabilization trajectory.
42280	92	19			CO2 (2 needed to be subscript) [Lubna Alam, Malaysia]	EDITORIAL: corrected
8736	92	24	92	30	I think timescales are important there: as long as they receive sediments inputs from corals, many low lying islands are probably not threatenned by sea level rise. The main questionmarks come when sea level rise continues rising over centuries while sediment productivity from corals is canceled due to cean warming and acifdification. [Goneri Le Cozannet, France]	NOTED: The SLR treatment is not only in terms of warming level but also in terms of actual trajectory, to account for the time-dependent aspect. The balance between the rate of SLR and the rate of accretion/growth is covered in WGII as it includes a discussion of vulnerability in addition to the SLR hazard
25532	92	32	92	33	Ch2 (see also Figure 2.21) also uses Sept. as an indicator and references should proably be made to this chapter for trends in sea ice. [Sharon Smith, Canada]	NOT APPLICABLE: Please note that the perspective here is that of projections. Much of the material in this section is going to be a hazard perspective that draws upon physical process understanding and projections taken from other chapters (Ch.4 in this case), where references and linkages to the observational basis for projections in CH2 is expected to be.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
41210	92	39	92	43	Please, consider changing “Alpine ecosystem” by “Mountain ecosystem,” although both are synonymous, in the sense of the sentence the broadest scope term “Mountain” seem more appropriate. [Lucas Ruiz, Argentina]	ACCEPTED: Text changed throughout
49892	92	39			read "Marzeion et al. (2014)" rather than "Marzeion et al., 2014" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: corrected
41212	92	42	92	45	Please use the proper term “thawing” instead of "melting" for permafrost. Please consider use “Mountain” or “high mountain system” instead of “Alpine systems.” The vast majority of mountain permafrost it is located in High Mountain of Asia and South America or Alaska and the use of Alpine systems could give the wrong impression that the authors refer to the Alps. [Lucas Ruiz, Argentina]	ACCEPTED: Text changed throughout
41214	92	43	92	43	Please use the proper term “thawing” instead of "melting" for permafrost. [Lucas Ruiz, Argentina]	ACCEPTED: Text changed throughout
25534	92	45	92	49	Permafrost area melting - bad terminology (permafrost thaws) - see earlier comment regarding permafrost indices. Also I'm not sure Ch 9 showed this relationship but used GMAT. The relationship on a regional to local level is not straight forward as it depends on vegetation as well as substrate conditions which affect the ground thermal properties and heat transfer. The models discussed do not consider the full vertical extent of permafrost. This section probably needs to be revisied and presented better. [Sharon Smith, Canada]	ACCEPTED: Chapter 9 adopts permafrost volume in the 3m layer now, and we switched to that metric accordingly.
51380	93	1	5	12	In this chapter a frequent reference to CMIP6 is made. Does this imply that a collection of CMIP6 outputs, made available via the Atlas online data hub, will be used to make AR6 assessment statements, also when these models and/or data have not yet been published in the peer-review literature? Some protocol on quality assurance of these results is needed [Bart Van den Hurk, Netherlands]	NOTED: The plan is to make use of CMIP6 outputs for assessment statements, and it is a report-wide plan so QA is implemented at a much wider level than just our chapter (Atlas database/interactive, for the most part).
51378	93	3	5	3	Which sensitivities showed which larger negative values? Unclear phrasing [Bart Van den Hurk, Netherlands]	NOT APPLICABLE. Treatment has been changed and P-E is no longer considered as a metric.
42282	93	27	93	28	ETCCDI and RFC2 need elaboration [Lubna Alam, Malaysia]	NOT APPLICABLE/REJECTED: ETCCDI has been eliminated from the text and the Table, in favour of the more general terminology "extreme indices"; RFC is defined in the first paragraph of this section, so we think it does not need to be expanded again here.
42284	94	6			Needed a single space after the citation [Lubna Alam, Malaysia]	EDITORIAL: corrected
49894	94	6			read "Arnell et al. (submitted) uses pattern" rather than "(Arnell et al., submitted)uses pattern" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: Citation updated to Arnell (2019)
51382	94	11	8	11	9.4% of what? Global land area? [Bart Van den Hurk, Netherlands]	NOTED: the sentence before this explains that we are talking about chances but we also repeat the concept within the sentence now.
51384	94	16	8	17	"low single digits" -> "a few percent" [Bart Van den Hurk, Netherlands]	ACCEPTED: Text changed accordingly
42286	94	25			Needed a single space before the citation started [Lubna Alam, Malaysia]	EDITORIAL: corrected
42288	94	27			Elaborate SLR [Lubna Alam, Malaysia]	REJECTED: SLR is defined early on in the chapter
46700	94	49	94	55	Assessment on ENSO variability is inconsistent with assessment in Chapter 2 and Chapter 3. [WGI TSU, France]	NOTED: We base this assessment on Chapter 4 (projections), which in turn considers Chapter 2 and 3.
42290	94	54			Elaborate ENSO [Lubna Alam, Malaysia]	ACCEPTED: Acronym expanded

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
51386	95	4	6	25	Section does not (yet) contain a lot of information, not fully clear what will be the type of assessment foreseen in SOD [Bart Van den Hurk, Netherlands]	NOTED: The Second Order Draft of Section 12.5.2 synthesizes updated literature and climate projections from WGI CH2-CH11 as well as new assessment directions developed in WGII Ch16 First Order Draft. The challenge is gathering information across chapters in a timely manner given that everybody is working until the very last minute. We keep adding, refining, reassessing as things mature.
42292	95	6			Elaborate RFC [Lubna Alam, Malaysia]	REJECTED: Defined in the first paragraph of this section
42294	95	22			Remove (before FWI [Lubna Alam, Malaysia]	NOT APPLICABLE: Treatment of FWI is no longer included in this section.
25536	95	43	95	48	Not sure this is a singluar event - Permafrost responds slowly to changes in climate and thawing to depths of 100s m can take centuries to millenia. The model results mentioned are likely from an equilibrium model which does not consider transient event or timing of thaw (not sure how relevant for hazard discussion). See also previous comment on pg 92 (line 45) regarding other factors affecting permafrost response to changing climate and reason way linkages are not straightforward or necessarily linear. [Sharon Smith, Canada]	TAKEN INTO ACCOUNT: This is a good point and we reconsidered our wording accordingly
25538	96	14			Table 12.11 - permafrost melt - incorrect terminology (permafrost thaws) - see previous comments regarding area. Sensitivity is not just a function of permafrost thawing but it depends on whether it is ice-rich, etc. [Sharon Smith, Canada]	NOTED: See answers to previous similar comments starting from 25528 and 25534. We follow Chapter 9 and its assessment here. Some degree of approximation and uncertainty in the relation is unavoidable. Good point about GMAT (GSAT actually in our speech) and GMST. On the basis of a report-wide agreement we have changed every instance to GSAT.
14912	96	18			A consistent and transparent approach will be needed to specify uncertainty ranges in Table 12.11. Will uncertainties in the inter-model scaling functions, for example, be included in the uncertainty ranges? [Clare Goodess, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: We strive to characterize uncertainty as much as the literature and assessments allow us to, and we qualify the meaning, origin and robustness of the uncertainty ranges.
8730	96	36	103	11	I think that this section on climate services is very useful. May be it could be highlighted that climate services include activities which do not necessarilly identify themselves as climate services (e.g., coastal flood risk assessment), especially in regions where the term "climate services" has been less used than in europe (?). (Note some typpo errors lines 32 p98.) [Goneri Le Cozannet, France]	Taken into account - text revised

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
39338	96	40	100	18	Some level of repetition across the different sections regarding the challenges around CS. I suggest a revision of these challenges (based on the comments provided above) and some streamlining in order to avoid unnecessary repetition as I belve that part of the problem is due to the act that there're challenges identified across sectiosn 12.6.1/2/3. I would either perhaps remove section 12.6.3. (on teh chellanges) and simply idnetify thevariuos challenegs across the two other sections or mainly use section 12.6.3 to describe the key challenges in CS. If so, perhaps a way of clearly identifying the different types of challenges could be to distinguish between the more macro and micro challenges that need be recognised and discussed. The macro-level challenges would include both the technical aspects of the climate information (e.g. access to data, downscaling, quality) as well as wider social and ethical aspects of CS (e.g. accessibility to CS, who benefits from CS, limited role of the social sciences) whilst the micro-level challenges would be associated with the development and provision of CS on the ground and on a more practical level (e.g. engagement with the users; challenges of effective co-production; design of the CS; delivery; etc). [Marta Bruno Soares, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - repetition has been reduced or eliminated
39310	96	42	96	44	I think it is important to recognise the fact that there's a multiplicity of definitions of CS that can have implications on how we distill this complex concept into 'useful, manageabe and practical interpretation' (Bruno Soares and Buontempo, 2019, p.3). In their recent paper, Weichselgartnera and Arheimer (2019; https://doi.org/10.1175/WCAS-D-18-0087.1) propose a qualitative classification of how climate change adaptation services can be organised to facilitate theconceptualization, operationalization, and evaluation of these services. [Marta Bruno Soares, United Kingdom (of Great Britain and Northern Ireland)]	Noted - IPCC AR5 WGII (Jones et al. 2014) already alludes to different definitions so it hasn't been repeated here
39308	96	44	96	46	I think it is important to refer after line 46 that although there's a difference between climate services (CS) and research-driven efforts there's still substantial overlaps between CS and other related-areas (e.g. climate change vulneraility, impacts and adaptation; disaster risk management) and therefore a need to differentiate between these similar (and complementary) operational and research areas. Bruno Soares ad Buontempo (2019; DOI: 10.1002/wcc.587) raise this aspect in their paper. [Marta Bruno Soares, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - the overlap between climate services and other related areas has been inserted and the paper cited
27426	96		97		Really appreciate the part on Context of climate services. However it would be very nice if more explanation on why/for what climate services are introduced in this chapter. How climate services can help facing the threat of climate change especially those linked to the Hazards assessed in this chapter [Fatima Driouech, Morocco]	Accepted - more explanation has been added of why this section is in this chapter
39312	97	3	97	4	Change the sentence to "In 2012, climate services were mostly provided by national hydrological and meteorological services (NMHSs)" [Marta Bruno Soares, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - sentence changed
14914	97	3			I would suggest inserting 'formalised' before climate services. Although not necessarily referred to as such, climate services were already being provided in a more ad hoc way by a range of organisations. [Clare Goodess, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - text revised

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
39314	97	8	97	9	Change the sentence to"In general, these services involve the interpretation, analysis, and communication of diverse (scientific) sources to a targeted group of decision-makers". I think it should also be clarified what it's meant by diverse sources (of what? information?). [Marta Bruno Soares, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - sentence changed
39318	97	13	97	26	I think the flow of ideas in this paragraph could be improved and the last sentence on the challenges around CS development should be moved as a paragraph on its own and further expanded upon (see coment above). [Marta Bruno Soares, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - we attempted to improve the flow of ideas in this paragraph.
51388	97	22	12	25	Another paper co-authored by myself (and cited later in this chapter) emphasises the need not only to rely on public (hydromet) services but also on procedures and infrastructure currently in place in many practitioners routines (van den Hurk, BJJM, LM Bouwer, C Buontempo, R Döscher, E Ercin, C Hananel, J Hunink, E Kjellström, B Klein, M Manez, F Pappenberger, L Pouget, M-H Ramos, PJ Ward, A Weerts and J Wijngaard, 2016: Improving predictions and management of hydrological extremes through climate services: www.imprex.eu. Climate Services, 1, 6–11, doi:10.1016/j.cliser.2016.01.001.) [Bart Van den Hurk, Netherlands]	Noted
6864	97	25	97	26	I suggest to add other important on-going debates raising concerns, e.g., on combining scientific and policy expertise (Reference: Olazabal M., Chiabai A., Foudi S. and Neumann M.B. (2018): Emergence of new knowledge for climate change adaptation. Environmental Science & Policy 83: 46-53.) [Juergen Weichselgartner, Germany]	Taken into account - reference added in second paragraph of 12.6.1
14916	97	25	97	26	I don't think that Troccoli et al really raise concerns but rather acknowledge the potential for further 'downstream' development and commercialisation. A similar point is made by a paper on stakeholder engagement in the same ECEM project: Goodess et al., 2019, Advancing climate services for the European renewable energy sector through capacity building and user engagement, Climate Services, accepted for publication subject to minor revision. [Clare Goodess, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - the sentence has been re-worded to clarify that Troccoli et al. haven't raised concerns about the commercialisation of climate services
39316	97	25	97	26	I think it is important to further develop the arguments around emerging challenges linked to climate services (see e.g. Keele, 2019 - https://doi.org/10.1007/s10584-019-02385-x ; Bruno Soares and Buontempo, 2019 - DOI: 10.1002/wcc.587;) [Marta Bruno Soares, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - sentence expanded

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
39320	97	28	97	36	I suggest chaging the paragraph to: "The IPCC, as the global scientific body for assessing state-of-the-art knowledge on climate change provides, through its assessment and special reports, one of the most comprehensive and credible sources of information for climate services. There are many precautionary decisions that are already taken at the local level based on this information however, depending on the decision context, this information may be too coarse, too broad or too disciplinary to directly inform decision-making at the scale where adaptation measures are taken (e.g.Howarth and Painter, 2016; Nissan et al., 2019). Thus, while the role of IPCC is clearly felt as a reference and authoritative starting point, there is a need for complementary information to translate the assessments at the local or sectoral level (Howarth and Painter, 2016; Vaughan et al., 2018) ."[placeholder: link to Chapter 1 Section 1.5.6 IPCC and role in Climate Services [Marta Bruno Soares, United Kingdom (of Great Britain and Northern Ireland)]	Editorial: Concepts have been expressed in the paragraph, shorter because of length constraints
51390	97	32	11	32	Here another reference to a paper co-authored by Chris Hewitt and myself (cited later) may be relevant, stressing the need to adjust climate model research to climate seervices demands (Van den Hurk, BJJM, Chris Hewitt, Daniela Jacob, Francisco Doblas-Reyes, Ralf Döscher and Janette Bessembinder (2018): The match between Climate Services demands and Earth System Models supplies; Climate Services 12, 59-63, https://doi.org/10.1016/j.cliser.2018.11.002) [Bart Van den Hurk, Netherlands]	Taken into account - reference added
39322	97	38	97	47	I think this paragraph could be improved in terms of flow of ideas. [Marta Bruno Soares, United Kingdom (of Great Britain and Northern Ireland)]	Editorial - flow of paragraph improved
39324	97	38	97	47	Other challenges that can also be considered here include: interoperablility of data (Giuliani et al., 2017 - DOI:https://doi.org/10.1016/j.cliser.2017.08.003); access to (open) data (Georgeson et al., 2017; DOI: 10.1126/sciadv.1602632; Hansen et al. 2019; https://doi.org/10.3389/fsufs.2019.00021); format of data (including moving away from tercile-based probabilistic forecasts e.g. Hansen et al., 2019; https://doi.org/10.3389/fsufs.2019.00021; Haines, 2019; https://doi.org/10.1007/s10584-018-2357-1) and funding mechanisms (Bruno Soares and Buontempo, 2019; DOI: 10.1002/wcc.587) [Marta Bruno Soares, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - reference added
6866	97	49	97	51	Climate services not only challenge research (see prior paragraph, line 38ff.) and communication (line 49ff.), but also the mode of knowledge production and transfer. [Juergen Weichselgartner, Germany]	Taken into account - text revised
39326	97	49	98	3	I think it is important to also refer to other challenges beyond the communication aspects and which relate to the co-production aspects of CS (e.g. Vincent et al., 2018: https://doi.org/10.1016/j.cliser.2018.11.001; Bruno Soares and Buontempo, 2019; DOI: 10.1002/wcc.587), the limited input from wider social science in this area (e.g. Bruno Soares and Buontempo, 2019; DOI: 10.1002/wcc.587); gender issues (Gumucio et al., 2019; https://doi.org/10.1080/17565529.2019.1613216); [Marta Bruno Soares, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - text revised
48086	97	51	97	51	The terms ?storyline?, ?tale of future weather? and ?climate risk narrative? are indistinctly. I?m not really sure how common are the two latter in the literature? [WGI TSU, France]	Noted - chapter 1 introduces the concept of storyline and chapter 12 cross-references

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
48366	98	1	98	3	Suggest adding the following reference: Jack et al., 2019, Climate Risk Narratives: An iterative reflective co-production process for producing and integrating climate knowledge (Climatic Change, submitted) available from Chris Jack <cjack@csag.uct.ac.za>. [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - reference added
14918	98	10	98	11	It seems a bit ingenuous to refer to such work as 'not scientifically novel'. In some cases while not novel in terms of climate science, it may well be novel in terms of social and or communication science, for example. [Clare Goodess, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - deleted "or is not scientifically novel"
6868	98	11	98	14	In addition to what information is required, on what time scales and in what format, information moves from useful to usable only when users effectively incorporate this information into a decision process (Lemos, M.C., Kirchhoff C.J. & Ramprasad V. (2012): Narrowing the climate information usability gap. Nature Climate Change 2: 789. [Juergen Weichselgartner, Germany]	Taken into account - text revised
39334	98	16	98	17	Other references of assessments of climate information needs include: Gregow et al., 2016 (https://doi.org/10.1175/BAMS-D-14-00271.1); Vincent et al. (2015; https://doi.org/10.1080/14693062.2015.1075374); Damm et al. 2018 (https://doi.org/10.1016/j.cliser.2019.02.001) [Marta Bruno Soares, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - references added
6870	98	23	98	29	I suggest to add to the list of features that need further clarification: the effectiveness of user engagement methods and the actual impact of climate services on decision-making [Juergen Weichselgartner, Germany]	Taken into account - see Challenges section
39328	98	31	98	34	Paragraph could be improved in terms of syntax and ideas. I also suggest perhaps moving this as it feels a bit out of plac at the moment. [Marta Bruno Soares, United Kingdom (of Great Britain and Northern Ireland)]	Editorial - paragraph improved
6872	98	32	98	32	5) 98nalysi should read "analyse" [Juergen Weichselgartner, Germany]	Editorial - corrected
42296	98	32		33	98nalysi, What does it mean 98nalysi? [Lubna Alam, Malaysia]	Editorial - corrected
6874	98	33	98	33	De Bruin et al. ?, the year is missing [Juergen Weichselgartner, Germany]	Editorial - corrected
6876	98	33	98	33	When 98nalysing should read "When analysing" [Juergen Weichselgartner, Germany]	Editorial - corrected
46044	98	33	98	33	“Analyzing” not “98nalysing” [Isaac Pearlman, United States of America]	Editorial - corrected
49896	98	33		34	read "When analysing four European climate services, Reinecke (2015) found " rather than "When 98nalysing four European climate services, (Reinecke, 2015) found " [Cyriaque Rufin Nguimalet, Central African Republic]	Editorial - corrected
39784	98	50	99	5	This reference that could be useful for this assessment: https://www.nature.com/articles/d41586-018-06856-6 [Carolina Vera, Argentina]	Noted

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
6878	98	51	99	2	An undifferentiated discourse about ‘‘the producer’’ and ‘‘the user’’ is problematic. It is important to start recognizing the reusing and repurposing among producers, providers and users. Going beyond clear producer–user roles often reveals a continuous cascade of different users/producers replacing each other along the production chain, when refining data, in various layers of processing, to finally obtain information and insight for decision-making. In addition to climate service producers, providers and users (note: there are also purveyors, a special type of climate service provider that uses climate-relevant data available from others and add value for users), climate service bodies (i.e., boundary organisations) are of critical importance. They operate at the interface between science and policy to create and sustain mutually beneficial connections between climate service producers, providers, and users. By integrating differing epistemic communities, knowledge systems, and societal sectors, they excel at providing space and mechanisms to support climate-relevant products and services in particular contexts, hence brokering knowledge to decision-making. References: Kirchhoff C.J., Lemos M.C. and Kalafatis S. (2015): Creating synergy with boundary chains: can they improve usability of climate information? Climate Risk Management 9: 77-85; Weichselgartner J. and Arheimer B. (2019): Evolving climate services into knowledge-action systems. Weather, Climate, and Society 11 (2): 385-399. [Juergen Weichselgartner, Germany]	Taken into account - text revised
35170	98	55	98	55	The principle of "co-production" in relation to the regional impact of climate change is decribed in detail by Schipper et al. (2019). Please add this reference. Reference: Schipper, J. W., Hackenbruch, J., Lentink, H. S., Sedlmeier, K., 2019: Integrating adaptation expertise into regional climate data analyses through tailored climate parameters. Meteor. Z., Vol. 28, No. 1., 41-57 pp., DOI: 10.1127/metz/2019/0878 External Link [Janus Willem Schipper, Germany]	Taken into account - reference added
14920	98	55			Co-production is widely claimed but in practice is difficult to achieve, and indeed is now always well defined. [Clare Goodess, United Kingdom (of Great Britain and Northern Ireland)]	Noted
27428	98		99		Assessment of the practice and products related to hazard information in climate services: this part needs more focus on the hazards within climate services context instead of staying broadly focusing on climate services in general. [Fatima Driouech, Morocco]	Noted - currently we cannot find peer-review literature that addresses this
39332	99	1	99	1	"which can be very resource intensive (Kolstad, 2019)" - there's also other examples that can be added here e.g. Buontempo et al. 2018 (DOI: https://doi.org/10.1016/j.cliser.2017.06.003); Falloon et al. 2018 (DOI: https://doi.org/10.1016/j.cliser.2017.08.002) [Marta Bruno Soares, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - references added

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
6862	99	2	99	5	I suggest to add to the list of different dimensions at least two more that are highly relevant for the knowledge-coproduction process regarding climate services: motivation and decision-making (both dimensions have been analysed in two recent publications). Climate services scholars interact with practitioners also with purposes other than increasing knowledge use. A lack of understanding of these motivations may lead to misguided requests and support (Knaggård et al. 2019). Moreover, the critical link between climate information and decision-making is almost absent in the chapter. Scholars and practitioners need to recognise the value and importance of climate services for decision-making. This includes not only enhancing our understanding of how climate information is generated, provided, and implemented in decision-making, but also fine-tuning our efforts on "what information can be produced" and "in which format it can be delivered" toward "which decision-making processes need what kind of information for which specific purpose" (Weichselgartner and Arheimer 2019). Both dimensions - motivation and decision-making - relate to communication and trust (which may be other terms that could be used to describe these dimension). While the general principles of coproduction—establishing long-term relationships between scientists and stakeholders, ensuring two-way communication between both groups, and keeping the focus on the production of usable science—are well understood, the mechanisms for achieving those goals have been discussed less (Meadow et al. 2015). Full references of the literature: Knaggård Å., Slunge D., Ekbom A., Göthberg M. and Sahlin U. (2019): Researchers' approaches to stakeholders: interaction or transfer of knowledge? Environmental Science & Policy 97: 25-35; Weichselgartner J. and Arheimer B. (2019): Evolving climate services into knowledge-action systems. Weather, Climate, and Society 11 (2): 385-399; Kruk M.C., Parker B., Marra J.J., Werner K., Heim R., Vose R. and Malsale P. (2017): Engaging with users of climate information and the coproduction of knowledge. Weather, Climate, and Society 9 (4): 839-849. [Juergen	Noted - these issues are addressed in WG2 (Ch17)
39330	99	9	99	11	I would also include examples of sectoral climate services for agriculture (e.g. Falloon et al., 208; DOI: https://doi.org/10.1016/j.cliser.2017.08.002). Other examples for CS on health is Lowe et al., 2017; https://doi.org/10.1016/S2542-5196(17)30064-5); [Marta Bruno Soares, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - references added
51392	99	11	13	12	Here you could refer to Atlas.5.6.3.4 giving an inventory of European climate change assessment products [Bart Van den Hurk, Netherlands]	Editorial - text revised
51394	99	16	13	18	Better to refer to the climate scenario overview rather than the climate data/model overview [Bart Van den Hurk, Netherlands]	Editorial - text revised
33276	99	37	100	17	An important challenge that is not mentioned is data availability and quality. This is particularly pertinent for low to middle income countries (which also tend to be more vulnerable to climate hazards). [Henry Neufeldt, Denmark]	Taken into account - text revised
35172	99	54	99	54	Hackenbruch et al. (2017) describe challenge c) very well by developing tailored climate information based on a survey among regional stakeholders. Please add this reference. Reference: Hackenbruch, J., T. Kunz-Plapp, S. Müller und J. W. Schipper, 2017: Tailoring climate parameters to information needs for local adaptation to climate change, Climate. 5(2), 25, DOI: 10.3390/cli5020025 External Link [Janus Willem Schipper, Germany]	Taken into account - reference added

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
39340	100	1	100	5	I would also include Bruno Soares et al., 2018 (DOI: 10.1002/wcc.523) as the paper provides an overview of methods and metrics to assess the value and benefits of forecats and climate services. Also Tall et al., 2018 (https://doi.org/10.1016/j.cliser.2018.06.001). [Marta Bruno Soares, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - reference added
42298	100	4			WMO needs elaboaration [Lubna Alam, Malaysia]	Editorial - corrected
42300	100	6			A single space is needed before the citation [Lubna Alam, Malaysia]	Editorial- corrected
6880	100	9	100	10	There are at least two more fundamental challenges that need to be addressed: How can we insure that the information provided by research influences climate-relevant decisions, policies, and actions, that is, the use of climate services? How can we evaluate the quality of changes implemented by climate service users, that is, the impact and success of climate services? I suggest to add the challenge of mapping and monitoring the information use in decision-making processes to trace the impacts of climate services on climate change mitigation and adaptation. Without shared forms of conceptualisation and operationalisation it remains difficult for governments and climate funds to check and compare the impacts of their actions and projects and to mainstream CCA in the broader activity portfolio. [Juergen Weichselgartner, Germany]	Noted - these issues are addressed in WG2 (Ch17)
51398	100	11	0	21	Reference could be made to the Communication section in the Atlas chapter (particularly Atlas.6.2) [Bart Van den Hurk, Netherlands]	**NOTED**: coordination has been made with the Atlas on this topic
42302	100	12			A single space is needed before the citation [Lubna Alam, Malaysia]	Rejected - there is no citation on this line
46008	100	26	103	13	While these examples of climateinformation for services show the basic differences between top-down and bottom-up approaches and also , between that of developed and developing counttries, it is suggested that there are new learning experiences from recent issues ofthe WMO Bulletin. [Lourdes Tibig, Philippines]	Rejected - WMO bulletin is not peer-reviewed literature
14922	100	28	103	11	While I recognise that this is cross-chapter box, since it is placed in Chapter 12 it would nonetheless be good to focus a bit more on hazards and thresholds. [Clare Goodess, United Kingdom (of Great Britain and Northern Ireland)]	Noted - text revised
51402	100	28	103	11	Very nice box, and nicely illustrating not only top-down/bottom-up approaches but also the use of storylines. More places in the AR6 report could possibly refer to this box [Bart Van den Hurk, Netherlands]	Noted - Chapters 1, 10 and Atlas have been encouraged to reference this box
6882	100	35	100	35	I suggest to add more recent literature supporting this statement, for instance: Christel I., Hemment D., Bojovic D., Cucchietti F., Calvo L., Stefaner M. and Buontempo C. (2018): Introducing design in the development of effective climate services. Climate Services 9: 111–121; Weichselgartner J. and Arheimer B. (2019): Evolving climate services into knowledge-action systems. Weather, Climate, and Society 11 (2): 385-399. [Juergen Weichselgartner, Germany]	Taken into account - reference added
6884	100	53			Section 12.6.3 'Challenges": Need a reference/standard and further statement on how '…disaster risk reduction' can be management for guiding the various countries. In particular, guidance needs to be given on contingency planning and risk/crisis communication. Need input for guidance on the legal and policy framework for community engagement and forming a 'single point of contact' for each country that interlinks the private and public sector communities with academia. [Ahmed Shalabi, Canada]	Taken into account - text revised drawing from Street, R. B., et al. (2019). "How could climate services support disaster risk reduction in the 21st century." International Journal of Disaster Risk Reduction 34: 28-33.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
48370	102	13	102	13	Suggest addiing "communities and" before "community development institutions". [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - text revised
48372	102	25	102	26	Suggest rephrasing this sentence to move "in Windhoek" to before the reference at the end and add "often" after "that" and ", e.g." after "areas". It also may be clearer to use "informal settlements" rather than "peri-urban areas". [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - text revised
48368	102	25	102	55	Suggest including some material on the other southern African cities that FRACTAL is working in (so this is more consistent with the sub-title of this section of the box). I provide some suggestions in specific locations in comments below. [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - text revised
51400	102	32	0	0	Is there any documenation on assessment on likelihoods/probabilities of each of these Climate Risk Narratives? [Bart Van den Hurk, Netherlands]	Rejected - from the paper: "An important principle is that CRNs should represent plausible future climate states without assigning probabilities to different narratives that would add a level of complexity to engaging with the narratives"
48374	102	32	102	32	Suggest adding the following reference with "CRN)": Jack et al., 2019, Climate Risk Narratives: An iterative reflective co-production process for producing and integrating climate knowledge (Climatic Change, submitted) available from Chris Jack <cjack@csag.uct.ac.za>. [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - reference added
48376	102	48	102	48	Either here is somewhere in this paragraph suggest adding some text that some of CRNs developed for FRACTAL including information on societal responses and infrographic versions (in Lusaka) and there were different experiences in Maputo and the FRACTAL Tier 2 cities (Blantyre, Gaborone and Harare [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	Rejected - would make box longer
6886	103	7			Section 12.6.3 'Challenges": Need a reference/standard and further statement on how to manage '…top-down and bottom-up'; suggest researching collective decision-making process for a crisis situation —A great reference "Governance of Risk, Hazards, and Disasters" Edited by G. Forino, S. Bonati, L.M. Calandra (2018) [Ahmed Shalabi, Canada]	Noted
46010	103	16	105	5	Uncertainties, knowledge gaps and research needs should be updated in subsequent drafts. [Lourdes Tibig, Philippines]	NOTED: We have updated this section to reflect the additional assessment and re-structuring of the Second Order Draft.
8954	103	23	103	23	As with comment above a key gap is how the dynamic nature of risk based upon the three components E, H and V are assessed, the paper by Viner et al above help to set up the discussion on the Dynamics of Risk. [david Viner, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: We have added a section (12.5.3) to focus on how adaptation and mitigation changes can in turn affect hazards, and include text in 12.3 about how vulnerability changes can affect hazard thresholds.
6888	103	28			Section 12.7 'Uncertainties, Knowledge gaps, & Research Needs': The reference to Fischer et (2009) for the Risk Management Framework is rather dated. Suggest the work/book by F. Bouder, D. Slavin, and R. Löfstedt on "The Tolerability of Risk; A New Framework for Risk Management" (2013) should be used. [Ahmed Shalabi, Canada]	TAKEN INTO ACCOUNT: We have considered the suggested reference in our assessment, which is also formed in consultation with a broader cross-WG group on Risk frameworks.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
8956	103	30	103	34	A major gap is the work that the practitioner community undertakes that is not captured through the IPCC process. Much of this work is not published in accessible format (e.g, it is in confidential client reports). The private sector practitioner community are at teh vanguard of building resileince and have a wealth of experience in doing this. Viner D and Howarth C 2014 Practitioners work and evidence in IPCC reports. Nature Climate Change Vol. 4 October 2014 [david Viner, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: Grey literature generally cannot be cited in the IPCC, but we included the following sentence to acknowledge to work of practitioners/consultancy: "However, a large part of climate services practices and products is published in grey literature as it is part of private consultancy (medium confidence)."
14924	103	50	104	2	Indices may not be used because they are defined by climate scientists and so not relevant to users/impacts - so these bullet points are all related. Similarly thresholds need to be identified from a user/impact perspective. [Clare Goodess, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: We emphasize in sections 12.1-12.3 and 12.6 that hazard thresholds and indices must be driven by the risk/impact community (i.e. stakeholders) and vary widely depending on the sector or asset under consideration in order to be useful and relatable to broader risk management.
8958	103	52	103	54	Thresholds also change as exposure changes, this relates to above comments about the dynamics of the component of risk [david Viner, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: We note that thresholds change owing to vulnerability (and the number of exposed and vulnerable assets) in 12.3. Hazard is less connected to exposure even as both are required to affect risk (which factor in hazard, exposure and vulnerability). Note that 'exposure' is sometimes also used to mean time duration subject to conditions, which is not our use here (we use 'exposure' to refer to the presence of assets affected by a hazard).
8960	103	55	103	55	Recommend also to include practitioners as well as stakeholders. [david Viner, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: Grey literature generally cannot be cited in the IPCC, but we included the following sentence to acknowledge to work of practitioners/consultancy: "However, a large part of climate services practices and products is published in grey literature as it is part of private consultancy (medium confidence)."
14926	104	8			I would also mention the climate services community here. [Clare Goodess, United Kingdom (of Great Britain and Northern Ireland)]	ACCEPTED: We now mention climate services community leadership and engagement beyond the CMIP6 VIACS Advisory Board (Ruane et al., 2016) process.
42304	104	22			A single space is needed before the citation [Lubna Alam, Malaysia]	EDITORIAL: corrected
14928	104	26	104	28	This statement needs some clarification - it could be misquoted as 'Global Climate Models are still of limited skill' [Clare Goodess, United Kingdom (of Great Britain and Northern Ireland)]	ACCEPTED: We have clarified related bullet points and the introduction to 12.7 to improve the wording and make it clear that limitations do not affect the key messages assessed in the report.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
8636	104	50	104	54	References required [Ibikunle Olaleru, Nigeria]	TAKEN INTO ACCOUNT: This statement is a result of our assessment of the literature available across the regions, so there is no single reference to point to here that would be appropriate (choosing a small number of specific examples may also be misleading). We now also point to the Atlas where there is a discussion of observational gaps
8638	105	1	105	13	References required [Ibikunle Olaleru, Nigeria]	TAKEN INTO ACCOUNT: This statement is a result of our assessment of the literature available for some hazards, so there is no single reference to point to here that would be appropriate (choosing a small number of specific examples may also be misleading). We now also point to CH11 which describes some climate phenomena as being less well observed
44022	105	8	105	9	A comment on detection/attribution results for island nations (large and small). I would not say that Detection and Attribution is completely lacking for island nations. Univariate gridpoint based detection attribution studies (e.g., Knutson et al. 2013 for temperature; Knutson and Ploshay 2016 for wet bulb globe temperature; and Knutson and Zeng 2018 for precipitation) are examples of studies that can in principal provide some information on detection and attribution for island regions, including small islands in some cases. Although these must be interpreted with caution, the gridbox data for points containing islands are often actually derived from island station data, not from the surrounding ocean (e.g., for precipitation records from land gauges extending back to 1900). Also results from nearby gridboxes (on the same or neighboring islands) can give similar results forming a sparse but coherent pattern and giving more confidence to the result. In my opinion, small island nations can begin to gain some detection/attribution insight on changes in their particular region climate through careful use of results from the univariate gridpoint based attribution studies. The clearest example is for surface temperature where islands and surrounding regions often have a coherent pattern of long-term warming, and in some cases, univariate tests indicate that detectable anthropogenic warming is occurring there (e.g. Knutson et al. 2013, see Fig. 10 of this paper). And similarly for Wet Bulb Globe Temperature, though the analysis of Knutson and Ploshay (2016) though this has a limitation of being a relatively short record (1973-2012) compared to surface temperature alone. Finally, the precipitation gridpoint based detection/attribution study of Knutson and Zeng (2018) shows several apparent cases of detectable anthropogenic decreasing (drying) trends for several larger and smaller island regions, including southern parts of Japan, western parts of the Maritime Continent, the Ceylon region, and some island regions of the Caribbean. A region with some coherent detectable anthropogenic increasing (wetting) precipitation trend over 1901-2010 is seen in parts of the Phillippines and central	ACCEPTED: We have softened this statement to clarify that Detection and Attribution studies are 'more rare' rather than 'lacking'. We have also considered the suggested references in 12.7 and 12.4.7 (the Small Islands section).

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
15486	105	19	105	21	Could you summarize some studies about the potential beneficial effects of climate change in early sections of this chapter? [Ruiqing Miao, United States of America]	TAKEN INTO ACCOUNT: We have added more clarity on beneficial aspects of climate change for some regions/sectors. A summary of studies mentioned earlier in the Chapter (e.g., 12.3) would be out of place here, although we include some examples in the FAQ12.3.
14930	105	20			Are the chapter authors confident that they have appropriately included published literature on potential beneficial effects? [Clare Goodess, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: We have added a bullet point in 12.7 to address the literature on benefits. We have adjusted the approach of CH12 to focus on climatic impact drivers, which include both hazards and beneficial effects, allowing us to add more clarity on complex interactions between sectors and climate phenomena that may be a mixture of hazardous and beneficial. We include beneficial effects in many sectors (e.g., CO2 for agriculture, reduction in cold extremes for health) but also note that those changes can be detrimental in other ways (even within the same sector; a reduction in cold extremes can be bad for health in a place like Dubai). We also include and FAQ to underscore that beneficial effects can also occur, however we do not want to give the impression that there is even balance between the as that requires risk and benefit/opportunity assessment in WGII.
6890	105	46			Section 12.7 'Uncertainties, Knowledge gaps, & Research Needs': The work by Jean-Marie Le Guen, contained in the previous reference, should be used. [Ahmed Shalabi, Canada]	TAKEN INTO ACCOUNT: We have considered the suggested reference in our assessment within 12.7.
6892	106	1			Section 12.7 'Uncertainties, Knowledge gaps, & Research Needs': It's not just a '…social-economical system', it's the complexity of a 'Social-Technical System'; See the work by "Technological Transitions and System Innovations; A Co-Evolutionary and Socio-Technical Analysis" by Frank W. Geels. [Ahmed Shalabi, Canada]	REJECTED: An explicit distinction between socio-technical and socio-economical is out of/beyond scope for WGI.
15488	107	24	107	29	I am not sure if (a) and (b) in this placeholder are related with the text in the answer. The text is about threshold and assets. [Ruiqing Miao, United States of America]	NOT APPLICABLE: We have redesigned FAQ text and figures to ensure direct relation to answering the question.
15490	109	1	109	1	It seems like the question and the answer do not match each other well. The question asks 'in what ways' but the answer provides the consequences of the shift. [Ruiqing Miao, United States of America]	TAKEN INTO ACCOUNT: We have reworded the answer to ensure that there is a direct connection with the question. The goal here is not to describe the processes of change, but look at the attributes of climate hazards that can change (magnitude/intensity, frequency, duration, timing, and spatial extent).

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
15492	109	3	109	3	You may want to give a quick answer at the very beginning of the first paragraph. Also, the first paragraph is kind of technical that may confuse general readers. [Ruiqing Miao, United States of America]	ACCEPTED: We have removed the first sentence (which was too broad and not necessary) so that the lead of the response is a direct answer of the question. We have also worked to improve readability and reduce technical language in the opening paragraph.
16114	110	12	110	15	Higher carbon dioxide concentration can make crops less nutritious. Please consider including the following studies in the discussion. 1. https://www.nature.com/articles/s41558-018-0253-3.epdf 2. https://advances.sciencemag.org/content/4/5/eaaq1012 [SAI MING LEE, China]	TAKEN INTO ACCOUNT: The main text does include an overview of the detrimental aspects of CO2 concentration increases for food quality, and we have added a mention in this FAQ to underscore that there are few examples of purely beneficial changes.
7990	122	17		19	"Dosio, A., and Panitz, Hans-Jürgen (2015). Climate change projections for CORDEX-Africa with COSMO-CLM regional climate model and differences with the driving global climate models. Clim. Dyn. 46. doi:10.1007/s00382-015-2664-4.(the date of publication is missing)" [Abdelkader Hamlat, Algeria]	EDITORIAL: corrected
7988	135	13		14	"Kruger, A. C., and Nxumalo, M. (2017). Surface temperature trends from homogenized time series in South Africa: 1931–2015.Int. J. Climatol. 37, 2364–2377. doi:10.1002/joc.4851.(the date of publication is missing)" [Abdelkader Hamlat, Algeria]	EDITORIAL: corrected
15494	163	1	163	6	The figure should be flipped so that you put 'WGI Chapters 1-11' on the very left, then 'WGI Chapter 12' in the middle, and then 'WGII Report' on the right so that the logic flow naturally. [Ruiqing Miao, United States of America]	REJECTED: We have left the figure as it is because we feel this best focuses the reader on the question of risk and impact (upper left) that is supported by information from WGII and WGI feeding in, which is the goal of WGI Chapter 12.
8950	163	5	163	5	Figure 12.1 As a practitioner undertaking numerous CCRAs fo rinfrastructure and other commercial areas I really do not recognise the process that is being described here. This could be a useful diagram and as above just be costructed with contributions from WG2 Chapters 16, 17 and 18. [david Viner, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: the figure has been made more clear
15496	165	1	165	1	For the thermometer image in the figure, one should explain the scale. Is it one degree or five degree between the long and thick bars? [Ruiqing Miao, United States of America]	REJECTED: we prefer no scale as this diagram is illustrative of the idea of graduated thresholds with differing impacts/risk and precisely does not intent to put numbers given the vast heterogeneity of assets within a given sector and regional systems that each could affect the specific threshold levels. We have added increased clarity so that the reader will understand the illustrative nature of this figure.
55478	165	1	165	1	the figures (and following one using the same layout) are hard to assess in this form. The content is clear, so maybe a different format might be more accessible. [Daniela Schmidt, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: We have enhanced the presentation and discussion of these figures to underscore the importance of graduated thresholds across diverse systems.
27126	165	4	165	4	Troad does not exist in the figure. Define Tcoldroads and Thotroads separetely or list them both if they have the same meaning = road wrapping [Edoardo Cremonese, Italy]	ACCEPTED: We distinguish hot and cold roads in the updated figure.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
27128	165	17	165	17	permafrost is relevant for water resources too (Jones, D. B., et al. "Mountain rock glaciers contain globally significant water stores." Scientific reports 8.1 (2018): 2834.). I would add Tpermafrost also in the water resources part of the figure [Edoardo Cremonese, Italy]	ACCEPTED: We include permafrost given its importance for runoff curves and overall seasonality of water resources.
27130	165	18	165	28	Reorder acronym definition in the caption following top-down sequence in the plot also for ecosystem and agriculture [Edoardo Cremonese, Italy]	ACCEPTED: We reordered the acronym definition in the caption to follow the top-down sequence in the plot
14932	165		166		I am not so convinced by the utility of these two figures. How much should be read into the relative position of indices, especially considering impacts in different sectors? The temperature figure seems somewhat more logical/comprehensible to me than the precipitation one which needs a bit more work/thought. [Clare Goodess, United Kingdom (of Great Britain and Northern Ireland)]	**ACCEPTED:** The utility of the graduated threshold concept is illustrative here, and as the reviewer suggested there temperature figure shows this well. the precipitation figure is removed given that it conveys the same concept as the temperature figure and is a bit harder to describe.
51326	173	3	25	3	remarkable that in NE Europe (Finland, Russia) the 1/100 yr discharge clearly decrease, while (intense) precipitation clearly increases [Bart Van den Hurk, Netherlands]	NOTED: this is explained in the text
51324	174	3	25	3	here GCM changes in Tx>35 are shown, while in the Atlas it is "warm days" and "warm nights", with a much less pronounced change pattern than in Chapter 12 [Bart Van den Hurk, Netherlands]	**NOTED:** consistency with Atlas is now made
26992	176	1	176	19	All panels show two solid lines with shading, but the text explains only one line per panel. Please make sure this is corrected when the figure is revised. [Joachim Rock, Germany]	**REJECTED:** The figures have been replaced by another figure
51368	176	10	51	10	very good and useful to show results for areas with > 1000 people/gridbox, to weigh the results towards high exposure areas [Bart Van den Hurk, Netherlands]	**NOTED**: Thank you for the positive comment, but the figures have been changed in the SOD
48574	177		177		In my opinion overall this chapter is clearly written howevr Fig. 12.15 (page 177) needs to be redrwan as its axis labels and caption is not clear and very hard to read. [Pushp Raj Tiwari, United Kingdom (of Great Britain and Northern Ireland)]	ACCEPTED: Figure 12.15 was a mock-up, it is being redrawn
31672	179	0	179	0	In Figure 12.17, in the "Expert analysis" part, Examples should also include the assessment of climate risks on the sourcing of raw materials. It is an important business concern, even more important than the risks on facilities for certain sectors. Proposition: after "index fund;" add: "methodologies that evaluate the climate risk on raw materials;" [Véronique Mariotti, France]	REJECTED: This example is too specific to be included in the list given in the figure. It is implicitly included in "provision of data to conduct climate risk assessment"
51396	179	3	9	4	I don't fully understand the vertical axis "focused - integrated". Could use a bit more explanation in the caption [Bart Van den Hurk, Netherlands]	TAKEN INTO ACCOUNT: the figure has been redesigned and figure caption has been extended
26664	197	1	197	2	In the caption is wrote "Figure 12.SM.17: As in Figure 12.13 but for observed climatologies over the reference period 1995-2014. Panels (a, b) are based on CPC, panels (d-f) use CPC but with (Livneh et al., 2015) for the USA and Mexico. (See Technical Annex VII for details).". Not present panels d-f, please add and call "panels (c-d)" [Alessandro Pezzoli, Italy]	NOT APPLICABLE: These figures do not exist anymore.
28488	12-55	52			The following paper showed the consistent result: Fábrega, J., Nakaegawa, T., Pinzón, R., Nakayama, K., & Arakawa, O. (2013). Hydroclimate projections for Panama in the late 21st Century. Hydrological Research Letters, 7(2), 23-29. [Tosiyuki Nakaegawa, Japan]	NOT APPLICABLE : section has been substantially changed.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
28490	12-56	52			The following papers showed the consistent result: Kusunoki, S., T. Nakaegawa, R. Pinzón, J. S. Galan and J. R. Fábrega, 2019: Future precipitation changes over Panama projected with the atmospheric global model MRI-AGCM3.2. Climate Dynamics, accepted. [Tosiyuki Nakaegawa, Japan]	REJECTED: the study is too specific on a limited area with one model
49636		56	25	1	read "(Lai, 2018; Grotjahn, submitted)" rather than "(Lai, 2018)(Grotjahn, submitted)" [Cyriaque Rufin Nguimalet, Central African Republic]	EDITORIAL: This has been corrected
7462					For the regional analysis, I think that the various regional assessments cited (McInnes, Vousdoukas and Sweet) need to be assessed in the framework of the chapter 9 sea level assessment. For example, how do the choices of ice sheet contribution in these assessments compare to the assessment in chapter 9. I think that there could be a table to summarise this comparison which would also enable discussion of regional sea level projections in chapter 12 derived from chapter 9. [Helene Hewitt, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: CH12 and CH9 have now coordinated the placement of assessments on ocean hazards, including changes in mean sea level. The physical explanations are provided in CH9, and the hazard projections are provided in CH12
11650					The report provides extensive discussion and results from downscaled multidecadal climate projections. Yet, there is essentially no skill in predicting changes in regional climate statistics when the models are run in hindcast for the last few decades. Example of papers who document this inability were reported on in Pielke Sr., R.A., R. Wilby, D. Niyogi, F. Hossain, K. Dairaku, J. Adegoke, G. Kallos, T. Seastedt, and K. Suding, 2012: Dealing with complexity and extreme events using a bottom-up, resource-based vulnerability perspective. Extreme Events and Natural Hazards: The Complexity Perspective Geophysical Monograph Series 196 © 2012. American Geophysical Union. All Rights Reserved. 10.1029/2011GM001086. http://pielkeclimatesci.files.wordpress.com/2012/10/r-3651.pdf Indeed, as discussed in Pielke Sr., R.A., and R.L. Wilby, 2012: Regional climate downscaling – what's the point? Eos Forum, 93, No. 5, 52-53, doi:10.1029/2012EO050008. http://pielkeclimatesci.files.wordpress.com/2012/02/r-361.pdf there are four types of downscaling. The Type 1 downscaling is used for short-term, numerical weather prediction. In dynamic type 1 downscaling the regional model includes initial conditions from observations. In type 1 statistical downscaling the regression relationships are developed from observed data and the type 1 dynamic model predictions. Type 2 dynamic downscaling refers to regional weather (or climate) simulations [e.g., Feser et al., 2011] in which the regional model's initial atmospheric conditions are forgotten (i.e., the predictions do not depend on the specific initial conditions) but results still depend on the lateral boundary conditions from a global numerical weather prediction where initial observed atmospheric conditions are not yet forgotten or are from a global reanalysis. Type 2 statistical downscaling uses the regression relationships developed for type 1 statistical downscaling except that the input variables are from the type 2 weather (or	TAKEN INTO ACCOUNT: We note a number of cases where models do have skill in predicting past regional changes, and we enhance our discussion of detection and attribution. Assessment of confidence in future projections is likewise built upon observed changes, the skill of our models to reproduce these observed changes, theoretical understanding of physical changes, the agreement in future projected changes, and the significance of future projections compared to internal variability. Discussion of downscaling approaches and physical mechanisms to attribute changes in climate trends and extreme events are described in WGI CH9, CH10 CH11, and the Atlas building off other WGI chapter findings). - We have enhanced discussion of the issues raised by the reviewer within Section 12.1 and the knowledge gaps section (12.7).P17 - WGI CH12 presents projections, not predictions, in the sense that findings are contingent on societal pathways and storylines that are not predictable from the current observed state. Results are similarly presented probabilistically to represent a combination of model, observational, and scenario uncertainty. Further discussion on strengths and weaknesses of downscaling approaches is provided in CH10 and the Atlas, and we incorporate a portion of this discussion in Sections 12.1 and the Knowledge Gaps section (12.7).

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
11652					Type 3 dynamic downscaling takes lateral boundary conditions from a global model prediction forced by specified real world surface boundary conditions such as seasonal weather predictions based on observed sea surface temperatures, but the initial observed atmospheric conditions in the global model are forgotten. Type 3 statistical downscaling uses the regression relationships developed for type 1 statistical downscaling except using the variables from the global model prediction forced by specified real-world surface boundary conditions. Type 4 dynamic downscaling takes lateral boundary conditions from an Earth system model in which coupled interactions among the atmosphere, ocean, biosphere, and cryosphere are predicted Other than terrain, all other components of the climate system are calculated by the model except for human forcings, including greenhouse gas emissions scenarios, which are prescribed. Type 4 statistical downscaling uses transfer functions developed for the present climate, fed with large scale atmospheric information taken from Earth system models representing future climate conditions. It is assumed that statistical relationships between real-world surface observations and large-scale weather patterns will not change. Type 4 downscaling has practical value but with the very important caveat that it should be used for model sensitivity experiments and not as predictions. Type 4 downscaling is what is reported on in the IPCC WG1 report. Because real-world observational constraints diminish from type 1 to type 4 downscaling, uncertainty grows as more climate variables must be predicted by models rather than obtained from observations. Thus, the regional projections presented in the IPCC WG1 report are based on regional mulitdecadal climate predictions which have little if any skill. [Roger Pielke Sr, United States of America]	TAKEN INTO ACCOUNT: Methodological approaches of downscaling and regional uncertainties are discussed in Chapter 10. - WGI CH12 presents projections, not predictions, in the sense that findings are contingent on societal pathways and storylines that are not predictable from the current observed state. Results are similarly presented probabilistically to represent a combination of model, observational, and scenario uncertainty, and we now include a more complete breakdown of uncertainties across model approaches (CMIP5, CMIP6, and CORDEX). We also incorporate a portion of the discussion around downscaling and bias-adjustment uncertainties in Sections 12.1 and the Knowledge Gaps section (12.7).

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
11654					The further tests to assess skill should include testing the following two hypotheses. The first argues that the accuracy of climate forecasts emerges only at time periods beyond a decade, when greenhouse gas emissions dominate over other human forcings, natural variability, and influences of initial value conditions. The hypothesis assumes that changes in climate are dominated by atmospheric emissions of greenhouse gases, of which CO2 is the most important. It represents the stance of the draft WG1 IPCC report. A second hypothesis is that multidecadal forecasts incorporating detailed initial value conditions and regional variation set an upper bound on the accuracy of climate projections based primarily on greenhouse gas emissions. According to that view, successful models must account for all important human forcings—including land surface change and management—and accurately treat natural climate variations on multidecadal time scales. Those requirements significantly complicate the task of prediction. Testing the hypotheses must be accomplished by using “hindcast” simulations that attempt to reproduce past climate behavior over multidecadal time scales. The simulations should be assessed by their ability to predict not just globally averaged metrics but changes in atmospheric and ocean circulation patterns and other regional phenomena. In the last IPCC WG1 report this was accomplished and presented in two separate chapters. Chapter 11 is titled Near-term climate change: projections and predictability” while Chapter 12 is titled “Long term climate change: projections, commitments and irreversibility”. Annex 1 “Atlas of global and regional climate projections” presents results based on Chapter 12. However, the literature clearly shows that Type 4 downscaling such as in Chapter 12 and the Annex cannot be any more skillful than shown in Chapter 11. The AR5 WG1 report ignored the implications of Chapter 11 and this mistake should not be perpetuated in AR6 WG1. To assume that skill, somehow, emerges for time	TAKEN INTO ACCOUNT: - WGI CH12 presents projections, not predictions, in the sense that findings are contingent on societal pathways and storylines that are not predictable from the current observed state. Results are similarly presented probabilistically to represent a combination of model, observational, and scenario uncertainty. Further discussion on strengths and weaknesses of downscaling approaches is provided in CH10 and the Atlas, and we incorporate a portion of this discussion in Sections 12.1 and the Knowledge Gaps section (12.7). - For many variables the direction and relative magnitude of change is much more robust than the raw values, particularly where theory strongly indicates a behaviour that models reproduce despite differences in their mean bias. - We show RCP8.5 Mid-century projections to highlight a plausible period that is more illustrative of robust climate changes given the stronger emergence of the climate signal in projections. - Bias-adjustment approaches are also selected as to favour robustness for the variables in focus using methods that are not likely to vary with climate change in ways that undermine the projected changes.
11656					The term “resolution” is used erroneously throughout the entire IPCC WG1 report. What is really meant is “grid increment”. The reason this is important is that in utilizing output from the models the actual spatial resolution is less than implied by the use of “resolution” as used in the report. While the modelers themselves know this is jargon shorthand for grid increment, users of the information will not generally know this. This issue is discussed in these articles. Pielke, R.A., 1991: A recommended specific definition of "resolution", Bull. Amer. Meteor. Soc., 12, 1914. http://pielkeclimatesci.files.wordpress.com/2009/09/nt-27.pdf Pielke Sr., R.A., 2001: Further comments on "The differentiation between grid spacing and resolution and their application to numerical modeling''. Bull. Amer. Meteor. Soc., 82, 699 http://pielkeclimatesci.wordpress.com/files/2009/10/r-241.pdf Laprise, R., 1992: The resolution of global spectral models. Bull. Amer. Meteor. Soc., 9, 1453-1454. http://pielkeclimatesci.files.wordpress.com/2009/09/nt-27a.pdf [Roger Pielke Sr, United States of America]	TAKEN INTO ACCOUNT: We have clarified the use of the term 'resolution' to be consistent with the glossary and other chapters and the CMIP6 HighResMIP, including specification that grid box size does not mean all physical processes at that scale are resolved.
27396					- Why snow hazard is missing for Africa? Snow represent important stocks of water for summer in many regions [Fatima Driouech, Morocco]	ACCEPTED- Africa snow hazards are now assessed

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27398					Figure 12.1 is important for illustrating the link and importance of assessing climate hazards for impact evaluation. However the Figure still needs more work to be clear, easy to understand and consistent. The links between different parts should be more explicit [Fatima Driouech, Morocco]	TAKEN INTO ACCOUNT: Figure 12.1 has been revised, also accounting for WGIII links on energy and the vocabulary regarding a more neutral treatment of climate phenomena.
27404					Table 12.2: Nice table. But the title needs more explanation [Fatima Driouech, Morocco]	ACCEPTED: the legend of Table 12.1 has been expanded to better explain the meaning of the different displayed items. Note that new vocabulary has been used, replacing hazards by "climatic impact drivers"
27406					Table 12.2: “mean wind decrase” needs correction [Fatima Driouech, Morocco]	TAKEN INTO ACCOUNT: However note that the "Mean wind decrease" category has now been changed to "Mean Wind speed" with the table showing the variables that are associated with changes (in either direction).
27414					Please specify what is meant with each sub-region (its extend) within continents [Fatima Driouech, Morocco]	TAKEN INTO ACCOUNT: We refer more clearly Chapter 1, Figure 1.13d in section 12.1 and in introduction to 12.4 so that readers can understand the geographic extent of regions in CH12 tables and figures.
27416					Some sub-regions are missing (ex in Table 12.3) [Fatima Driouech, Morocco]	TAKEN INTO ACCOUNT: We added North Africa and now also include prominent sub-sections and tables for polar and open ocean regions, providing more comprehensive and even global coverage.
27418					Tables 12.3 to 12.9 are not easily readable. The number of colors used maybe reduced using symbols like + and – to indicate increase and decrease respectively [Fatima Driouech, Morocco]	TAKEN INTO ACCOUNT: Colours representing broader sector and climatic impact drivers have been reconfigured to avoid any potential confusion with the assessed colours at the intersection of these rows and columns in the table.
27420					- In 12.3 : the relevance of climate hazards for key sectors is very important and the way it has been introduced in the chapter is very good. I would be good if these parts includes more explanations, examples and references [Fatima Driouech, Morocco]	TAKEN INTO ACCOUNT: We have expanded some explanations, examples, and references in collaboration with WGII contributing authors although space constraints limit the extent to which this is possible. The new framework also facilitates discussion of both hazardous and beneficial changes in climatic impact drivers.
27424					Uncertainty language should be reviewed through all the chapter to ensure consistency and robustness [Fatima Driouech, Morocco]	TAKEN INTO ACCOUNT: Uncertainty language has been improved for consistency and robustness.
27430					More homogeneity between the region parts would be nice: observed changes then projected ones. [Fatima Driouech, Morocco]	TAKEN INTO ACCOUNT: All regional sections have been updated with additional attention on polar regions and open ocean regions. We also include more discussion of observed hazard changes although some of this information is provided in CH2, CH11 (particularly for extremes), and the Atlas (particularly for mean trends).

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
39336					I think it is important to recognise the critical role of other organisations (beyond NHMS) in providing and supporting the use of climate services across the world (e.g. RIMES and ICIMOD in Asia; IGAD/ICPAC in the Great Horn of Africa; etc). As mentioned in the report, there's a substantial breath of grey literature on these efforts and I think it would be important tosomehow recognise that in the assessment. [Marta Bruno Soares, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: We have broadened and generalized our discussion of climate service and other boundary organizations in order to avoid any implication of promoting or omitting select organizations.
39342					Harjanne's paper (https://doi.org/10.1016/j.gloenvcha.2017.06.008) also provides an interesting perspective on the institutional analysis and discourses around climate services [Marta Bruno Soares, United Kingdom (of Great Britain and Northern Ireland)]	TAKEN INTO ACCOUNT: We have considered the recommended paper as part of the chapter assessment.
39344					Cross-chapter box 12.2. is too long and could be streamlined and perhaps more concise in the messag it seeks to convey. [Marta Bruno Soares, United Kingdom (of Great Britain and Northern Ireland)]	ACCEPTED: Cross-chapter box 12.2 is revised to make it shorter, more streamlined, and more concisely focused on key messages
41260					It is important to have this chapter to highlight the regional impact of climate change and the different impacts of such change in different parts of the world. The regional spread of the many authors reflects a good attempt to bring diverse regional inputs into the picture. I am not sure if it is WG policy but the literature review is best I can tell only of English Language journals. This is remarkable especially in the regional context. Although the composition of the group of authors is regionally balanced there is perhaps inevitably an imbalance in the treatment of different regions. Perhaps this could be reduced in places by noting the lack of studies on some key regional issues. While it is perhaps convenient and “politically correct” to organize the treatment of continents alphabetically it does result in disconnects in the flow of information for example the separation of North and South America. Also given its importance in the regional context the Arctic might be treated separately. Within the regional analysis there is a significant difference in the approaches, for example the section on Central and South America is introduced by a clear breakdown of the region into components which are described individually in a very coherent way. In contrast Asia an extremely diverse and complicated, land mass covering a good portion of the globe is treated as a unit with about the same amount of content as Australasia, absurd in my view. The treatment of Central and South America might with regional adaptation, be a model for the other sections. Although the breakdown of the regional components into a standard set of hazards it would be useful to introduce each region with an introductory statement outlining the most important regional hazards. This would help the general reader and produce a clearer picture of the varied importance of different hazards in different parts of this world. [Leonard Berry, United States of America]	TAKEN INTO ACCOUNT: We have added an additional Lead Author to help us better reach literature from East Asia, including non-English journals. We also include review of Spanish- and Portuguese-language literature in Latin America, and Arabic and Farsi literature in the Middle East, North Africa, and Central Asia.

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41342					Why is RCP8,5 contrasted with 4.5 and not 2.6 in this chapter? One would expect that projects contrast high and low emission scenarios [Debra Roberts, South Africa]	TAKEN INTO ACCOUNT: Figures and discussion in this chapter now uses RCP2.6 and RCP8.5 to approximately bound the overall range of hazard changes. In our figures we use RCP8.5 as a more clear example of the types of hazard changes that are projected given that the signal is more likely to be distinguishable from the background noise than would be possible in RCP2.6. These representative projections also provide a point of comparison that is intended to allow the reader to visualize how different RCPs or time periods may respond in comparison given relative consistency in pattern-scaling.
41346					Important to consider a balanced treatment of countries in 12.4.6 [Debra Roberts, South Africa]	ACCEPTED: WE have enhanced our discussion of Canada and Mexico commensurate with available literature to bring more balance into the North America section.
46698					Assessment on modes of variability occurs in Section 1.3.3; Section 2.4; Section 3.7; Section 4.4.3, 4.5.3; Section 6.2.2.5.1; Section 7.1.1/2 ; Section 8.3.1.3.2, 8.3.2.2, 8.3.2.4.1, 8.3.2.9.1, 8.4.2.5,8.5.2.2.1, 8.3.2.9.2, 8.4.2.5, 8.3.2.9.3, 8.4.2.5, 8.3.2.9.4, 8.4.2.5, Figure 8.43, 8.5.2.2.1, 8.5.2.2.1; Section 9.2.2.1, 9.2.2.3, Section 9.4.3.2, BOX 9.2, 9.2.3.1, Table 9.1, Section 9.2.1, Cross-Chapter Box 9.1, BOX 9.2, 9.6.2.1.1, 9.6.2.1.2, 9.5.4.7, 9.2.5; Section 10.1.4.2, 10.4.2.2, 10.6.3.3; Section 11.3.1, 11.7.1.1, 11.6.2, 11.1.5,11.4.1, 11.6.1, Table 11.4; Section 12.4.1, 12.4.4.3, 12.5.2.3; Section Atlas.5.2.1.2, Atlas.5.3.1.1, Atlas.5.3.2.1, Atlas.5.5.1.1, Atlas.5.5.2.1, Atlas.5.6.2.1, Atlas.5.6.3.1, Atlas.5.10.2.1, Atlas.5.10.2.2. This topic is addressed in ES of Chapter 2, 3, 4, 7, 11, addressed in box in chapter 9, and broadly addressed in above-mentioned subsections in chapter 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12. [WGI TSU, France]	NOTED: we thank the reviewer for these information

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49898					Question: Why erosion is not considered in this report like a climate hazard linked to multiples variables such as water, ice, glacier and wind into catchments/basins, inland or continent? Coastal erosion is the uniquetype debated at least into this chapter 12. [Cyriaque Rufin Nguimalet, Central African Republic]	TAKEN INTO ACCOUNT: As the reviewer notes, there are many hazards that lead to land erosion, and there are many additional factors related to land and river management that are more appropriately described in WGII. Our use of climatic impact drivers requires that they can be clearly connected to a discrete set of essential climate variables, and our attempts to treat land erosion in this manner made it clear that this was a conglomerate of many hazards that result in land erosion as an impact. WGII CH8 will include an assessment of land as a resource, with erosion as a primary impact driven by an array of hazards, which we preview in section 12.3 (and Table 12.2). Coastal erosion is a process that is more easily mapped onto ocean movement at the coastline, connecting to waves and mean currents. The loss of coastal land and property is an impact and risk that results directly from this erosion hazard (although potentially modified by building codes and beach replenishment efforts that would be handled in the vulnerability/exposure discussions within WGII).
55286					There may be global map for each climate hazard that will be subdivided into regional maps within a same figure. Maps indentifying hotspots or regions may be added in Atlas of WGI with proper tracking. [Muhammad Amjad, Pakistan]	ACCEPTED: We now utilize global maps for more hazards, including extreme heat days (Tx>35C), extreme hot/humid conditions (Wet bulb), extreme sea levels, and drought (Standardized precipitation index). These are presented at the top of Section 12.4 and include regional summary analysis for each region so that we can represent uncertainty from climate models, time periods, and emissions pathways (RCPs). We also rely on the mean temperature and precipitation change projections assessed by the Atlas.
55292					Messages related to each hazard for climate community in particular and public/stakeholders in general may be adedd. [Muhammad Amjad, Pakistan]	TAKEN INTO ACCOUNT: We have updated and refined our key messages in the executive summary with a focus on regional stakeholders.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
57504					Figure 12.3: the design of the illustration imply that temp. hazard thresholds can be compared one with another at the inter-group level (e.g. p erosion for agriculture is slightly lower than for ecosystems, therefore p erosion for agriculture is more critical). if this comparision does not stand, the design of the figure should be revised, as the reader tends to make such comparision with the current layout (TSU graphics officer can provide guidance) // group labels should be moved right below the main title, so they are visible at first and if possible, written horizontally for better reading // the thermometer should be placed on the left, close to cold/heat [WGI TSU, France]	TAKEN INTO ACCOUNT: We have added stronger guidance to the figure caption to underscore that this is a conceptual figure that does not specify actual temperature levels, which makes it not directly comparable across sectors, and also that the intent is to identify graduating thresholds and as temperatures become more extreme in the hot and cold direction. - move thermometer to the left - place group labels in a more readable location/orientation
57506					Figure 12.4: the design of the illustration imply that precip. hazard thresholds can be compared one with another at the inter-group level (e.g. T severe for health is slightly lower than T hotroads, therefore Tsevere is more critical). if this comparision does not stand, the design of the figure should be revised, as the reader tends to make such comparision with the current layout (TSU graphics officer can provide guidance) // group labels should be moved right below the main title, so they are visible at first and if possible, written horizontally for better reading // the ruler should be placed on the left, close to dry/wet [WGI TSU, France]	TAKEN INTO ACCOUNT: We have added stronger guidance to the figure caption to underscore that this is a conceptual figure that does not specify actual precipitation rates, which makes it not directly comparable across sectors, and also that the intent is to identify graduating thresholds and as temperatures become more extreme in the hot and cold direction. - move precipitation gauge to the left - place group labels in a more readable location/orientation
57508					Figures 12.5, 6, 7, 10, 11, 12, 13: These figure would benefit from a general title right on top of the panel, if any comes to mind (e.g. for figure 12.11: changes of selected hazard indices in Europe) // units could be placed right above the color bar // some secondary title could be less jargony, ideally (e.g. b,c,e,g,h: if space allows, is their anyway they could reflect moreof the caption contenct rather than acronyms?) [WGI TSU, France]	NOT APPLICABLE: We have reconfigured and replaced these figures with a different approach for regional hazard projections. TAKEN INTO ACCOUNT: We clearly label their replacements.
57510					Figure 12.14: if possible, acronymes should be spelled out in figure // it is unclear what red and blue lines are in the figure/ ideally, adding a legend or annotation directly in the figure explaining what red/blue and dashed lines are would increase clarity. [WGI TSU, France]	TAKEN INTO ACCOUNT: These placeholder figures have been replaced with updated figures and are clearly labelled.
57512					Figure 11.15: the design could be more engaging. Contact TSU graphics officer for guidance/support. [WGI TSU, France]	TAKEN INTO ACCOUNT: We assume the reviewer was referring to figure 12.15, which was a placeholder figure that is being reconstituted to be more engaging for the Second Order Draft.
57514					web interface: since the website is open to everyone, it would be better to use the name of the months in full (June/July/August) rather than JJA, which is not a common way to refer to months outside of the science world. [WGI TSU, France]	NOT APPLICABLE: This is an inquiry for the Atlas.