

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
35374	0	0	0	0	Uneven observational data coverage was identified in the previous IPCC reports. "We can make this report different by giving some quantified measure or threshold regarding the data coverage". For example, we can identify that this was the percentage of data coverage in the particular region at particular timescale and this much percentage is required to conduct a reliable analysis or to validate a model simulations for that time period. In this regards, we can make quantified maps for each region and mention the data improvement with different timescales. This approach will be beneficial to the researchers working on data assimilation, as they will target the data lacking time period to supplement the missing data. In the long run, we can add the results of CMIP6 validation with or without the data improved regions in Second Order Draft (SOD) of AR6. [Mehwish Ramzan, Pakistan]	Considered but no change is made. This seems to be a good idea, but it is an important research subject rather than a job for AR6 that assesses available literature. The threshold for data coverage at which a reliable analysis can be made depends on the objective of the analysis. For example, if the interest is to examine long-term trend in mean temperature over a continent, a relatively sparse observational network may be good enough. On the other hand, if the interest is to know long-term change in short-duration extreme precipitation, one would need to have a much denser station network with observations over a long period of time.
53866	0	0	0	0	It would be good to go through the chapter and examine many of the general statements to ensure that they hold over less-studied areas (e.g. least-developed countries with poor data records, tropical areas, etc). Sometimes a study from the US will have conclusions that are not transferrable to these regions, and it would be good to indicate what might be different about these places. Perhaps you could have a separate box highlighting the parts of the world with the most sparse observational networks, and what implications that has for our understanding of extreme events in those regions. There is increased attention to climate adaptation in the most vulnerable regions, but policy-makers and practitioners often have a hard time understanding what we do or do not know about climate variability and change in these places. [Erin Coughlan de Perez, United States of America]	Considered. We have paid close attention to statements that are generally true for different regions and those are true only to specific regions.
53868	0	0	0	0	The "model evaluation" sections are excellent; it is very helpful to have an understanding of what is known about model performance before reading about the projections. However, these sections highlight a few place specific studies and otherwise only include summary statements from the global studies. Is there a way to depict model performance for extremes with a more global coverage? Can this be linked to the Atlas? It would be an incredibly useful set of maps! [Erin Coughlan de Perez, United States of America]	Noted and considered. The model evaluation section in FOD is not complete due to the lack of availability of CMIP6 data and new literatures. This is now improved.
48034	0	0	0	0	Scoping Outline Check: All bullets from approved outline are covered in the first order draft but further focus on 'compound events' could be further enhanced. [WGI TSU, France]	Noted with thanks. Compound events section is enhanced as much as literatures allow.
55460	0	0	0	0	CMIP acronym is used throughout text from page 5 without any explanation except for its occurrence in page 18 [GENITO MAURE, Mozambique]	Noted. CMIP is now spelled out when it appears in the chapter the first time.
28842	0	0	0	0	The ES is far too long and didn't really work for me as the main points were not that clear, but the rest of the chapter is really nice - clear structure and well presented. I also like your subset of temperature levels. The sections have useful summaries and I quite like the fact that they are in bold, but may not fit with formatting elsewhere in report. Figure ideas are nicely developed [Piers Piers Forster, United Kingdom (of Great Britain and Northern Ireland)]	Noted and considered. The ES was shortened and used the format that was agreed across chapters.
50860	0	0	0	0	There is an emerging body of literature regarding changes in observed hourly rainfall extremes that is not reflected in this report. This is an important area of research due to the impacts it can have in urban flooding and the progress of the last few years should be presented here. I suggest starting with [Lenderink, G. and Fowler, H.J. (2017) 'Understanding rainfall extremes', Nature Climate Change, 7, p. 391.] and the references therein, as well as including more recent work like: Guerreiro, S.B., Fowler, H.J., Barbero, R., Westra, S., Lenderink, G., Blenkinsop, S., Lewis, E. and Li, X.-F. (2018) 'Detection of continental-scale intensification of hourly rainfall extremes', Nature Climate Change, 8(9), pp. 803-807. Barbero, R., Westra, S., Lenderink, G. & Fowler, H. J. Temperature-extreme precipitation scaling: a two-way causality? Int. J. Climatol. 38,e1274–e1279 (2018). Lenderink, G., Barbero, R., Loriaux, J. M. & Fowler, H. J. Super-Clausius–Clapeyron scaling of extreme hourly convective precipitation and its relation to large-scale atmospheric conditions. J. Clim. 30, 6037–6052 (2017). Barbero, R., Fowler, H. J., Lenderink, G. & Blenkinsop, S. Is the intensification of precipitation extremes with global warming better detected at hourly than daily resolutions? Geophys. Res. Lett. 44, 974–983 (2017). [Selma Guerreiro, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Assessment on changes in sub-daily extreme precipitation is added.

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48578	0	0	0	0	Overall in Chapter 11, the reviewer got an impression that there are relatively large weights of AR5 and SREX. This is probably because the manuscript is FOD. The proportion of contents obtained after AR5 and SREX is expected to increase in the SOD. [Kazuhiisa Tsuboki, Japan]	Noted. New literatures are added uif available by the cut-off date
28878	0	0	0	0	I like the FAQs 11.1 and 11.2. FAQ 11.2 is too technical I think - could almost be a box more merged with FAQ 12.2 which is very similar. In fact FAQ 11.3 [Piers Piers Forster, United Kingdom (of Great Britain and Northern Ireland)]	Noted. These are heavily revised to make them less technical.
14278	0	0			Here are some additional references (with a general summary of my understanding) that could be assessed if they are relevant for key messages (sorry for the list): Kendon et al. (2019) Nature Comms, doi:10.1038/s41467-019-09776-9.: Higher resolution convection-permitting simulations project more severe changes in both wet and dry extremes over Africa. Murray-Tortarolo et al. (2016) GRL, doi:10.1002/2016GL068240: more intense dry seasons in arid regions 1989-2005 and linked to decreased NPP Burdanowitz et al. 2019 ACP doi:10.5194/2FACP-2019-136: hourly ship-based rainfall shows super-Clausius Clapeyron scaling of 99th percentile extremes (above 8.5%/K) with no reduction in duration at higher temperatures. Zhang et al. (2019) GRL, doi:10.1029/2018GL079071: Enhanced latent heat release through atmospheric rivers can invigorate the parent storm Boers et al. (2019) Nature, doi:10.1038/s41586-018-0872-x: global-scale atmospheric dynamics involving Rossby Waves generate coinciding remote linkages of extreme-rainfall events. Curry et al. (2019) GRL, doi:10.1029/2018GL080720: A transition from snow melt to extreme precipitation events is projected to alter the timing and increase the severity of river flooding over western Canada based on simulations. Hawcroft et al. (2018) ERL, doi:10.1088/1748-9326/aaed59: extreme precipitation within intense extra tropical cyclones are projected to intensify over Europe and north America in line with expectations from thermodynamics though this is modulated by uncertainty in how storm track location will change in a warming climate, Marelle et al. (2018) GRL, doi:10.1029/2018GL079567: future warming could shift extremes later in the year especially at higher latitudes Espinosa et al. (2018) GRL, doi:10.1029/2017GL076968: Atmospheric rivers (ARs) ~10% fewer, ~25% longer, ~25% wider globally with stronger moisture transport under RCP8.5 future scenario; ~50-60% more frequent & transport ~20% stronger in midlatitudes where most frequent. Maidens et al. (2019) J. Clim., doi:10.1175/jcli-d-18-0433.1: influence of tropical disturbances on weather extremes in Europe during winter 2015/16 Yin et al. (2018) Nature Comms., doi:10.1038/s41467-018-06765-2: observed increase in daily runoff	Noted with thanks for the references.
52998	0				I ran out of time to comment on large chunks of the chapter but there are a lot of typos, grammatical errors and awkward constructs in this chapter that I haven't commented on. Presumably these will be fixed for the SOD. [Lisa Alexander, Australia]	Noted, yes, this is addressed in SOD.
14122	0				GENERAL: Well done on producing a nice Chapter 11 first order draft on extremes. I find the mini summaries at the end of each section are useful and should be repeated in other chapters if not already. There are many typographical errors that should have been removed by or perhaps were even introduced at the TSU collation stage (words stuck together, etc) so I do not list all these. Some sections require checking by a native English speaker (e.g. 11.4.1). Coordination with Chapter 8 on heavy precipitation, flooding and drought is expected and some text could be merged, deleted or moved for the SOD. [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Noted. We have discussed and agreed with Chapter on coordination.
53048	0				Obviously an important chapter for the links to WGII. I encourage the authors to contact WGII authors to ask for comments, commenting on their drafts and also involve them here as CAs when that can strengthen the consistency and integration. If help is needed for coordination across WGs, ask TSU/Burea for help. [Jan Fuglestedt, Norway]	Noted. The coordination has been done at working group level
53050	0				A general remark: Please check the Special Reports on various topics covered in ch11 in order to be aware of the assessments done there. If different conclusions and assessment are obtained in this chapter, it will be useful to clarify and explain [Jan Fuglestedt, Norway]	Noted. This is considered in SOD. We state clearly that these reports are our starting point.
53064	0				The summaries given in the end of sections are very useful given the complex material presented in the sections. Hope this can be kept in coming versions. [Jan Fuglestedt, Norway]	Noted. Yes, this is kept and enhanced when possible.
30294	0				All figures should be checked for resolution [Nazan An, Turkey]	Noted. The figures were produced at publication quality for SOD.

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43366	0				This chapter has a relatively high frequency of words run together (missing spaces), missing words, and typographical errors. It needs a good proof-read before completion of the SOD. [James Renwick, New Zealand]	Noted. A lot of missing space is due to formatting. The new version is also been edited and proof-read by native English speakers.
43878	0				the issue of winter cooling with higher than previously frequency of cold extremes in northern parts of Europe and Asia after 1990 should be mentioned. Trends in extremes are statistically not significant, because of very high year-to-year variability, but the phenomenon should be included in this chapter. Cohen J., et al., 2014, Recent Arctic amplification and extreme mid-latitude weather, Nature Geoscience, 7: 627-637, for details. [Joanna Wibig, Poland]	Noted. This is assessed in this chapter
26732	0				I would first like to congratulate the authors on producing a very substantial first order draft, from reading which I learned quite a few new things. Weather and climate extremes are important topics, where an interesting clash between advances in physical understanding, difficulties in interpreting observations, models that are sometimes put to the test by the small-scale phenomena, and even philosophical issues. [Thorsten Mauritsen, Sweden]	Noted with thanks
26734	0				In this regard, I would like to advise the author team to put physical understanding, whenever it exists, first. The current text spends a substantial amount of time on summarising the past reports up front. This makes reading the text difficult since the background is not yet explained. I suggest starting each section with a physical explanation of the phenomenon (some already do this). [Thorsten Mauritsen, Sweden]	Considered. The description of assessments from earlier reports is to provide a starting point of our assessment. It is shortened. The assessment itself takes physical understanding into consideration. Physical understanding is a very important component to inform the assessment.
54382	0				Extreme winds are one gap in this chapter (other than by implication from trends in severe storms). Chapter 2 does not address them either; they should be considered somewhere. [Blair Trewin, Australia]	Considered. There are not a lot literatures on extreme wind, but we have added a short section on this.
26736	0				And furthermore it is sometimes difficult to figure out if there has been an advance or not, since the past reports statements are disjoint from the current reports statements. I think this could be toned down, and there should be a focus on the most important differences, not on being comprehensive. [Thorsten Mauritsen, Sweden]	Noted and considered. The assessment has to provide a full picture of the state of climate extremes to inform the government, rather than just the new advance in our understanding of the science. Nevertheless, we also highlight new findings.
43120	0				The chapter is looking really good so far - well done! [David Frame, New Zealand]	Noted with thanks
43906	0				Commenting on the tropical cyclone (TC) part of the Chapter, first there are important inconsistencies between the executive summary and what is in the main text for a number of TC variables. The executive summary section on TCs seems in pretty good shape, but within the main chapter some of the TC statements are stronger than in the executive summary. I have put in suggested changes to make the main chapter findings consistent with the executive summary. Basically, in my comments I'm trying to make the report's TC/climate findings consistent with a recent WMO assessment report on TCs and Climate Change on which I was lead author. (Regarding the WMO report, Part I on detection and attribution of TC changes was just accepted at BAMS and is available online, and Part II on TC Projections is currently still in review at BAMS.) In the WMO assessment, we considered published work on detectable anthropogenic influence on TCs from two different perspectives: i) a Type I error avoidance perspective, as we've done in the past, where we aim not to conclude in error that there was a detectable anthropogenic influence when there was no such detectable influence; and ii) a Type II error avoidance perspective, where we aim at avoiding understating anthropogenic influence or avoiding not concluding that there was anthropogenic influence in cases where there was. More details on this issue are in that now-available report. IPCC may not want to take such an approach as avoiding Type II error. Type II error avoidance is aimed more at a risk assessment audience as opposed to a more typical detection/attribution state-of-knowledge audience. I'm just raising this general issue here for awareness. The WMO assessment report contains a number of examples and statements that arise from considering the Type II error avoidance perspective. These statements could be included here in principle, but I have not included them in my specific text comments below. However, they are available in the new WMO assessment report (Part I) if needed. [Thomas Knutson, United States of America]	Thank you for the thorough review. 1) We have addressed the individual comments in the text and respond to them below. 2) SOD has included Tom Knutson as a Contributing Author in Chapter 11. 3) relevant SOD assessment is consistent with WMO report. 4) The concept about the Type II error used in WMO report is not used in AR6 assessment and as such, does not apply to this chapter's assessment.
21382	0				In sections 11.5, as there are many data limitations related to floods and droughts. Mention your specific relationship with the changing climate [Gwenaelle GREMION, Canada]	Noted but we are not sure about exactly what the reviewer is suggesting.

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26832	0				The extra-tropical cyclones are missing from some parts of this chapter, e.g. Tables 11.1, 11.2 and 11.6. A figure similar to the tropical cyclone figure 11.18 would help or a cross reference to Figure 4.28. [Ruth McDonald, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Extratropical cyclones has been merged with atmospheric rivers in a single section called midlatitudes cyclones. Key messages from this new section were added to the corresponding tables.
55770	0				What is the impact of weather/climate extremes on health? [Ariane Middel, United States of America]	Noted. The impact is not within the scope of the Working Group I report. As such, we do not assess impacts.
50694	1	1	1	1	Great job! I really enjoyed reading this chapter, it contains a wealth of information and is highly interesting to read. I did not yet comment on small edits as I assume the text will still change quite a bit. [Olivia Martius, Switzerland]	Noted with thanks.
44210	1	1	1	1	I believe that this chapter is very important, above all the analyzes that are done at the regional level, because on this information, decision makers can be pressured to make efforts to improve actions by the climate of a certain region or country. In this sense, I find that the chapters do not mention the climatic events that are actually occurring in the countries, for example, in South America. Furthermore, I believe that not including this information does not support the scientific work done in these countries. From what I see in this chapter, there are no contributions from Chilean scientists who work in climate and who have publications in those areas. I suggest that among the contributors to the chapter include colleagues from all continents, so that the regional vision can be really captured in the chapter. [angelica CASANOVA-KATNY, Chile]	Noted and considered. While we try to be inclusive, we do not necessarily include a CA from every country. But we do have lead authors and contributing authors from all continents including several south American authors.
48670	1	1	196	1	This chapter, concerning for South America, focus much more in AMZ and SES. There are other regions where the extremes changed in the last decades and by the end of this century, the authors should focus the chapter for SA analysing other regions over the continent. [Lincoln Alves, Brazil]	Noted and considered
30222	1	1	204	1	note that chapter 8 comments do not really tally with what is said about sub-daily extremes in this chapter (11). For e.g.: "a global increase in the frequency/intensity of extreme hourly to daily precipitation (high confidence) (8.4.1.2.1)," (p8, line29-30 in Ch8) - This chapter (11) should give the sense that hourly extremes are likely to increase at at least CC rate (with sufficient moisture availability) and could increase at higher rates (low confidence). It does not cover the literature in this area sufficiently at the moment. I have tried to give some comments here but in the next draft you should work with the authors of Chapter 8 (many of whom overlap with this chapter, and include myself) to make sure there is a consistent message on sub-daily precipitation extremes across the two chapters, that you are more precise about language in terms of observed changes to long and short duration extremes and their projected changes and that you consult the latest literature (as there is a lot missing at the moment) [Hayley Fowler, United Kingdom (of Great Britain and Northern Ireland)]	Considered. A dedicated section on sub-daily precipitation is now added.
44578	1	1	204	1	This chapter presents a comprehensive assessment of weather and climate extremes in a changing climate. The chapter is well structured. I noted a few editorial corrections. Some important and relevant references are suggested to be incorporated in this Chapter. [Krishnan Raghavan, India]	Noted with thanks.
14524	1	1	204	3	This chapter is well structured and written, generally speaking. However, it would be better if the contents of global change in extreme climate is moved to Chapter 2, and those of regional change are integrated into the current Chapter 10, or Chapters 10 and 11 are merged into one, especially considering the serious faultiness of the current Chapter 10. In any case, I would suggest the authors of this chapter to collect, read, assess and cite more publications on region change in extreme climate, including those published in some special issues of international journals. My second suggestion would be that the long-term change in local-scale intense convection processes such as thunderstorms, tornadoes and hailstones be assessed in a subsection. There appeared some analyses for certain regions in recent years. My third suggestion is related to a bigger emphasis of some key or sensitive regions such as northern Africa, East Asia, Arctic and the Tibetan Plateau. This kind of information would be very important to assessment of impact and vulnerability. (CUG, Guoyu Ren) [Guoyu Ren, China]	Noted and considered. It is a collective decision of WGI report authors that this chapter assess extremes from the global to regional scales. The delineation of regions is also agreed across the chapters. As to the assessment on small scale extremes such as tornadoes etc., it is limited by available literature.
9808	1	1	204	4	Without giving excessive attention to individual typos and grammatical mistakes, I do want to note that this chapter, more than some others, had so many language and typographical errors that it was difficult to read and understand in sections--the authors and editors should work carefully to address this overall issue with the text in the chapter. [Andra Garner, United States of America]	Noted. This is been addressed with help by native English speakers to edit and proof-read.
51432	1	1	204	4	no reference is made to the Atlas chapter of AR6, which probably should be included in the SOD [Bart Van den Hurk, Netherlands]	Considered. This is now mentioned in introduction.

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40400	1		204		I consider this chapter is of relevant importance for decision makers. Therefore, I strongly recommend focusing on regional results. In this sense, I consider that regional section should be extended and global results should be shortened, especially for those variables characterized with high spatial variability in their extremes (for example: precipitation and floods) and because weather and climate extremes impact on regional and local scales and decisions regarding mitigation and adaptation are also managed at those scales. [Vanessa Pántano, Argentina]	Considered. There was a dedicated section 11.9 to provide regional results in FOD. In SOD, we have integrated regional results into the global assessment to make the regional results more prominent.
44148	2	4	204	4	I reviewed the Chapter(11), I like the comprehensive structures, contents, different types of extreme in different regions and future projections. So, I have no special comments on Chapter(11). Pls accept my highly appreciation to all respectful authors and experts. Congratulations! [Kyaw Lwin Oo, Myanmar]	Noted with thanks.
38922	3	13	3	18	There is a relationship between ETCs and large scale wind-storms, but this is by no means simple. I think a separate section on wind-storms (possibly also including coastal storm surge effects) would be appropriate, rather than very short paragraphs. [Uwe Ulbrich, Germany]	Noted. A new CA (Kathy McInnes) has been included to provide material on wind extremes.
55462	5	1	5	13	The concept of heavy precipitation is introduced without bounding it with actual values. Assuming rainfall follows different patterns across the world, this concept may become unclear for the majority of the readers. [GENITO MAURE, Mozambique]	Noted. From other comments it seems that the term "heavy precipitation" is not always well understood. Might consider rewording, e.g. "intense precipitation". A very specific definition might not be useful, i.e. in some cases absolute thresholds are used and in other cases percentiles. To be revisited with Section 11.4's LAs.
54480	5	1	7	54	The executive summary and large parts of the chapter focus on low level of warmings such as 1.5, 2 and 3°C. This may be due to the fact that the chapter starts from SR1.5. But I would strongly suggest to also assess the consequences of higher levels of warming including 4 and 5°C. Even if those levels of warming are not desirable and hopefully even not probable, they are extremely relevant from a risk perspective. Changes in extremes may be so large for high levels of warming that they are associated with very high risks even though the probability may be lower than for low warming levels. [Erich Fischer, Switzerland]	Noted. We have decided to focus on 1.5, 2 and 4°C in the SOD, instead of 1.5, 2 and 3.
53054	5	1	10	50	The ES is well written and useful, and quite well structured with various topics separated clearly. You could consider introducing a clearer separation of past and future under the different topics; that would help the reader. E.g., page 6 line 4: past. Page 6 line 35: Future [Jan Fuglestad, Norway]	Considered. The ES is restructured such that assessments for past changes and attribution and future projection are in separate paragraphs.
38882	5	1	10	50	Please check remarks on confidence levels: It is confusing if the certainty of obvious methodological approaches is quoted in the same way as the certainty of particular scientific results. I recommend to discard the confidence levels for obvious methodological effects. I also recommend to assign methodological suggestions and results based on data to separate sub-chapters. [Uwe Ulbrich, Germany]	Noted and considered.
21380	5	1	204	1	There are some inconsistencies in the structure of the chapter across sections. For example, each subsection in section 11.3 ends with a summary paragraph in bold text, while section 11.4 does't include summary paragraphs except in subsection 11.4.4 and 11.4.5. Also, at the beginning of section 11.4 authors include an introduction paragraph about the limitations of the analysis while section 11.3 does not include any introduction to the topic. Section 11.5 starts with a general introduction to the results of the SREX report. I think the entire chapter would benefit of a uniform structure; possibly adding the introduction paragraphs in all sections, which miss it, and adding the summary paragraphs in bold text to the subsections that do not include them yet. [Gwenaëlle GREMION, Canada]	Noted. A more homogeneous format throughout the chapter was implemented for the SOD.
54118	5	3	5	11	It is suggested that an explanation be provided for who can benefit from reading this chapter and how it can add value on policy making and regional planning (in the executive summary). [Husain Najafi, Iran]	Rejected. This chapter is no different from the other chapters, it is addressed to the general readership of the AR6.
54120	5	3	5	11	It is suggested that an explanation be provided of the main results depicted in this chapter based on confidence and likelihood for main weather and extreme events (e.g. heatwaves, heavy floods, droughts) so that readers can easily find the information in the executive summary. This approach was taken in other chapters (e.g. chapter 10) as well. [Husain Najafi, Iran]	We do not fully understand this comment. The main results are highlighted with confidence and likelihood language. The reviewer maybe means to say that we could highlight specific sentences in bold face. We do this for the SOD.
21392	5	3		11	Climate always refer to past, present and future variability, as it does for extreme events. Please reference Box 11.2 Extremes in paleoclimate archives in this executive summary chapter [Gwenaëlle GREMION, Canada]	Noted. Reference to paleo-box added in the ES.

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44660	5	5	5	5	"human, managed and natural systems" corrected to "human, management and natural systems" [Liang Zhao, China]	Reject. This is not referring to impacts on management but to impacts on managed systems.
21384	5	5	5	5	Human' systems does not make sense. 'Managed' already implies human impacts and is therefore more appropriate here. I would suggest: 'their impacts on managed and natural systems.' [Gwenaelle GREMION, Canada]	Reject. "Human systems" are populations, cities, etc. This does not focus only on vegetation but also on human impacts. The important part is not the management, but that people themselves (e.g. their health, livelihood, etc) might be affected.
38878	5	5	5	6	While extremes considered are mostly regional in their occurrence, this is not a "regional chapter" [Uwe Ulbrich, Germany]	Reject. This chapter belongs to the 3 regional chapters of the AR6 WG1.
48728	5	6	5	6	Should be "4" regional chapters and include "Atlas" with 10 and 12. [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Changed the text to "Chapters 10 and 12, complemented by the Atlas".
48636	5	6	5	6	As one of the three "regional chapters" of the AR6 WG1 report (together with Chapters 10 and 12) + ATLAS [Lincoln Alves, Brazil]	Noted. Changed the text to "Chapters 10 and 12, complemented by the Atlas".
50114	5	11	5	11	Just a comment. What is the major differences between weather extreme event and climate extreme event? The current version has put all of the kinds of extreme events together and may make the different timescales of events mixing. This will not be good to help readers deeply understand the logics among different extreme events. May generally divide the events into the two basic categories, the weather and climate events. [Hong-Li Ren, China]	Noted. Background on this distinction is provided in the IPCC SREX. We have also addressed in Section 11.1 that extreme weather refers to events of weather scale while extreme climate refers to events of climate scale. On the other hand, the long-term behaviour of weather events is climate and thus long-term changes in the weather events are also changes in the climate. In this sense, it is does not make a lot sense to make a clear distinction from the assessment perspective.
28494	5	15		28	Issue: The paragraph heading is about new methods compared to AR5. The paragraph discussed new methodological developments, but did not make any comparisons to the methods at the time of AR5. Suggestion: Should include a few sentences explaining how new methods differ from old ones. Are new methods able to explain climate phenomena more clearly? [Kanoksri Sarinnapakorn, Thailand]	Noted. Due to space limitation, this aspect is removed from ES.
21386	5	17	5	17	Wrong tense, use present perfect. Replace by: "There has been several new methodological developments..." [Gwenaelle GREMION, Canada]	Accepted.
54180	5	17	5	17	"However, there were..." perhaps should read "However, there have been..." [Sarah Sparrow, United Kingdom (of Great Britain and Northern Ireland)]	Accepted.
14124	5	18	5	24	long sentence, suggest breaking up [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Noted.
43204	5	20			awkward sentence structure. Could replace 'including the' with 'and' [Rachel Taylor, Australia]	Not applicable. Text was changed and does no longer mention this text.
51404	5	21	#REF!	#REF!	I would "framing" not identify with "the attribution question being asked" [Bart Van den Hurk, Netherlands]	Noted. Changed "addressed" to "asked"
30150	5	21	5	24	As well as substantial advances in these areas there has also been substantial advance in the understanding of sub-daily precipitation and particularly its extremes since the AR5 or the SREX, including from both gauge and remote sensing observations as well as convection-permitting modelling. [Hayley Fowler, United Kingdom (of Great Britain and Northern Ireland)]	Noted
6802	5	21	5	28	This section should make mention to the growing extreme event literature based on Large Ensemble experiments. The more substantial sampling of internal variability in this type of experiments is crucial to adequately capture the magnitude and the likelihood of simulated extreme events and how they may change under warming. This type of experiments, and their advantages, have only become common place in recent years and their relevance to the study of extreme events should be made more prominent, both in this paragraph and generally throughout the chapter. [Laura Suarez-Gutierrez, Germany]	Noted and considered. It is true there is growing literature based on large ensemble experiments but analysis of changes in extremes based on these experiments are still quite limited. The available literatures are included in the assessment.
14126	5	24	5	25	are compound events and multi-variate extremes defined in the glossary? [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	We suggest having the Zscheischler definition in the glossary.
44662	5	33	5	33	"global warming has reached 1°C approximately in 2017" corrected to "global warming has reached approximately 1°C in 2017" [Liang Zhao, China]	Accepted.

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54308	5	33	5	41	Ultimately, statements about global temperatures here should be linked to findings in other AR6 chapters in preference to AR5 and SR1.5 (although that obviously wasn't practical in FOD). [Blair Trewin, Australia]	Noted. Yes, was updated for the SOD
9188	5	33	5	41	The warming of 1°C since pre-industrial is only partly human-induced, hence the first sentence needs correction; the statement of 0.5°C warming since 1950 needs checking as global HadSST data shows an increase of only 0.33°C since then. [Jim O'Brien, Ireland]	Rejected. As shown in the IPCC SR15, the 1°C of global warming is the fraction of global warming that can be attributed to human forcing. 2nd statement is also misleading: HadSST only captures warming of SST, global warming is based on warming on both land and oceans and oceans are warming more slowly.
21388	5	34	5	35	Rephrase sentence. The following is suggested: 'Studies on recently observed (i.e. past decade) extreme events provide a broad picture of ...' [Gwenaelle GREMION, Canada]	Accepted.
37926	5	34			Change "the pre-industrial period, i.e. 1850-1900" to "the early-industrial baseline (1850-1900)" to be consistent with terminology introduced in Chapter 1, Box 1.3. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Final terminology still has to be agreed for AR6. Kept as is for the time being.
43206	5	36			leave out 'or about' [Rachel Taylor, Australia]	Accepted
21390	5	37	5	38	Does not make sense. Need to restructure this sentence to: 'Lack of reliable data prior to 1950 prevented the detection and attribution of extreme changes.' [Gwenaelle GREMION, Canada]	Rejected, we think that the sentence is understandable as is.
21394	5	37		38	Add reference to Box 11.2 Extremes in paleoclimate archives [Gwenaelle GREMION, Canada]	Noted. Reference to paleo-box added in the ES.
49358	5	39	41		The end year of 2012 is unsatisfactory for an assessment that is to be published in 2021. Can a somewhat later year be used in this Executive Summary, considering that information from later years is provided in the sections of Chapter 11 themselves? [Imke Durre, United States of America]	Accepted. New analyses became available and the end year was adjusted.
53052	5	43	5	45	Please, coordinate chosen levels with ch1 and other chapters - as well as across WGs [Jan Fuglestedt, Norway]	Noted. This is the plan.
29814	5	43	5	45	If pattern scaling works (Chapter 4), there is no need for assessing the changes for various levels. You can assess the % change in the intensity or frequency per unit global mean temperature change. So the question is "Does pattern scaling work for extreme changes"? [Govindasamy Bala, India]	Rejected. There are other approaches than pattern scaling, e.g. using an "empirical" pattern scaling, in which the data is extracted at specific warming levels. A linear pattern scaling works to some extent, but this is not true for all variables.
26228	5	44	5	45	It may be more friendly to the readers to show corresponding eras of 1.5, 2, 3, and 4 degree warmings in a specific emissions scenario. [Chihiro Kodama, Japan]	Rejected, would be too detailed information. Differences are not substantial for different emissions scenarios. Some information might be included in the supp., Info to illustrate this point.
21396	5	44		47	Adapt sentence to CMIP6 if available [Gwenaelle GREMION, Canada]	Considered. SOD assessment includes new findings based on CMIP6 simulations.
48730	5	45	5	46	Suggest adding "and some CORDEX" after CMIP5 and "(and more CORDEX)" after CMIP6. [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	Noted
54116	5	51	6	1	It is suggested to add an explanation why details of emissions scenarios do not affect projected extreme events in one supportive sentence and relevant citations. [Husain Najafi, Iran]	This is highlighted in the main text and also addressed in the IPCC SR15 report.
32108	5		10		I welcome organising the assessment around extremes for global warming levels. In some cases (e.g. extreme hot daytime temperatures) quantification is excellent; in others (e.g. projected trends in heavy precipitation) it is essential to add quantification of the changes. [Rowan Sutton, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Have revised assessment to better provide quantification of changes.
48008	5		11		Exec Summary is quite long and in an incorrect format (please stick to 2 IPCC pages - 950 words per page). Additionally, please add an introductory paragraph explaining the purpose of the chapter (see SR1.5 for guidance) and please start every paragraph with a bolded sentence that give the main point, which is then followed by further details. Could the regional statement be systematically structured in some way? [WGI TSU, France]	This is considered. We have carefully edited the Exec Summary.
21408	6	1		1	Remove '(high confidence)', repetition in this sentence [Gwenaelle GREMION, Canada]	Accepted.
46298	6	3	11	55	There were not any indices to identify warm and cold days, heavy precipitations and drought as well as in various places of the world [sadegh zeyaayan, Iran]	Noted. Do not understand comment

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
46300	6	3	11	55	this report involves invaluable information about changes occurred about trend of extremes through the world, but from my point of view this report emphasises only on certain places of the world.it is advisable to cover the findings from a vast variety of climates of the world,therefore it needs to be comprehensive [sadeqh zeyaeyan, Iran]	Rejected. The chapter already covers a very large fraction of land areas and includes much more regional material compared to the SREX or AR5. But we have included further regional literature in the SOD.
57574	6	3	11	55	There were not any indices to identify warm and cold days , heavy precipitations and drought as well as in various places of the world [Sahar Tajbakhsh Mosalman, Iran]	Noted. Do not understand comment
57576	6	3	11	55	this report involves invaluable information about changes occurred about trend of extremes through the world, but from my point of view this report emphasises only on certain places of the world.it is advisable to cover the findings from a vast variety of climates of the world,therefore it needs to be comprehensive [Sahar Tajbakhsh Mosalman, Iran]	Rejected. The chapter already covers a very large fraction of land areas and includes much more regional material compared to the SREX or AR5. But we have included further regional literature in the SOD.
21404	6	5	6	6	"It is virtually certain". I think it is better to merge both lines in a single sentence. [Gwenaelle GREMION, Canada]	Accepted.
54452	6	5	6	8	It would be good to specify over what period the observed trend have been assessed [Erich Fischer, Switzerland]	Rejected. This is indicated earlier in the text.
29816	6	5	6	9	Is there a systematic meridional dependence for the intensity and frequency? For instance, do we see more in high latitudes than in the low latitudes? [Govindasamy Bala, India]	Noted. For intensity yes (i.e. highest increase in cold extremes in high latitudes, highest increase in hot extremes in mid-latitudes). For frequency also (highest increase in number of hot days in the tropics. Highlighted this more clearly for the SOD.
49360	6	5	7		Although a time period is mentioned earlier in the Executive Summary, these statements about recent changes lack a reference to the time period to which they apply (e.g., since the middle of the 20th century). The same applies on page 11-7, line 4, elsewhere in the executive summary, as well as in the summary paragraph of Section 11.3.3, where it is less clear which time period applies. [Imke Durre, United States of America]	Rejected. The reference time period is as indicated in the introduction (i.e. since 1950 and generally up to 2012 or more recent).
46398	6	6			availability [sadeqh zeyaeyan, Iran]	Reject. This is not a typo ("ability" is the term meant there).
57674	6	6			availability [Sahar Tajbakhsh Mosalman, Iran]	Reject. This is not a typo ("ability" is the term meant there).
14004	6	6			availability [saeedeh Kouzegaran, Iran]	Rejected. This is not a typo ("ability" is the term meant there).
37928	6	7			The second occurrence of "in the" in this line should be deleted. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	accepted
27432	6	8	6	9	In the sentence "These changes are identified in most land regions but in some regions, in particular in Africa, there is less certainty regarding these changes due to lack of data availability (high confidence)", it is important to relativize by specifying the regions/parts with clear lack of data. Otherwise the observed trends in temperature extremes may be questioned everywhere in the continent which is unfounded (clear trends are detected in many regions) [Fatima Driouech, Morocco]	Accepted. Reworded as "in parts of Africa"
48638	6	8	6	9	same in South America [Lincoln Alves, Brazil]	Rejected. Signals are also clear in South America.
27458	6	9	6	9	Please correct "availability" [Fatima Driouech, Morocco]	Corrected.
50070	6	9	6	9	I would say "...less certainty regarding THE MAGNITUDE OF these changes...". There is less doubt regarding the sign of these changes, especially for the maximum temperature [ARONA DIEDHIOU, Cote d'Ivoire]	Noted. However, we also meant sign here, as there is no data it is not possible to have a clear assessment.
31502	6	10			A reference to the Arctic box could be made here. [Rein Haarsma, Netherlands]	Rejected. Too detailed for a mention at this level of the ES (but the box is mentioned later in the ES)
44664	6	11	6	11	"the sign of the observed recent changes" corrected to "the sign of the observed recently changes" [Liang Zhao, China]	Rejected. Proposed revision would not change meaning of text and would not improve it.
52718	6	11	6	18	These statements are very uninformative. Please rewrite in a way that they become user relevant. For background, see the recent paper Shepherd, Phil Trans Roy Soc, 2019. [Douglas Maraun, Austria]	Not applicable. Text has been shortened and has been substantially revised.
54454	6	12	6	13	This statement is unclear. It raises questions about the representation of extremes but remains vague. [Erich Fischer, Switzerland]	Not applicable. Text has been shortened and has been substantially revised.
27020	6	13	6	13	what do you mean by some please clarify [Mansour Almazroui, Saudi Arabia]	Not applicable. Text was changed and does no longer mention this wording.
21410	6	14		16	Adapt sentence to CMIP6 if available [Gwenaelle GREMION, Canada]	Accepted. Updated for SOD

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21412	6	16		18	Any consistent approach and standardization of these parameters or tune to best fit? [Gwenaelle GREMION, Canada]	Noted. Clarified for SOD.
46400	6	17			depend [sadeh zeyaayan, Iran]	This is not a typo. The subject of this verb is singular ("ability")
57676	6	17			depend [Sahar Tajbakhsh Mosalman, Iran]	This is not a typo. The subject of this verb is singular ("ability")
14006	6	17			depend [saeedeh Kouzegaran, Iran]	This is not a typo. The subject of this verb is singular ("ability")
44666	6	18	6	18	"the way indices" corrected to "the way of indices" [Liang Zhao, China]	Rejected. Suggested change is not correct English.
26738	6	20	6	22	I think we can increase our confidence in this case to virtually certain. [Thorsten Mauritsen, Sweden]	Considered. The assessment language has been recalibrated with additional evidence. It is also reformulated slightly. Instead of saying "contributed to...", it is stated as "main contributor".
21414	6	20		22	The formulation and/or is misleading. Does it mean: very likely contribution to increased increased likelihood, very likely contribution to increased severity? Or does it mean: very likely contribution to increase likelihood AND severity, and very likely contribution to increased likelihood OR severity. Same comment for hot and cold extremes. I would suggest using a likelihood scale term for each component of these extremes; one for the increases in the likelihood, and one for the increases in the severity [Gwenaelle GREMION, Canada]	Rejected. This would be too detailed information. The ES was already too long, cannot provide this level of detail. But chapter text includes more distinction.
52982	6	23	6	23	in contrary needs reworded [Lisa Alexander, Australia]	Rejected. Wording seems suitable.
51406	6	24	#REF!	#REF!	Not only regional variability and forcings, but also regional feedbacks play a role here [Bart Van den Hurk, Netherlands]	Accepted.
55762	6	26	6	27	"There is also medium confidence that land cover changes have affected changes in hot extremes over the course of the 20th century." -> how is medium confidence determined in this case? I would argue that the field or "urban climate" has extensively examined and proven that land use/land cover change leads to urban heating (on top of the climate change signal). It looks like page 18, line 18 ranks this as "high confidence". [Ariane Middel, United States of America]	Noted. What is meant here is more general and also of larger scale than urban climate. There is specific wording in the SOD's ES about effect of urbanization in cities (high confidence).
21416	6	26		27	Please specify whether the medium confidence in land cover change effect on hot extremes is for global or regional scale [Gwenaelle GREMION, Canada]	Noted. We added "mostly on regional scale" to this sentence. Some effects are global, but the main effects are regional.
26740	6	27	6	28	Since this statement lacks a sign of the change, and is unspecific of region, the confidence statement is rather meaningless. [Thorsten Mauritsen, Sweden]	Noted. We provided a more quantitative assessment for SOD.
26984	6	28	6	33	This reads different from the corresponding text in Chapter 10, where there is more detail and more confidence expressed in the text. Please check and make sure the weighing of the underlying literature is identical in both chapters. [Joachim Rock, Germany]	Noted. This is not relevant anymore as the ES is shortened and does not contain this statement.
29818	6	35	6	38	The earlier discussion shows that the frequency and intensity have already increased. Then, why to say they will increase only if the warming exceeds 1.5 deg C? [Govindasamy Bala, India]	Accepted. Text reworded accordingly.
27022	6	35	6	52	the arid land constitute one third of the land surface however it is not mentioned in the executive summary, this is a bit strange. Please add an assessment for the air land. [Mansour Almazroui, Saudi Arabia]	Rejected. It was decided to assess by continents and AR6 regions rather than by types of climate.
21398	6	36	6	37	Remove article 'the' in 'global and continental scales' [Gwenaelle GREMION, Canada]	Accepted.
21418	6	38		39	The formulation and/or is misleading. Does it mean: virtually certain that frequency of heat waves will increase and virtually certain that the intensity of heat waves will increase. Or does it mean: virtually certain frequency or intensity of heat waves will increase? I suggest using a likelihood scale term for each component and/or: one for "the increase of length, frequency AND intensity", and one for "the increase of length, frequency, OR intensity". Because more intense does not mean more frequent. [Gwenaelle GREMION, Canada]	Considered. The ES is heavily edited and does not contain "and/or" wording.
37930	6	38			Change "preindustrial values" to either the "pre-industrial baseline" or "the early-industrial baseline" depending on whether the reference is 1750 or 1850-1900, for consistency with Chapter 1 terminology. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Final terminology still has to be agreed for AR6. Kept as is for the time being.
29820	6	42	6	43	I do not think that the statement "All of these changes would become increasingly larger for each increment of 0.5°C of warming (high confidence)" is needed. It looks as if the changes happen in steps. I suggest removing this sentence. [Govindasamy Bala, India]	Noted. Has been clarified in text

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
21400	6	43	6	44	Temperature extremes warm' does not make sense. Re-order sentence as follows: 'There is high confidence that the intensity of warm events associated with temperature extremes on land is larger than the increase in global mean temperature' [Gwenaelle GREMION, Canada]	Noted. Reworded text to address highlighted issue.
21406	6	43	6	46	"There is a high confidence". Sentence seems to be not clear. Consider rephrasing [Gwenaelle GREMION, Canada]	Noted. Text revised.
21420	6	43		44	What does 'warm more strongly' mean? Please refine to other terms such as: faster, more intensively, or increasing trend in temperature extremes on land is higher than the trend in global mean temperature [Gwenaelle GREMION, Canada]	Noted. It means that the warming is larger for extremes than mean temperatures in many cases. We don't feel that a rewording is necessary here.
54456	6	44	6	46	Over what range does this factor of 2 with respect to global mean temperature hold? Is there really enough independent evidence for medium confidence here? Observational constraints and D&A literature suggests that models may be overestimating this amplification [Erich Fischer, Switzerland]	Noted. Clarified for SOD.
21402	6	45	6	45	Replace 'up to twice larger than' by: 'twice as high as that of' [Gwenaelle GREMION, Canada]	Rejected. Previous wording was not found problematic by other reviewers.
43208	6	45			suggest replacing 'larger than' with 'the magnitude of' [Rachel Taylor, Australia]	Accepted
54458	6	47	6	49	Again, do we have that much confidence in our models that they get this amplification correct. Model evaluation of trends suggests that some model are substantially off even if internal variability is taken into account. [Erich Fischer, Switzerland]	Noted. Clarified for SOD.
54460	6	49	6	51	I agree with this statement and I would also argue that there is evidence that they are linear. But do we really have "high confidence" in this statement. In my opinion that would require more than simple model evidence. [Erich Fischer, Switzerland]	Noted. Have clarified in the text that this is based on model projections.
51408	6	51	#REF!	52	it is not clear what is meant with "thresholds": "cold days or warm days" is not particularly descriptive. Do you mean relative or absolute thresholds? The non-linearity statement is an important wone, so it is good to have a precise understanding of what it is that responds non-linearly [Bart Van den Hurk, Netherlands]	Noted, example provided in parenthesis (e.g. 90th percentile in late 20th century conditions)
54122	7	1	7	28	I suggested that an explanation of a definition of heavy precipitation be provided and included in this part. [Husain Najafi, Iran]	Accepted. Included two new sentences at beginning of summary assessment: "'Heavy precipitation' refers to intense precipitation above pre-defined thresholds or given high percentiles (e.g. 90th percentile). Most of the available studies on changes in heavy precipitation have focused on long-term changes (trends) in the annual maximum -day or 5-day precipitation"
7630	7	1	7	28	Heavy precipitation should be divided into heavy rainfall in the warm season and snowfall in the cold season [Guoping Li, China]	Rejected. Would be too detailed for ES given space constraints. This is also limited by availability of literatures.
44150	7	1	7	55	"Heavy precipitation' has been mentioned as an extreme event. Please define what explains precipitation as 'heavy' for instance by adding the sentence from 11.4 , page 37, line 20-21, "Most of the available studies have focused on long-term changes (trends) in the annual maximum -day or 5-day precipitation". [Dorcas Kalele, Kenya]	Noted. Have included a clarification on this point.
27024	7	3	7	3	please clarify the meaning of adequate observations [Mansour Almazroui, Saudi Arabia]	Rejected, would be too detailed for ES text (is already too long). This is explained in the chapter text.
54462	7	3	7	4	A period over which this statement is valid should be added [Erich Fischer, Switzerland]	Rejected, would be too detailed for ES text (is already too long). This is explained in the chapter text.
30152	7	3	7	13	I think you could split this out more to talk about persistent extremes (5 day and longer heavy precip), and also shorter than daily extremes. I think we are more confident about changes to daily extremes but studies are now being down which examine changes to persistent extremes (e.g. by Lisa Alexander) and to review the state of the art in terms of changes to short duration extremes (e.g. see the State of the Climate report in 2018) [Hayley Fowler, United Kingdom (of Great Britain and Northern Ireland)]	Agreed. A separate section on other durations (5-day and sub-daily) was added to the underlying text in 11.4
52986	7	3	7	13	I think the confidence statement depends on the time and space scales we're talking about. I'm guessing 'high confidence' refers mainly to daily timescales? It might be better to qualify what you mean here by heavy precipitation as the scales are important. [Lisa Alexander, Australia]	Agreed. The text was modified to be more precise.
14128	7	3			how heavy is extreme precipitation? e.g. Pendergrass (2018) Science [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The article is mentioned in the main text but not clear how relevant it would be for executive summary.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
51410	7	4	#REF!	#REF!	I would add "and its observational accuracy" after "variability of precipitation" [Bart Van den Hurk, Netherlands]	Accepted
16076	7	8	7	11	Increase in frequency and/or intensity of heavy rainfall is also observed in southern China. See Fig. 2.33 of IPCC WGI AR5 (Ch.2, P.215). [SAI MING LEE, China]	Noted. Text changed to "most parts of Asia".
21422	7	8		11	The formulation and/or is misleading. It is necessary that frequency and intensity should be distinguished, and with it the degree of confidence. What does a High confidence in the increase in frequency and/or intensity of heavy rainfall mean? Does it become more frequent and more intense, only more frequent or only more intense? What is the confidence level for each of these three aspects for the regions mentioned in this sentence? [Gwenaelle GREMION, Canada]	Considered. The ES is heavily edited and does not contain "and/or" wording.
26230	7	9	7	9	"central Asia, most of South Asia" should be replaced with "most parts of Asia", as stated in Page 78, Line 2. [Chihiro Kodama, Japan]	Accepted
56444	7	11	7	12	change to "Central Europe, Italy and eastern Mediterranean region" (see later why) [Pierluigi Claps, Italy]	Noted, but do generally not highlight single countries in the text.
27462	7	13	7	13	Would it be possible to list the regions with decrease concerned by this sentence "A few regions show medium confidence in decreases in heavy precipitation". Such information would be much appreciated as the larger percentage is for increases [Fatima Driouech, Morocco]	Considered. This is described in the main text but space is limited here in ES to add more material.
27436	7	13			Would it be possible to list the regions with decrease concerned by this sentence "A few regions show medium confidence in decreases in heavy precipitation". Such information would be much appreciated as the larger percentage is for increases [Fatima Driouech, Morocco]	Noted. Seems too detailed given space constraints
52988	7	15	7	20	Similarly to my above comment I think it needs to be clear what exactly you mean by 'intensification of heavy precipitation' and on what what timescales. If we have few observations (e.g. on sub-daily timescales) then can we have high confidence in an anthropogenic influence? [Lisa Alexander, Australia]	Noted. Have clarified that the assessment provided is for daily extremes
30154	7	16	7	17	Thermodynamic processes are the dominant driver for this response, but 17 dynamic processes are also relevant (high confidence) [Hayley Fowler, United Kingdom (of Great Britain and Northern Ireland)]	This is a repetition of the text, review comment seems to be missing.
30156	7	16	7	17	"Thermodynamic processes are the dominant driver for this response, but dynamic processes are also relevant (high confidence)". I think that is right - thermodynamics controls the intensity response and dynamics control the frequency. There is also evidence that these mechanisms combine to produce larger than expected increases in extremes in some regions (and particularly for short duration extremes - see Lenderink and Fowler 2017 NCC for short review) [Hayley Fowler, United Kingdom (of Great Britain and Northern Ireland)]	Noted. This is reflected in the underlying sections 11.4/11.7
14130	7	17			improved understanding is rather vague and this sentence could be removed since the next sentence seems adequate and more precise [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The new ES is shortened and does not contain this sentence.
26742	7	18	7	20	I don't think it is right to put a confidence statement on a development of a set of tools. There are also many other issues with models that have little to do with resolution. [Thorsten Mauritsen, Sweden]	Accepted. Confidence assessments removed.
14132	7	22			A higher than likely certainty could be ascribed for intensification of heavy precipitation events (e.g. meteorologically defined) compared to increases in heavy precipitation (which can span different types of meteorological events) [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Considered. The relevant ES statement is heavily edited. In SOD, it is stated that "over almost all land regions, it is very likely ...".
29822	7	23	7	24	The sentence can terminate at "global warming". It is not that the heavy precipitation increases for 1.5 deg and beyond. They have already increased and will continue to increase. [Govindasamy Bala, India]	Noted. Changed the text to "with higher global warming, even with a stabilization at 1.5°C"
44668	7	24	7	24	"available" corrected to "availably" [Liang Zhao, China]	Rejected. Suggested correction would not be correct English
54464	7	25	7	25	I suggest to also assess the pattern of future intensification in heavy precipitation here. I think there has been a lot of progress since AR5 [Erich Fischer, Switzerland]	Noted. This is now assessed in the main text but the ES is shortened.
43362	7	27	7	28	Replace "produce yet more precipitation" with "becomes even heavier" [James Renwick, New Zealand]	Accepted.
43210	7	27	7	28	suggest 'There is medium to high confidence that precipitation associated with tropical cyclones will increase' [Rachel Taylor, Australia]	Accepted. Text changed to "There is medium-to-high confidence that precipitation associated with tropical cyclones will increase under global warming."
26232	7	28	7	28	Please consider adding "It is very likely that the precipitation associated with extratropical cyclones will increase in the future through thermodynamic factor". [Chihiro Kodama, Japan]	Accepted. We have added a statement about future changes in precipitation associated with ETCs.
44154	7	29			Please add a remark on hail and thunderstorms in the Executive Summary , quoting a part from page 72, line 34-35: 'There is low to medium confidence that hail, tornados, and thunderstorms are more frequent and have intensified'. Rationale: the impacts of hail on especially agriculture can be huge, therefore a remark would be critical in an Executive Summary' [Dorcas Kalele, Kenya]	Noted and considered. The assessment in 11.7.5 was revised and ES updated to reflect that.

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48732	7	30	7	30	Just a question, is it appropriate to include material on flooding/water logging as I thought it had been agreed that WG I was focusing only on weather and climate hazards and not on physical system impacts of these (though I agree that the following paragraph includes important contextual information - in which case maybe it is relevant in Ch 12)? [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. Topic is here focusing on physical aspects. Limits of assessment are considered
54124	7	30	7	42	It is suggested that some studies which analyzes floods attributed mostly to climate change are provided as illuetaration. [Husain Najafi, Iran]	Rejected. This is done in the main section on this topic (Section 11.5). Mot enough space to discuss this in detail in the ES.
48640	7	30	8	32	It would be better moved to the Chapter 12 - Hazard [Lincoln Alves, Brazil]	Rejected. Follwoing a discussion with chapter 12, there was an agreement that physical aspects related to floods and droughts need to be addressed in chapter 11.
56446	7	33	7	33	add "snow accumulation and melting" [Pierluigi Claps, Italy]	Accepted
50072	7	33	7	33	"Other factors include..." increasing length of wet spells, not necessarily "heavy rainfall" only. [ARONA DIEDHIOU, Cote d'Ivoire]	Accepted
50074	7	33	7	33	"antecedent soil moisture" or "soil water content" ? [ARONA DIEDHIOU, Cote d'Ivoire]	Noted. The two formulations are equivalent, did not change the text
14134	7	41			"at the global scale" [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	accepted
30110	7	42	7	42	A reference to Fig. 11.5 is made but this figure (about temperature) is not related to the topic (floods). [Bruno Wilhelm, France]	Rejected. The reference is not to Fig. 11.5 but to section 11.5
54126	7	44	8	33	It is suggested that some studies which analyzes droughts attributed mostly to climate change are provided as illuetaration. [Husain Najafi, Iran]	Rejected. Not enough space to provide more detail. But such information is available in the main text of the chapter.
54128	7	44	8	33	It is suggested that a discussion be provided for in which spatiotemporal scales, droughts can be studied in the context of detection and attributions and impact studies. [Husain Najafi, Iran]	Noted. This topic is too detailed for the ES.
26744	7	46	7	47	No reason to put a confidence statement here. [Thorsten Mauritsen, Sweden]	Accepted
38880	7	47	7	47	Referring to general remark on Chapter 11, page 5-10: Please check remarks on confidence levels: It is confusing if the certainty of obvious methodological approaches is quoted in the same way as the certainty of particular scientific results. The sentence referenced here is a particularly clear example of the problem. [Uwe Ulbrich, Germany]	Accepted. Removed assessment of confidence here.
9436	7	52	7	52	It is sugested to enhance clarity by substituting the term "drought measures" by "drought parameters". [Klaus Radunsky Radunsky, Austria]	Rejected. "Drought parameter" would not be clearer, this would be understood as parameters that affect drought
26746	7	53	7	54	No reason to put a confidence statement here. [Thorsten Mauritsen, Sweden]	Accepted
9438	8	1	8	2	dynamic process: Process structure and parameters can change at each time; thermodynamic process: a passage of a thermodynamic system from an initial to a final state of thermodynamic equilibrium. It is suggested to include such explanation, e.g. as a footnote. [Klaus Radunsky Radunsky, Austria]	Noted. There is a box on thermodynamic vs dynamic processes. A reference to this box was added to the ES
26748	8	1	8	21	This paragraph seems rather detailed and somewhat cryptic. [Thorsten Mauritsen, Sweden]	Accepted. Reworded and restructured to clarify assessment.
54466	8	2	8	5	The previous paragraph emphasizes that it is essential to differentiate between drought definitions but this statements uses drought as a generic term. Are you suggesting that the statement applies to all definitions? It may not be obvious how thermodynamic effects affect meteorological and hydrological drought. [Erich Fischer, Switzerland]	Accepted. For the SOD, the drought assessment was provided separately for different types of droughts
52720	8	4			Not only occurrence, but also the length of drought. [Douglas Maraun, Austria]	Accepted. Assessment of drought severity, frequency and duration has been included in the SOD.
55926	8	8	5	7	Not clear enough, should be better explained. [Olga Zolina, France]	The page/line numbers are not clear in the entry of the reviewer (end page/line is before start page/line)
54468	8	10	8	12	Sentence is not clear. I confused what drought definition it applies to. Is this whole paragraph about observed trends or the drought response to enhanced GHG concentrations in past and future? [Erich Fischer, Switzerland]	Accepted. Text has been updated to fully separate observed, attributed and projected trends, and to also distinguish changes affecting different types of droughts.
29824	8	15	8	19	The consensus on precip change is "wet areas become wetter and dry areas become drier" This implies that the subtropical regions such as the Mediterranean, Southern Africa, Southern North Americ, etcwould see more incidence of droughts. I would prescribe a high confidence here. [Govindasamy Bala, India]	Rejected. This summary statement is a misunderstanding, because semi-arid areas are not dry but have a transitional climate regime. In addition, some humid regions (e.g. Central Europe) are projected to become drier.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
27026	8	23	8	32	please add an assessment of the drought characteristic in the Central Asia arid land, scientific papers are emerging now in the literature [Mansour Almazroui, Saudi Arabia]	Rejected. Cannot provide very detailed regional assessments. But was considered in underlying chapter
54470	8	27	8	30	Why is this projected drought assessment restricted to low warming levels? Is part of the low level of confidence a result of the high role of internal variability at low levels of warming. [Erich Fischer, Switzerland]	Accepted. Higher warming levels were considered in SOD assessment.
21424	8	38	8	38	Replace 'reduce confidence in their fidelity.' by: 'limit reaching confident predictions.' [Gwenaelle GREMION, Canada]	Noted. The ES is heavily edited and does not contain similar wording.
26750	8	38	8	40	First, this statement is vague. Second, I think there is controversy towards the aerosol theory alluded to here. I suppose the idea is that reduced aerosols over the North Atlantic region leads to warmer SSTs and hence more TCs. Though the rapid SST warming may well also be associated with either internal variability (AMO) or ocean current changes altering the SST patterns. [Thorsten Mauritsen, Sweden]	Rejected. We don't feel that the statement is vague. The assessment of the literature that provides medium confidence is found below in the body of the chapter. There is indeed controversy, but this is regarding relative contribution of aerosol forcing to observed variability (which incorporates internal variability, etc); virtually all of the papers implicate at least some contribution from aerosols. This is what our statement is based on and it is consistent with previous assessment reports (e.g. the recent WMO report).
43908	8	44	8	46	Suggest the following rewording: "There is medium-to-high confidence that global tropical cyclone precipitation rates will increase; the median projected increase is about 7% per degree Celsius global warming implying an increase at roughly the rate at which atmospheric water vapor in tropics is projected to increase (i.e., Clausius-Clapeyron scaling). There is medium-to-high confidence that average peak TC wind speeds will increase..." [Thomas Knutson, United States of America]	Accepted.
43820	8	44	8	50	An example of extreme precipitation increase does not follow to C.C. relation, see Kawase et al (2019) (Contribution of Historical Global Warming to Local-Scale Heavy Precipitation in Western Japan Estimated by Large Ensemble High-Resolution Simulations : H. Kawase Y. Imada H. Sasaki T. Nakaegawa A. Murata M. Nosaka I. Takayabu First published: 29 May 2019 https://doi.org/10.1029/2018JD030155). Here the mountains brought about some difference in precip. change, locally. [Izuru Takayabu, Japan]	Noted, thank you. This is an interesting paper and result, but it is fairly specific and the forcing mechanism isn't climate-dependent (topographic forcing). Since this doesn't change the assessment and we're not trying to perform a literature review, we prefer to not include this.
43822	8	44	8	50	"tropical cycloe transition speed may be slowing": We have a research discussing on the slow-down midlatitude TC, which induces a long lasting heavy rainfall, causes a severe disaster in Japan. It appears in Kanada et al, (2017) (doi:10.2151/sola.2017-045). [Izuru Takayabu, Japan]	Noted, thank you. Since this text is about tropical cyclones, we feel that it would be out of place to cite a paper on mid-latitude cyclones here.
16078	8	44	9	2	The statement "there is high confidence that sea level rise will lead to higher risk due to extreme coastal water levels combined with storm surge due to TCs" should be included as appropriate. [SAI MING LEE, China]	Accepted. Text added.
54472	8	45	8	45	Is this per degree global or local warming? [Erich Fischer, Switzerland]	Global, as it pertains to global TC statistics.
29826	8	46	8	46	Why to specify a threshold of 1.5 deg here? As written, it suggests that the increase occurs suddenly at 1.5 deg warming. [Govindasamy Bala, India]	This text has been deleted and replaced.
15604	8	48	8	48	In addition to the structural changes, the circulation change, especially around the convergence area, can enhance precipitation rate beyond the CC. Most typical example is the orographic precipitation induced by tropical cyclones which exceeds CC . [Tomonori Sato, Japan]	We have added a statement about increased moisture convergence due to increased intensity (we can cite Knutson et al. 2015 and another recent paper to support this). No reference provided here to support changes in orographic lifting.
9440	8	49	8	49	It is suggested to substitute "translation speed" by the term "translational speed". A cyclone does not translate anything but moves along a pathway. [Klaus Radunsky Radunsky, Austria]	Translation is correct and appropriate. Rotation and translation: "A rotation is the turning of an object around a fixed point. And a translation is a scenario where every point in an object is moved the exact same distance and in the same exact direction, without being rotated."
43910	8	52	8	52	Suggest to delete beginning phrase: "Larger intensity changes are projected in stronger storms and..." I'm not sure what the basis is for this statement. There is no confidence level assigned to it. Larger than what? [Thomas Knutson, United States of America]	Accepted.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
21426	8	54	8	54	"There is low confidence Tropical cyclone". There is a recent paper on the volcanic activity impacts on the tropical cyclone (https://www.nature.com/articles/s41612-019-0070-z). This can be considered as a potential reference in the report. [Gwenaëlle GREMION, Canada]	Noted, thank you. Since our mandate is to address links to climate change, this paper is not highly relevant.
43912	8	55	8	55	Suggest rewording to "Most projections identify a reduction averaging about 6% per degree Celsius, but..." [Thomas Knutson, United States of America]	Accepted. Modified to "Most projections identify an average reduction of about 6% per degree Celsius, but..."
26836	8				A section on extra-tropical cyclones could be added to the executive summary. [Ruth McDonald, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. We have added a summary on the new section about Midlatitude storms that merges ETCs and ARs in the Executive Summary of the SOD.
43914	9	1	9	2	Suggest deleting the sentence "There is low confidence in projections of changes in tropical cyclones in individual ocean basins." This conflicts with p. 11-62, line 16. If you are going to make a statement on this topic, I suggest using the one on p. 11-62, line 16. [Thomas Knutson, United States of America]	Accepted. Sentence deleted during modification of this section.
26234	9	3	9	3	I suggest to add summary of extratropical cyclone here. [Chihiro Kodama, Japan]	Accepted. We have added a summary on the new section about Midlatitude storms that merges ETCs and ARs in the Executive Summary of the SOD.
50632	9	6	9	6	sever events --> severe weather [Olivia Martius, Switzerland]	Rejected, could not find this typo in the text.
44156	9	7	9	10	These two sentences are not accurate. It's unclear what is meant by these lists of items being "viewed with new perspectives" Also, the definition of severe convective storms doesn't depend strongly on the literature. Most readers will understand the definition of severe convective storms as one that produces hail, lightning, tornadoes, heavy rain, or strong convective winds. [David Schultz, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Texts are modified to avoid confusion.
44160	9	10	9	10	Elsewhere in the report (p. 11-59, 11-98), it says that past and future trends in tornadoes are low confidence. [David Schultz, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The sentence here is changed to be more specific: "Observation shows that there is medium confidence that tornado activity has increased in the United States over the 2000s with a decrease in the number of days per year when tornadoes are observed."
29828	9	10	9	13	Heavy precipitation is associated with convection. The increase in the intensity of extreme precipitation should suggest an increase in the intensity of convection. Can you assign a high confidence? [Govindasamy Bala, India]	Taken into account. The text was changed as "It is very likely that extreme precipitation associated with severe convective storms has increased".
26752	9	11			What kind of intensification? If precipitation, then it seems at odds with earlier statements. [Thorsten Mauritsen, Sweden]	Noted. This sentence is modified and are more specific.
39068	9	12	9	13	The statement on low confidence appears to be conflict (at least for heavy precipitation) with the statements on Chapter 8, page 32, lines 4 and further [Lenderink Geert, Netherlands]	Taken into account
46148	9	15			Please, although discussed later in the chapter, expand this paragraph, adding some examples of both: compound events and of their impacts. [Marina Baldi, Italy]	Considered but we don't have space in ES to provide examples.
46150	9	17			Please, details why compound events are "very relevant for impacts". [Marina Baldi, Italy]	Considered but we don't have space in ES to provide details.
39070	9	18	9	18	I disagree with high confidence here because statistics of compound events are usually more difficult (and more influence by natural variability) than those of single statistics. [Lenderink Geert, Netherlands]	Rejected - the 'high confidence' in this statement refers to the extreme impacts of the events.
26756	9	18	9	21	This statement is unspecific as to what types on compound events are meant, thus the confidence statement is rather meaningless. [Thorsten Mauritsen, Sweden]	Accepted - wording changed to clarify what specific compound events are determined with high confidence
26754	9	18			No reason to put a confidence statement here. [Thorsten Mauritsen, Sweden]	Agreed, the first occurrence of "confidence" is removed.
52722	9	18			First confidence statement in that line: isn't that bluntly obvious? Do we need a confidence statement? [Douglas Maraun, Austria]	Agreed, the first occurrence of "confidence" is removed.
15606	9	19	9	19	It would be nice if the author can add the other examples, such as those related with precipitation extremes. Intense tropical/extratropical cyclone and enhanced precipitation amount (and therefore, more river discharge) collaboratively raise the sea level along the coastal regions. [Tomonori Sato, Japan]	Accepted - further details added about compound flooding in coastal regions.
38884	9	19	9	21	This is not a good example for a compound event, as heat and drought are directly physically connected (to a certain degree). Please choose an example of compound events in which the factors are largely independent from each other. [Uwe Ulbrich, Germany]	Rejected - Although they are physically connected in some ways, these are still compound events as defined within the assessed literature and within the report.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
52992	9	23	10	27	This section is very uneven in terms of content for each continent. Europe only gets 5 lines when this is one of the regions that has been most heavily studied. I recommend that you use a more even handed template for summarising each continent so it's much easier to make a comparison of the different regional changes. Also it would be good to have some indication how confidence language has changed compared to AR5 (if at all). [Lisa Alexander, Australia]	Noted: We wrote more about Europe in this paragraph.
48734	9	23	10	27	There is potential or actual overlap with findings presented here and in Ch 12 and the Atlas which should be addressed in the SOD. [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	Accepted: The references on extremes from Atlas and Chapter 12 were moved to Chapter 11.
54474	9	23	10	27	The summary for the regional changes in extremes lack information on what SSP they apply to. I am not sure whether all the statements with "very likely" also apply to and SSP1-1.9 if internal variability is taken into account. [Erich Fischer, Switzerland]	Rejected: We are not using SSPs.
54130	9	23	10	28	The title referred to regional changes but the explanations are provided at continental scale. A definition of region is provided in chapter 10. It is suggested that this part is revised based on definition of regional studies in other chapters for consistency. [Husain Najafi, Iran]	Rejected: Inside each continent we are describing regional climate change in land regions as defined in Figure 1.16a. See Section 1.5.2.2 (Types of regions used in AR6). See also AR6 WGI land/ocean reference regions (Figure Atlas.2 b)
9446	9	23	10	50	Please, include references to the relevant subchapter of the main report. [Klaus Radunsky Radunsky, Austria]	Rejected: We decided to let references inside the Tables (11.3-11.8).
53858	9	25	9	27	This seems to be in contradiction with what is written in the Atlas p. 29 lines 13-18. [Erin Coughlan de Perez, United States of America]	Rejected: Atlas p. 29 (lines 13-18) is reporting what was written at SR15 and AR5: For East Africa the seasonal mean temperature is increasing. In Chapter 11 (page 9 - lines 25-27) the text is about heat waves which have increased over Africa except Central and East Africa.
43824	9	25	9	34	It is mainly focused to Ts, Precip., and dryness. How about many other items, for example Wind, RH, or Sunshine? Does we have not enough accuracy to predict such items? [Izuru Takayabu, Japan]	Rejected: Specially over Africa the lack of long series of reliable meteorological data is a major challenge to detect climate change in other variables.
9442	9	31	9	33	This sentence is rather convoluted and should be reformulated in order to add clarity. E.g.: With respect to dryness, there is medium confidence in increase of Consecutive Dry Days (CDD) over South Africa and a decrease of CDD over West Africa. [Klaus Radunsky Radunsky, Austria]	Accepted: a text revision has been carried out
50076	9	34	9	34	"except in the SAHARA...". "Sahara and Central Sahe!" I would say. [ARONA DIEDHIOU, Cote d'Ivoire]	Not applicable. Text was changed
53860	9	36	9	37	What about the influence of aerosols? Perhaps worth mentioning in this section [Erin Coughlan de Perez, United States of America]	Noted. But it is unclear what this comment is meant for as the page/line numbers do not correspond to any section. In any case, the ES is heavily edited.
9990	9	37	9	37	Authors should definitely refer to the recent HIMAP assessment report -Krishnan R. et al. (2019) Unravelling Climate Change in the Hindu Kush Himalaya: Rapid Warming in the Mountains and Increasing Extremes. In: Wester P., Mishra A., Mukherji A., Shrestha A. (eds) The Hindu Kush Himalaya Assessment. Springer, Cham - see https://link.springer.com/chapter/10.1007/978-3-319-92288-1_3 [Valerio Lucarini, United Kingdom (of Great Britain and Northern Ireland)]	Accepted: The literature has been added in the SOD.
21428	9	37	9	37	most part of Asian continent' sounds odd and lacks an article. Suggested change: 'most parts of Asia' [Gwenaelle GREMION, Canada]	Accepted: text revised
21430	9	38	9	38	Repetition if agreeing with the above comment. Therefore, I suggest replacing 'Asia' by 'the continent' [Gwenaelle GREMION, Canada]	Accepted
44580	9	38	9	41	"However there is medium confidence Northeast China". This sentence seems somewhat abrupt. It is not clear why one would expect the "observed precipitation extremes to decrease in the central Tibetan Plateau, ..southwestern parts of Pakistan...Northeast China". [Krishnan Raghavan, India]	Accepted: text revised
27028	9	44	9	44	high confidence that it is very likely it is used only in Australasia any explanation why? [Mansour Almazroui, Saudi Arabia]	Accepted: text has been revised to "very likely"
31892	9	44	9	44	Australia [Wei Zhang, United States of America]	Rejected: this refers to Australia and other countries in Australasian region
43212	9	44	9	46	Is it necessary to say these things are both high confidence and very likely? [Rachel Taylor, Australia]	Accepted: text has been revised to "very likely"
52990	9	44	9	46	Does 'very likely' not imply 'high confidence' and therefore you can just say 'it is very likely' or 'it is extremely likely' etc? [Lisa Alexander, Australia]	Accepted: text has been revised to "very likely"

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
50862	9	48	9	49	The statement only applies to daily rainfall, Guerreiro et al (2018) shows increases in both frequency and magnitude of hourly rainfall both in North and South Australia. The relative increases are bigger in the North, but still reach double CC-scaling in the South and are outside the range of natural variability. Guerreiro, S.B., Fowler, H.J., Barbero, R., Westra, S., Lenderink, G., Blenkinsop, S., Lewis, E. and Li, X.-F. (2018) 'Detection of continental-scale intensification of hourly rainfall extremes', Nature Climate Change, 8(9), pp. 803-807. [Selma Guerreiro, United Kingdom (of Great Britain and Northern Ireland)]	Noted: The executive summary does refer to daily data unless stated otherwise. We have added this reference to the Australasian Table.
9444	9	49	9	52	The finding: There is low to medium confidence that extreme precipitation will increase over Australia and New Zealand by the end of the 21st century lacks unfortunately the context (linkage to emission scenario). Therefore it is suggested to include such very relevant information on the context in the main report as well as in the executive summary. [Klaus Radunsky Radunsky, Austria]	Accepted. We have added a sentence to provide more context. The text now reads: "There is low confidence that extreme precipitation will increase over Australia and New Zealand by the end of the 21st century with increases being larger for higher emissions scenarios."
21432	9	50	9	50	Replace 'also' by 'equally' [Gwenaelle GREMION, Canada]	Accepted
32366	9		9		It seems the section for ETCs is missing from the executive summar. [Simon Brown, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. We have added a summary on the new section about Midlatitude storms that merges ETCs and ARs in the Executive Summary of the SOD.
26986	10	7	10	9	Please check: There cannot be an increase and a decrease in the number of hot days simultaneously. [Joachim Rock, Germany]	Accepted: The phrase was changed.
8082	10	7	10	9	Specify the decades since the results change greatly according to the period considered [Soledad Collazo, Argentina]	Accepted: We are thinking about the 5 last decades.
40380	10	7	10	9	Minor comment: Please, clarify if the increase is observed for the whole period whereas decrease is observed in the lasts decades. The way it is written, seems to happened both in the lasts decades. It is also confused "South (Central) America", is it Central America and South America or is it the central part of South America? [Vanessa Pántano, Argentina]	Accepted: The text was changed to clarify
9798	10	7	10	14	The acronym "SES" for South East South America is confusing and a bit jarring to read, since it's not intuitively understood why the A from America would be left out of the acronym. Is it possible to either eliminate this acronym, if it's not really needed, or else change it to a more intuitive SESA? [Andra Garner, United States of America]	Rejected: South America is divided in 6 regions. Now (after LAM3) the acronyms are: CAM, NWS, NSA, NES, SAM, SWS, SES and SSA.
51412	10	7	17	9	There seems contradictory information about increases/decreases of warm days and nights in this sentence (increase in general, and decrease in the last decade?) [Bart Van den Hurk, Netherlands]	Noted, the original writing was wrong. It is corrected now.
21434	10	9	10	11	Re-order sentence to: 'Projected changes in temperature extreme indices show an extremely likely (high confidence) widespread warming over Central and South America by the end of the 21st century' [Gwenaelle GREMION, Canada]	Accepted
9800	10	16	10	18	The first sentence of this paragraph is very confusing. Start with the first phrase: "In North America, dominant changes in observed extremes include very likely increase (high confidence) in the number of warm days and nights and decrease in the number of cold days and nights. . . ." On its own, this makes sense. However, the second phrase of the sentence reads, ". . . , also over central North America and the eastern United States, albeit with changes smaller than elsewhere in North America." Were these regions (central North America and eastern United States) not included, then, in the first part of the sentence, which speaks broadly of "North America"? If the first sentence refers only to specific parts of the continent, this needs to be made clear. If the first part of the sentence is meant to apply to the entire continent, including central North America and the eastern United States, then I suggest either rewording or removing the second part of the sentence to be more clear. [Andra Garner, United States of America]	Accepted: Revised sentences read: "Over much of North America, changes in observed extremes include a very likely increase (high confidence) in the number of warm days and nights and decrease in the number of cold days and nights. However, these changes over central North America and the eastern United States are smaller than elsewhere in the continent."
53056	10	29	10	35	While I find the storyline approach useful and promising, I am not sure whether it needs to be mentioned in the ES as a "Finding". I would rather use it and refer to what it provides of insights. [Jan Fuglested, Norway]	Accepted - this statement has been removed from the ES.
55030	10	29	10	37	The title of this section has "low-probability high-impact" events, and then in line 37 you call it "high-impact low probability" event. I suggest to use only one. In Chapter 4 these time of events are termed "low probability high-impact". [Rojas Maisa, Chile]	Accepted, changed to low probability high-impact throughout the section.
32110	10	29	10	50	The important topic of low-probability high impact events could usefully be illustrated by developing specific physically plausible scenarios (e.g. Sutton, ESD 2018). See for example my Comment 39 on chapter 8 about changes in precipitation extremes. [Rowan Sutton, United Kingdom (of Great Britain and Northern Ireland)]	ACCEPTED. The reference has been added to the discussion of developing physically plausible scenarios which is now part of section 11.2

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21436	10	35	10	35	Replace 'develop' by 'provide' [Gwenaelle GREMION, Canada]	Not applicable - this statement has been removed from the ES.
9448	10	35	10	35	There is lack of clarity about the message of the sentence. It might be clearer if the verb "develop" is substituted by "provide". [Klaus Radunsky Radunsky, Austria]	Not applicable - this statement has been removed from the ES.
52994	10	37	10	37	It seems strange that a high confidence statement is used here when we are talking about a gap. [Lisa Alexander, Australia]	Not applicable - this statement has been removed from the ES.
26758	10	37	10	41	Confidence statements in a lack of knowledge seem inappropriate. [Thorsten Mauritsen, Sweden]	Not applicable - this statement has been removed from the ES.
45970	10	37	10	50	Knowledge gaps are increasingly contributing to low institutional capacity to adapt to climate change, in particular, these single extreme events (those that have been attributed to anthropogenic climate change). High- impact low -probability events, because they lie outside the range of observed analogues will be additional source of high vulnerability. It is thus, critical that attention be given this area of research. [Lourdes Tibig, Philippines]	Not applicable - this statement has been removed from the ES.
52996	10	44	10	50	Surely a knowledge gap still has to be the inability of our climate models to simulate extremes and/or some of the conditions that lead to them which in turn limits our inability to do detection and attribution on some extremes and our ability to make plausible future projections. [Lisa Alexander, Australia]	Not applicable - this statement has been removed from the ES.
35364	10	44	10	50	In executive summary, knowledge gaps are identified. But how to overcome those knowledge gaps should also be advised. [Mehwish Ramzan, Pakistan]	Rejected. This is a short section, because of space constraints, more details cannot be provided.
54134	10	44	10	50	Knowledge gaps require more explanations and more careful considerations. For example, knowledge gaps relevant to understanding responsible mechanisms of extremes are not provided. [Husain Najafi, Iran]	Rejected. This is a short section, because of space constraints, more details cannot be provided.
43116	10	44		50	I think the section (and chapter) work really well, but I would split the final paragraph (Knowledge Gaps) in the Exec Summary, and re-order it. The geographical informational gaps should be made more prominent, and could be flagged as priorities for new observational networks. The list of events not well-understood should either use no examples or more than one. And the sentence on tipping points is a bit vague - I would suggest cutting it, and saying something more substantial in the main text. [David Frame, New Zealand]	Considered. The final section is reformulated.
52724	10	44			I would add changes in dynamics driving extreme events, and super Clausius-Clapeyron scaling. Both need much more research. [Douglas Maraun, Austria]	Accepted: It was included in the paragraph.
21438	10	46	10	46	Shorten and make first sentence more concise. Suggestion: 'There are currently several knowledge gaps associated with studies on extreme events.' [Gwenaelle GREMION, Canada]	Noted. Text was slightly revised
44582	10	46	10	50	There are some remaining areas associated with knowledge gaps in extremes research at present. Some topics are still insufficiently investigated such as hail. Also, possible changes ..., in particular in Africa. This paragraph is very general. A more focused summary of the knowledge gaps could be presented here. [Krishnan Raghavan, India]	Considered but such details cannot be provided in ES limited by space. More details are provided in the chapter.
44122	10	46	10	50	short-duration extreme precipitation events are also a gap (as outlined on p37) [Michaela Dolk, United States of America]	Considered. This really depends what is considered to be a gap. There are new literatures on short-duration and subdaily precipitation extremes which were included in FOD and assessed in more detail in the SOD. However, our knowledge on this is limited.
51414	10	46	40	16	remove "areas associated with" from this sentence [Bart Van den Hurk, Netherlands]	Noted. Text removed
21442	10	46		50	Please reference Box 11.2 Extremes in paleoclimate archives. This box received its own subchapter title "Knowledge gaps", thus should be integrated in this "knowledge gaps" section of the executive summary [Gwenaelle GREMION, Canada]	Accepted, referred to in SOD:
54132	10	47	10	47	change "has" to "as" [Husain Najafi, Iran]	Accepted
21440	10	47	10	47	Chapter explores much larger uncertainty and lack of knowledge relating to droughts and tropical cyclones, and little is said in this chapter regarding hail. Moreover, hail, as suggested in the chapter, forms part of a bigger concept of severe convective storms which are poorly understood in terms of their future behavior. I would therefore suggest to incorporate those key words and replace hail by convective storms, as follows: 'still insufficiently investigated such as severe convective storms, tropical cyclones and droughts'. [Gwenaelle GREMION, Canada]	Noted. Added following text: "and there are some remaining uncertainties regarding changes in some extremes such as droughts and tropical cyclone, although evidence have become much more robust in these areas compared to the AR5"

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26760	10	48			I would be careful with using the word 'tipping-point' which implies irreversibility or hysteresis. There are many alternatives, but perhaps what is meant is regional rapid regime changes. [Thorsten Mauritsen, Sweden]	Accepted. We still mention tipping point, but also include a mention of rapid regime changes.
50078	10	50	10	50	"observational gaps". I would add "observational gaps and literature". [ARONA DIEDHIOU, Cote d'Ivoire]	Noted. Replaced with "observational and literature gaps".
37932	10	50			Change "world's regions" to "regions of the world". [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Accepted
15620	11	1	19	27	There is an accumulation of evidences that the global climate change can increase the frequency and magnitude of extreme events. However, at the same time, it is also well known that the internal variability has a direct influence on the recent and near-future extreme events. Therefore, I feel it is nicer to argue the effect of internal variability in the separate section or in a new BOX. I notice there are several sentences commenting on the effect of internal variability, but they are distributed, limited in aspects, and not well organized. [Tomonori Sato, Japan]	Noted. The main focus is to assess changes in extremes rather than the causes of individual extremes. If there is a change in internal variability that result in changes in extremes, that will be assessed.
21444	11	11	11	12	Addition of the following words to improve coherence of sentence 'assessed in IPCC reports': 'assessed continuously in IPCC reports' [Gwenaelle GREMION, Canada]	Accepted. Reworded
32368	11	14	11	14	I think we need to be careful when we use the phrase "relative to climatology" as what does this mean in the future when the climate is rapidly changing? This problem goes away somewhat if we talk in terms of probability, such as "the 0.01 annual exceedance probability in 2050" [Simon Brown, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. The sentence has been removed.
27438	11	15	17		Not easy to understand why excluding the southern part of the Mediterranean from this important conclusion [Fatima Driouech, Morocco]	Noted, but we are not sure what this comment meant as there is no mentioning of excluding southern part of the Mediterranean
54182	11	18	11	18	a space is needed before (SR15,IPCC, 2018) [Sarah Sparrow, United Kingdom (of Great Britain and Northern Ireland)]	Accepted
54184	11	19	11	19	a space is needed before (SROCC) [Sarah Sparrow, United Kingdom (of Great Britain and Northern Ireland)]	Accepted
27856	11	22	11	34	(pg.11 lines 22-34) - This paragraph would be more clear if the opening statement presented what is new for AR6 first and then compared back to previous reports. [roderik van de wal, Netherlands]	Accepted. Paragraph is re-organized.
52726	11	22	11	34	I would add a link to Chapter 10 here. We are somehow providing the framework for understanding regional changes, in terms of discussing model experiments, model performance, role of internal variability, attribution of regional trends, constructing messages. Many of these issues are relevant for Chapter 11. [Douglas Maraun, Austria]	Accepted, some working added.
54186	11	25	11	25	a space is needed before (Collins et al., 2013a) [Sarah Sparrow, United Kingdom (of Great Britain and Northern Ireland)]	Accepted
21446	11	25	11	25	Replace 'were of largescale in general' to: 'were in general focused on large-scale events.' [Gwenaelle GREMION, Canada]	Noted. Note that the assessment is conducted at the large scale, but the (extreme) events that are assessed are not always of large-scale (e.g., annual maximum one-day precipitation may be of small scale but drought is of large-scale). For this reason, we are not focusing in large-scale events.
14136	11	25			of largescale --> at large scales [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted.
14138	11	28			a global [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted.
38886	11	29	11	31	Few people will recall the structure of SREX Chapter 3, so the reference is not clear and thus should be discarded or explained. [Uwe Ulbrich, Germany]	Agreed, reference to structure is not important (as we provide outline in the next paragraph) and is removed.
21448	11	30	11	30	Replace 'and extremes assessed' to: 'and types of extremes assessed' [Gwenaelle GREMION, Canada]	Accepted.
15298	11	32	11	34	A bit more concretely, perhaps, one could say "Chapter 12 translates the assessment of changes in extremes provided here into changes in metrics that quantify impact-relevant hazards" [Claudia Tebaldi, United States of America]	Accepted
45972	11	36	11	44	Excellent framing and structuring in this chapter [Lourdes Tibig, Philippines]	Noted, thanks.
21456	11	43		44	Suggested changes: 'entails several boxes such as extremes viewed from paleoclimate archives, and FAQs to more specific topics'. [Gwenaelle GREMION, Canada]	Noted. This part is rewritten to also provide justification of selection of these boxes

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
54038	11	46	11	49	It is useful to refer to Sendei, of course, but DRR is not the whole story where climate change impacts are concerned. It is misleading to apply only DRR terminology in the context of climate changes that are not all hazardous, and are not all associated with short-term disasters. [Timothy Carter, Finland]	Noted. We use the common AR6 risk framework.
45608	11	47	12	46	I find this section 11.1.2 scientifically poor. The first paragraph discusses the difference between weather and climate extremes but concludes that there is no difference; this could be stated in one sentence. The second paragraph discusses the issue of event definition, in particular the calendar conditioning; again, I think that it could be shortened. The last paragraph discusses the difference between changes in frequency vs. intensity, which are by nature strongly linked (two features of the same statistical distribution). I think that this section should rather introduce statistical notions (e.g. percentile exceedances, return periods/levels) and say that there are two kinds of approaches for studying weather extremes under climate change: attribution of single events (e.g. the heatwave of year y / location l), or analysis of extremes taken collectively (e.g. the global fate of heatwaves or extreme indices such as Txx, RX1d, etc.). [Julien Cattiaux, France]	Noted. The purpose of this section is not to define "IPCC" extremes that we will study in this chapter. The purpose is to describe the different definitions that have been used in the literatures thereby providing proper context when we assess results from different studies. We have shortened sentence when we can and also rewritten/rephrased when needed.
44616	11	47	12	46	It is suggested that a sentence be added to this section providing the answer to the question posed in the title (i.e. What is an extreme event?). The proposed wording can be "An extreme event is something that happens that is very unusual and can be described as reaching a very high or highest degree of change" [Danny Ramsuchit, South Africa]	Noted. We have made clear we use the definition of extremes following AR5.
52728	11	47			Please discuss here that the events typically discussed in the climate literature are often not user relevant as they describe moderate extremes and do not directly provide information about design values (which range from 100 year to several 100.000 year return values). [Douglas Maraun, Austria]	Considered. While it is true events discussed in many papers don't necessarily address issues of a particular user group, it is not a fair statement to say such analysis are not user relevant. For example, an engineer can infer from an increase in annual maximum 1-day precipitation that they need to increase his 100-yr return value of maximum one-day precipitation. No change to the text is made.
21450	11	49	11	52	This sentence does not make sense and needs shortening. I am struggling to suggest a correction as I do not fully understand the middle section of the sentence. My suggestion (based on my understanding) would be: "The risk framework defined in the SREX report (IPCC, 2012) articulates clearly that the impacts of a given hazard are strongly related to the exposure and vulnerability to extremes. As a result, increased resilience and adaptation can reduce exposure and vulnerability to hazards associated with extreme events." [Gwenaelle GREMION, Canada]	Noted, sentence has rewritten to improve clarity.
21452	11	53	11	53	one-to-one correspondence' sounds odd. Replace by: 'causal relationship' [Gwenaelle GREMION, Canada]	Rejected. One-to-one is more precise than causal relationship in this context. If an extreme cause an impact, there is then a causal relationship.
35366	11	54	11	55	I think we need to revise the definition of extremes and vulnerability depending upon the "socioeconomic status of the region suffering from it". [Mehwish Ramzan, Pakistan]	Rejected. What you mentioned here is more relevant to hazard than extreme and changes in hazard are assessed in chapter 12.
21454	11	54	11	55	Rephrase sentence as it sounds odd. Suggestion as follows: 'Extreme impacts can also occur when already vulnerable human and natural systems are exposed to weather and climate events that are not by nature considered very extreme'. [Gwenaelle GREMION, Canada]	Not applicable any more as the sentence is now removed.
21458	12	5	12	5	Rephrase: 'The definitions of rare vary, depending on purposes.' by 'The use of the term rare varies, depending on the context used.' [Gwenaelle GREMION, Canada]	Noted. This sentence is modified

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
9980	12	5	12	14	I believe that the Report should be more precise at this regard, and make explicit reference at this stage to extreme value theory. What is mentioned now is too hadn-waving. Possible references: Books: Coles S. (2001) An Introduction to Statistical Modeling of Extreme Values. Springer, London. Embrechts P., Klüppelberg C. and Mikosch T. (1997) Modelling extremal events for insurance and finance. Berlin: Springer Verlag; Lucarini, V. D. Faranda, A. C. G. M. M. de Freitas et al., (2001) Extremes and recurrence in dynamical systems, John Wiley & Sons, Hoboken - Review papers: M. Ghil, P. Yiou, S. Hallegatte et al., "Extreme events: dynamics, statistics and prediction," Nonlinear Processes in Geophysics, vol. 18, no. 3, pp. 295–350, 2011; Katz, R. W., M. B. Parlange, and P. Naveau, 2002: Statistics of extremes in hydrology. Advances in Water Resources, 25, 1287-1304, doi:10.1016/S0309-1708(02)00056-8. [Valerio Lucarini, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The purpose of this section is not to define "IPCC" extremes that we will study in this chapter. The purpose is to describe the different definitions that have been used in the literatures thereby providing proper context when we assess results from different studies. We have shortened sentence when we can and rewritten/rephrased when needed.
14142	12	5			suggest: purposes --> application [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted
54568	12	12	16	28	The explanation is great but there is need to put references in some statements. For instance, page 12, line 16-28, there is need to put references. The impacts of weather and climate extremes depend on the community vulnerability level [Mark Owidhi, Kenya]	Considered. We have stated right at the start of section 11.1.2 that the magnitude of impacts is determined by exposure and vulnerability. This explanation is meant to provide some context for the assessments that extremes have been examined in literature in different ways and that the assessment is to synthesize all evidence available to us, even though some evidence may seem to be contradictory to each other. We have reorganized this section to make this aspect clear.
46152	12	14			I suggest to add few examples, and related references, of weather and climate extremes in order to explain better the differences between the two. [Marina Baldi, Italy]	Noted. While it is nice to add examples, we are also concerned about the length of the chapter
21460	12	16	12	17	Rephrase and shorten first sentence to: "The interpretation of extreme events must be placed in adequate context since there are different ways to define extremes." [Gwenaëlle GREMION, Canada]	Noted. This sentence is rephrased.
27858	12	16	12	28	(pg.12 lines 16-28) Can be more concise with main point here. Each example could be tied back to how the two different events can be interpreted differently. (pg.12 lines 30-46) A new paragraph should be a new idea with a clear topic sentence. Starting again with "another example" is vague. Another example of what? It also sounds like a continuation of the preceding paragraph. Possible solution: Interpretation in the analysis of extreme events is also dependent on the way questions about the event are posed." [roderik van de wal, Netherlands]	Noted. The paragraphs have been edited.
21462	12	18	12	18	Replace 'to ask' by 'to consider' [Gwenaëlle GREMION, Canada]	Noted but text is not changed
14144	12	27			at different times of year [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted
21464	12	30	12	30	Replace 'to the way questions are posed, such as change in the frequency for a given magnitude of extremes or change in the magnitude for a particular return period.' to: 'to the way hypotheses are worded, such as changes in the frequency for a given magnitude of extremes versus changes in the magnitude for a particular return period.' [Gwenaëlle GREMION, Canada]	Noted but text is not changed
53862	12	30	12	46	Can you clarify how frequency and magnitude of the same event can change at different rates? Their definition is intertwined, e.g. the frequency of a certain magnitude event. [Erin Coughlan de Perez, United States of America]	Noted, a few more words are added
46402	12	31			changes [sadeh zeyaeyan, Iran]	Accepted
57678	12	31			changes [Sahar Tajbakhsh Mosalman, Iran]	Accepted
14008	12	31			changes [saeedeh Kouzegaran, Iran]	Accepted
46404	12	33			a rare event [sadeh zeyaeyan, Iran]	Accepted
57680	12	33			a rare event [Sahar Tajbakhsh Mosalman, Iran]	Accepted
14010	12	33			a rare event [saeedeh Kouzegaran, Iran]	Accepted
14146	12	38			the considered extremes: in... [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted
21466	12	42	12	42	When similar damage occurs' - similar to what? Need to be more specific. No correction suggested as it is unclear what the author means. [Gwenaëlle GREMION, Canada]	Noted, text revised
21468	12	42	12	42	"it is important to ask", Please add space between to and ask [Gwenaëlle GREMION, Canada]	Accepted

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16276	12	42	12	44	It was not clearly explained why it is more important to ask frequency or magnitude relative to the change (or lack of change) in the event impact. [Tabassam Raza, Philippines]	rejected. This was explained.
43826	12	49	12	49	Here, some very important points have been stressed. If we could get some schematic figure of it, it would be much better. [Izuru Takayabu, Japan]	Noted, but we do not feel the need to add a schematic figure.
48736	12	49	12	49	Should there also be a reference in this section to extremes constructed via "physical reasoning" such as those used in thinking about "surprises" and very high impact but very low probability events? [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	Considered. We do not see them as a different type of extremes. For example, some kind of extreme precipitation (such as the concept of probable maximum precipitation used in engineering application) can only be understood from the storyline approach but it is not a different type of extreme per se. While they are not treated as a separate type, section 11.2 method section does cover this.
27860	12	49	12	49	(pg.12 line 49) @!"Types of extremes" or "Types of extreme events" rather than: "Extreme types" (pg.13 lines 26-35) @!This paragraph does not clearly support main idea of 11.1.3 but instead @!discusses future projection. [roderik van de wal, Netherlands]	Accepted. The wording is changed as suggested. The last paragraph is moved to method section 11.2.
45610	12	49	13	38	Line 53: The considered events are included because of their relevance to impacts. This is not the only reason, and not all events causing impacts are included (e.g. thunderstorms, tornadoes). The considered events are actually included because this is what state-of-the-art observations and climate models allow to analyse. More generally, I find that this section 11.1.3 gives too much importance to impacts and not enough importance to climate science. I also think that sentences like « multiple concurrent events can lead to impacts that are much larger than the sum of individual impacts » have no scientific basis. [Julien Cattiaux, France]	Considered and some changes are made to the text. We added that the consideration of the types of extremes assessed also limited by the availability of literature. We don't agree that there is no science basis for multivariate extremes to produce much larger impacts. We have referred to Section 11.8 for more details.
44124	12	52	12	52	definition of compound does not encompass all types of compound events (e.g. multivariate, concurrent and sequential) [Michaela Dolk, United States of America]	Considered. The definition does include all types of compound events you mentioned though the exact working is a bit different. We have slightly reworded the text.
50634	12	53	12	53	check that the definition of compound events is consistent throughout the chapter, e.g. p13 l21 [Olivia Martius, Switzerland]	Noted. This has been checked.
50636	13	1	13	2	Suggest to mention the non-extreme events that lead to severe impacts here again [Olivia Martius, Switzerland]	Noted but no action is taken. As we don't assess impacts and as Chapter 12 is dedicated for handshaking with Working Group II report, we do not see the need to mention this here.
21470	13	1	13	2	Change grammar and punctuation of following sentence: 'Marine extremes such as marine heat wave, extreme sea level, are assessed in Chapter 9' to: 'Marine-related extremes such as marine heat waves and extreme sea level are assessed in Chapter 9' [Gwenaëlle GREMION, Canada]	Accepted.
40382	13	7	13	8	However, there are lots of papers regarding SPI index, which is based on monthly precipitation. [Vanessa Pántano, Argentina]	Considered. This aspect is assessed in drought section as SPI is often studied within the context of drought.
15594	13	7	13	8	As it is mentioned already, there are few studies of precipitation extremes in long time scales. However, there are increasing number of papers available by the aid of resampling technique and a large ensemble of GCM simulations. This will be an important aspect of the extreme events and therefore I would suggest to mention here. (1) Norris, Jesse, Gang Chen, and J. David Neelin. "Changes in frequency of large precipitation accumulations over land in a warming climate from the CESM Large Ensemble: the roles of moisture, circulation and duration." <i>Journal of Climate</i> 2019 (2019). (2) Hatsuzuka, D., and T. Sato, 2019: Future changes in monthly extreme precipitation in Japan using large-ensemble regional climate simulations. <i>J. Hydrometeor.</i> , 20, 563-574, DOI: 10.1175/JHM-D-18-0095.1 [Tomonori Sato, Japan]	Considered. But the literature of precipitation of time scale longer than 5-days is very limited. Studies on SPI are often conducted in the context of drought which is assessed in drought section. To address this and comments on short-duration extreme precipitation, we now have a separate section on "other time scale".
50638	13	10	13	10	Suggest to explain why short duration precip extremes and long duration precip. And temperature extremes are impact relevant [Olivia Martius, Switzerland]	Considered and some explanations are added.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
38888	13	12	13	12	You write "storms", but apparently mean tropical and extratropical cyclones. I recommend to use the latter explicitly, as an individual strong shower is sometimes called a "rainstorm", and so it is not clear what exactly you mean. [Uwe Ulbrich, Germany]	Accepted.
44158	13	13	13	14	Tornadoes can be up to 1 km across and can last for tens of minutes. [David Schultz, United Kingdom (of Great Britain and Northern Ireland)]	Noted and the relevant texts are reworded.
50640	13	14	13	14	I was told not to use "on the other hand" without a preceding on the one hand --> there are several occurrences, maybe use in contrast [Olivia Martius, Switzerland]	Accepted, text modified.
21472	13	19	13	19	Replace 'combine' by 'come together' [Gwenaelle GREMION, Canada]	Accepted.
30290	13	26	13	26	"As in the SR15 report (Hoegh-Guldberg et al., 2018, hereafter referred to as SR15 Ch3)" report (Hoegh is adjacent [Nazan An, Turkey]	Accepted
54188	13	26	13	26	a space is needed before (Hoegh-Guldberg et al., 2018, hereafter referred to as SR15 Ch3) [Sarah Sparrow, United Kingdom (of Great Britain and Northern Ireland)]	Accepted
15300	13	30	13	31	using "directly" here may suggest a more straightforward and easy connection than we actually have: thinking of each aspect involved on either side of GMST (regional extremes, and cumulative emissions), some large uncertainties persist. Maybe for some aspects the directly is defensible, for others not as much. [Claudia Tebaldi, United States of America]	Accepted. The word directly is removed.
21478	13	33		35	Adapt sentence to CMIP6 if available [Gwenaelle GREMION, Canada]	Noted and considered.
45976	13	37	13	54	Tables 11-1 and 11-2 will be very useful. Please include projected changes at different temperature levels. [Lourdes Tibig, Philippines]	Considered.
21474	13	43	13	44	First part of the caption of Table 11.1 needs rewording (and more specific) to reflect the table itself. Suggested rewording as follows: 'Synthesis table on observed changes in extremes since 1950 compared with human-induced contribution to the observed trends. Note that observed changes in marine extremes are assessed in the cross-chapter box 9.1 in Chapter 9.' [Gwenaelle GREMION, Canada]	Considered. The table caption is reworded.
45974	13	49	14	24	compound events being treated here is expected to highlight the needed attention to cascading impacts.. It is suggested that additional references on extreme and compound events be found and synthesized, in particular, iterative risk assessment and management (responses). [Lourdes Tibig, Philippines]	Considered. While compound event is assessed, we are limited to the scope of this chapter (that we do not assess impacts), and the availability of the literature.
21476	13	51	13	52	First part of the caption of Table 11.1 needs to be more specific to reflect the table itself. Suggested rewording as follows: 'Synthesis table on projected changes in extremes at different levels of global warming. Note that projected changes in marine extremes are assessed in the cross-chapter box 9.1 in Chapter 9.' [Gwenaelle GREMION, Canada]	Considered. The table caption is reworded.
28026	14	11	14	33	(pg.14 lines 11-33) #lots of strong quotes to support argument for this section however, #not always clearly tied back to argument [roderik van de wal, Netherlands]	Considered. Some sentences are edited.
31894	14	11	14	33	This paragraph focuses on responses of mean and extreme precipitation to global mean surface temperature changes. Given the fact that global surface temperature cannot represent changes in atmospheric moisture directly, the changes in the scaling of extreme precipitation is better resolved by dew point temperature which includes both temperature and relative humidity in the atmosphere (Lenderink and Fowler 2017; Ali et al. 2018; Zhang et al. 2019). Some discussions on the contrasting the responses of extreme precipitation to changes in surface air and dew point temperatures would be helpful. Zhang, W., G. Villarini, and M. Wehner (2019), Contrasting the responses of extreme precipitation to changes in surface air and dew point temperatures, Climatic Change, 154(1), 257-271, doi:10.1007/s10584-019-02415-8. Ali H, Fowler J, Mishra V (2018) Global observational evidence of strong linkage between dew point temperature and precipitation extremes. Geophys Res Lett. Lenderink G, Fowler HJ (2017) Understanding rainfall extremes. Nat Clim Chang 7:391 [Wei Zhang, United States of America]	Considered. This aspect is now carefully assessed in a section on sub-daily precipitation. The notion that humidity is a better predictor than temperature is based on the few papers cited here. These papers are based on a method that mistakenly interprets conditional quantiles as precipitation response to global warming. As the method is wrong, the results need to be verified.
27862	14	11	14	33	(pg.14 lines 11-33) #Very quote heavy in this section but not always clearly connected back to main point. [roderik van de wal, Netherlands]	Considered. Some sentences are edited.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
37934	14	13			There are many references in this chapter to extreme precipitation increasing at about the 7%/°C rate, following the Clausius Clapeyron relationship. But we read elsewhere in this FOD that precipitation on average must increase at the 1-3%/°C rate because of radiative constraints. Some discussion of how this is reconciled would be welcome in this chapter. Does it imply a decrease in the number of extreme precipitation events? Does it imply a lower increase, or even a decrease, in precipitation from light and medium precipitation events, with possible implications for droughts? [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Considered. We have added some words to reflect this. While there is evidence of higher rate for very extreme events, we haven't seen papers that show reduction in less extreme events.
50642	14	14	14	14	Plus changes in vertical stability (convection) and meridional temperature gradients (storms). [Olivia Martius, Switzerland]	Accepted.
6804	14	16	14	21	Here as well as later on in the chapter, there is mention of an increase in extremes that is linear to the mean warming increase. This is not totally true in the regions where temperature variability increases, such as Central Europe, and should not be so quickly dismissed. Additionally, studies find that more extreme events warm more than extreme events with shorter return periods (e.g. 100-year vs 20-year return levels over Europe in Suarez-Gutierrez et al., 2018) [Laura Suarez-Gutierrez, Germany]	Considered. We have softened the word as "to the first approximation ...". The aspect that at the regional scale, it may not scale linearly ... " is discussed in a later subsection on local/regional process etc.
50882	14	25	14	25	However, observational studies have exhibited higher scaling rates (super-CC) for sub-daily rainfall extremes in Australia (Guerreiro et al, 2018), Netherlands (Lenderink and van Meijgaard, 2008) and Germany (Berg et al., 2013). Guerreiro, S.B., Fowler, H.J., Barbero, R., Westra, S., Lenderink, G., Blenkinsop, S., Lewis, E. and Li, X.-F. 'Detection of continental-scale intensification of hourly rainfall extremes', Nature Climate Change, 8(9), (2018), pp. 803-807. G. Lenderink, E. van Meijgaard. Increase in hourly precipitation extremes beyond expectations from temperature changes. Nat. Geosci., 1 (2008), pp. 511-514 P. Berg, C. Moseley, J.O. Haerter. Strong increase in convective precipitation in response to higher temperatures. Nat. Geosci., 6 (2013), pp. 181-185 [Selma Guerreiro, United Kingdom (of Great Britain and Northern Ireland)]	Considered. This is now assessed. Note that the observation studies that follow the Lenderink and Meijgaard (2008) do not establish precipitation response to long-term warming. The rate as estimated by that method is conditional quantile, i.e., high quantile precipitation conditional on (daily) temperature. As both precipitation and temperature are influenced by other drivers such as seasonal cycle, it is unclear what is the linkage between those estimates and precipitation response to warming.
14148	14	25			America [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted
50644	14	28	14	28	This statement is very vague and difficult to understand without a lot of prior knowledge [Olivia Martius, Switzerland]	Noted. This is more an introduction to section 11.1.6.
16280	14	32	14	33	What is much lower? The confidence? If so, how low? Is there a need to provide verbal description about low, lower, or lowest and so on... [Tabassam Raza, Philippines]	Considered. We have reworded the text.
53058	14	38	14	38	This box is very useful. [Jan Fuglestad, Norway]	Noted
50646	14	38	16	23	The box is difficult to read, it would help the reader to introduce paragraph headings and structure the text by these topics [Olivia Martius, Switzerland]	Taken into account. We have added subtitles to separate the discussion according to most of the extreme types discussed in the chapter.
43504	14	38	17	23	Box 11.1: Adding a discussion on dynamic contribution to the changes in Asian monsoon precipitation extremes in view of previous studies (Freychet et al. 2015; Kitoh 2017; Lee et al. 2018) would be useful to make this box more comprehensive. [Seung-Ki Min, Republic of Korea]	Rejected. This box does not aim at describing comprehensively all possible influences of dynamic/thermodynamic changes in extremes but to highlight some key aspects. A more detailed regional assessment that includes monsoon systems is given in Chapter 8.
56506	14	38	17	24	The text should clarify the role of lapse-rate changes, which can be considered thermodynamic changes as well (but are distinctive to what is discussed in the text). Lapse-rate changes follow from fundamental atmospheric properties (e.g. Held and Soden 2000) and have been shown to have an important impact on e.g. the Mediterranean amplification (Kroner et al 2017, http://dx.doi.org/10.1007/s00382-016-3276-3 ; Brogli, et al. 2019, https://doi.org/10.1175/JCLI-D-18-0431.1) [Christoph Schär, Switzerland]	Taken into account. We have now added specific details on thermodynamic changes related with changes in the vertical lapse-rate.
14150	14	40	14	45	I'm not sure that reference to the rather stiff Oxford dictionary definitions of thermodynamics and dynamics is useful and a short summary would be better or simply replace it with the next lines: "Applied to climate science, thermodynamics refer to exchanges of energy while dynamics are associated with atmospheric motions." It would also be useful to make the distinction between dynamical changes related to spatial changes in the large-scale circulation features and modification in local dynamical characteristics for example strengthening of convective updraft. Additionally, I think (thermo)dynamical can be replaced with (thermo)dynamic. [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. We have removed the reference to the Oxford dictionary and provided a climate specific definition. We have also replaced (thermo)dynamical by thermo(dynamics) in the title and most of the text. The distinction about large-scale and local dynamic changes affecting precipitation extremes is now made more explicit.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
26762	14	40	14	45	I did not really like starting it this way, perhaps paraphrase? [Thorsten Mauritsen, Sweden]	Accepted. We have now removed the dictionary definitions and included an introduction that is climate specific.
54476	14	40	14	49	I think this text needs more work. As it stands it may cause additional confusion (dynamics are highly relevant for the exchanges of energy and describe kinetic energy as one type of energy). It would also be helpful to discuss how such a separation could consistently treat lapse-rate changes and land surface feedbacks. [Erich Fischer, Switzerland]	Accepted. We have now removed the dictionary definitions and provided a climate specific definition. We have also added more details on the influence of the effects of lapse rate changes and surface feedbacks.
43364	14	40	14	52	Although a bit long and technical, this paragraph gives a very nice description of thermodynamic and dynamic effects. [James Renwick, New Zealand]	Noted.
52730	14	40	14	52	I don't find these dictionary definitions useful for the purpose of introducing the terms. I would really go for a climate specific definition here. By the way, the Shepherd paper is from 2014, not 2016. [Douglas Maraun, Austria]	Accepted. We have now removed the dictionary definitions and included an introduction that is climate specific. We have also corrected the Shepherd reference.
44126	14	45	14	46	and oceans [Michaela Dolk, United States of America]	Accepted. Text has been revised accordingly.
54840	14				The box on thermodynamic vs dynamic is very useful [Gabriele Hegerl, United Kingdom (of Great Britain and Northern Ireland)]	Noted with thanks
14152	15	3	15	5	I think Arctic amplification is also strongly related to a second thermodynamic process, that of increased latent heat transport by the atmosphere due to strengthening of the latitudinal moisture gradient that is determined by the Clausius Clapeyron equation. [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. We have substantially modified the description of thermodynamic processes influencing Arctic amplification.
30062	15	3	15	5	This seems to still be a lingering misconception. At least in the models, the main drivers of Arctic amplification are the lapse-rate feedback and the Planck feedback (Pithan & Mauritsen 2014 NGeo doi: 10.1038/NGeo2071, already in your reference list), though the albedo feedback comes close. One of the earlier chapters I reviewed recognizes this, so at the very least you need to ensure consistency across chapters. [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. We have now revised the text and expanding the feedbacks involved based on the discussion on Arctic amplification provided in 7.6.2.1.
54478	15	3	15	5	Arctic Amplification is more than sea-ice albedo feedbacks. Check and refer to the text by Kyle Armour in chapter 7 and 4. [Erich Fischer, Switzerland]	Accepted. We have now revised the text and expanding the feedbacks involved based on the discussion on Arctic amplification provided in 7.6.2.1.
53060	15	3	15	7	Check consistency with what ch7 writes about Arctic Amplification [Jan Fuglested, Norway]	Accepted. We have now revised the text and expanding the feedbacks involved based on the discussion on Arctic amplification provided in 7.6.2.1.
6806	15	8	15	14	It would be relevant to mention the literature based on dynamical adjustment for this section. Several papers use this method to separate dynamical and thermodynamical effects on temperature extremes in North America (e.g. Diffenbaugh and Ashfaq,2010; Mettfield et al. 2017) [Laura Suarez-Gutierrez, Germany]	Rejected. There is limited space in this box to make a review about the various methods used to separate dynamical/thermodynamical contributions.
14154	15	11			suggest: "further heating of the air immediately above" since latent heating will also heat the air remotely where condensation takes place. [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. The text has been modified.
14156	15	11			Greenhouse_gases_also, regional_temperatures, physiological_responses [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Editorial – copyedit to be completed prior to publication
21482	15	12	15	12	"Greenhousegasesalso ...". Please add the space between Greenhouse gases also. [Gwenaelle GREMION, Canada]	Editorial – copyedit to be completed prior to publication
14158	15	13			I would not call this a direct response since increased CO2 can cause enhanced plant water use efficiency that can reduce evapotranspiration but also increase growth in marginally dry regions, both of which indirectly alter temperature but in different ways. This could be explained or removed and explained elsewhere. [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. We have added "indirect effects" in the text.
55928	15	15	35	55	Here (otherwise outside of box) something should be said about scaling of CC equation (both spatial and temporal) with citations to e.g. [Lenderink, G., R. Barbero, J.M. Loriaux, and H.J. Fowler, 2017: Super-Clausius-Clapeyron Scaling of Extreme Hourly Convective Precipitation and Its Relation to Large-Scale Atmospheric Conditions. J. Climate, 30, 6037–6052, https://doi.org/10.1175/JCLI-D-16-0808.1] and other related papers. [Olga Zolina, France]	Rejected. Subdaily and super-adiabatic or super CC scaling rates are now discussed in "Heavy precipitation" Section (section 11.4).
21480	15	17	15	17	Replace 'but there can be uncertainty' by: 'but uncertainty remains' [Gwenaelle GREMION, Canada]	Not applicable. This paragraph has been removed.
50648	15	17	15	18	This statement is very vague and difficult to understand without a lot of prior knowledge [Olivia Martius, Switzerland]	Not applicable. This paragraph has been removed.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
9982	15	18	15	22	Note that recently new systematic approaches have been proposed for the study of heat waves, see M. Galfi et al, J. Stat. Mech. (2019) 033404 [Valerio Lucarini, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. This citation does not address the thermodynamics Vs. dynamics separation and does not appear to be very relevant.
50650	15	19	15	19	I stumbled across the expression "essential element" maybe just "one element"? [Olivia Martius, Switzerland]	Accepted. This sentence has been modified and the expression "essential element" has been removed.
30064	15	27	15	30	I think you could be even stronger than this. See Scheff & Frierson (2012 J.Clim. doi: 10.1175/JCLI-D-11-00393.1) and Chadwick et al. (2013 J.Clim. doi: 0.1175/JCLI-D-12-00543.1). [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. We have added one reference but we have kept the level of confidence in the statement.
52732	15	27			occurrence: and length! [Douglas Maraun, Austria]	Accepted. The text has been changed accordingly.
14160	15	28			suggest replacing "catch phrase" with "simplistic statement" or "summarising statement" [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. We have replaced "catch phrase" with "simplistic statement".
52734	15	32			replace "explanation for" by "contributor to" [Douglas Maraun, Austria]	Accepted. The text has been changed accordingly.
54060	15	35	16	3	The paragraph on precipitation extremes in Box 11.1 makes reference to CC scaling and atmospheric moisture content but some specific detail on precipitation extremes might be useful as CC scaling is used to infer the potential for future changes in flash/urban flooding - in particular, results have indicated the sensitivity of scaling to season, the range of the temperature distribution, precipitation accumulation period (e.g. daily v sub-daily as in e.g. Lenderink and van Meijgaard, 2008: super-CC scaling for short duration extremes may be worth of mention in this section.) and methodology. It may also be appropriate to mention the application of dew point temperature in such studies as this is emerging as a more appropriate variable to use in scaling studies as it provides a direct measure of humidity (Lenderink et al., 2017) REFERENCES Lenderink, G., Barbero, R., Loriaux, J. M., and Fowler, H. J.: Super Clausius–Clapeyron scaling of extreme hourly convective precipitation and its relation to large-scale atmospheric conditions, J. Climate, 30, 6037–6052, https://doi.org/10.1175/JCLI-D-16-0808.1 , 2017. [Stephen Blenkinsop, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. This BOX discuss in length the relation between C-C scaling and changes in precipitation extremes and some of the factors mentioned by the reviewer such as the duration of events.
32370	15	36			I'm guessing that it is deliberate to favour the most recent publications, even if they are not doing much more than updates with new data. Anyway partitioning thermodynamic and dynamic is not new see : Dynamic and thermodynamic changes in mean and extreme precipitation under changed climate By: Emori, S; Brown, SJ GEOPHYSICAL RESEARCH LETTERS Volume: 32 Issue: 17 Article Number: L17706 Published: SEP 13 2005 [Simon Brown, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Yes, we try to highlight those results that have not been considered in earlier assessments. We have added a sentence mentioning that this separation was already assessed in AR5.
30158	15	43	15	45	Note that this relationships also approximately holds for extreme precipitation (at the daily level at least). In observations, Westra et al. https://journals.ametsoc.org/doi/full/10.1175/JCLI-D-12-00502.1 show that daily trends globally are consistent with clausius clapeyron scaling on GMST. Fischer and Knutti go further and examine observations, GCM simulations and theory and find that all match https://www.nature.com/articles/nclimate3110 [Hayley Fowler, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. We have added a few sentences discussing the validity of Clausius-Clapeyron scaling for observations.
14162	15	44	15	45	7 % for every degree of surface warming near the Earth's surface" sounds odd following a previous clarification and I suggest removing the first "surface" (the CC rate is much larger at higher colder levels of the atmosphere which is why near surface is needed). [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. We have revised the text.
39072	15	50	15	53	The link between soil drting and extremes is not so clear. There are indications that the parameterized models do not have a realistic response, like in Lenderink G and van Meijgaard E 2010 Linking increases in hourly precipitation extremes to atmospheric temperature and moisture changes Environ. Res. Lett. 5 025208 and Hohenegger C, Brockhaus P, Bretherton C S and Schär C 2009 The Soil Moisture–Precipitation Feedback in Simulations with Explicit and Parameterized Convection J. Clim. 22 5003–20 Online: http://journals.ametsoc.org/doi/abs/10.1175/2009JCLI2604.1 [Lenderink Geert, Netherlands]	Accepted. We have added a sentence with the references suggested to clarify this issue.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
43928	15	52	16	3	Suggest to add here: "The observed decreases in relative humidity over land regions have only a very minor mitigating influence on increasing trends in a metrics used to monitor human heat stress, such as wet bulb globe temperature (WBGT). WBGT still show a detectable anthropogenic increase over many land regions since the 1970s, driven by increases in temperature (Knutson and Ploshay 2016; Li et al. 2017). " References cited: 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 Li, C., Zhang, X., Zwiers, F., Fang, Y. and Michalak, A. M. (2017), Recent Very Hot Summers in Northern Hemispheric Land Areas Measured by Wet Bulb Globe Temperature Will Be the Norm Within 20 Years. Earth's Future, 5: 1203-1216. doi:10.1002/2017EF000639 [Thomas Knutson, United States of America]	Rejected. In this section we do not assess human heat stress metrics.
31896	15	53	15	54	Shouldn't it be "global thermodynamic contribution to specific humidity"? [Wei Zhang, United States of America]	Accepted. Text has been revised.
14164	16	1			so are [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Text has been revised.
50654	16	5	16	5	I agree that from a local point of view (framework of Pfahl et al) the lifting is the key dynamical contribution, however, non-locally the dynamical contributions are far more complex, e.g. through the advection of moisture, through changes in the stability, and non-linear feedbacks of all of these factors. [Olivia Martius, Switzerland]	Taken into account. We have revised the text and provided more details on dynamical changes and their complexities. However, it should be noted that the aim of this box is not to be fully comprehensive but to provide some key aspects of the dynamics/thermodynamics separation.
52736	16	5	16	8	The vertical motion does not arise from these phenomena. These phenomena, including the vertical motion, are a result of various instabilities (e.g. baroclinic, symmetric, convective). [Douglas Maraun, Austria]	Taken into account. We have modified this sentence to make reference to hydrodynamic instabilities at the source of the changes.
52738	16	5	16	16	An important missing issue is the overall stability of the atmosphere, which increases towards the Tropics and decreases towards the poles. This has a strong impact on vertical velocities. [Douglas Maraun, Austria]	Taken into account. We have added "static stability" as an example of large-scale dynamical changes. A detailed discussion of dynamical large-scale changes is given in Chapter 8.
14166	16	5			Suggest: "Dynamic contribution to heavy precipitation is determined by changes in atmospheric vertical motion resulting from..." [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Text has been revised.
30160	16	7	16	8	"whose frequency and intensity are largely controlled by the large-scale circulation". This is not necessarily the case. Thermodynamic forcing tends to control the intensity of heavy precip (see Pfahl et al. 2017 and other papers) but large-scale dynamic forcing will change frequency of events. For some events, i.e. convective extremes from thunderstorms, local dynamics enhance the thermodynamic effect so although large-scale dynamic forcing may control the overall frequency, thermodynamics and local scale enhancements control the intensity changes (see Lenderink and Fowler, 2017 NCC and references therein) [Hayley Fowler, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. We have removed the sentence "whose frequency and intensity are largely controlled by the large-scale circulation" and modified the text to make clear that dynamical changes can be related with large-scale conditions and within the storm conditions.
50652	16	11	16	11	Please explain in more detail, I do not think that a non-expert in this subfield can understand the point [Olivia Martius, Switzerland]	Taken into account. The text now provides further details to better understand the complexity of the changes.
30162	16	14	16	16	In particular, "contributions from changes in the dynamical term can either lead to increases or decreases of precipitation extremes and thus lead to smaller or even a reversal of thermodynamic climate changes". This is true on large scales but not necessarily true for thunderstorm type events - dynamics tends to increase intensity - see comment above [Hayley Fowler, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. We have removed the sentence "whose frequency and intensity are largely controlled by the large-scale circulation" and modified the text to make clear that dynamical changes can be related with large-scale conditions and within the storm conditions.
39074	16	15	16	15	In the Nie et al paper it is an amplification not a decrease as the text suggests. The follow paper related close to Nie paper: Hohenegger C, Brockhaus P, Bretherton C S and Schär C 2009 The Soil Moisture–Precipitation Feedback in Simulations with Explicit and Parameterized Convection J. Clim. 22 5003–20 Online: http://journals.ametsoc.org/doi/abs/10.1175/2009JCLI2604.1 , Figure 8 top panel showing dynamic amplification at high dew point temperatures [Lenderink Geert, Netherlands]	Accepted. The reference to Nie et al has been removed in this specific case. We have not included the reference to Hohenegger et al. (2009) as it refers to soil moisture feedbacks and it is not relevant for this statement.
30066	16	16	16	16	Otto et al. (2016) is not a peer-reviewed publication and so should not be cited here, especially since it is not needed (as there are many other papers being cited in support of the statement). [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. We have removed the reference.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
29700	16	18	16	27	Make it clear that the first part of this paragraph refers to extratropical cyclones. The second part refers to tropical cyclones over the same ocean basin (N. Atl.); therefore, it seems that the process of extratropical transition of tropical cyclones should be mentioned here. [Alexander Alexander Baker, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. This paragraph has been removed.
14168	16	19			Also, event attribution may need further explanation since they are usually used to attribute to greenhouse gas forcing which can exert thermodynamic and dynamic changes. Also, "events, attribution". [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. This paragraph has been removed.
52740	16	21	16	23	This statement should be deleted, or at least tuned down. Both papers are based on one (in fact the same) GCM/RCM combination, but the response in the relevant dynamical changes differs strongly from model to model. Using another model might give just the opposite signal. In fact this statement is in contradiction with the statement below (line 41-43, midlatitudinal transition areas) [Douglas Maraun, Austria]	Not applicable. This paragraph has been removed.
43930	16	23	16	25	Suggest to add here: ", although tropical cyclone simulations under future warming conditions tend to produce precipitation rate increases that scale at roughly the thermodynamic (Clausius-Clapeyron) rate when averaged within a few hundred km radius of the storm (Knutson et al. 2015). Ref: 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, https://doi.org/10.1175/JCLI-D-15-0129.1 . See Fig. 12. [Thomas Knutson, United States of America]	Not applicable. This paragraph has been removed.
14170	16	29			"% per degree of warming" - is this the standard format or should it be "% per degree Celsius of warming". %/K is used later in the box. [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	accepted. The expression "degree of warming" is widely used throughout the report so we have replaced %/K by % per degree of warming.
52742	16	33			Explain briefly that efficiency is linked to cloud microphysics [Douglas Maraun, Austria]	Accepted. We have added " (often related with microphysical processes)"
26238	16	40	16	40	I cannot find decrease in the dynamic component in most of the extratropics and please delete "and extratropics". [Chihiro Kodama, Japan]	Accepted. While there are a few small areas in extratropical regions showing decreases, only the subtropics show large regions where the dynamic contribution is negative. We have removed and and extratropics" from the text.
26240	16	43	16	45	Tandon et al. (2018) focused on the subtropics, not extratropocs, and please delete "and extratropics". [Chihiro Kodama, Japan]	Taken into account. In Tandon et al. (2018b) the analysis includes the extratropics too. We have added that reference in the text.
30164	17	2	17	6	You should add reference here to all the work done on this by Geert Lenderink and co-authors - i.e. Super-Clausius-Clapeyron scaling of extreme hourly convective precipitation and its relation to large-scale atmospheric conditions G Lenderink, R Barbero, JM Loriaux, HJ Fowler Journal of Climate 30 (15), 6037-6052; Large-scale controls on extreme precipitation JM Loriaux, G Lenderink, AP Siebesma Journal of Climate 30 (3), 955-968, and there are many others [Hayley Fowler, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. Subdaily and super-adiabatic or super CC scaling rates are now discussed in "Heavy precipitation" Section (section 11.4).
39076	17	3	17	5	It is not only the duration but also the size could be an important factor, as e.g. In Prein A F, Liu C, Ikeda K, Trier S B, Rasmussen R M, Holland G J and Clark M P 2017 Increased rainfall volume from future convective storms in the US Nat. Clim. Chang. 7 880–4 Online: http://dx.doi.org/10.1038/s41558-017-0007-7 and https://iopscience.iop.org/article/10.1088/1748-9326/ab214a/pdf , and KendonKendon E J, Ban N, Roberts N M, Fowler H J, Roberts M J, Chan S C, Evans J P, Fosser G and Wilkinson J M 2017 Do Convection-Permitting Regional Climate Models Improve Projections of Future Precipitation Change? Bull. Am. Meteorol. Soc. 98 79–93 Online: http://journals.ametsoc.org/doi/10.1175/BAMS-D-15-0004.1 [Lenderink Geert, Netherlands]	Not applicable. We have removed the reference to duration as this is now covered in detail the "Heavy precipitation" section. In the "Extreme storms" section there is also discussion about the size of MCCs.
50656	17	6	17	6	Yes but there are also studies that find a weakening of the cyclones due to changes in the cyclone structures, Kirshbaum , D. J., T. M. Merlis, J. R. Gyakum, and R. McTaggart-Cowan, 2018: Sensitivity of Idealized Moist Baroclinic Waves to Environmental Temperature and Moisture Content. J. Atmos. Sci., 75, 337-360. [Olivia Martius, Switzerland]	Accepted. We have revised the text and added this reference.
30166	17	6	17	9	Include reference to one or two of the many papers by Lizzie Kendon's group in this area here: i.e. for e.g. https://journals.ametsoc.org/doi/full/10.1175/BAMS-D-15-0004.1 [Hayley Fowler, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. We have added Kendon et al (2014).

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
30168	17	10	17	13	"Some studies performed using convection permitting simulations have suggested that the future intensification of precipitation extremes can depend on the duration of events with shorter-duration events showing higher scaling rates (e.g., Kendon et al., 2014), but other studies did not show differences (e.g., Ban et al., 2015)." THIS STATEMENT IS WRONG AS WRITTEN - the Kendon et al study does not show higher scaling rates for shorter-duration than longer-duration events but it shows that you need convection-permitting model simulations to provide projections of increases in short-duration extremes in warm (convection dominated seasons). This is summarised in the review paper by Kendon: https://journals.ametsoc.org/doi/full/10.1175/BAMS-D-15-0004.1 . The paper that looks at scaling by Kendon's group is different - Chan et al. 2016: Chan, S.C., Kendon, E.J., Roberts, N.M., Fowler, H.J., Blenkinsop, S. 2016: Downturn in scaling of UK extreme rainfall with temperature for future hottest days. Nature Geoscience, 9, 24–28, DOI: 10.1038/NGEO2596. This shows that CP models can reproduce observed scaling relation but that coarser resolution RCMs cannot. Ban's study suggests that both can produce scaling. I would suggest re-reading these papers. [Hayley Fowler, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. We have revised the text accordingly. The dependence of precipitation in the duration of the events is discussed in detail in the "Heavy precipitation" section.
52744	17	10			Please add Meredith et al., J Geophys. Res., 2015. They showed that peak intensities in precipitation are also linked to the simulation of realistic updrafts, which are not well parameterised. Similarly downdrafts resulting in cold pools and moderation of convection are not well parameterised. [Douglas Maraun, Austria]	Accepted. This reference has been added.
14172	17	15			A distinction between changes in the number of extreme event (which are strongly influenced by dynamics) from the changing severity of an extreme event when the meteorological conditions occur (which is strongly affected by thermodynamics) would be useful and policy relevant since more confidence may be ascribed to the later case, sometimes referred to rather confusingly as "storyline" which can also be misinterpreted as a "narrative approach". [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. We have summarized extreme precipitation changes and comment on the frequency/intensity issue. Further assessment on this is given in Chapter 8.
55930	17	17	48	60	Expanding of Hadley circulation and changes in its intensity (not mentioned here) also (and likely first of all) results in poleward deflection of tropical cyclone tracks and moving to the north the locations of tropical cyclone max intensity (Studholme and Gulev 2018, J. Climate, doi:10.1175/JCLI-D-17-0852.1, Sharmila and Walsh, 2018, Nature Climate Change, doi:10.1038/s41558-018-0227-5, Altman et al., 2018 PNAS, DOI: 10.1073/pnas.1808979115). [Olga Zolina, France]	Noted. The poleward shift of tropical cyclones is discussed in Section 11.7 but not in BOX 11.1.
27864	17	29	17	29	- ENSO is the only example referenced in this section. Could benefit from including studies about other large scale circulation phenomena. [roderik van de wal, Netherlands]	Noted. These details are topics of other specific sections.
50658	17	29	17	29	Please define large-scale circulation, what is the difference to teleconnection patterns? Which time scales are included and why? [Olivia Martius, Switzerland]	Noted. These details are topics of other chapters.
43278	17	29	18	6	I think some information on the respond of the polar vortex to climate change should be added here, which links to cold extremes. [Yongjie Huang, United States of America]	Noted. Not directly relevant here. This is specifically addressed in Section 11.3 and Chapter 10.
54136	17	29	18	6	Discussion of large-scale circulations at sub-seasonal to seasonal time scale is not addressed at all. [Husain Najafi, Iran]	Noted. These details are topics of other chapters.
52750	17	29			Chapter 10 discusses the effects of large-scale circulation on regional climate. A link would be useful. [Douglas Maraun, Austria]	Accepted. Citing Chapter 10.
51420	17	31	18	6	spaces are missing at various occasions in this section [Bart Van den Hurk, Netherlands]	Accepted.
32372	17	34			The following paper characterises the impact of ENSO on the spatial scale and intensity of heatwaves in Australia. MODELLING THE EFFECT OF THE EL NINO-SOUTHERN OSCILLATION ON EXTREME SPATIAL TEMPERATURE EVENTS OVER AUSTRALIA By: Winter, Hugo C.; Tawn, Jonathan A.; Brown, Simon J. Annals of Applied Statistics Volume: 10 Issue: 4 Pages: 2075-2101 Published: DEC 2016 [Simon Brown, United Kingdom (of Great Britain and Northern Ireland)]	Noted.
52748	17	35			replace "position" by "extent"? [Douglas Maraun, Austria]	accepted
21484	17	36	17	36	"where tropical and extra-tropical cyclone occur ...". Please add space between cyclone occur...." [Gwenaelle GREMION, Canada]	Accepted.
52746	17	36			replace "determine" by "influence"? [Douglas Maraun, Austria]	accepted
44584	17	41	17	41	Replace 'astropical' by 'as tropical' [Krishnan Raghavan, India]	Accepted.
50660	17	44	17	44	Please add references [Olivia Martius, Switzerland]	Noted. Specific topics were moved to specific sections.
8084	17	48	17	48	Delete "various": Changes of most of the atmospheric large-scale circulation drivers are uncertain. [Soledad Collazo, Argentina]	Accepted.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
6808	17	48	17	51	The current understanding of how blocking events may change under warming and how this may affect extreme temperatures and drought should be briefly summarized here. [Laura Suarez-Gutierrez, Germany]	Noted. These details are topics of other specific sections.
15618	17	48	18	1	The author may also refer to NAO, subtropical/polar frontal jets (circumglobal teleconnection; CGT) which are crucial global pattern that potentially cause extreme events in middle-high latitude regions. [Tomonori Sato, Japan]	Noted. These details are topics of other specific sections.
15614	17	48	18	6	Recent studies highlighted that the volcanic eruption can intensify the ENSO- and NAO-induced regional climate anomalies through dynamical and thermodynamical pathways. (1) Dogar, M. M., and T. Sato, Regional climate response of Middle Eastern, African and South Asian monsoon regions to explosive volcanism and ENSO forcing. J. Geophys. Res. Atmospheres, accepted. DOI: 10.1029/2019JD030358 [Tomonori Sato, Japan]	Noted. These details are topics of other specific sections.
25454	17	49	17	49	Ch 2 (including Fig 2.18) also makes conclusion re very likely Hadley cell widening - should include reference to Ch2 here also? [Sharon Smith, Canada]	Accepted. Change to refer to Chapter 2.
21486	17	50	17	50	"which would effect tendencies ...". Please add space between effect tendencies ..." [Gwenaelle GREMION, Canada]	Accepted.
8086	17	51	17	54	Rewrite the sentence. It is unclear. A suggestion: "The ENSO is relevant for projected global changes in extreme events because it is very likely that ENSO favour various extreme events in wide areas including droughts (Section 11.6 and Box 11.3) and tropical cyclones (see sections 11.7.1); nevertheless, the projection of ENSO is uncertain (Chapter 4)" [Soledad Collazo, Argentina]	Accepted. Revised using the suggested sentence.
14174	17	52			ENSO events [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	accepted
26764	18	3	18	6	Not sure there is reason to make a confidence statement about something this obvious. The low/medium statements are not specific on what is meant, so rather meaningless. [Thorsten Mauritsen, Sweden]	Considered and the statements are adjusted. The first statement is changed as a statement of fact (with no confidence level assigned, as this is obvious). The low confidence statements remain as, well, our confidence on how extremes will respond to changes in circulation is low.
54190	18	4	18	4	a space is needed between "especially" and "on" [Sarah Sparrow, United Kingdom (of Great Britain and Northern Ireland)]	accepted.
54192	18	5	18	5	a space is needed between "overall" and "low" [Sarah Sparrow, United Kingdom (of Great Britain and Northern Ireland)]	accepted.
21488	18	5	18	5	"overall low ...". Again please add space between overall low..." [Gwenaelle GREMION, Canada]	accepted
52752	18	6			Please rephrase this statement. Even if the confidence is low, we have high confidence that there will be changes – we just don't know in which direction. See the Shpherd PTRSA 2019 paper as guidance again. [Douglas Maraun, Austria]	Noted.
15596	18	9	19	27	Majority of models participating future projections do not consider snow cover in the urban canopy model. Since the urban heat island will be mitigated by the snow cover, many climate models overestimate the current urban effect in the winter-spring seasons. As snow cover duration shortens in the future, the urban surface is more exposed, and the urban temperature increases more rapidly via albedo feedback and increased Bowen ratio. In snowy urban areas, the effect is estimated as large as 0.5K which is comparable magnitude with the effect of artificial heat release. (1) Mori, K., and T. Sato, 2015: Evaluating the Role of Snow Cover in Urban Canopy Layer on the Urban Heat Island in Sapporo, Japan with a Regional Climate Model. J. Meteor. Soc. Japan, 93, 581-592, DOI: 10.2151/jmsj.2015-039. [Tomonori Sato, Japan]	Noted but this aspect is too detailed and is considered to be beyond the scope of this assessment.
15612	18	11	19	27	Please consider commenting on the importance of land surface models that may influence the degree of the uncertainty of extreme events. Since the climate extremes are often evaluated for (near) surface environments. The amplitude of those extremeness is strongly dependent on the surface processes (including energy budget) and is thereby very sensitive to the anomalies in soil moisture, snow, and SST for coastal regions. The uncertainty regarding to the extreme event is contingent with the performance of the land surface model; whether it can simulate realistic land-atmosphere interaction. [Tomonori Sato, Japan]	Agreed. This aspect was expanded in the SOD.
21490	18	12	18	12	There must be a space between the references e.g. "...2013:Miralles", here need to add space "... 2013; Miralles...". Here and elsewhere required [Gwenaelle GREMION, Canada]	accepted
21492	18	13	18	13	"...concentrations(H...". Please add space between "concentrations (...." [Gwenaelle GREMION, Canada]	accepted

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
54570	18	16	11	50	It will be interesting to look at ITCZ and changes in the extremes [Mark Owidhi, Kenya]	noted. We are not sure what this is referenced to. No action taken.
55766	18	18	18	36	Include discussion of anthropogenic surface materials (asphalt, concrete) and the urban heat island as another example [Ariane Middel, United States of America]	accepted
15598	18	18	18	36	You may comment on the effect of urbanization (or other land use change that reduce soil moisture) as well. It can amplify the magnitude of hot extreme. [Tomonori Sato, Japan]	accepted
52754	18	18	18	50	There is quite some overlap with Chapter 10. We should check whether this is justified, or whether parts should be moved from one Chapter to the other. [Douglas Maraun, Austria]	noted. We have coordinated with Chapter 10
14178	18	24			Is "ca." standard? "about" is easier to read and understand. [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	accepted.
15384	18	27	18	30	An impact of deforestation on floods is missed. Please add. Tan-Soo, J. S., Adnan, N., Ahmad, I., Pattanayak, S. K., & Vincent, J. R. (2016). Econometric evidence on forest ecosystem services: deforestation and flooding in Malaysia. <i>Environmental and resource economics</i> , 63(1), 25-44. Moghadasi, N., Karimirad, I., & Sheikh, V. (2018). Assessing the Impact of Land Use Changes and Rangelands and Forest Degradation on Flooding Using Watershed Modeling System. In <i>Natural Hazards-Risk Assessment and Vulnerability Reduction</i> . IntechOpen. Chaudhary, R. P., Uprety, Y., & Rimal, S. K. (2016). Deforestation in Nepal: Causes, consequences and responses. <i>Biological and Environmental hazards, risks, and disasters</i> , 335-372. [Oksana Lipka, Russian Federation]	Noted. While deforestation has effect on regional and local floods, they are not assessed here due to limited scope on flood assessment of this chapter.
31898	18	31	18	31	temperate [Wei Zhang, United States of America]	accepted
14180	18	31			temperature --> temperate [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	accepted
14182	18	34			insance --> instance [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	accepted
21494	19	1	19	19	All dual references needs spacing in between them [Gwenaëlle GREMION, Canada]	accepted
52756	19	2			Would it be useful to sketch what spatial and local (temporal) feedbacks are? [Douglas Maraun, Austria]	Rejected. Would be too detailed for the assessment.
15600	19	6	19	7	There are many other studies investigating the effect of lakes. Other studies showed that oasis and irrigation can also modify the thunderstorms. (1) Sato, T., F. Kimura, and A. S. Hasegawa, 2007: Vegetation and topographic control of cloud activity over arid/semiarid Asia. <i>J. Geophys. Res. -Atmospheres</i> , 112, D24109, DOI: 10.1029/2006JD008129, (2) Singh, Prasamsa, and Kenji Nakamura. "Diurnal variation in summer precipitation over the central Tibetan Plateau." <i>Journal of Geophysical Research: Atmospheres</i> 114.D20 (2009). (3) Huang et al. "General Features of Radar-Observed Boundary Layer Convergence Lines and Their Associated Convection Over a Sharp Vegetation-Contrast Area." <i>Geophysical Research Letters</i> 46.5 (2019): 2865-2873. [Tomonori Sato, Japan]	Noted. We in general includes post-AR5 literature and we do not necessarily include all published papers.
14184	19	6			The following does not seem relevant for climate change unless lakes increase the response of heavy precipitation associated with thunderstorms relative to comparable land regions without the influence of lakes. "Locally the presence of lakes may amplify heavy precipitation associated with thunderstorms (Thiery et al., 2016)." [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. The sentence is removed.
30068	19	8	19	9	This seems to be a misreading of Pithan & Mauritsen (2014), who found the ice-albedo feedback to be only the third most important factor in Arctic amplification. [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. The text does not discuss main factors that contribute to Arctic amplification. The focus here is just to say snow/ice albedo feedback plays a role

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
30170	19	10	19	11	Add in reference to new sub-daily precipitation dataset - GSDR : https://journals.ametsoc.org/doi/abs/10.1175/JCLI-D-18-0143.1. This brings together Dunn's HadISD dataset with national records collected in the INTENSE project and has been QC'd using methods developed by: Lewis, E., Quinn, N., Blenkinsop, S., Fowler, H.J., Freer, J., Tanguy, M., Hitt, O., Coxon, G., Bates, P., Woods, R. 2018. A rule based quality control method for hourly rainfall data and a 1km resolution gridded hourly rainfall dataset for Great Britain: CEH-GEAR1hr. Journal of Hydrology, 564, 930-943, DOI: 10.1016/j.jhydrol.2018.07.034. Blenkinsop, S., Lewis, E., Chan, S., Fowler, H.J. 2017. Quality control of an hourly rainfall dataset and climatology of extremes for the UK. International Journal of Climatology, 37(2), 722–740, DOI: 10.1002/joc.4735. These were adapted to work at the global scale and will be submitted as a paper soon. Perhaps you could also add this global QC method into the next sentences alongside the Dunn method? There is more information about this in Blenkinsop, S., Fowler, H.J., Barbero, R., Chan, S.C., Guerreiro, S.B., Kendon, E., Lenderink, G., Lewis, E., Li, X.-F., Westra, S., Alexander, L., Allan, R.P., Berg, P., Dunn, R.J.H., Ekström, M., Evans, J.P., Holland, G., Jones, R., Kjellström, E., Klein-Tank, A., Lettenmaier, D., Mishra, V., Prein, A.F., Sheffield, J., Tye, M.R. 2018. The INTENSE project: using observations and models to understand the past, present and future of sub-daily rainfall extremes. Adv. Sci. Res., 15, 117-126, DOI: 10.5194/asr-15-117-2018. [Hayley Fowler, United Kingdom (of Great Britain and Northern Ireland)]	Considered. But this seems to be out of place. Or perhaps the page/line numbers are wrong. These are more relevant to section 11.2 and were considered there.
21496	19	13	19	13	space between "extremesin.." is required! [Gwenaelle GREMION, Canada]	accepted
55932	19	19	15	19	Whether this has links to compound extremes, or this is something different (my impression is something different). Should be better explained with direct reference to compound extremes, stating that this is a different phenomenon (while not sure that this is really different from what is termed as compound event). [Olga Zolina, France]	Noted and considered. This is treated from the perspective of processes (feedback).
26766	19	21			No reason to put a confidence statement here. [Thorsten Mauritsen, Sweden]	Accepted.
55934	19	22			Data and methods. Should be stated in the beginning that major requirements are high temporal and spatial resolution, and these can be hardly achieved simultaneously at least with station data. [Olga Zolina, France]	Noted and reflected in the revised version
21498	19	23	19	23	"temperature feedback, play .." please add space between feedback, play [Gwenaelle GREMION, Canada]	accepted
52758	19	32			Chapter 10 has a discussion of regional observations, again with some overlap. We should discuss to what extent material should be moved. [Douglas Maraun, Austria]	noted and considered. This was coordinated with Chapter 10 in SOD.
27868	19	34	19	34	(pg.19 line 34) #The second sentence of this paragraph is a more clear opening statement. It would be more clear to use this sentence first and then mention that previous reports #elt with this idea. [roderik van de wal, Netherlands]	Accepted- Text revised
21506	19	34		49	This entire paragraph refers to the comparison between extremes and climate, and the challenges following data averaging and resolution standardization. The terms 'long-term changes' or 'long-term trends' should be accompanied by a time frame. Climate variability is commonly expressed in 30yr time windows, how does the singular event integration over this time scale affect the signal? [Gwenaelle GREMION, Canada]	Not applicable- sentence removed
21502	19	41		42	Sentence difficult to understand. Proposed change: 'Because daily data is averaged out during seasonal mean computing, summer mean temperature should show a lower amplitude daily maxima. [Gwenaelle GREMION, Canada]	Not applicable- sentence removed
21504	19	43		44	Sentence difficult to understand. Proposed change 'the same applies for signal-to-noise ratio between summer mean and daily maxima'. [Gwenaelle GREMION, Canada]	Not applicable- sentence removed
14186	19	47			trends [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable- sentence removed
46154	19	49			add a reference, please [Marina Baldi, Italy]	Not applicable- sentence removed
53002	19	52	20	42	This section is really badly written with numerous typos and it really detracts from the 'reporting crisis' message I think needs to be made here. [Lisa Alexander, Australia]	Noted. These are corrected in SOD
48642	19	52	21	5	Observations for extremes (11.2.1) overlaps partly with Atlas.3 [Lincoln Alves, Brazil]	noted and considered. Some materials from Atlas were merged to section 11.2
54138	19	52	21	17	It is suggested that relevant reference is provided to chapter 10 in the mentioned lines. Some discussions overlap with chapter 10 or provided in more details there (in chapter 10) that can be referred to the chapter 10. [Husain Najafi, Iran]	noted and considered. This was coordinated with Chapter 10 in SOD.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
25456	19	52			Section 11.2.1.1 - Presumably these issues existed in previous assessment. Should there be less background information and more focus on improvements made since AR5 regarding use of limited data records etc. [Sharon Smith, Canada]	Noted and considered, this subsection is being rewritten.
21500	19	55	19	55	Some where "extra-tropical is written with "-" and here it is without hyphen. Better to be consistent in entire chapter [Gwenaelle GREMION, Canada]	Considered. This has been made consistent throughout the chapter.
21510	20	1		2	Avoid the use of and/or. Prefer 'or' here [Gwenaelle GREMION, Canada]	Accepted.
21516	20	1		29	Paragraph difficult to follow due to the presence of too many typos, incorrect English or words missing (e.g. line 9) [Gwenaelle GREMION, Canada]	Noted. Errors and typos are corrected.
37936	20	2	20	3	The sentence that spans these lines should be specific about the networks that have declined, and provide statistics or references. Comments 13, 34 and 35 on related text in Chapter 1 point out that the substantial review published by GCOS in 2015 identifies a number of network improvements, contrary to comments in that Chapter - hence the need to be specific (and consistent with whatever revisions are made in Chapter 1). [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Considered. But we do not see our role in assessing/reporting details about changes in various network. No change is made here.
14188	20	2	20	10	This section needs checking as it contains many errors e.g. avaiable --> available, leve?, avaiability, tracebility, etc [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted.
21512	20	2		3	Quoting the following sentence "networks' density with station data available have decreased in recent years"...due to? Lack money for maintenance? Decreased scientific or political interest? Please add a line, this is relevant. [Gwenaelle GREMION, Canada]	Rejected. Assessing the cause of deterioration of network is outside the scope of this chapter.
53000	20	7	20	7	the leve of improvement is still limited by the avaiability? [Lisa Alexander, Australia]	Noted. The level of improvement is still limited by data availability. The change is made.
21514	20	7		9	Should read 'level of improvement' and 'countries' [Gwenaelle GREMION, Canada]	accepted
46338	20	7			level [sadeh zeyaeyan, Iran]	accepted
57614	20	7			level [Sahar Tajbakhsh Mosalman, Iran]	accepted
13294	20	7			level [Mansoureh Kouhi, Iran]	accepted.
56448	20	8	20	8	conuntries reads "countries" [Pierluigi Claps, Italy]	Accepted
54842	20	8			section on reanalysis: the key issue are that trends are not reliable due to lack of homogeneity in time this could come out clearer (and I am not convinced this was invented by Sillmann there is a gazillion papers on this and many much older) [Gabriele Hegerl, United Kingdom (of Great Britain and Northern Ireland)]	Considered. This is now cleaner.
37938	20	10	20	11	What sub-daily observations of precipitation are being referred to here? Willett et al.(2014) did not discuss precipitation observations. GCOS(2015 - reference in Chapter 1) showed international exchange of a lower number of sub-daily observations of precipitation than temperature. For humidity, the percentage of synoptic observations from the WMO network reporting dewpoint alongside temperature was 98% in data received by ECMWF in October 2014, up from 97% in October 2002. The NCEI dataset used as input by Willett et al.(2014) had rather fewer such pairs. A dewpoint observation was present for 92% of temperature observations in October 2014. The quality control applied by Willett et al. reduced the relative number of humidity observations further, but the measurement itself is more challenging than the measurement of temperature, so that is something that might have to be accepted. All in all, the situation for humidity is perhaps not as bad as might be thought from the wording of the sentence in the FOD. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Considered. The passage was rewritten taking this comment into consideration.
56450	20	11	20	11	which reads "which is" [Pierluigi Claps, Italy]	accepted
28496	20	17		29	Some references would be helpful [Kanoksri Sarinnapakorn, Thailand]	Noted. References are now added.
53004	20	19	20	23	You haven't provided any references for these claims. There are several papers now that directly address the order of operation for extremes and how it impacts extreme calculation and global and regional trends etc. [Lisa Alexander, Australia]	Taken into account. The findings of these papers were considered and references added
46156	20	19	20	24	Please, clarify this point, making the text simpler. Maybe add an example? [Marina Baldi, Italy]	Considered, some references added.
43872	20	19	20	29	the issue of the smoothing extremes during construction of gridded data sets should be included here. Haylock M.R., et al. 2008, - J. Geophys. Res. 113, D20119 (smoothing of extremes), Hofstra N., et al. 2010: Climate Dynam. 35, 841-858 (effects of station density), Wibig et al., 2013, Met. Zeitschrift Vol. 23, No. 2, 181-187 (effect of station density on smoothing extremes) [Joanna Wibig, Poland]	Considered. Recent literatures are now cited.
27870	20	19	20	29	(pg.20 lines 19-29) - Can condense many of these statements to convey the same message with fewer words/sentences. [roderik van de wal, Netherlands]	Considered. The text is reformulated.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
55936	20	20	11	11	Importance of regional very high resolution networks of station data should be highlighted, see e.g. Zolina et al. (2014, BAMS, http://dx.doi.org/10.1175/BAMS-D-12-00134.1/) [Olga Zolina, France]	Noted and considered. This subsection was rewritten.
55938	20	20	22	23	Not clear why "In regions with very limited station density, the gridded values are closer to point estimate of extremes" [Olga Zolina, France]	Considered. Text is rephrased to improve clarity.
55940	20	20	32	33	While index-based data products provide a broader spatial coverage than raw variables.... Why so? Indexes are usually calculated from the raw data and if you don't deal raw data you are not able to calculate indexes. [Olga Zolina, France]	Considered. The correct wording is now used, it meant to be interpolated data.
21508	20	21	20	21	please add space between "...thencomputed" [Gwenaëlle GREMION, Canada]	accepted
46340	20	21			then computed [sadegh zeyaeyan, Iran]	accepted
57616	20	21			then computed [Sahar Tajbakhsh Mosalman, Iran]	accepted
13296	20	21			then computed [Mansoureh Kouhi, Iran]	accepted
43932	20	27	20	29	A reference to include for this sentence is Chen and Knutson 2008. Ref: Chen, C. and T. Knutson, 2008: On the Verification and Comparison of Extreme Rainfall Indices from Climate Models. J. Climate, 21, 1605–1621, https://doi.org/10.1175/2007JCLI1494.1 [Thomas Knutson, United States of America]	Considered, reference added.
54844	20	29		35	There are also very good papers by Van Oldenbrough and Zwiers on a trend covariate; and there is (possibly still unpublished) work by Richard Smith [Gabriele Hegerl, United Kingdom (of Great Britain and Northern Ireland)]	Noted. But we are not sure what this comment really means. No action is taken.
35340	20	31	20	31	"with between" - perhaps "with better" [Dunn Robert, United Kingdom (of Great Britain and Northern Ireland)]	Accepted.
56452	20	31	20	31	with between reads "with better" [Pierluigi Claps, Italy]	accepted
53864	20	31	20	36	Assuming you mean "better agreement" in line 31, I would check this statement for temperature information in the tropics. In much of Africa, datasets do not agree on the timing or climatology of heatwaves, for example. While the better agreement might apply in the extratropics, there is such a scarcity of station data in many of these tropical regions that there is strong disagreement in the models about how and when temperature extremes happen. [Erin Coughlan de Perez, United States of America]	Considered. What we mean by agreement is not location by location comparison and in some regions it is still not the case. This is now made clear.
37940	20	31			The second "between" on this line presumably should be "better". [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	accepted
50080	20	38	20	42	several typos. This paragraph may be removed because the main substance was highlighted in the two previous paragraphs [ARONA DIEDHIOU, Cote d'Ivoire]	Accepted. Agreed and paragraph removed
16282	20	41	20	42	There is a critical typographic error that can change the meaning of the conclusive statement. It has to be clarified whether it is a qualitative or quantitative assessment ...an example can be provided to make the [Tabassam Raza, Philippines]	Does not apply, paragraph removed
48738	20	45	20	45	Just a question, have analyses of the GCOS ECV datasets been undertaken looking at extremes and, if so, should these be mentioned here briefly. [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	Noted. As far as we are aware of, this is still yet to be done. But it is unclear if this is needed as most of exiting literature use data set for which the GCOS stations are subsets.
46158	20	47	21	3	I would like to add a note and a reference on the characteristics of the disomogeneities in the information which can be derived from satellite. Are they different in different geographical regions? There are differences along the coastline and the interior of a country? There are improvements with the latest satellites used?... [Marina Baldi, Italy]	Considered. Data homogeneity issue is considered when assessing changes in extremes.
53006	20	47	21	5	You should be able to use the Special Issue in ERL on extreme precipitation observations as a reference here too. This includes several intercomparison studies of precipitation products based on the FROGs database (Roca et al. 2019). I would say that yes we need to be cautious about satellite observations (and some datasets are better than others) but their utility for climate scale (i.e. long-term trend) analysis might not actually be too bad especially for those products which correct using in situ data. This does not mean that they are a substitute for good in situ obs and improved data coverage but I think moving forward we will have to rely on these products more and more for our climate assessments. [Lisa Alexander, Australia]	Considered. This is now cited in SOD.
14190	20	47			Remove "Introduced in 1979," which is not correct and not needed. [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Text revised
46512	20	50	20	50	please check "orbiting satellites" to "polar orbiting satellites" [Park Kyungwon, Republic of Korea]	text revised
14192	20	50			"orbiting" --> "low-Earth orbit" since geostationary satellites do sample continuously [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	changed to polar orbiting

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
44586	20	51	20	52	It would be useful to mention that satellite-based rainfall products have provided important insights about precipitation extremes. For example, Tan et al. (2015) analyzed TRMM precipitation and ISCCP cloud products and showed that regional increases in tropical precipitation have linkages to frequency of organized deep convection (eg., Tan (2015) - Nature 519, 451–454. doi:10.1038/nature14339). Other examples include, Hamada et al. (2015) on the linkage between heaviest rainfall and tallest storms. Nature Communications, 6, Article Number 6213. Furthermore, the TRMM satellite products have also provided important insights about the role of latent heating from mesoscale convective systems and organized convection in the genesis of mid-tropospheric cyclones of the Indian monsoon and heavy precipitation (eg. Ayantika Dey Choudhury et al. 2018, J.Atmos.Sci., DOI: 10.1175/JAS-D-17-0356.1) [Krishnan Raghavan, India]	Considered. Some new references on satellite-based rainfall products are cited.
46516	20	52	20	52	please correct "(2019)analysed" to "(2019) analysed" [Park Kyungwon, Republic of Korea]	accepted.
38890	20	54	20	55	Radiosonde results, in particular those of homogenized radiosonde time series, should also be mentioned. [Uwe Ulbrich, Germany]	Rejected. Here we are more focused the dataset most relevant to the scope of chapter 11, we do not intend to assess all data sets.
21518	21	2	21	2	please add space between "butthey'... [Gwenaelle GREMION, Canada]	accepted
46514	21	2	21	2	please correct "butthey" to "but they" [Park Kyungwon, Republic of Korea]	accepted
46342	21	2			but they [sadegh zeyaeayan, Iran]	accepted
57618	21	2			but they [Sahar Tajbakhsh Mosalman, Iran]	accepted
13298	21	2			but they [Mansoureh Kouhi, Iran]	accepted
53008	21	8	21	17	Again the FROGS database intercomparisons (in the ERL SI on extreme precipitation) will provide some more references as to why reanalyses have limited use in long-term analysis [Lisa Alexander, Australia]	This is considered in SOD
21520	21	8		8	Consider refining subtitle to 'Reanalyses data as observational proxy for extremes' [Gwenaelle GREMION, Canada]	Taken into account
37942	21	10	21	17	The limited horizontal resolution of past reanalyses is probably at least as big an impediment to using their datasets to study extreme precipitation as the issues with the assimilated observational data mentioned in this paragraph. Much better representation of the rainfall associated with tropical cyclones is seen for ERA5 than for ERA-Interim, though ECMWF's higher resolution operational data assimilation system shows there is still scope for further improvement (Hersbach et al., to be submitted shortly). [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Considered. This aspect is now reflected in SOD.
46160	21	10	21	17	What about other region of the World? May I ask the Authors to add some discussion about other sets of reanalysis? For ECMWF I suggest to visit the page: Browse reanalysis datasets - https://www.ecmwf.int/en/forecasts/datasets/browse-reanalysis-datasets While for a more comprehensive table, visit the page: https://climatedataguide.ucar.edu/climate-data/atmospheric-reanalysis-overview-comparison-tables [Marina Baldi, Italy]	considered. While reanalysis data are important for many applications, they are not the predominant datasets that are suited to analysis of historical changes of weather and climate extremes. For this reason they are not discussed in this chapter.
14194	21	10			"as a proxy observation" or "as proxy observations" or "as a proxy for observations" [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	changed to "as an observational proxy"
50662	21	12	21	12	Please add references [Olivia Martius, Switzerland]	accepted
21522	21	15		15	Consider adding short definition of 'Pentadal rainfall estimates' under brackets such as '(five-day rainfall)'. Uncommon term for non expert [Gwenaelle GREMION, Canada]	Considered, rephrased.
21524	21	17		17	Remove 'that' [Gwenaelle GREMION, Canada]	accepted
44648	21	20	21	27	I think bootstrap method should be considered here. Especially, when studying the ETCCDI index. [Liang Zhao, China]	Considered. But bootstrap is not usually used in the estimation of changes although it is often used in the estimation of uncertainty of trend.
46162	21	20	21	35	A word should be spent about the indices proposed, and largely adopted in most of the literature (as also mentioned later in the same chapter), by the joint CCI/CLIVAR/JCOMM Expert Team (ET) on Climate Change Detection and Indices (ETCCDI) https://www.wcrp-climate.org/etccdi http://etccdi.pacificclimate.org/index.shtml [Marina Baldi, Italy]	Taken into account and sentence has been added the ETCCDI indices
55942	21	21	29	35	There are also many studies which analysed high percentiles from the other theoretical distributions (like Gamma, Weibull). This should be mentioned as well. [Olga Zolina, France]	Not applicable- subsection rewritten
54140	21	22	21	27	It is suggested that suggested frameworks based on literature and the names of some methods (e.g. . The Mann–Kendall test (multiple trend analysis)) are provided here with relavant citations. One example is Zohrabi et al., 2016 (DOI 10.1007/s00704-016-1896-5). [Husain Najafi, Iran]	Noted. But we are not assessing the method per se. This is now clear in SOD.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
54062	21	22	21	35	Trend detection may be a term that is associated with linear trend methods for many and I wonder if change detection/detection of change is a more appropriate term as the change in a variable/statistic mat be assessed between two periods as in Guerreiro et al above and others. [Stephen Blenkinsop, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Title has been changed
32374	21	22	21	35	This is a general comment on statistical methods. There is little discussion of the adequacy, or the use of more advanced statistical methods. For pragmatic reasons the field has simplified the metrics and the methods to make the task possible. Yet this is not ideal, extremes are rare and have spatial and temporal dependence which nearly all studies are ignoring requiring advanced statistics. This is a deficiency in our discipline and needs highlighting. Here are some of the things we could and should be doing. This section only deals with a very specific and small area. Trend is very narrow. What about "chages" or "nonatationarity" . Modelling spatial extreme events with environmental applications. Tawn, J; Shooter, R; Towe, R; Lamb, R. SPATIAL STATISTICS, Volume: 28, Pages: 39-58, DEC 2018 Statistical Modeling of Spatial Extremes, Davison, A. C.; Padoan, S. A.; Ribatet, M., STATISTICAL SCIENCE Volume: 27 Issue: 2 Pages: 161-186 Published: MAY 2012 [Simon Brown, United Kingdom (of Great Britain and Northern Ireland)]	Considered. This aspect was highlighted in SOD.
26768	21	22	21	35	I am not sure what is meant by 'power' here? In more general terms different methods make different trade-offs between their ability to detect and the risk of false detections. [Thorsten Mauritsen, Sweden]	Not applicable. The sentence has been removed.
15302	21	22	21	35	A bit more explanation in this short section would be of benefit. Instead of distribution-free it could be said that the non-parametric methods do not assume any specific distribution for the variables that they are trying to characterize. The last sentence should explain that GMST is used as a regressor, or more generally as an explanatory variable for the trend in the parameters of the GEV. [Claudia Tebaldi, United States of America]	accepted
28498	21	22		35	Issue: Nonparametric method was mentioned, but no examples. Suggestion: Give some examples of indices that would require nonparametric method and which nonparametric method to use. [Kanoksri Sarinnapakorn, Thailand]	Thank you for the comment. We have included the ETCCDI indices.
14196	21	23			Subsection 11.2.2 was not clear to me, particularly from line 22-31 [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Considered, the subsection is rewritten to improve clarity.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
26818	21	29	21	31	<p>I am concerned that there could be some misunderstanding of this paragraph. GEV distributions are not the only statistical approach to modelling extreme values. I wondered if it would be more appropriate to talk about extreme value analysis (EVA) first before commenting that one statistical model used is the GEV. Another frequently used approach is the GPD distribution which has some advantages over the GEV distributions. If useful I have briefly sketched out a form of words below but please feel free to ignore if not appropriate. These words are based on the "Enabling resilient UK energy infrastructure: natural hazard characterisation" project that I was involved with. Volume 1: Introduction provides a good introduction to extreme value analysis. (https://www.imeche.org/docs/default-source/1-oscar/themes/eti-documents/vol1_intro.pdf?sfvrsn=2)</p> <p>"Extreme value analysis (EVA) is a statistical methodology that is used to model only the most extreme events that occur within a record, such as daily maximum temperatures. It allows the quantification of observed extreme events and can be used to extrapolated to extremes that have a larger magnitude than those observed in the record. An added advantage is that it can be used to quantify the robustness of these extrapolated extremes.</p> <p>Extreme value distributions are typically fitted to a subset of data that have been categorised as extreme – as standard statistical models fit the body of the data well but can model the extreme values poorly. Two main approaches that are often used for modelling extreme events are block maxima and threshold exceedance models.</p> <p>Block maxima select the largest observation in a given time block (i.e. year) and then fit a generalised extreme value (GEV) distribution to the selected set of extreme events. On the other hand threshold exceedance models select a high threshold. Any observations above this threshold are used to fit a form of the generalised Pareto distribution (GPD). The advantage of the GPD of the GEV approach is that it can potentially select more extreme events than the GEV as more than one extreme event can be selected from a given time block.</p> <p>EVA assumes that the data in the selected subset of extreme events are independent. This is not always true for weather and climate extremes. However, this issue can be overcome by fitting a non-stationary version of the EVA distribution with time or other variables as co-variables (Katz, 2010)" [Kate Brown, United Kingdom (of Great Britain and Northern Ireland)]</p>	Thank you for the comment. We have included a sentence on extreme value theory and a reference to Coles 2001
27872	21	29	21	35	<p>(pg.21 lines 29-35) Missing opening sentence with main point of this paragraph. Otherwise main point similar enough to combine with previous paragraph. [roderik van de wal, Netherlands]</p>	Subsection have been rewritten to account for the comment
52760	21	29			<p>"known or assumed" sounds weird. Also: we never know. The assumption is that we have iid random variables and are in an asymptotic case. We do not know whether we are in iid (typically we are not) and whether we are in the asymptotics already. We just know whether the distribution fits, but this tells us little about extrapolation. In a recent paper (De Michele and Avanzi, Scientific Reports 8:14204) it is argued that we are far away from the asymptotics when using annual maxima of daily precipitation. So you may delete the "known". In fact you could just state that data are modelled using the GEV (or GPD). [Douglas Maraun, Austria]</p>	Not applicable- sentence removed
32376	21	31			<p>Another early example would be: Global changes in extreme daily temperature since 1950, S. J. Brown, 1 J. Caesar, 1 and C. A. T. Ferro, JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 113, D05115, doi:10.1029/2006JD008091, 2008 [Simon Brown, United Kingdom (of Great Britain and Northern Ireland)]</p>	Considered. We usually only include papers published post-AR5,
52762	21	32			<p>The reason for the higher power is that a suitable parametric distribution is applied, not that we know that the distribution is correct (see comment above). [Douglas Maraun, Austria]</p>	Considered, wording rephrased.
32378	21	34			<p>There are many examples of using global temperature as the climate change metric in non-stationary EV analysis. Section gives the impression this is a new thing for AR6. Here are just two:</p> <p>Climate projections of future extreme events accounting for modelling uncertainties and historical simulation biases: Brown, S J.; M, James M.; Sexton, D M. H.; et al. CLIMATE DYNAMICS Volume: 43 Issue: 9-10 Pages: 2681-2705 NOV 2014</p> <p>Analysis of precipitation extremes in an ensemble of transient regional climate model simulations for the Rhine basin, Hanel, Martin; Buishand, T. Adri, CLIMATE DYNAMICS Volume: 36 Issue: 5-6 Pages: 1135-1153 Published: MAR 2011 [Simon Brown, United Kingdom (of Great Britain and Northern Ireland)]</p>	Noted, the more recent paper is cited.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
48740	21	38	21	38	Suggest adding in a reference to relevant CORDEX studies here as well (e.g. in collaboration with the Atlas). Also, regional climate models more generally should be referred to here as they are also used in extreme event attribution. [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	Considered. Coordinated with Atlas on this for SOD.
54142	21	38	22	12	It is suggested to add relevant references in modeling extremes for example: weather@home (see Massey, N., Jones, R., Otto, F.E.L., Aina, T., Wilson, S., Murphy, J.M., Hassell, D., Yamazaki, Y.H. and Allen, M.R. (2015) Weather@home - development and validation of a very large ensemble modelling system for probabilistic event attribution. Quarterly Journal of the Royal Meteorological Society, 141(690): 1528-1545.) [Husain Najafi, Iran]	considered. More relevant papers have been included in the assessment. Suggested papers are added.
52764	21	38			I find this section a bit weak and unspecific – or maybe even too long given the overlaps with the later specific discussions? Anyway, you may link to Chapter 10 – we have very thorough discussions of evaluation and added value there. [Douglas Maraun, Austria]	Considered. SOD was coordinated with Chapter 10
6810	21	40	21	48	Again, this section should mention how large ensemble modelling experiments offer new possibilities when studying extreme events. Here is particularly relevant how this type of experiments allows us to perform more robust model evaluation studies and comparisons to observations, such as those in Maher et al. 2019 (under review in JAMES) [Laura Suarez-Gutierrez, Germany]	Rejected. Maher et al. (2019) show new opportunities offered by large ensemble for model evaluation but the paper does not provide an evaluation of model performance in simulating extremes. The section assesses models performance in simulating extremes rather than how one can/should evaluate model's performance. For this reason, while the suggestion is good it is also not very relevant to the scope of the section.
50664	21	41	21	41	the reference is unclear, are you referring to the models or to the weather systems [Olivia Martius, Switzerland]	Considered. The revised text makes the intension clear.
50666	21	45	21	45	Please add references [Olivia Martius, Switzerland]	Considered, reference added.
50668	21	47	21	47	Please add references [Olivia Martius, Switzerland]	Considered, reference added.
6812	21	50	21	53	From this text is not clear to me how models fail to reproduce the observed distribution, please clarify. Schaller et al., 2018 find that having a larger ensemble improves the representation of observed European extreme temperatures in several models. They find however that large ensemble experiments with around 30 members fall short in simulating the most extreme observed events, at least in the case of the models considered in the study. Suarez-Gutierrez et al. 2018 find that this is not the case for the 100-member MPI Grand Ensemble, that simulates events with maximum temperatures as extreme as those observed and higher. [Laura Suarez-Gutierrez, Germany]	Considered. The relevant text is rewritten. The papers you mentioned are now included in the assessment.
21526	21	51		52	Consider changing 'high temperature extremes in well observed European regions' to 'temperature extremes european regions densely populated by observations' [Gwenaelle GREMION, Canada]	Considered, rephrased.
50670	21	55	21	55	Please define extreme storms [Olivia Martius, Switzerland]	Not applicable- sentence removed
29702	21	55	22	12	It should be mentioned here that the models resolution increases move towards explicitly resolving processes leading to extreme precipitation events, with less reliance from the convection parameterisations. [Alexander Alexander Baker, United Kingdom (of Great Britain and Northern Ireland)]	Considered. This aspect was already in the subsection.
40384	22	2	22	4	Empirical statistical downscaling (ESD) also contributes to GCM simulation. Both RCM and ESD allow for a better representation of regional climate characteristics (Haylock et al., 2006; Menéndez et al., 2009; Huth et al., 2015). Haylock, M.R., Cawley, G.C., Harpham, C., Wilby, R.L. and Goodess, C.M. (2006) Downscaling heavy precipitation over the United Kingdom: a comparison of dynamical and statistical methods and their future scenarios. International Journal of Climatology, 26, 1397–1415. https://doi.org/10.1002/joc.1318 . Menéndez, C.G., de Castro, M., Boulanger, J.-P., D'Onofrio, A., Sanchez, E., Sörensson, A.A., Blazquez, J., Elizalde, A., Jacob, D., Le Treut, H., Li, Z. X., Núñez, M.N., Pessacq, N., Pfeiffer, S., Rojas, M., Rolla, A., Samuelsson, P., Solman, S.A. and Teichmann, C. (2009) Downscaling extreme month-long anomalies in southern South America. Climatic Change, 98, 379–403. https://doi.org/10.1007/s10584-009-9739-3 . Huth, R., Mikšovský, J., Štěpánek, P., Belda, M., Farda, A., Chládková, Z. and Pišoft, P. (2015) Comparative validation of statistical and dynamical downscaling models on a dense grid in central Europe: temperature. Theoretical and Applied Climatology, 120, 533–553. https://doi.org/10.1007/s00704-014-1190-3 [Vanessa Pántano, Argentina]	Considered. We do not consider statistical downscaling as contributing to GCM simulations. The regional model aspect is considered. New references are added.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
8228	22	7	22	7	Improved representation of mesoscale convective systems has recently been shown in convection-permitting simulations https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2018EA000491 [Declan Finney, United Kingdom (of Great Britain and Northern Ireland)]	considered. Text is rephrased.
27874	22	7	22	12	(pg.22 lines 7-12) - Consecutive sentences beginning with however [roderik van de wal, Netherlands]	Taken into account. Text revised
39078	22	8	22	8	for a analysis of natural variability and forced signal at high resolution, see Aalbers E E, Lenderink G, van Meijgaard E and van den Hurk B J J M 2018 Local-scale changes in mean and heavy precipitation in Western Europe, climate change or internal variability? Clim. Dyn. 50 4745–66 Online: http://dx.doi.org/10.1007/s00382-017-3901-9 [Lenderink Geert, Netherlands]	Considered. This paper is assessed in SOD
50672	22	8	22	8	Please define structural uncertainty [Olivia Martius, Switzerland]	Rejected- the term is well known and defined in the literature.
56516	22	10	22	11	Prein et al., 2017c is listed twice. [Nikolina Ban, Switzerland]	Noted, corrected.
27030	22	11	22	11	please add reference De Troch et al. 2013 about the grey zone parametrization and its use for improving the precipitation extreme characteristics [Mansour Almazroui, Saudi Arabia]	considered. The main message here is that convection permitting simulation is still too short for the purpose of climate change analysis. No action is taken.
56518	22	11	22	12	The efforts in that direction are underway. Please see Coppola et al., 2018 [Coppola, E., Sobolowski, S., Pichelli, E. et al. Clim Dyn (2018). A first-of-its-kind multi-model convection permitting ensemble for investigating convective phenomena over Europe and the Mediterranean. https://doi.org/10.1007/s00382-018-4521-8]. [Nikolina Ban, Switzerland]	Considered. Text rephrased.
30172	22	11	22	12	"However, multi-decadal convection permitting simulations are not currently computational feasible, limiting their usefulness in evaluating changes in extremes." THIS is not true. The UK Met Office have recently completed an ensemble of 12 CPM runs at 2.2km over a whole UK (inclu Ireland) domain for 100 year time period 1980-2080. Based on boundary conditions from a PPE. These will be released in Oct 2019 to the public and first papers on analysis of the results will be submitted at the same time. They are perhaps not computationally feasible over global domain but over large domains they are (esp if you use GPU like Christoph Schaer does) [Hayley Fowler, United Kingdom (of Great Britain and Northern Ireland)]	Considered. Text rephrased.
39080	22	12	22	12	I think this is too negative. There are also a number of studies that use PGW or surrogate warming experiment to arrive at better signal to noise ratio's. Of course, these are limited to the thermodynamic driven part of the response, but still this is one of the major components (see e.g. in https://iopscience.iop.org/article/10.1088/1748-9326/ab214a/pdf , figure 8 where the response to the PGW experiment is actually rather close the response derived from observed changes [Lenderink Geert, Netherlands]	Considered. Text rephrased.
21530	22	12		12	computationally feasible' [Gwenaelle GREMION, Canada]	Accepted- Text revised
52766	22	12			But there are the simulations of the CORDEX flagship pilot study on convection (Coppola et al., Clim. Dynam., 2019) soon to be finished. These are not multidecadal, but decadal and across a large ensemble. [Douglas Maraun, Austria]	Considered. More detail on the modelling of regional information is in section 10. Reference to the exact section has been added.
6814	22	15	22	29	There is a very strong focus on detection and attribution studies over several sections and subsections, here and later on in the chapter. While this is appropriate, it should be clarified in the section headings and topic sentences what the different focus is for different sections, and rearranged or merged where needed. Although the focus of this chapter on D&A studies is appropriate, it should not happen in detriment of focusing on future climate projection studies, which are arguably as relevant if not more. [Laura Suarez-Gutierrez, Germany]	Noted. This section is about detection and attribution. Projection is discussed elsewhere.
55458	22	17	22	20	The optimal fingerprint method is introduced for the first time without references and details thereof are given without clarity. Also, transferring extreme values to a gaussian distribution to use the method is also given, again without references. [GENITO MAURE, Mozambique]	Considered. We added a reference to Chapter 3 which has more detailed treatment.
52768	22	17	22	26	This section is not really understandable and does not provide much information for a non expert. E.g., what does it mean that a method is not optimized? Either shorten or render more specific and informative. [Douglas Maraun, Austria]	Considered. The text is expanded with additional references as well.
26770	22	17	22	26	This section isn't readable for non-experts. [Thorsten Mauritsen, Sweden]	Considered. The text is expanded with additional references

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
56504	22	17	22	26	This section lacks a critical discussion of some of the key limitations of many current attribution studies. The discussion should address the following limitations: (i) models often underestimate natural variability, leading to overconfident attribution statements (Bellprat et al. 2019, https://doi.org/10.1038/s41467-019-09729-2); (ii) often global sea-surface patterns are carried over to the future climate leading to conditional (rather than absolute) probabilities; (iii) the target variables are often selected for too large regions and too long time period, and do thus not reflect the true nature and amplitude of the extremes considered (e.g. Schar and Jendritzky, 2004, DOI: 10.1038/432559a) [Christoph Schär, Switzerland]	Considered. These are more applicable to event attribution section there we do address these issues. More literature on this point has been added.
21532	22	17		26	I did not understand how detection and attribution works! Paragraph difficult to follow, with complicated construction. As extremes do not follow a Gaussian distribution, is the probability index chosen, the stationary or non-stationary option? This is unclear as it stands [Gwenaelle GREMION, Canada]	considered. Text is expanded with new references.
54328	22	19	22	19	Replace "transferred" with "transformed" [Blair Trewin, Australia]	accepted
46344	22	19			do not [sadeqh zeyaeayan, Iran]	Rejected. Unclear comment.
57620	22	19			do not [Sahar Tajbakhsh Mosalman, Iran]	Rejected. Unclear comment.
13300	22	19			do not [Mansoureh Kouhi, Iran]	Rejected. Unclear comment.
54194	22	20	22	20	a space is needed after both citations on this line [Sarah Sparrow, United Kingdom (of Great Britain and Northern Ireland)]	accepted
54196	22	22	22	22	a space is needed after (2013) [Sarah Sparrow, United Kingdom (of Great Britain and Northern Ireland)]	accepted
32380	22	23			D & A studies looking at changes in extreme value distributions/parameters have been around for some time. Text is a bit misleading. Eg The Role of Human Activity in the Recent Warming of Extremely Warm Daytime Temperatures. Christidis, Nikolaos; Stott, Peter A.; Brown, Simon J. JOURNAL OF CLIMATE Volume: 24 Issue: 7 Pages: 1922-1930 Published: APR 1 2011 [Simon Brown, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Text is revised.
50676	22	25	22	25	Please explain midlatitude planetary wave modulation [Olivia Martius, Switzerland]	Noted but the page/line number seems to be wrong. No action is taken here.
27876	22	26	22	26	(pg.22 line 26) - Final sentence of paragraph should close with <name of method> rather than "this method" [roderik van de wal, Netherlands]	Noted, text revised
45612	22	29	23	52	In this section 11.2.5, the authors could consider referencing Cattiaux and Ribes 2018 who discuss the problem of event definition for attribution. In particular they discuss the issue of conditioning (here page 23 lines 3-25) and they quantify the sensitivity of attribution results to the selection of the spatio-temporal scale (here page 23 lines 27-36). They show that the sentence « large scale averages yield higher attributable changes » (here page 23 line 32) is true for temperature but not true for precipitation (for which the signal is stronger at smaller scale). Reference : Cattiaux, J. and A. Ribes (2018), Defining single extreme weather events in a climate perspective, Bulletin of the American Meteorological Society, 99, 1557–1568. doi :10.1175/BAMS-D-17-0281.1 [Julien Cattiaux, France]	Accepted. Text revised accordingly.
54178	22	29	23	55	Should this section also reference for AMIP style risk-based attribution experiments the importance of representing the uncertainty in the naturalised conditions (e.g. SSTs) which can have a large impact on the quantitative results e.g. Schaller et al 2016, Sparrow et al 2018. [Sarah Sparrow, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Reference has been added.
38904	22	29	23	55	This section lacks a clear explanation of the methodology: how is a percentage of attributable extreme events computed (This is only mentioned in later sections of the chapter, e.g. referring to Fischer and Knutti). A misunderstanding of such percentages and individual assignments must be avoided. I suggest an explanation in the form: "An extreme event is counted as being attributable to climate change, if the following conditions are fulfilled...." [Uwe Ulbrich, Germany]	Accepted. Text has been revised to incorporate mentioning of the concrete methodology, including two recent 'best practice' papers..
21534	22	29		29	What is the difference between 11.2.4. attribution of extremes, and 11.2.5. Extreme event attribution. Correct inconsistency [Gwenaelle GREMION, Canada]	considered. The SOD makes the distinction clear. One is attribution to long-term changes and the other is event probability. Though the two can also be connected.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
27878	22	31	22	34	(pg.22 lines 31-34) @This small paragraph can be omitted with the same point conveyed simply @By beginning the section with "since AR5" (pg.23 lines 21-25) @Can be combined with previous paragraph as they both have similar main points [roderik van de wal, Netherlands]	Noted, text revised
21536	22	31		32	Is the section referred in bracket (10.6.2) from AR5 or this AR6, it is unclear as it stands in this sentence [Gwenaëlle GREMION, Canada]	Considered. It referred to AR5. We now give proper reference.
51422	22	33	30	34	unclear phrase "for which the issue of human influence has already arisen" [Bart Van den Hurk, Netherlands]	Accepted. Changed the wording.
51424	22	39	30	44	unclear what you mean with "framing" in this section [Bart Van den Hurk, Netherlands]	Accepted. Framing is defined in the revised text.
30070	22	39	22	39	The two approaches are not equivalent. Suggest changing to 'complementary'. They are equivalent for the same pdf, but the storyline approach (if it is considered as a magnitude-oriented framing) does not require a pdf, so they are certainly not equivalent. [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	Considered. We agree with this and text is revised.
21528	22	43	22	43	please add space between "identifiedthat...." [Gwenaëlle GREMION, Canada]	accepted
30072	22	43	22	43	Otto et al. (2016) is not a peer-reviewed publication and so should not be cited here, especially since it is not needed. [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	rejected. Otto et al., 2016 is peer-reviewed and relevant here. https://www.nature.com/articles/nclimate3089
54198	22	43	22	43	a space is needed after (2016) and identified [Sarah Sparrow, United Kingdom (of Great Britain and Northern Ireland)]	accepted
21538	22	43		44	Besides needing additional word spacing, the last sentence misses a word after 'framing of ' leading to unclarity [Gwenaëlle GREMION, Canada]	Rejected. Sentence is correct.
46346	22	43			identified that [sadegh zeyaeyan, Iran]	accepted
57622	22	43			identified that [Sahar Tajbakhsh Mosalman, Iran]	accepted
13302	22	43			identified that [Mansoureh Kouhi, Iran]	accepted
52770	22	46			Should this be called risk-based, as the term risk is not used in the IPCC sense here, but rather in a hazard sense? [Douglas Maraun, Austria]	accepted. Added 'so-called' as it's a misnomer in the literature.
52772	22	47			replace "quantified" by "estimated" [Douglas Maraun, Austria]	Accepted. Text revised.
39026	22	52	22	52	Another example of large-ensemble AGCM: Mizuta, R., A. Murata, M. Ishii, H. Shigama, K. Hibino, N. Mori, O. Arakawa, Y. Imada, K. Yoshida, T. Aoyagi, H. Kawase, M. Mori, Y. Okada, T. Shimura, T. Nagatomo, M. Ikeda, H. Endo, M. Nosaka, M. Arai, C. Takahashi, K. Tanaka, T. Takemi, Y. Tachikawa, K. Temur, Y. Kamae, M. Watanabe, H. Sasaki, A. Kitoh, I. Takayabu, E. Nakakita, and M. Kimoto, 2017: Over 5000 Years of Ensemble Future Climate Simulations by 60 km Global and 20 km Regional Atmospheric Models. Bull. Amer. Meteor. Soc., 98, 1383-1398, doi:10.1175/BAMS-D-16-0099.1. [Masahide Kimoto, Japan]	Accepted. Publication has been added
52774	23	3	23	25	I found this paragraph weak and biased, mainly as it does not at all discuss the reasons for conditional event attribution. These are, among others: GCMs often have substantial circulation errors which bias "conventional" EA results – this argument is in particular valid in many mid-latitude regions where anthropogenic circulation changes over the last decades have been weak compared to internal variability, such that constant circulation statistics are a valid assumption. Second, in particular localised extreme events often require much higher resolutions than standard GCMs as used, e.g., in weather at home, can provide to simulate realistic climate change responses (e.g., for deep convection). Conditional event attribution allows for very high resolution simulations to overcome this problem. In particular in the first case, conditional EA allows one to ask often more user-relevant questions (how would the event have been w/o climate change?). In particular the use of the term "very conditional" sounds very derogative and is to a large extent arbitrary. I request a thorough revision of these paragraphs. [Douglas Maraun, Austria]	Considered. Paragraph revised.
21540	23	3		19	Paragraph very difficult to understand. What is the state which the human influence on extreme depend on? What is a conditional approach? How are applied the storylines to rare events? How rare? What are the condition limits imposed? What does highly conditional hindcast attribution approach mean? What's the difference between conditional statement and attribution statement? [Gwenaëlle GREMION, Canada]	Considered, section rephrased.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
38892	23	4	23	5	Naming "sea surface temperatures and sea ice concentrations" als parts of the climate system is misleading in this sentence. It should be replaced with "ocean and sea ice", as it is the whole system that changes, not just the interface. This plays a role, for example, as one has to distinguish the spatial and temporal scales involved. The recommended change is in line with the content of the subsequent sentences. [Uwe Ulbrich, Germany]	Accepted. Sentence has been revised.
51426	23	5	50	6	but simultaneously, this SST/sea ice state may also depend on anthropogenic influence [Bart Van den Hurk, Netherlands]	Accepted. A references to that effect has been added.
44588	23	11	23	11	Priya et al. 2015 is a relevant citation. This attribution of heavy precipitation occurrence over Pakistan during 2010 to Tropical Indo-Pacific SST anomalies was highlighted in this study. Ref: Priya et al. (2015): Impacts of Indo-Pacific Sea Surface Temperature Anomalies on the Summer Monsoon Circulation and Heavy Precipitation over Northwest India–Pakistan Region during 2010. J. Climate, Vol 28, 3714-3730. [Krishnan Raghavan, India]	Rejected. Reference is not relevant in this general introduction, but in the regional overview table 11.9.
55032	23	12	10	12	Could include a reference to section in chapter 1 here. Also in chapter 1 the concept of "event-storylines" was introduced that would be good to use in this section. [Rojas Maisa, Chile]	Accepted. A reference to chapter 1 has been made and event-storylines are now addressed in section 11.2.4.
30074	23	14	23	19	I do not disagree with anything said in this caveat. However, it seems unbalanced to only identify the limitations of the storyline approach and not of the risk-based approach. On line 13 it is said that storyline approaches can be applied to events that "are too rare to otherwise analyze". You could add something like "or where the very specific aspects of a particular event were key to the impacts". That's the heart of the issue: the risk-based approach necessarily requires a blurring of the conditions behind the extreme event (Shepherd 2016, in your reference list). [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Suggested wording added.
30076	23	21	23	25	It needs to be stated that the nature of the thermodynamic and dynamic uncertainties are very different (indeed you say that yourself elsewhere in the chapter). If they were not, there would be no need for the storyline approach! [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Added a sentence to that effect.
38894	23	22	23	22	The assignment of climate change effects to local changes in temperature and humidity is somewhat misleading: local station measurements can be influenced by local effects like urbanisation. Thus, it is often regional effects rather than just local effects which influence local extremes, for example producing in strong convective systems. Such regional influences include factors like vertical stability (differential warming or humidity change) and 3-d winds. [Uwe Ulbrich, Germany]	Considered, wording rephrased.
54846	23	22			I am not sure the thermodynamic effect is local, as the increased moisture can be transported Indeed global mean temperature does a good job predicting some of this. So please don't say local here [Gabriele Hegerl, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Removed 'local' & 'locally' in the paragraph.
38896	23	29	23	29	It is not just the magnitude of an event (which would often be thought of the peak value of a parameter), but additionally its characteristics, such as duration, spatial extent etc. [Uwe Ulbrich, Germany]	Accepted. This has been added.
51428	23	31	32	11	you mean a measure of heat stress than includes other variables than temperature alone? [Bart Van den Hurk, Netherlands]	Accepted. /this has been clarified.
21542	23	34		36	Consider changing this last sentence to: 'In general, large-scale extreme heat and long-period extreme precipitation events provide a higher confidence in attribution than the more localized and shorter events, such as storms' [Gwenaelle GREMION, Canada]	Considered, section rephrased.
52776	23	38	23	48	Here, a link to the box on thermodynamic and dynamic changes should be made. Standard GCMs have huge uncertainties in simulating circulation responses, i.e., any attribution where circulation plays an important role is often meaningless (at least in the mid-latitudes). For localised events parameterisations (deep convection, feedback strenghts) are very important. This discussion can then nicely link to the limitations of "conventional" event attribution and the need for conditional attribution. A paper to cite is the recent contribution by Sutton et al., Nature, 2018 on the current state of attribution research. [Douglas Maraun, Austria]	Accepted. Reference to box has been added.
51430	23	39	36	40	do you mean "stretch the capabilities..." instead of "stress the capabilities..."? [Bart Van den Hurk, Netherlands]	Accepted. Text has been revised.
21544	23	43		43	What is an overarching model evaluation? Please specify its meaning and why it would provide better statistics [Gwenaelle GREMION, Canada]	Considered, rephrased for clarity.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
52778	23	50	23	52	How can uncertainties be thoroughly assessed based upon one model? I suggest to generally assign low confidence as long as there are no other supporting arguments. Thus, if thermodynamical processes dominate, one may have reason for higher confidence, but not if dynamics dominate. This should then be the guidance note for statements also in Box 11.1 (page 11, line 23, comment above). [Douglas Maraun, Austria]	Considered. Confidence is assigned as low when only one model is used. A discussion on this has been added at the end of section 11.2.5.
21546	23	50		52	Add references related to multimodel and references for single model wthats thorough uncertainty assessment [Gwenaelle GREMION, Canada]	Considered. New references added.
53062	24	1	24	39	Section 11.2.6 is useful but it is also a bit unclear what the implications are. Especially the last para brings up some important aspects (i.e. definition of responses), but then it is quite loosley stated that "this seems to be less a problem for extremes assessed in this chapter". I think this needs some more basis - i.e. references or points to where the underlying assessment for this can be found in the chapter. [Jan Fuglestedt, Norway]	Considered. More discussion along with references are provided.
52780	24	1			In principle I very much like the approach of looking at warming levels. But this implicitly assumes that a pattern scaling approach works. Has anyone checked to what extent this is valid for dynamical changes, where patterns shift in space? [Douglas Maraun, Austria]	Thank you. To be considered for the SOD
39028	24	1			Nice discussion. Remarks on types of phenomena that are scaled well with warming levels and those not would benefit the readers. [Masahide Kimoto, Japan]	Thank you
21562	24	6	24	6	please add space between".. (2018a)found..." [Gwenaelle GREMION, Canada]	accepted.
21566	24	6		8	please consider the following changes 'increase in GMST has a quasi linear relationship' in reference to 'close to linear' terms used in Sun et al. (2018a) [Gwenaelle GREMION, Canada]	Accepted. Text revised
21568	24	8		8	Please add the study period 'for the observation period 1961 - 2015' after 'in China' [Gwenaelle GREMION, Canada]	Accepted. Text revised
50674	24	23	24	23	This is done per individual model? [Olivia Martius, Switzerland]	Noted, per individual model. This is now clear in the text.
21570	24	25		25	Proposed change: 'respond linearly with' rather than 'scale' for sentence clarity [Gwenaelle GREMION, Canada]	Accepted. Text revised
26772	24	35	24	39	I would recommend the chapter authors focus on extremes at different warming levels (as they do in most places), rather than in transients. To first order, I think one can make the extreme phenomena do not depend to any major extent on the global climate trajectory (warming, cooling, stabilizing). The current temperature at any one instance is the most important variable. [Thorsten Mauritsen, Sweden]	Noted. It is unavoidable to use transient response if one use CMIP5 and CMIP6 type simulations as these scenario simulations are transient simulations.
28500	24	37		38	Issue: What are the effects as mentioned in this sentence: The use of different definition of responses can have profound effects on certain extremes such as sea level rise? Suggestion: More elaboration. [Kanoksri Sarinapakorn, Thailand]	Taken into account for the SOD
48644	24	42	36	12	Section 11.3 on temperature extreme overlaps partly with Atlas.5 (Regional syntheses and case studies). Same outline and content. Needs coordination among CLAs [Lincoln Alves, Brazil]	Accepted. Have coordinated with Atlas.5
45614	24	42	37	12	This section 11.3 assesses changes in temperature extremes. I find it surprising that changes in temperature variability in general (at intra-seasonal, inter-seasonal or inter-annual scales) are not discussed at all, as they modulate changes in extremes by affecting the temperature distribution. [Julien Cattiaux, France]	Taken into account - text revised
54848	24	42			I like the organization of all the sections by mechanisms, trends, predictions etc. however its tricky to read as if scrolling (or later leafing) through you have to pin down what aspect of extremes is being discussed - I would keep the variable name in the subheading names [Gabriele Hegerl, United Kingdom (of Great Britain and Northern Ireland)]	To be considered for the SOD
54850	24	42			The temperature Section as all the other sections focuses on trends since 1950 - as all sections do. This is easier, but also dangerous as for example, over the central US the dustbowl heatwaves set records that may topple soon but to my knowledge havent toppled and hence a small trend since 1950 pales against such events. similarly, there are good discussions in hurricane counts etc; and also storms, where some longterm horizons put questionmarks on some trends since 1950 or worse 1970s. I would discuss some of these earlier events and trends. There is a nice paper by Andrew King discussing the dustbowl period also by Tim Cowan J Climate (involving me sorry - 2017) and some in progress. in some places early events are discussed but it is rare, and a missed opportunity i think [Gabriele Hegerl, United Kingdom (of Great Britain and Northern Ireland)]	Noted

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
13944	24	44	24	44	Another mechanism for changes in temperature extremes is changes in thermal advection due to changes in the mean state temperature gradients (eg Holmes et al, https://doi.org/10.1175/JCLI-D-14-00735.1 and Ayarzagueno and Screen, https://doi.org/10.1002/2016GL068092). [Tim Woollings, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Temperature advection is not a driver, and its associated with any drivers in general. Refers are Holmes for land-ocean contrast, Ayarzagueno and Screen for the polar-midlatitude interaction.
54332	24	44	26	24	This section deals almost exclusively with heat extremes, although its title implies that both heat and cold extremes are in scope here. Cold extremes are especially relevant in the discussion of the urban heat island (p26 lines 16-24). [Blair Trewin, Australia]	Noted. While cold extremes can be relevant, we are also limited by literature. No action is taken.
21550	24	46	24	46	The reference AR5 Ch 10 is incomplete, it would be AR5: The physical science basis, Ch 10 or AR5 WGI, Ch 10 [Gwenaelle GREMION, Canada]	Accepted.
21564	24	46	24	46	please check the spacing [Gwenaelle GREMION, Canada]	Accepted.
21548	24	46	24	48	This sentence states that greenhouse gases forcing is the dominant factor for increases and decreases of warm and cold extreme respectively. But increases and decreases in what? Intensity, frequency, duration? I think this sentence would be improved by more specific clarification. [Gwenaelle GREMION, Canada]	Accepted. Here frequency is specifically mentioned. Intensity and duration depends on definition of extremes.
44650	24	46	24	50	With regard to the increase in warm days and the reduction in cold days, I think that ocean-atmosphere interactions should be added here, e.g: Warming in the Pacific Ocean increases the frequency of ENSO events, which has a direct impact on extreme events in East Asia. [Liang Zhao, China]	Accepted. ENSO does not directly affect temperature extremes, but indirectly through changing atmospheric circulation.
21560	24	46	24	55	Suggest combining both paragraphs in one order to avoid repetition of concepts or ideas. [Gwenaelle GREMION, Canada]	Accepted.
46348	24	46			factor for [sadeqh zeyaeyan, Iran]	Accepted.
46350	24	46			the increasess [sadeqh zeyaeyan, Iran]	Accepted.
57624	24	46			factor for [Sahar Tajbakhsh Mosalman, Iran]	Accepted.
57626	24	46			the increasess [Sahar Tajbakhsh Mosalman, Iran]	Accepted.
44518	24	46			Typos indentifies as 'factorfortheincreases' [Shaikat Ali, Pakistan]	Accepted.
13304	24	46			factor for [Mansoureh Kouhi, Iran]	Accepted.
13306	24	46			the increasess [Mansoureh Kouhi, Iran]	Accepted.
43506	24	49	24	50	"changes in large-scale circulations due to anthropogenic warming" looks incorrect, given the low confidence assessment made for this in section 11.1.5 and Box 11.1. Removing "due to anthropogenic warming" or similar change is suggested. [Seung-Ki Min, Republic of Korea]	Accepted
27880	24	52	24	52	Page 11-24, line 52: This is already mentioned in lines 46-47. Page 11-25, lines 19-20: Which extremes in which regions? Page 11-25, lines 31-33: Which aspects of global mean temperatures are decoupled from what characteristics of temperature extremes due to what natural variabilities? Page 11-26, lines 2-3: Is this deforestation on a global scale? Or on a local scale and directly correlated to the warming regions? Page 11-26, lines 5-8: Why are these processes not represented in CMIP5 and CMIP6 simulations? [roderik van de wal, Netherlands]	Taken into account for the 1st point. The related sentence was revised. Accepted for the 2nd point. Temperature extremes in many regions in the mid-latitudes Accepted for the 3rd point. Accepted for the 4th point. Local effects. Noted for the 5th point.
21554	24	52	24	53	this is a repetition of lines 46-47 [Gwenaelle GREMION, Canada]	Taken into account. The related sentence was revised.
21552	24	52	24	54	This sentence is very long and confusing to follow. It would be easier to understand if it were divided it into two short sentences. [Gwenaelle GREMION, Canada]	Taken into account. The related sentence was revised.
8088	24	52	24	54	Delete this sentence since it repeats the information of the previous paragraph. [Soledad Collazo, Argentina]	Taken into account. The related sentence was revised.
44652	24	52	25	12	Regarding the source of CO2, it is worthwhile to add the carbon released by the melting of glaciers and frozen soils, the carbon stored in the frozen soil far exceeds expectations. [Liang Zhao, China]	Noted. The change in glaciers and soils are indirectly related to the changes in temperature extremes.
21556	24	54	24	54	The reference to "Chapter 2" is too vague, it should refer to chapter 2 section 2.3.1.1 in this report [Gwenaelle GREMION, Canada]	Accepted.
21558	24	54	24	55	The expression "the magnitude of changes in extremes" could be confusing . Please consider rephrasing to "changes in the intensity/magnitude of temperature extremes". [Gwenaelle GREMION, Canada]	Accepted.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
13940	25	3	25	3	I might be out of date here, but isn't the land-sea contrast largely due to differing lapse rate characteristics rather than heat storage? (eg Joshi et al 2008, climate dynamics). [Tim Woollings, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. This should be a subject to Section 7.6.6.2.
26774	25	3			It is not true that land warms more than the oceans due to its lower heat capacity. In fact, land warm more than the oceans even in simulations where only the SSTs are warmed (amip4K). The authors can find guidance in Chapter 7.6.2.2. [Thorsten Mauritsen, Sweden]	Accepted. Omit heat capacity, SOD of Chap 7 is re-organized, and no suitable reference.
6816	25	10	25	12	Again, the justification to dismiss changes in variability as little and non important is not all clear to me. [Laura Suarez-Gutierrez, Germany]	Taken into account. This cause was deleted.
30078	25	11	25	12	I suppose this is true over most land areas, but Tamarin-Brodsky et al. (2019 J.Clim. doi: 10.1175/JCLI-D-18-0462.1) shows a few land regions where projected skewness changes in boreal summer are negative (see their Fig. 1f). [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Refer to Tamarin-Brodsky et al. by stating existence of exceptions.
44654	25	14	25	29	I think Arctic warming should be considered here, e.g: Extremely low temperature events caused by winter warming in the Arctic. [Liang Zhao, China]	Noted. This is already considered here.
16284	25	14	25	29	The evidence from literature was consistent that there is "low confidence". I would suggest changing the wording here to omit the inconclusiveness as it does not contribute to the findings from the literature review. [Tabassam Raza, Philippines]	Noted. The sentence was modified.
29276	25	18	25	19	There is no univogue causal relation btw the stormtracks and the blocking patterns, I would rather say "... Such as the interaction of the stormtrack behavior with blocking patterns" [Fabio D'Andrea, France]	Accepted. Changed as suggested.
52782	25	20			delete "mechanisms", or replace by events. Also they are not linked to, but they cause these extremes. [Douglas Maraun, Austria]	Accepted. Changed as suggested.
21572	25	21	25	21	The reference Parker et al, 2014 seems to be inadequate in this context. The text indicates that the reference is about an Australia wide phenomenon, but the reference only relates to Victoria. Please consider adding the following reference: Perkins-Kirkpatrick, S.E., White, C.J., Alexander, L.V. et al. Climatic Change (2016) 139: 101. https://doi.org/10.1007/s10584-016-1650-0 [Gwenaelle GREMION, Canada]	Accepted. Add reference of Perkins-Kirkpatrick et al.
41146	25	21	25	21	Suggest citing work of Brunner et al. (2017; 2018) on the connection of blocking with heat waves and cold spells in Europe Brunner et al. (2017) showed the connection of atmospheric blocking to European temperature extremes in spring. They found a highly significant link between blocking and cold and warm spells that changes during spring. Blocking over the northeastern Atlantic and Scandinavia is found correlated with the occurrence of cold spells in Europe, particularly early in spring, whereas blocking over central Europe is associated with warmer conditions, particularly from March onward. Brunner et al. (2018) investigated the dependence of present and future European temperature extremes on the location of atmospheric blocking. They found a strong correlation of blocking with northern European heat waves in summer, spring, and fall. Blocking increases the cold spell frequency particularly in southern Europe in fall, winter, and spring. References: Brunner, L., G. C. Hegerl, and A. K. Steiner (2017), Connecting atmospheric blocking to European temperature extremes in spring, J. Climate, 30(2), 585–594, doi:10.1175/JCLI-D-16-0518.1 Brunner, L., N. Schaller, J. Anstey, J. Sillmann, and A. K. Steiner (2018), Dependence of present and future European temperature extremes on the location of atmospheric blocking, Geophys. Res. Lett., 45(12), 6311–6320, doi:10.1029/2018GL077837 [Andrea K. Steiner, Austria]	Accepted. Add two references.
44590	25	22	25	22	Rohini et al. 2016 is a relevant citation for Asia. Rohini et al. (2016): On the Variability and Increasing Trends of Heat Waves over India. Scientific Reports 6:26153 DOI: 10.1038/srep26153 [Krishnan Raghavan, India]	Accepted. But Rohini's anticyclone might not be related here.
21574	25	22	25	22	The reference Ratman et al 2016 seems to be inadequate in this context. The text indicates that the reference is about an Asian phenomenon, but the reference only relates to India. Please consider adding the following reference which relates to southern China: Chen, R., Z. Wen, and R. Lu, 2016: Evolution of the Circulation Anomalies and the Quasi-Biweekly Oscillations Associated with Extreme Heat Events in Southern China. J. Climate, 29, 6909–6921, https://doi.org/10.1175/JCLI-D-16-0160.1 [Gwenaelle GREMION, Canada]	Accepted. Chen et al is added, but Rarman is also remained.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
21576	25	24	25	26	I don't think Chapter 3 (in this report) highlights that statement. The only sentence I have found about that is "confidence is low for human influence on blocking activities". But these chapter does not highlight any results about storm tracks and blocking patterns based on observations, or at least I have not found it. Additionally, Woollings et al ,2018 concluded that "no fully consistent long term trends in blocking have yet emerged in observations". While most of results in chapter 4 are based on model projections and I think chapter 5 is not related to this topic. So please check this sentence and the references provided to support that claim [Gwenaelle GREMION, Canada]	Accepted. References to Chapters 2 and 3 are corrected and the reference to Woolings et al is omitted.
13942	25	24	25	26	This may be true for storm tracks (particularly northern summer) but we found quite limited evidence for any observed trends in blocking in the Woollings et al (2018) paper. [Tim Woollings, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. References to Chapters 2 and 3 are corrected, and the reference to Woolings et al is omitted.
55944	25	25	14		This is a bit unclear and very hard to handle, especially by general readership. For instance, whether cold-air outbreaks are of this kind of phenomena? [Olga Zolina, France]	Noted.
21578	25	26	25	28	Section 11.1.5 does not directly mention results about the Arctic warming. I think it is more accurate take this reference out, and refer only to the cross-chapter box 10.1. [Gwenaelle GREMION, Canada]	Accepted. The reference to Section 11.1.5 is excluded
30080	25	28	25	29	The one place where there is an accepted circulation response to GHG warming is the poleward shift of the SAM, which has been shown by Tamarin-Brodsky et al. (2019 J.Clim. doi: 10.1175/JCLI-D-18-0462.1) to lead to negative temperature skewness changes during boreal summer over SH midlatitude land areas. [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Tamarin-Brodsky et al is referred to as an example of effects of circulation changes in response to warming on temperature extremes.
32384	25	29			The following paper finds the dominant uncertainty, by a factor of 2-3, resides in the local feedbacks rather than changes in circulation confirming changes in circulation are of second order importance for future heatwave changes. Influences of Circulation and Climate Change on European Summer Heat Extremes, Clark, Robin T.; Brown, Simon J. JOURNAL OF CLIMATE Volume: 26 Issue: 23 Pages: 9621-9632 DEC 2013 [Simon Brown, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Clark and Brown is referred to as an example of effects of circulation changes in response to warming on temperature extremes.
44658	25	31	25	38	Short-term climate variability should also be added here. E.g The AO/NAO, although the correlation between AO and cold surge is not high now, the AO/NAO is very important for the prediction of the extension of the cold wave. [Liang Zhao, China]	Accepted. Effects of AO/NAO to temperature extremes are included.
54330	25	34	25	34	Chapter 3 refers to this as the "slower surface global warming" period. [Blair Trewin, Australia]	Accepted. Use "slower surface global warming".
21580	25	34	25	34	The reference to Chapter 3 does not seem to be specific enough, consider referenincg cross chapter box 3.1 instead. [Gwenaelle GREMION, Canada]	Accepted. Referred to Box 3.1 specifically.
8090	25	35	25	38	Add a reference to Loikith et al. (2017) where they study the associations between extreme temperature months and four prominent modes of recurrent climate variability are examined over South America. (Loikith, P. C., Detzer, J., Mechoso, C. R., Lee, H., & Barkhordarian, A. (2017). The influence of recurrent modes of climate variability on the occurrence of monthly temperature extremes over South America. Journal of Geophysical Research: Atmospheres, 122, 10,297– 10,311. https://doi.org/10.1002/2017JD027561) [Soledad Collazo, Argentina]	Accepted. Loikith et al is referred to as an example for relation between temperature extremes and various climate modes.
35318	25	40	25	53	A relevant reference here could be cited to demonstrate the importance of soil moisture in daily record high and low temperatures; the ratio of daily record highs to record lows has been increasing, and for the early 2000s stood at about 2:1 for the U.S.; however, model simulations show a somewhat larger ratio because the record highs are increasing faster in the model compared to observations (record lows are decreasing at similar rates). There is evidence that increasing precipitation over regions of the U.S. increase evapotranspiration during the day so that the record highs don't get as high in the observations, while the models don't show as strong a positive precipitation trend: Meehl, G.A., C. Tebaldi, and D. Adams-Smith, 2016: U.S. daily temperature records past, present and future. Proc. Nat. Acad. Sci., doi: 10.1073/pnas.1606117113. [Gerald Meehl, United States of America]	Accepted. Meehl et al. is added as an example of the research on soil moisture feedback.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
29278	25	43	25	43	I would also say that the feedback, at the regional scale can be non-local and have a spatial complex behavior. Sorry for self-citation, but I think it is needed here. I would quote: Marc Stéfanon, Philippe Drobinski, Fabio D'Andrea, Cindy Lebeau-pin-Brossier, Sophie Bastin, 2013: Soil moisture-temperature feedbacks at meso-scale during summer heat waves over Western Europe. <i>Climate Dynamics</i> , 2013 <doi:10.1007/s00382-013-1794-9>, Zampieri, M., F. D'Andrea, R. Vautard, Ph. Ciais, N. de Noblet-Ducoudré, P. Yiou, 2009: Hot European Summers and the role of soil moisture in the propagation of Mediterranean drought. <i>Journal of Climate</i> , 22, 4747–4758, Vautard, R., P. Yiou, F. D'Andrea, N. de Noblet, N. Viovy, C. Cassou, J. Polcher, P. Ciais, M. Kageyama, Y. Fan, 2007: Mediterranean trigger of European summer drought and heat waves <i>Geophysical Research Letters</i> . 34, L07711, doi:10.1029/2006GL028001. [Fabio D'Andrea, France]	Accepted. Non-local aspects are also referred to.
21582	25	43	25	47	This sentence presents the results from only one study and the authors indicate in brackets "(medium confidence)". I don't think it is appropriate to use the confidence language presenting results from a single model study. [Gwenaëlle GREMION, Canada]	Accepted. The sentence is removed.
32388	25	43			the role of soil drying on modelled extreme temperatures can be complex and depends on how dry the soil is to start with. The paper below demonstrates the drying temperature enhancement mechanism can selectively apply to different parts of the temperature distribution, not just the upper tail. Modeling northern hemisphere summer heat extreme changes and their uncertainties using a physics ensemble of climate sensitivity experiments. Clark, Robin T.; Brown, Simon J.; Murphy, James M. <i>JOURNAL OF CLIMATE</i> Volume: 19 Issue: 17 Pages: 4418-4435 SEP 2006 [Simon Brown, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The development of the model is important, but this is not a subject of this section.
46352	25	45			and about [sadegh zeyaeyan, Iran]	Accepted.
57628	25	45			and about [Sahar Tajbakhsh Mosalman, Iran]	Accepted.
13308	25	45			and about [Mansoureh Kouhi, Iran]	Accepted.
46354	25	46			mid latitudes in [sadegh zeyaeyan, Iran]	Accepted.
57630	25	46			mid latitudes in [Sahar Tajbakhsh Mosalman, Iran]	Accepted.
13310	25	46			mid latitudes in [Mansoureh Kouhi, Iran]	Accepted.
28458	25	47	25	47	"Vogel et al., (2017) showed" -> "Vogel et al., (2017) showed" [HIDEO SHIOGAMA, Japan]	Accepted
6700	26	3	26	5	Some relevant references are missing: Avila et al. (2012); Pitman et al. (2012); Li et al. (2018) Avila, F. B., A. J. Pitman, M. G. Donat, L. V. Alexander, and G. Abramowitz, 2012: Climate model simulated changes in temperature extremes due to land cover change. <i>J. Geophys. Res.-Atmos.</i> , 117, D04108, https://doi.org/10.1029/2011JD016382 . Li, X., H. Chen, J. Wei, W. Hua, S. Sun, H. Ma, X. Li, and J. Li, 2018: Inconsistent Responses of Hot Extremes to Historical Land Use and Cover Change Among the Selected CMIP5 Models. <i>J. Geophys. Res.-Atmos.</i> , 123, 3497-3512, https://doi.org/10.1002/2017JD028161 . Pitman, A. J., de Noblet-Ducoudré, N., Avila, F. B., Alexander, L. V., Boisier, J.-P., Brovkin, V., Delire, C., Cruz, F., Donat, M. G., Gayler, V., van den Hurk, B., Reick, C., and Voldoire, A., 2012: Effects of land cover change on temperature and rainfall extremes in multi-model ensemble simulations, <i>Earth Syst. Dynam.</i> , 3, 213-231, https://doi.org/10.5194/esd-3-213-2012 . [Xing Li, China]	Accepted. These references are added as the effects of the land cover change on temperature extremes and their uncertainties.
52784	26	9	26	14	The examples here are discussed as quite detailed regional showcases in Chapter 10. There should be a link to the corresponding sections. [Douglas Maraun, Austria]	Accepted. Chapter 10 and related sections are referred to.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
14526	26	16	26	24	With regard of urbanization effect or urban island effect in the extreme climate series, the current assessment may need to be considered for a major revision. This issue could be in subsection data problems (uncertainties) or in subsection drivers of extreme change observed. I prefer the former. In any case, the review of the relevant publications is insufficient, and the citations are improper. Please note that you are saying the effect of urbanization on long-term trends of extreme climate events frequency and intensity especially of extreme surface air temperature at the surface climate stations during the past decades if not a century. You are saying neither the urban heat island its self, nor the surface urban heat island as seen by satellite. The surface temperature as sensed by satellite is rather different from that recorded from the climate stations, and also there is a large difference between the near-surface air urban heat island (UHI) and surface urban heat island (SUHI). You should focus on surface air temperature and UHI, because all the extreme temperature indices are developed by using data of surface air observations. Specifically, you should focus on the urbanization effect (or increased UHI intensity) on surface air extreme temperature trends over a time period long enough for monitoring, detection and attribution of climate change at local, regional and larger scales. Most of the studies in this aspect have been conducted for East Asia in particular in mainland China for the last decade. For UHI (or urbanization) effect on mean surface air temperature change, the currently cited publications (Rizwan et al, 2008, Imhoff et al., 2010, Peng et al, 2012, Zhao et al., 2014, Zhou et al, 2014b) are mostly irrelevant to the point, for example, and the following ones could be read and reviewed: 1). Ren, G. Y., Z. Y. Chu, Z. H. Chen, Y. Y. Ren, 2007, Implications of temporal change in urban heat island intensity observed at Beijing and Wuhan Stations, Geophys. Res. Lett., 34, L05711, doi:10.1029/2006GL027927; 2). Ren, Guoyu, Yaqing Zhou, Ziyang Chu, Jiangxing Zhou, Aiyang Zhang, Jun Guo and Xuefeng Liu, 2008, Urbanization effect on observed surface air temperature trend in North China, Journal of Climate, 21(6), 1333–1348; 3). Ren, Y.Y., G.Y. Ren, 2011, A remote-sensing method of selecting reference stations for evaluating urbanization effect on surface air temperature trends, Journal of Climate, 24 (7), 3179-3189; 4). Yang, X. C., Y. L. Hou, Y. L., & B. D. Chen, B. D. (2011). Observed surface warming induced by urbanization in east China[http://dx.doi.org/10.1029/2010JD015452]. Journal of Geophysical Research, 116, D14113. 5). Yang, Y. J., B. W. Wu, B. W., C. E. Shi, C. E., Zhang, J. H., Li, Y. B., Tang, W. A., Wen, H. Y., Zhang, H. Q., Shi, T.et al., (2013). Impacts of urbanization and station-relocation on surface air temperature series in Anhui province, China. Pure and Applied Geophysics, 170 (11), 1969–1983. ; 6). Ren, G. Y., Z. Y. Chu, Z. H. Chen, Y. Y. Ren, 2007, Implications of temporal change in urban heat island intensity observed at Beijing and Wuhan Stations, Geophys. Res. Lett., 34, L05711, doi:10.1029/2006GL027927.	Considered. The section is expanded with discussion on UHI.
21584	26	17	26	17	The reference Zhao et al 2014 is not included in the reference list. In contrast, there is one reference to Zhao et al 2014a, but it is not related to the reviewed topic. Please correct this citation, either add the missing Zhao et al 2014 to the reference list, or replace the intext citation with the correct source. [Gwenaelle GREMION, Canada]	Rejected. Zhao et al.(2014) is appropriate here and in the reference list. Zhao, L., Lee, X., Smith, R. B., and Oleson, K. (2014). Strong contributions of local background climate to urban heat islands. Nature 511, 216–219. doi:10.1038/nature13462.
21586	26	22	26	24	Authors claim that “Changes in agricultural land use in continental scale moderate hot temperature extremes in summer”. The language here is using “changes” and “moderate” together in the sentences makes it challenging to understand. Changes in land use can also intensify hot extremes, so perhaps it would be better to soften the language to say “could moderate”. Secondly, I don't think this sentence is accurate enough with the references provided. Mueller and Seneviratne, 2014 talk about the overestimation of evapotranspiration in climate models, so I would not cite it here. And Thiery et al 2017 is well referenced but it is not enough to support that claim. So please add another reference. [Gwenaelle GREMION, Canada]	Accepted. Mueller and Seneviratne, (2014) is moved to the different paragraph on the uncertainties of the land models.
6698	26	23	26	23	"is islikely" maybe "it is likely" [Xing Li, China]	Accepted
28460	26	23	26	23	"is islikely" -> "it is likely" [HIDEO SHIOGAMA, Japan]	Accepted.
13312	26	23			is likely [Mansoureh Kouhi, Iran]	Accepted.
46356	26	23			is likely [sadegh zeyaeyan, Iran]	Accepted.
57632	26	23			is likely [Sahar Tajbakhsh Mosalman, Iran]	Accepted.
45978	26	26	26	38	Excellent synthesis (with confidence levels) [Lourdes Tibig, Philippines]	Noted.
21588	26	29	26	30	The authors mention the snow/ice albedo temperature feedbacks in the summary paragraph, but they did not discuss results related to it in this section nor do they provide references. Some cursory information is provided in section 11.1 and box 11.1. In my opinion the authors should include in this section a small discussion based on the literature, such as Diro, G.T., Sushama, L. & Huziy, O. Clim Dyn (2018) 50: 2993. https://doi.org/10.1007/s00382-017-3788-5 [Gwenaelle GREMION, Canada]	Accepted. Added a discussion of snow/ice albedo temperature feedback on temperature extremes, and referred to Diro et al. in the previous paragraph.
43508	26	30	26	37	This statement of high confidence on aerosol influences on extremes looks overestimated, not well supported by enough number of evidences. Only two studies for East Asia and one study for North America were provided above (lines 9-14). [Seung-Ki Min, Republic of Korea]	Taken into account. This sentence is removed from the summary of this subsection.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
21590	26	33	26	37	These sentences seems a bit repetitive after reading the beginning of the summary paragraph. The only new information provided is about “changes in circulation patterns”. That I think it could be included with just one sentence without repetitions may be after line 27. [Gwenaelle GREMION, Canada]	Accepted. This sentence is merged to the previous sentence.
26776	26	36			Are you sure you mean Asia here? Perhaps North America? [Thorsten Mauritsen, Sweden]	Taken into account. This sentence is removed from the summary statements. It is based on Dong et al. (2016) in the main texts.
21592	26	37	26	38	The last sentence of the summary paragraph is based on page 25 lines 24-26, which do not appear to have sufficient support, as written. If references can't be provided to support the claims made on page 25 lines 24-26, then it needs to be deleted as does this (page 26 lines 37-38) related claim. [Gwenaelle GREMION, Canada]	Taken into account. Now this statement is supported by referring to Chapter 2-4.
41148	26	38	26	38	“...low confidence in projections of characteristics of ..., and blockings, and their links to extreme temperatures in mid-latitudes.” Brunner et al (2017, 2018) found highly significant links between blocking and heat waves and cold spells in Europe. See comment 6 above. References: Brunner, L., G. C. Hegerl, and A. K. Steiner (2017), Connecting atmospheric blocking to European temperature extremes in spring, <i>J. Climate</i> , 30(2), 585–594, doi:10.1175/JCLI-D-16-0518.1 Brunner, L., N. Schaller, J. Anstey, J. Sillmann, and A. K. Steiner (2018), Dependence of present and future European temperature extremes on the location of atmospheric blocking, <i>Geophys. Res. Lett.</i> , 45(12), 6311–6320, doi:10.1029/2018GL077837 [Andrea K. Steiner, Austria]	Taken into account. The assessment is based on Chapter 4
21594	26	43	26	43	The expression “decrease in cold days and nights” could be confused with the intensity of the temperature extremes. The author should say “decrease in the number of cold days and nights”as they say after that with the results on warm temperature events. [Gwenaelle GREMION, Canada]	Accepted - text revised
53010	26	48	26	48	This seems to be the first mention of ETCCDI indices and the nomenclature of the indices TX90p and TXx etc has not been explained. It seems that there is a link that needs to be made somewhere to what these indices are and what they represent especially since you refer to their acronyms later on. [Lisa Alexander, Australia]	Accepted - text revised
46164	26	48	26	48	Add a reference (or a web site) to ETCCDI indices [Marina Baldi, Italy]	Accepted - a website was added
37944	26	52			The index TX90p is explained in the following paragraph. That explanation should be moved up to here. Likewise explain what TXx refers to. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - text revised
14528	27	1	27	15	Recently, Zhang et al. (submitted) presents an analysis of changes in global land extreme temperature indices (1951-2015) based on a new global land surface daily air temperature dataset recently developed by the China Meteorological Administration (CMA). The results, which are generally consistent with previous studies including that by Alexander et al. (2006, 2016), show that the global land average annual and seasonal mean extreme temperature indices series all experienced significant long-term changes associated with warming, with cold threshold indices (frost days, icing days, cold nights and cold days) decreasing, warm threshold indices (summer days, tropical nights and warm days) increasing, and all absolute indices (TXX, TXN, TNX and TNN) also increasing, over the last 65 years. For example, cold nights and cold days decreased by rates of -1.07d/decade and -0.76d/decade, and warm nights and warm days increased by rates of 1.33d/decade and 0.95d/decade, over the period analyzed. The extreme temperature indices series based on daily minimum temperatures generally had a stronger and more significant trend than those based on daily maximum temperatures. The most significant warming occurred after the mid-1970s, and a few extreme temperature indices showed no significant trend over the period from 1951 to mid-1970s. Most parts of the global land experienced significant warming trends over the period 1951-2015 in terms of the extreme temperature indices, but the largest trends appeared in mid to high latitudes of Eurasian Continent. (Zhang, Panfeng, Guoyu Ren, Yan Xu, Xiaolan L. Wang, Yun Qin, Xiubao Sun, Yuyu Ren, 2019, Observed changes in extreme temperature over the global land based on a newly developed daily dataset, <i>Journal of Climate</i> , in revision). (CUG, Guoyu Ren) [Guoyu Ren, China]	Taken into account - Text revised

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
35342	27	2	27	4	Do you mean that the trends increasing (rate of change getting faster), rather than there are trends for an increase between these two example years (non zero rate of change)? Are the example percentages for the years specified, or intended to represent indicative values for those periods? [Dunn Robert, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - text revised
21596	27	9	27	9	it is unclear what "these indices" refers to [Gwenaelle GREMION, Canada]	Taken into account - text revised
21598	27	11	27	12	should be re-written "despite only slight warming or constant global annual mean temperatures" (otherwise it sounds like "constant" refers to warming [Gwenaelle GREMION, Canada])	Accepted - text revised
54334	27	16	27	22	An assessment (perhaps through a figure) of how the trends mapped in Figure 11.1 compare with mean temperature trends over the same areas would be useful. [Blair Trewin, Australia]	Rejected. This chapter focuses on the climate extremes.
21600	27	16	27	22	I think this paragraph is not well included in the text. It refers to the description of the figure instead of commenting the results. Maybe the authors could modify the paragraph and move it into line 36 to help with the flow of the text. Also in my opinion authors should discuss these results for each of the continents in the following paragraphs. [Gwenaelle GREMION, Canada]	Taken into account - text revised
35344	27	17	27	17	HadEX3 reference will be Dunn et al 2019. The 2014 reference relates to the uncertainty assessment of HadEX2 [Dunn Robert, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - reference to be replaced
35346	27	19	27	19	HadEX3 does include GHCND as one of its data sources, but there are many others. [Dunn Robert, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - text revised
27882	27	20	27	20	Page 11-27, line 20: The time period from 1951 to 2018 is 67 years, not 45 years	Accepted - text revised
					Page 11-27, line 44: Omit e.g.-parts, these are not needed I think	Accepted - text revised
					Page 11-29, lines 5-7: Deforestation is already mentioned in section 11.3.1	Accepted - text deleted
					Page 11-29, lines 23-25: Why is a global increase only observed in Europe, Asia and Australia? What about the other continents? [roderik van de wal, Netherlands]	Rejected - this part is the assessment summary
37946	27	21			It would be helpful to know whether the inadequacy of station measurements refers primarily to a deficiency in current observations, requiring network improvement, or a deficiency in the availability of observations for the 1950s, 1960s and 1970s, for which there may be some scope for data rescue. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Rejected - beyond the scope of this subsection
44128	27	29	27	44	unclear [Michaela Dolk, United States of America]	Noted
21602	27	38	27	38	Some of the ETCCDI indices discussed in the text have not been defined in the manuscript, such as, Tnx, or Txn. Additionally, authors should be careful to keep the same nomenclature along the chapter. I have seen Txx and Txx which can confuse the reader unfamiliar with these indices. [Gwenaelle GREMION, Canada]	Accepted - text revised
53012	27	38	27	40	This bit seems a bit idiosyncratic talking about numerous acronyms and names of datasets etc. A good assessment of the available literature is missing here (there are more Australian studies that have looked at temperature extremes). [Lisa Alexander, Australia]	Accepted - text revised
16286	27	38	27	42	A short explanation of what the implication of the increase or decrease in the various temperature indices shown in this observation which can be used as a smoother transition between the two literatures cited in the content. [Tabassam Raza, Philippines]	Taken into account - text revised
16290	27	38	28	33	It is understandable that there are various studies per region regarding temperature extremes. However, it would be beneficial to find common observation points to show where one region has more available studies and data over other regions. Basically, a standard of presenting the observations from literature for each region is needed... [Tabassam Raza, Philippines]	Noted
40444	27	44	27	49	The paragraph concerning Temperature extreme trends over Europe should be expanded. This is a general comment concerning also paragraphs on heavy precipitation extremes as well as droughts and floods. [Christos Zerefos, Greece]	Noted - detailed assessment refer to Section 11.9.
16288	27	51	27	53	This section of the chapter discusses about temperature extremes, yet the observations presented for Africa does not seem to be specific for the topic, unlike in the other regions. It should be stated if there is lack of data available regarding maximum and minimum temperatures and recommendation that there should be better data gathering for the Africa region. This was highlighted in the section summary (p. 29, lines 26-27) but should also be highlighted in the paragraph. [Tabassam Raza, Philippines]	Noted
38898	27	51	27	53	This is in contradiction to Fig. 11.1, which shows small trends, partly of opposite signature. [Uwe Ulbrich, Germany]	Taken into account - text revised

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
21604	27	53	27	53	I don't think the reference Funk et al 2016 supports this statement. This article analyzes the influence of anthropogenic warming on Ethiopia and southern Africa droughts. So I think it should not be cited here. [Gwenaelle GREMION, Canada]	Accepted - text revised
50082	27	53	27	53	References given are not specific to West Africa region. Please add : Ringard et al., (2016); The intensification of thermal extremes in west Africa; Global and Planetary Change, 139, 66–77, doi: 10.1016/j.gloplacha.2015.12.009 [ARONA DIEDHIOU, Cote d'Ivoire]	Accepted - reference added
54144	27	55	28	6	One can add studies conducted in the Southwest Asia. [Husain Najafi, Iran]	Accepted - reference added
45980	27	55	28	6	There are additional studies in Asia (e.g., Cinco et al, 2016; Mayowa et al, 2015; Shahid ,S., 2911, etc.) [Lourdes Tibig, Philippines]	Take into consideration. The studies of Mayowa et al, 2015 and Shahid 2011 are about rainfall, which are not suitable for the assessment on temperature extremes. The reference of Cinco et al, 2016 can not be found. Instead, we added the study of ALSarmi and Washington, 2014.
15608	27	55	28	6	Please consider adding a study over Northeast Asia, showing the recent increase of hot extremes based on the observational data. (1) Erdenebat, E., and T. Sato, 2016: Recent increase in heat wave frequency around Mongolia: role of atmospheric forcing and possible influence of soil moisture deficit. Atmos. Sci. Lett., 17, 135-140, DOI: 10.1002/asl.616 [Tomonori Sato, Japan]	Accepted - reference added and text revised
21608	28	1	28	3	This sentence is unclear. To precise what adjectives refer to, it could be rewritten as: "The warming in the coldest day and night is larger than IN the warmest day and night, respectively, which is concurrent with WARMING IN the coldest night larger than IN the coldest day and WARMING IN the warmest night larger than IN the warmest day." [Gwenaelle GREMION, Canada]	Accepted - text revised
21606	28	1	28	4	These sentences are identical to the text in the abstract of the cited article Zhou et al 2016. Please, quote those sentences or rewrite them. [Gwenaelle GREMION, Canada]	Accepted - text revised
14530	28	1	28	33	In China, the main extreme temperature indices show a generally more significant change than those of global land average over the periods since 1950s, based on the daily data from the national observational networks of more than 700 stations (e.g. Zhai and Pan, 2003. Zhai, P., Pan, X., 2003. Trends in temperature extremes during 1951-1999 in China. Geophys. Res. Lett. 30 (17), 169-172; You et al, 2008. You, Q., Kang, S., Aguilar, E., et al., 2008. Changes in daily climate extremes in the eastern and central Tibetan Plateau during 1961-2005. J. Geophys. Res. Atmos. 113 (D7), 1639-1647; Ren et al., 2010. Ren, Guoyu, Guolin Feng, Zhongwei Yan, 2010, Progress in observational studies of climate extremes and changes in mainland China, Climatic and Environmental Research (in Chinese), 15(4): 337-353; Zhou and Ren, 2011. Zhou, Y., Ren, G., 2011. Change in extreme temperature event frequency over mainland China during 1961-2008. Clim. Res. 50 (1-2), 125-139; and hundreds of, if not thousands of, other relevant publications in English and Chinese). The larger and more significant warming as viewed from extreme temperature indices change might have been caused, at least partially, by the effect of urbanization on surface air temperature change especially the minimum temperature change around the observational stations (Ren and Zhou, 2014. Ren, G., Zhou, Y., 2014. Urbanization effect on trends of extreme temperature indices of national stations over mainland China, 1961-2008. J. Clim. 27 (6), 2340e2360). (CUG, Guoyu Ren) [Guoyu Ren, China]	Noted. The references published after the AR5 are mainly assessed. The effect of urbanization is beyond the scope of this subsection
21610	28	2	28	3	should be re-written "which is concurrent with the warming in the coldest night larger than in the coldest day and the warming in the warmest night larger than in the warmest day" [Gwenaelle GREMION, Canada]	Accepted - text revised
9984	28	4	28	6	See recent papers on analysis of extremes in Southern Pakistan (station data) Zahid, M., Blender, R., Lucarini, V., and Bramati, M. C.: Return levels of temperature extremes in southern Pakistan, Earth Syst. Dynam., 8, 1263-1278, https://doi.org/10.5194/esd-8-1263-2017, 2017 [Valerio Lucarini, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - reference added
44520	28	4	28	6	Similar results are also shown by Ali et al., (2019) with respect to Pakistan. Ali, S., Eum, H. I., Cho, J., Dan, L., Khan, F., Dairaku, K., ... & Fahad, S. (2019). Assessment of climate extremes in future projections downscaled by multiple statistical downscaling methods over Pakistan. Atmospheric Research, 222, 114-133. Need to be cited [Shaukat Ali, Pakistan]	Rejected - here is for the observed trends, not future changes

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
32362	28	8	28	24	The description of changes in temperature extremes for North America is very US-centered. Suggest the following paper by Vincent et al. (2018) which calculates trends in many indices at stations across Canada. L.A. Vincent, X. Zhang, É. Mekis, H. Wan & E.J. Bush (2018) Changes in Canada's Climate: Trends in Indices Based on Daily Temperature and Precipitation Data, Atmosphere-Ocean, 56:5, 332-349, DOI: 10.1080/07055900.2018.1514579 [Megan Kirchmeier-Young, Canada]	Accepted - text revised
35320	28	8	28	24	A relevant reference here could be cited to show that the ratio of daily record highs to record lows has been increasing, and for the early 2000s stood at about 2:1 for the U.S.; however, model simulations show a somewhat larger ratio because the record highs are increasing faster in the model compared to observations (record lows are decreasing at similar rates). There is evidence that increasing precipitation over regions of the U.S. increase evapotranspiration during the day so that the record highs don't get as high in the observations, while the models don't show as strong a positive precipitation trend: Meehl, G.A., C. Tebaldi, and D. Adams-Smith, 2016: U.S. daily temperature records past, present and future. Proc. Nat. Acad. Sci., doi: 10.1073/pnas.1606117113. [Gerald Meehl, United States of America]	Taken into account- reference added in Section 11.3.3
21612	28	15	28	15	should be "[...] the cold tail of the minimum temperature distribution, with cooling [...]" [Gwenaëlle GREMION, Canada]	Accepted - text revised
21614	28	30	28	30	specify what "particular differences" means [Gwenaëlle GREMION, Canada]	Taken into account - text revised
21616	28	38	28	38	Specify which period "centennial trend" refers to [Gwenaëlle GREMION, Canada]	Accepted - text revised
21618	28	38	28	38	For which period is this "centennial trend" determined? [Gwenaëlle GREMION, Canada]	Accepted - text revised
13314	28	46			global scale [Mansoureh Kouhi, Iran]	Accepted - text revised
46358	28	46			global scale [sadegh zeyaeyan, Iran]	Accepted - text revised
57634	28	46			global scale [Sahar Tajbakhsh Mosalman, Iran]	Accepted - text revised
21620	28	47	28	50	What is the reference for this statement? [Gwenaëlle GREMION, Canada]	Accepted - reference added
38900	28	49	28	49	"Excess heat factor" is not explained in preceding text.. [Uwe Ulbrich, Germany]	Accepted - text revised
21622	28	49	28	50	I think here we need a reference for these results based on the HadGHCND database. [Gwenaëlle GREMION, Canada]	Accepted - reference added
35348	28	50	28	50	Does HadGHCND need a reference? [Dunn Robert, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - reference added
28502	28	52			It would be good to provide some information for studies in South East Asia region. [Kanoksri Sarinnapakorn, Thailand]	Taken into account - text revised
21624	28	54	28	55	The reference You et al 2016 is not included in the list of references. [Gwenaëlle GREMION, Canada]	Taken into account - text revised
21626	28	55	29	3	These sentences should be rewritten because the first sentence does not make sense in context. The second sentence should be put in quotes, as it is identical to the cited article. [Gwenaëlle GREMION, Canada]	Taken into account - text revised
21628	29	5	29	5	Based on the cited article, I think it is more accurate to replace "in some mid-latitudes regions" by "in northern mid-latitudes regions". [Gwenaëlle GREMION, Canada]	Not applicable - sentences deleted
54336	29	9	29	18	The introduction to this chapter defined marine heatwaves as being out of scope of this chapter (but in scope for Chapter 9) - suggest discussing this between the chapters. [Blair Trewin, Australia]	Not Applicable - sentences deleted
21630	29	9	29	18	The authors clearly explained in the executive summary, that marine extreme events including marine heat waves are addressed in Chapter 9 (Page 5 lines 9-12). Therefore I would take the indicated paragraph about marine heat waves out of this section. [Gwenaëlle GREMION, Canada]	Accepted - paragraph deleted
21632	29	20	29	29	The first two or three sentences of the summary paragraph could be combined. The sentence "changes in both warm and cold extremes have also occurred over Europe, Australasia, and Asia" is not accurate enough. Authors should indicate changes in intensity frequency or duration. If authors mean to refer to changes in frequency, that was already said in the previous two sentences and does not need to be repeated. Please, clarify this. Also the next sentence in the summary paragraph reads "increase in the intensity, duration and the number of heatwaves days" which is confusing. It should read "increase in the intensity and duration of heatwaves and in the number of heatwaves days". Then authors include results for marine heatwaves which should be taken out to be consistent with the executive summary that states marine issues will be covered in Chapter 9. [Gwenaëlle GREMION, Canada]	Taken into account - text revised
15602	29	20	29	29	I feel it is safe to mention that the occurrence of hot/cold extremes are strongly regulated by internal variability of climate system. (1) Sato, T. and T. Nakamura, Intensification of hot Eurasian summers by climate change and land-atmosphere interaction. (Sci Rep., in revision) [Tomonori Sato, Japan]	Rejected - the influence of internal variability is beyond the scope since this subsection focuses on the TRENDS of temperature extremes.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
38902	29	20	29	29	The fact that the low lying tropics seem to show little trends in all continents should be mentioned. [Uwe Ulbrich, Germany]	Rejected - references are needed for this assessment
50084	29	22	29	22	"It is very likely these changes..." please correct to "It is very likely THAT these changes..." [ARONA DIEDHIOU, Cote d'Ivoire]	Accepted - text revised
25458	29	22	29	23	Shouldn't this be revised to "available regional data/evidence indicates these changes have very likely occurred over....." The way it is written it bakes it sounds like changes are only occurring where data available but could be occurring elsewhere [Sharon Smith, Canada]	Taken into account - combined with other comment
15304	29	22	29	23	Somehow the first statement about the "global scale" would seem to make this "also" redundant. Maybe say "have also occurred at the regional scale in EU, AU, AS. [Claudia Tebaldi, United States of America]	Accepted - text revised
50086	29	26	29	27	"...in southern Africa and South America...". This is true also for Western Africa. Please correct to "...in western and southern Africa and South America..." [ARONA DIEDHIOU, Cote d'Ivoire]	Accepted - text revised
26778	29	35			Some CMIP6 models may well warm substantially faster than observed in the second half of the Century. I suggest the chapter authors avoid to rely on models being able to capture global warming. See also my comment on page 24, line 35. [Thorsten Mauritsen, Sweden]	Noted
13316	29	46			are captured [Mansoureh Kouhi, Iran]	Accepted - text revised
46360	29	46			are captured [sadegh zeyaeayan, Iran]	Accepted - text revised
57636	29	46			are captured [Sahar Tajbaksh Mosalman, Iran]	Accepted - text revised
21634	29	51	29	54	The first sentence of the paragraph describes the study and conclusions of Dong et al 2015 and can also be related to results in Zhou et al 2014a. However, the references to Sun et al 2016 does not seem appropriate as this study uses a different period. Similarly the reference to Yang et al 2014 does not seem appropriate because that study only analyze frequency indices. Maybe the sentence could be modified to more accurately reflect all the articles it references, or the delete the references that are not appropriate. [Gwenaelle GREMION, Canada]	Accepted - references deleted
21636	29	53	29	53	The expression "threshold indices better than percentile indices" is confusing. Do the authors refer to absolute indices and percentile-based indices? Reading Don et al 2015, I think authors refer to intensity indices in comparison to frequency indices. Please, clarify this in the text. [Gwenaelle GREMION, Canada]	Accepted - text revised
21638	29	54	29	54	The reference Zhou et al 2014 is not in the reference list, it is listed as Zhou et al, 2014a [Gwenaelle GREMION, Canada]	Accepted - text revised
21640	29	54	30	1	The authors refer to Grotjahn et al 2016 to present the CMIP5 model evaluation in reproducing temperature extreme indices over North America. However, this study is based on a comparison with the ERA Interim reanalysis and do not include a comparison with gridded observational data. In this same article, the authors discuss the differences between reanalysis products in simulating extreme events. For this reason, I think a comparison between CMIP5 models and observations should be included in this part of the text in addition to Grotjahn et al 2016 results or replacing it. Maybe authors can adapt the results from Sillmann et al (Sillmann, J., Kharin, V. V., Zhang, X., Zwiers, F. W., and Bronaugh, D. (2013), Climate extremes indices in the CMIP5 multimodel ensemble: Part 1. Model evaluation in the present climate, J. Geophys. Res. Atmos., 118, 1716–1733, doi:10.1002/jgrd.50203.) over North America in this part of the text. [Gwenaelle GREMION, Canada]	Accepted - text revised
21642	29	55	30	1	unclear phrase "highest in spring, compared to winter, then summer and autumn" [Gwenaelle GREMION, Canada]	Taken into account - text revised
21644	30	5	30	6	Please add a reference to the appropriate section of the AR5 WRI to this sentence [Gwenaelle GREMION, Canada]	Accepted - text revised
21646	30	6	30	9	This sentence is confusing. It seems to indicate that CMIP5 models overestimate the warming of hot extremes in Europe, North America, South America, and parts of South Africa. However, the provided reference (Donat et al 2017) indicated that the warming of hot extremes over Europe and Southern Africa also are shown in observations, so models are not overestimating the warming in those regions. Please, check the reference and modify this sentence accordingly. [Gwenaelle GREMION, Canada]	Rejected - Consistent with the result of Donat et al. 2017
50088	30	8	30	8	"and parts of Southern Africa". Please correct "and parts of western and southern Africa". Ringard et al 2016 did this evaluation for Abidjan and Niamey (West Africa) in comparing changes between the periods 1980-2012 and 1950-2012 [ARONA DIEDHIOU, Cote d'Ivoire]	Accepted - text revised
21648	30	13	30	13	The authors refer to the "recent 15 years" to indicate the hiatus period. Taking into account the expected publication date of the AR6, I don't think this expression is accurate. I think it should read "the first 15 years of the 21st century". [Gwenaelle GREMION, Canada]	Accepted - text revised

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
6818	30	13	30	15	This wording referring to the recent warming hiatus is positively outdated. Rather than a “discrepancy between observed and simulated trends”, observed trends deviated from the ensemble mean trend in CMIP5 and single model large ensembles. On its own time-scale, the hiatus is not all that different from an extreme event, and has been to a great degree attributed to internal variability (Marotzke and Forster, 2015; Hedemann et al., 2017) [Laura Suarez-Gutierrez, Germany]	Taken into account - text revised
21650	30	19	30	20	not clear what the sentence is supposed to mean. As it reads now, it sounds like the mean is small, i.e. a low temperature [Gwenaelle GREMION, Canada]	Taken into account - text revised
21652	30	24	30	25	Change to “[...] may also have contributed to the observed local cooling trends [...]” to make it clear that it refers to observations and not models [Gwenaelle GREMION, Canada]	Accepted - text revised
21654	30	28	30	37	This paragraph sounds repetitive to the information previously provided, except for results over Australasia which can be included for example in line 1. Also this paragraph ends attributing model deficiencies to the lack of representation of agricultural management referring section 11.3.2. I think this sentence is not well supported, as there are many processes, included in section 11.3.2, whose lack of representation or poor representation may explain models deficiencies, such as vegetation cover, snow cover, soil moisture, atmospheric patterns, etc, as well as the quantity and quality of observational data which also play an important role in model evaluations. [Gwenaelle GREMION, Canada]	Taken into account - text revised. This paragraph is for the evaluation of trends. The attribution of model deficiencies is deleted
35322	30	28	30	37	A relevant reference here could be cited to show that the ratio of daily record highs to record lows has been increasing, and for the early 2000s stood at about 2:1 for the U.S.; however, model simulations show a somewhat larger ratio because the record highs are increasing faster in the model compared to observations (record lows are decreasing at similar rates). There is evidence that increasing precipitation over regions of the U.S. increase evapotranspiration during the day so that the record highs don't get as high in the observations, while the models don't show as strong a positive precipitation trend: Meehl, G.A., C. Tebaldi, and D. Adams-Smith, 2016: U.S. daily temperature records past, present and future. Proc. Nat. Acad. Sci., doi: 10.1073/pnas.1606117113. [Gerald Meehl, United States of America]	Accepted - reference added
50090	30	37	30	37	At the end of the paragraph (after "...some of these discrepancies.") I propose to add in few sentences the case of West Africa where the evaluation of temperature related indices in CMIP5 has been done: "In West and Central Africa, Diedhiou et al. (2018) compared scaling relationship of changes of ETCCDI temperature indices as function of global temperature values for the period 1920–2010 (compared to the reference period 1961–1990) from CMIP5 models (historical) and observation-based data(GSWP3). Both models and observations show an increase in temperature, but the warming is around 1°C in CMIP5 models and 2°C in GSWP3 confirming that the models likely underestimate the temperature rise (Sherwood et al 2014). Except over Central Africa, The daily thermal range (ΔDTR) decreases with temperature rising both in the models and in the observations. In all the subregions, ΔTX90P increases with temperature rising as well as warm spells duration mainly over the Sahel band, but over Guinea Coast and Central Africa the models underestimate the magnitude and rate of change with temperature. Sherwood S C, Bony S and Dufresne J L (2014); Spread in model climate sensitivity traced to atmospheric convective mixing; Nature; 505, 37. [ARONA DIEDHIOU, Cote d'Ivoire]	Accepted - text revised
21656	30	45	30	48	While these two sentences are very similar to the abstract of Freychet et al 2018, these sentences do not refer well to Wang et al 2018a. Wang et al 2018a employed a regional climate model for their study, which could differ from AMIP or global simulations with SST-fixed. I think these two sentences should be rewritten to refer both studies. [Gwenaelle GREMION, Canada]	Taken into account - text revised
35368	30	50	30	54	Are there any results for extreme climatology for CORDEX South Asia to be included in this section? [Mehwish Ramzan, Pakistan]	Noted

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
21658	30	50	30	55	Some of the references included in this paragraph seem inappropriate to be included in this paragraph which is presumably about temperature extremes. Zhu et al 2018 and Dosio et al 2015 did not evaluate the representation of temperature extremes but rather precipitation extremes.. Kotlarsli et al 2014 evaluated the simulated climatologies and not temperature extremes. Ruti et al 2016 present the description of the MED-CORDEX project but I don't think it is a good example for evaluations of RCMs in reproducing temperature extremes. A good example for a complete study about the evaluation of RCMs in reproducing temperature extremes using the EURO-CORDEX is missed (Vautard et al 2013: The simulation of European heat waves from an ensemble of regional climate models within the EURO-CORDEX project Clim Dyn (2013) 41: 2555. https://doi.org/10.1007/s00382-013-1714-z). It should be cited here. [Gwenaelle GREMION, Canada]	Accepted - text revised
21660	30	50	31	10	I don't think the discussion about the representation of temperature extremes in RCM simulations is complete. Authors should indicate that there are many factors within regional simulations that affect the added value of RCM in simulating temperature extremes, such as the resolution jumps (4km, 10km, 25km, 50km), convective parameterizations (Brisson et al 2016; How well can a convection-permitting climate model reproduce decadal statistics of precipitation, temperature and cloud characteristics?), etc. Although, the literature probably is not robust enough to reach clear conclusions, I think those differences among RCM simulations should be at least mentioned here. [Gwenaelle GREMION, Canada]	Noted - here just assess the performance of RCMs, not discuss the reason
55464	30	51	30	51	No explanation given for CORDEX experiment of it's first occurrence. References only given on Page 40, line 16-17 [GENITO MAURE, Mozambique]	Taken into consideration - text revised
21662	30	54	31	1	I don't think that based on the current literature, authors can confirm a substantial improvement of RCM simulations over GCM simulations in reproducing temperature extremes. I think most of the articles state that the added value in RCM simulations of temperature extremes is very dependent on the parameters employed (e.j. Vautard et al 2013). Please soften the language in the sentence to support this, or support the claim with other sources [Gwenaelle GREMION, Canada]	Accepted - text revised
21664	31	12	31	13	The first sentence of the summary paragraph is ambiguous. It reads "climate models can represent the overall warming observed". I guess authors here refers to "extreme warm events" but using just warming it could be confused with the global mean temperature which is not the focus of this section. [Gwenaelle GREMION, Canada]	Accepted - text revised
15306	31	12	31	16	I think there could be added an additional sentence giving some sense of how this performance manifests itself, not only that "it depends". [Claudia Tebaldi, United States of America]	Noted - It is hard to give details in summary
43510	31	12	31	16	This summary focuses on evaluating models in terms of the observed trend reproduction, not considering climatology simulation skills such as mean intensity and its interannual variability, which are also important metrics. [Seung-Ki Min, Republic of Korea]	Accepted - text revised
26780	31	15	31	16	No reason to put a confidence statement here. [Thorsten Mauritsen, Sweden]	Accepted - text revised
21666	31	15	31	16	The expression "temporal and spatial periods" should be replaced by something like "temporal periods and spatial scales". [Gwenaelle GREMION, Canada]	Accepted - text revised
27884	31	18	31	19	Page 11-31, line 19: The title could be changed. It now says 'attribution' twice. Suggestion: 'Detection and attribution' Page 11-31, lines 28-29: Is there a quantification of the contribution of the natural weather variability Page 11-31, lines 38-39: The sentence 'as much as 75%' is quite broad. Could this be specified more? Page 11-33, lines 39-40: Elaborate more on the 'wrong sign'. What are the cause and effect of this? Page 11-33, lines 40-42: Deforestation already mentioned twice in section 11.3.1 and 11.3.2 [roderik van de wal, Netherlands]	Rejected - title refers to two distinct but related areas; Rejected - this statement refers to the AR5 synthesis of literature of many events, not one specific study that can be quantified; ; Accepted - text revised; Accepted - details added though cause not discussed in Lejeune et al 2017 study; Taken into account. Remove it here
21668	31	21	33	45	it would be helpful to have an overview of the methods used in D&A studies. The methods used in individual studies are mentioned for some of the cited studies, but for most of them they are not. The sentence p32 l30-31 could be moved to the beginning of the section, with the addition of which methods are principally used [Gwenaelle GREMION, Canada]	Noted - this is at the beginning of the section on event attribution

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32386	31	21	34	6	I feel that there is a lack of clarity between D&A of trends in extremes and the D&A of an event. Perhaps this should be broken into two sub sections [Simon Brown, United Kingdom (of Great Britain and Northern Ireland)]	Noted
54572	31	31	31	31	In line 31 page 31, there should be a space between words recent and literature. Also, there is need to look at detection and attribution, event attribution within the tropical region. [Mark Owidhi, Kenya]	Accepted - space add. And noted.
44522	31	31	31	31	Typos indentifies as 'recent literature on human influence on long-term' [Shaikat Ali, Pakistan]	Accepted - text revised
55946	31	31	41	49	Unclear whether the references are related to all these statements or only to the last one. [Olga Zolina, France]	Accepted - text revised
21670	31	36	31	36	The reference Wang et al 2017e should be replaced by Wang et al 2017d. [Gwenaelle GREMION, Canada]	Accepted - text revised
13098	31	44	31	44	To balance the statement in the current text, one stronger evidence should be added after '...as well as different data availability.': [After explaining the roles of urbanization and the abnormal western Pacific subtropical high, Zhou et al. (2019) suggested a robust estimation of attributed risk to the anthropogenic forcing (by 23%) in such extremes as the record-breaking heatwave in Central Eastern China in 2017.] Reference: Zhou, C., and Wang, K., Qi, D., and Tan, J., (2019). Attribution of a record-breaking heatwave event in summer 2017 over Yangtze River Delta. Bull. Am. Meteorol. Soc., 100, 97-103. doi: 10.1175/BAMS-D-17-0090.2. [Zhou Chunlüe, United States of America]	Not applicable - sentences deleted
21672	31	44	31	49	The last two sentences of the paragraph do not fit in this section. They are about model evaluation results, that were presented in section 11.3.3. They should be removed from this section [Gwenaelle GREMION, Canada]	Accepted - text deleted
21674	31	55	31	55	The reference "Christidis et al 2016" should read "Christidis and Stott 2016" [Gwenaelle GREMION, Canada]	Accepted - text revised
21676	32	2	32	7	The last two sentences of the paragraph refer to results on recent studies but they do not provide the references. Please specify the references [Gwenaelle GREMION, Canada]	Accepted - references added.
15308	32	9	32	14	Possibly additional reference (US-centric but relating records to average temperature) Meehl et al. 2016 https://doi.org/10.1073/pnas.1606117113 [Claudia Tebaldi, United States of America]	Accepted - text revised
54338	32	24	32	28	A more recent paper covering this ground is Pepler et al 2018 (http://www.bom.gov.au/jshess/docs/2018/68.011.Pepler.pdf). Note that the Crimp et al paper uses unhomogenised data, which affects conclusions as many sites in the region have moved from urban to non-urban locations since the 1990s (Dittus and Pepler use homogenised data. The Pepler et al 2018 paper should also be included in Table 11.5 and associated discussion. [Blair Trewin, Australia]	Accepted - text revised
21678	32	41	32	41	Here the authors references Li et al 2017, but the information referenced seems to be inconsistent with the information contained in the Li et al 2017 paper is included in the list of references. Please double check the referencing here and make sure the in-text citation matches the references list. [Gwenaelle GREMION, Canada]	Accepted - reference corrected
21680	32	49	32	49	Knutson et al 2014 included in the list of references is a study of precipitation extreme events over the US, please include the correct reference in the reference list. [Gwenaelle GREMION, Canada]	Accepted - reference corrected
21682	32	55	32	55	The reference Peterson et al 2013 is indicated in the list of references as Peterson et al 2013a. [Gwenaelle GREMION, Canada]	Accepted - text revised
54854	33	6			After reading this, it would have been nice to have some list or reference of types of events that have been attributed with what conclusion. Its not easy to summarize, but no summary at all is a bit disappointing! [Gabriele Hegerl, United Kingdom (of Great Britain and Northern Ireland)]	Noted
54340	33	8	33	18	A partial contrast to this is the result of Grose et al 2018 (https://journals.ametsoc.org/doi/pdf/10.1175/BAMS-D-17-0088.1), who found that for a frost event in Western Australia in September 2016, anthropogenic influences on circulation acted opposite to anthropogenically forced warming. [Blair Trewin, Australia]	Accepted - text revised
8282	34	9	36	11	Suggestion is to add more references such as Guo Xiaojun, Jianbin Huang, Yong Luo, Zongci Zhao and Ying Xu, 2016, Projection of heat waves over China for eight different global warming targets using 12 CMIP5 models, Theor. Appl. Climatol., doi: 10.1007/s00704-015-1718-1 [Zong Ci Zhao, China]	Taken into account - reference added

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
6820	34	11	34	19	As well as in SR15, this section fails to address the uncertainty between, in this case, the 1.5C vs 2C climate projections that arises due to internal variability. For example in the case of European summer maximum temperatures, although the projected temperature distribution at 2C is on average more than 1 degree warmer than for 1.5C, due to internal variability only 10% of the most extreme maximum temperatures at 2C of global warming could be avoided by limiting warming to 1.5C (Suarez-Gutierrez et al., 2018). This point is crucial to evaluate the avoided impacts of climate change by maintaining global warming below fixed GMST limits, and should come across much more prominently in this report. [Laura Suarez-Gutierrez, Germany]	Noted
32382	34	13			If thresholds defining a heatwave are fixed at present day levels then it is given that they will be longer, however, this is not particularly useful statement. The paper below finds "that for all CMIP5 GCMs temporal dependence is unaffected by greenhouse gas induced climate change indicating that durations of heatwaves, that exceed time varying high thresholds (i.e. the 1-year level), will not change in the future." Characterising the changing behaviour of heatwaves with climate change, Hugo C Winter , Simon J Brown and Jonathan A Tawn, Dynamics and Statistics of the Climate System, 2016 [Simon Brown, United Kingdom (of Great Britain and Northern Ireland)]	Noted - this is the assessment conclusion from the AR5
54342	34	26	34	29	The findings of model evaluation studies that found that the warming of extreme high temperatures in historical model simulations tended to be too strong (p30 line 6-13) should perhaps be considered as a caveat to the findings here (and in following paragraphs) for projections, in particular the assessments at the end of p36/start of p37. [Blair Trewin, Australia]	Noted
37948	34	41	35	2	Figures 11.3 and 11.4 have cross-hatching almost everywhere. As such the hatching simply distracts from these figures. It could be removed, and a statement made in the text or captions to the effect that almost everywhere at least two thirds of the models agree as to sign. Alternatively, a more stringent criterion for plotting cross-hatching could be used. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Accepted, we switched to a more stringent criterion
44524	35	5	35	5	Typo indentifies as 'showschangesin' [Shaukat Ali, Pakistan]	Accepted - text revised
21684	35	29	35	35	Authors say that there are studies of projected temperature extremes at the regional and country level, but they did not discuss their results or provide references for those studies. I don't know if they are necessary because in my opinion the literature review that is already done is complete enough. But then I would remove the sentence saying that those studies exists. Also in the last line of this paragraph authors include results of marine heatwaves, while at the beginning of the chapter authors indicate that results on marine heat waves are in chapter 9. I would take these lines out of this section. [Gwenaelle GREMION, Canada]	Accepted - text revised
55948	35	35	33	35	Reference on marine heat waves needed. [Olga Zolina, France]	Not Applicable
6822	35	37	35	37	What does future projections of observed temperatures mean? [Laura Suarez-Gutierrez, Germany]	Taken into account - text revised
21686	35	43	35	44	The authors may have misread results from Tebaldi and Wehner 2018. Table 1 in this article shows that by the end of the century the land fraction increases to 92% and 62% under the RCP8.5 and RCP4.5. Please, check the provided numbers. [Gwenaelle GREMION, Canada]	Accepted - text revised
21688	36	2	36	3	The reference Wehner et al 2018 is not in the reference list. I think authors refer to Wehner et al 2018b. [Gwenaelle GREMION, Canada]	Accepted - text revised
37950	36	17			Change "pre-industrial conditions" to "the early-industrial baseline" for consistency with the terminology set out in Chapter 1. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. The figure was removed.
37952	36	26			Change "pre-industrial conditions" to "the early-industrial baseline" for consistency with the terminology set out in Chapter 1. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. The figure was removed.
37954	36	34			Change "pre-industrial conditions" to "the early-industrial baseline" for consistency with the terminology set out in Chapter 1. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. The figure was removed.
27032	36	48	37	12	Arid land is missing, which is about 1/3 of global land surface [Mansour Almazroui, Saudi Arabia]	Noted
21690	36	52	36	53	In the summary paragraph, authors say that "It is virtually certain that the length frequency and/or intensity of warm spells or heatwaves will increase over most land areas". However in this section warm/cold spells and heatwaves have not been discussed except for the AR5 results and marine heatwave, which are out of topic here. [Gwenaelle GREMION, Canada]	Taken into account - text revised

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
43512	37	1	37	7	Projections of extreme changes here are made based on multi-model averages only. Providing inter-model ranges like 5-95% would be needed for better communications of uncertainties at regional scales. [Seung-Ki Min, Republic of Korea]	Noted
13318	37	4			high- latitude regions [Mansoureh Kouhi, Iran]	Accepted - text revised
46362	37	4			high- latitude regions [sadeqh zeyaayan, Iran]	Accepted - text revised
57638	37	4			high- latitude regions [Sahar Tajbakhsh Mosalman, Iran]	Accepted - text revised
13320	37	5			regions is [Mansoureh Kouhi, Iran]	Accepted - text revised
46364	37	5			regions is [sadeqh zeyaayan, Iran]	Accepted - text revised
57640	37	5			regions is [Sahar Tajbakhsh Mosalman, Iran]	Accepted - text revised
40386	37	11	37	44	Section 11.4: Even though there is another section regarding regional assessments, I suggest including in this section more emphasis on the spatial variability of the results. For example, in page -39, lines 7-12: results are well described, but even though there is a dominant wetting trend, Skansi et al (2013) show high spatial variability in the results and I consider this is not clear in the text. Being more specific: Whereas page 11-39 line 7 states "For South America the dominant signal is a wetting trend", page 80, lines 34-35 states "There is low to medium confidence in trends of extreme precipitation over Central and South America depending on the region". The first statement is too strong considering bias, spatial variability, etc whereas the second statement is more adequate for this variable. [Vanessa Pántano, Argentina]	The assessment is based on multiple lines of evidence including those from observations, and from theoretical understanding etc. The reasoning presented here has already be considered.
26782	37	11			Do you mean a 'stronger than linear warming'? [Thorsten Mauritsen, Sweden]	Noted
38906	37	15	37	26	A statement is required to which time and spatial scale the subsequent statements on changing extremes refer. Is it 5-day precip (as in Fig. 11.8), daily or hourly. The time-scales should be explicitly mentioned. [Uwe Ulbrich, Germany]	Accepted, in text time scale is explicitly mentioned
56508	37	15	42		The text commonly uses percentile indices. For all occurrence with precipitation, clarification is needed whether this pertains to all-event or wet-event percentiles. The text should also discuss that this distinction is important and failure may lead to biased estimates (see Schär et al. 2016: Percentile indices for assessing changes in heavy precipitation events. http://dx.doi.org/10.1007/s10584-016-1669-2). Many past studies have been affected by this problem and have used wet-event percentiles which are potentially misleading. [Christoph Schär, Switzerland]	Noted. It will be too detailed to have assessments based on different definitions arising from different samples used for percentile computation. However, an explicit mention of this was added at the beginning of the section.
48646	37	15	44	11	Section 11.4 on heavy precipitation overlaps partly with Atlas.5 (Regional syntheses and case studies). Same outline and content (observed trends, model evaluation, attribution, projections). Needs coordination among CLAs [Lincoln Alves, Brazil]	Noted
52786	37	15			As stated in the introduction to this section, one can assess many different types of extreme precipitation. Throughout the text, information about which type is considered in a given situation is often missing, even though different types may respond differently to forcings (e.g., 5 day vs. 3 hourly; 95th percentile vs. 20 year return level). Please be more precise! [Douglas Maraun, Austria]	Noted
27886	37	17	37	18	Page 11-37, lines 17-18: What is the definition of heavy precipitation? It is stated that 'most studies are based on precipitation accumulated over a short period of time'. However, this does not define anything about the amount of precipitation. [roderik van de wal, Netherlands]	Noted, it is difficult to get a uniform definition across literature and hence, the definition is kept subjective
31900	37	17	37	20	Although there are not many studies that examine subdaily extreme precipitation, some studies have found a stronger impacts of anthropogenic forcing on subdaily extreme precipitation than daily ones (Scoccimarro et al. 2015; Prein et al. 2017; Zhang et al. 2017). Because there is a rising number of studies that focus on subdaily extreme precipitation, it would be helpful to include a paragraph to discuss subdaily extreme precipitation and its modulation by anthropogenic forcing. Scoccimarro, E., G. Villarini, M. Vichi, M. Zampieri, P.G. Fogli, A. Bellucci, and S. Gualdi, 2015: Projected Changes in Intense Precipitation over Europe at the Daily and Subdaily Time Scales. <i>J. Climate</i> , 28, 6193–6203, https://doi.org/10.1175/JCLI-D-14-00779.1 Zhang, W., G. Villarini, E. Scoccimarro, and G. A. Vecchi (2017), Stronger influences of increased CO2 on subdaily precipitation extremes than at the daily scale, <i>Geophysical Research Letters</i> , 44(14), 7464-7471. Prein, A. F., R. M. Rasmussen, K. Ikeda, C. Liu, M. P. Clark, and G. J. Holland (2017), The future intensification of hourly precipitation extremes, <i>Nature Clim. Change</i> , 7(1), 48-52, doi:10.1038/nclimate3168. [Wei Zhang, United States of America]	Accepted and added

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21692	37	17	41	43	Be consistent with the use of RX5day vs Rx5day and all other abbreviations [Gwenaelle GREMION, Canada]	Accepted
21694	37	17	44	11	The organization of section 11.4 made it challenging to understand. Specifically, in several instances sentences within paragraphs were not clearly related or connected. Often the first sentence of a paragraph is considered a topic sentence, and all subsequent sentences are obviously related to this first one. Several paragraphs seemed to change topic part way through. [Gwenaelle GREMION, Canada]	Noted
21696	37	17	44	11	Please check all references cited in this section. Some sentences in this section of the report do not accurately reflect what is in the reports they cite. Take care to not "copy" messages without their relevant context [Gwenaelle GREMION, Canada]	Noted
52788	37	17			I would not refer to this as definition, at least not fully. When comparing 3h and 5d precipitation extremes, these are not different definitions but simply different types. Within a type one could look at different extremeness (e.g., 95th percentile), and only when getting even more technical I would speak of a definition (e.g., how the 95th percentile is defined). [Douglas Maraun, Austria]	Accept, modified
14198	37	17			remove "of available": redundant and incorrect grammar. Section 11.4.1 could be corrected by a native English speaker/the TSU. [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Noted
30174	37	18	37	20	Although there has been an increasing body of work on sub-daily extreme precipitation since the AR5 and SREX lead by the INTENSE initiative of GEWEX (and associated project). See Blenkinsop, S., Fowler, H.J., Barbero, R., Chan, S.C., Guerreiro, S.B., Kendon, E., Lenderink, G., Lewis, E., Li, X.-F., Westra, S., Alexander, L., Allan, R.P., Berg, P., Dunn, R.J.H., Ekström, M., Evans, J.P., Holland, G., Jones, R., Kjellström, E., Klein-Tank, A., Lettenmaier, D., Mishra, V., Prein, A.F., Sheffield, J., Tye, M.R. 2018. The INTENSE project: using observations and models to understand the past, present and future of sub-daily rainfall extremes. Adv. Sci. Res., 15, 117-126, DOI: 10.5194/asr-15-117-2018. [Hayley Fowler, United Kingdom (of Great Britain and Northern Ireland)]	Accepted
52792	37	24	37	25	This sentence ("The available...") is a zero statement. Availability always limits. Please delete or rephrase. The key sentence is the following. [Douglas Maraun, Austria]	Noted and modified
54046	37	24	37	26	Comments on the lack of information on extreme precipitation for durations shorter than a day but while this is true in a relative context there is a nonetheless expanding area of research in this area which could be commented upon. I provide more potential details at the relevant points below. In particular, some comment may be made on the effort within the Global Energy and Water Exchanges (GEWEX) Hydroclimatology Panel Cross-Cutting project on sub-daily precipitation extremes, addressing the World Climate Research Programme "Grand Challenge" on extremes (see Blenkinsop et al., 2018 for a review) and has produced a new global sub-daily rainfall (GSDR) dataset (see Lewis et al, 2019) (may be appropriate for Section 11.2.1.1) yielding information on sub-daily climatology, its drivers and observed change. REFERENCES Blenkinsop S, Fowler HJ, Lewis E, Guerreiro S, Li X-F, Chan SC, Barbero R, Lenderink G, Westra S, Kendon E, Ekstrom M, Tye MR, et al., 2018. The INTENSE project: using observations and models to understand the past, present and future of sub-daily rainfall extremes. Advances in Science and Research, 15, 117-126. Lewis, E., H. Fowler, L. Alexander, R. Dunn, F. McClean, R. Barbero, S. Guerreiro, X. Li, and S. Blenkinsop, 2019. GSDR: A global sub-daily rainfall dataset. J. Climate, https://doi.org/10.1175/JCLI-D-18-0143.1 [Stephen Blenkinsop, United Kingdom (of Great Britain and Northern Ireland)]	Accepted and assessments of sub-daily precipitation are added
21698	37	25	37	26	I suggest adding one sentence about why studies of heavy precipitation of less than one day are missing (e.g. Missing station data, since most stations record once a day, limited spatial resolution of models, missing simulations of convection, etc) see e.g. Zhang, X., Zwiers, F.W., Li, G., Wan, H., Cannon, A.J., 2017. Complexity in estimating past and future extreme short-duration rainfall. Nature Geoscience 10, 255. [Gwenaelle GREMION, Canada]	Accepted and modified

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
30176	37	25	37	26	Although I agree that there are less studies at the sub-daily scale you should not overlook those studies that have been done. For e.g. Westra et al. 2014 Revs. Geophysics. provide a nice overview of studies on sub-daily heavy precip looking at changes (not always trends). This was updated by Blenkinsop for the State of the Climate review in 2018 where a supplementary figure provides information on all studies that have looked (last year at least) at changes, trends in sub-daily (hourly in the main) extreme precip. In general these show increases. updated for SoC2019 it is Online Figure 2.SB.5 [Hayley Fowler, United Kingdom (of Great Britain and Northern Ireland)]	Accepted and assessments of sub-daily precipitation are added
14200	37	25			Seems to repeat earlier lines: "Information on extreme precipitation for durations longer than a few days or shorter than a day is lacking in particular." [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted and the 1st sentence is deleted
56454	37	26	37	26	change "a day is lacking" to "a day is almost lacking" [Pierluigi Claps, Italy]	Accepted
39082	37	26	37	26	There is quite some literature now on changs in subdaily extremes from recent model simulations. [Lenderink Geert, Netherlands]	Accept and assessments of sub-daily precipitation are added
52790	37	26			Please refer to Section 11.7.3 here. I was confused when not finding anything about convective storms here. [Douglas Maraun, Austria]	Rejected; here we are introducing heavy precipitation, not the detailed reasons
21700	37	29	37	29	Maybe change the title to "mechanisms and drivers of changes" to make clear that it is about drivers that cause changes... Not about drivers of heavy precipitation in general [Gwenaelle GREMION, Canada]	Rejected. This section title is consistent with other sections.
30180	37	29	37	29	You should add a section in here referring to mechanisms and drivers for sub-daily extremes as there has been some work done on this now. Some of this is summarised in Blenkinsop et al. 2018 Adv. Sci Res 15, 117-126. Some in Lenderink and Fowler, 2017 in NCC. I would be happy to construct a section on this for the report if you would like me to summarise the work in this area as this is all I have been working on for the last 5 years. These are some papers from my own group but there are many more from other groups particularly in Australia: Ali, H., Fowler, H.J., Mishra, V. 2018. Global observational evidence of strong linkage between dew point temperature and precipitation extremes. Geophysical Research Letters, 45, 12320-12330, DOI: 10.1029/2018GL080557. Guerreiro, S., Fowler, H.J., Barbero, R., Westra, S., Lenderink, G., Blenkinsop, S., Lewis, E., Li, X.-F. 2018. Detection of continental-scale intensification of hourly rainfall extremes. Nature Climate Change, 8(9), 803-807, DOI: 10.1038/s41558-018-0245-3. Lenderink, G., Barbero, R., Westra, S., Fowler, H.J. 2018. Reply to comments on "Temperature-extreme precipitation scaling: a two-way causality?" International Journal of Climatology, 38(12), 4664-4666, DOI: 10.1002/joc.5799. Blenkinsop, S., Fowler, H.J., Barbero, R., Chan, S.C., Guerreiro, S.B., Kendon, E., Lenderink, G., Lewis, E., Li, X.-F., Westra, S., Alexander, L., Allan, R.P., Berg, P., Dunn, R.J.H., Ekström, M., Evans, J.P., Holland, G., Jones, R., Kjellström, E., Klein-Tank, A., Lettenmaier, D., Mishra, V., Prein, A.F., Sheffield, J., Tye, M.R. 2018. The INTENSE project: using observations and models to understand the past, present and future of sub-daily rainfall extremes. Adv. Sci. Res., 15, 117-126, DOI: 10.5194/asr-15-117-2018. Barbero, R., Abatzoglou, J.T., Fowler, H.J. 2018: Contribution of large-scale midlatitude disturbances to hourly precipitation extremes in the United States. Climate Dynamics, DOI: 10.1007/s00382-018-4123-5. Chan, S.C., Kendon, E.J., Roberts, N.M., Blenkinsop, S., Fowler, H.J. 2018: Large-scale predictors for extreme hourly precipitation events in convection-permitting climate simulations. Journal of Climate, 31(6), 2115-2131, doi: 10.1175/JCLI-D-17-0404.1. Barbero, R., Westra, S., Lenderink, G., Fowler, H.J. 2018: Temperature-extreme precipitation scaling: a two-way causality? International Journal of Climatology, 38, e1274-e1279, DOI: 10.1002/joc.5370. Lenderink, G., Barbero, R., Loriaux, J.M., Fowler, H.J. 2017. Super Clausius-Clapeyron scaling of extreme hourly precipitation and its relation to large-scale atmospheric conditions. Journal of Climate, 30(15), 6037-6052, DOI: 10.1175/JCLI-D-16-0888.1	Accepted. Added a paragraph on sub-daily extreme precipitation
26784	37	29	38	29	This section would benefit from a general rewrite. There are quite a few things that can be said based on fundamental physics about heavy precipitation and how it is expected to change. Much of this is in Box 11.1, which is unfortunate, because that is not where a reader would look for it. [Thorsten Mauritsen, Sweden]	Noted. We added more explanation on basic physics. We do not change Box 11.1, which is just referred to in this section. We also refer to Chapter 8 (Section 8.2.2), which is more devoted to processes determining precipitation intensity.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
14270	37	29	38	29	There is high confidence that latent heating can invogotate the parent storm (Zhang et al. (2019) GRL, doi:10.1029/2018GL079071; Nie et al. (2019) PNAS, doi:10.1073/pnas.1800357115) which can increase precipitation intensity above that expected fro Clausius Clapeyron, yet the latent heat release will increase stability of the atmosphere on larger space and time scales (e.g. Loriaux et al. 2017 J. Clim doi:10.1175/JCLI-D-16-0381.1) thereby altering the intensity distribution and leading to contrasting responses at smaller and larger space and time scales (e.g. Pendergrass 2018 Science, http://science.sciencemag.org/content/360/6393/1072). [see aslo 8.2.2.1.2] [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. We used the suggested sentence to the first paragraph.
52796	37	29			I found the organisaton of this section somewhat arbitrary without any guidance, in particular the choice and order of regions. This should be changed/better motivated. [Douglas Maraun, Austria]	Considered. Text is modified to improve.
43846	37	31	37	37	Accumulated space-borne precipitation radar observation data from TRMM and GPM satellite brought a new perspective for extreme precipitation. It was found that over tropics and subtropics, extreme precipitation has weak linkage with extreme convection, but associated with more warm-type rainfall under relatively stable but moist free tropospheric conditions (Hamada et al. 2015). Especially in moist monsoon regions, heavy precipitation is characterized with more warm-type rainfall (Sohn et al. 2013, Hamada and Takayabu 2018). (ref.) Hamada, A., Y. N. Takayabu, C. Liu, and E. J. Zipser, 2015: Weak linkage between the heaviest rainfall and tallest storms. Nat. Commun., Vol. 6(6213), doi: http://dx.doi.org/10.1038/ncomms7213 . Hamada, A, and Y. N. Takayabu, 2018: Large-scale environmental conditions related to midsummer extreme rainfall events around Japan in the TRMM region, J. Climate, 31, 6933-6945. https://doi.org/10.1175/JCLI-D-17-0632.1 Sohn, B. J., Ryu, G.-H., Song, H.-J. & Ou, M.-L. Characteristic features of warm-type rain producing heavy rainfall over the Korean Peninsula inferred from TRMM measurements. Mon. Wea. Rev. 141, 3873–3888 (2013). [Izuru Takayabu, Japan]	Noted. The aspect of cloud microphysics characteristics on storms are described in section 11.7.3 Extreme Storms.
52794	37	31			Is this something that was assessed? I think it is a bluntly obvious matter of fact. [Douglas Maraun, Austria]	Noted and modified
7626	37	32	37	32	followsthe (follows the) [Guoping Li, China]	accepted
30178	37	32	37	34	The thermodynamic change generally follows CC scaling apart from for sub-daily extremes which in some regions show super-cc scaling (e.g. Guerreiro et al. 2018 NCC): Guerreiro, S., Fowler, H.J., Barbero, R., Westra, S., Lenderink, G., Blenkinsop, S., Lewis, E., Li, X.-F. 2018. Detection of continental-scale intensification of hourly rainfall extremes. Nature Climate Change, 8(9), 803-807, DOI: 10.1038/s41558-018-0245-3. This paper also detected a change in heavy hourly precip outside natural variability and so should also be added as information to the detection and attribution section. [Hayley Fowler, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. This reference is cited for the sub-daily precipitation changes.
13322	37	32			follows the [Mansoureh Kouhi, Iran]	accepted
46366	37	32			follows the [sadegh zeyaeyan, Iran]	accepted
57642	37	32			follows the [Sahar Tajbakhsh Mosalman, Iran]	Accept
37956	37	34			"is" should be "are", or "changes" should be "change" in the previous line. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	accepted
14202	37	36			Chapter 8 is signposted for monsoon but then monsoons are discussed so perhaps keep one or the other. I suggest removing the following paragraph on monsoons since the general drivers are being discussed here and this paragraph breaks the flow a bit. [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Agree. We modify the paragraph by referring to Chap 8 and consistency.
55950	37	37	20	22	There are also a lot of literature on the analysis of seasonal values (not only annual maximum) and values exceeding some threshold. More generally, issue of seasonality shuld be highlighted [Olga Zolina, France]	rejected: seasonal values do not really come under heavy precipitation, here we refer to a duration of maximum 5 days
54574	37	37			How well could we incorporate the influence of local features in the future projection of rainfall? Most models do not take into consideration the influence of local features such as lakes and mountains [Mark Owidhi, Kenya]	Rejected. This comment is not related to this point. Regional models take care of local factors.
54576	37	37			There is great uncertainty on future rainfall projections especially within the East Africa region. How best can this be explained; are there some convincing results with great [Mark Owidhi, Kenya]	Noted. The local aspect in the East African region should be considered in other sections and Chapters 10, 12.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
21702	37	39	37	44	<p>The following could be appended in this paragraph, after the first sentence, to help explain the mechanisms in question. "Underlying mechanisms for such changes include the weakening of the large-scale monsoon circulation (Kitoh et al., 2013, Hsu et al., 2013), which results from the stabilization of the tropical atmosphere associated with global warming (Vecchi et al., 2007), the modulation of regional monsoon circulation by land-sea thermal contrast changes (Turner et al., 2012), the gradient of SST warming patterns (Chen et al., 2015), and changes in synoptic scale circulations, such as monsoon depressions (Pfah et al., 2017, Turner et al., 2012), and tropical cyclones (Schleussner et al., 2016)" This information is extracted from the recent study by Zhang et al., 2018.</p> <p>References:</p> <ol style="list-style-type: none"> 1. Kitoh, A. et al. Monsoons in a changing world: a regional perspective in a global context. <i>J. Geophys. Res.</i> 118, 3053–3065 (2013). 2. Schleussner et al. Differential climate impacts for policy-relevant limits to global warming: the case of 1.5 °C and 2 °C. <i>Earth Syst. Dyn.</i> 7, 327–351 (2016). 3. Turner, A. G. & Annamalai, H. Climate change and the South Asian summer monsoon. <i>Nat. Clim. Change</i> 2, 587–595 (2012). 4. Vecchi, G. A. & Soden, B. J. Global warming and the weakening of the tropical circulation. <i>J. Clim.</i> 20, 4316–4340 (2007). 5. Hsu, P. C., Li, T., Murakami, H. & Kitoh, A. Future change of the global monsoon revealed from 19 CMIP5 models. <i>J. Geophys. Res.</i> 118, 1247–1260 (2013). 6. Pfah, S., O’Gorman, P. A. & Fischer, E. M. Understanding the regional pattern of projected future changes in extreme precipitation. <i>Nat. Clim. Change</i> 7, 423–427 (2017). 7. Chen, X. & Zhou, T. Distinct effects of global mean warming and regional sea surface warming pattern on projected uncertainty in the South Asian summer monsoon. <i>Geophys. Res. Lett.</i> 42, 9433–9439 (2015). 8. Zhang, W., Zhou, T., Zou, L., Zhang, L. & Chen, X. Reduced exposure to extreme precipitation from 0.5 °C less warming in global land monsoon regions. <i>Nat. Commun.</i> (2018). doi:10.1038/s41467-018-05633-3 [Gwenaëlle GREMION, Canada] 	Accepted. The monsoon paragraph was rewritten using the suggested sentences.
9000	37	39			"tropical overturning circulation" not clear - define Hadley cell circulation? [Ségolène Berthou, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The texts in this section were reduced and details were removed.
21704	37	42	37	42	Add in Line 42 that "(...) in some regions, but our understanding of monsoon circulations remain limited because of the complexity of these systems (Seth et al., 2019) [Gwenaëlle GREMION, Canada]	Accepted. The sentence was modified.
9002	37	43	37	44	This sentence is not clear at all. [Ségolène Berthou, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. The sentence was deleted.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
31902	37	46	38	9	<p>This part may need some improvements. This may be improved by discussing:</p> <ol style="list-style-type: none"> 1. Impacts of climate modes (e.g., ENSO, Pacific Meridional Mode Atlantic Meridional Mode, Atlantic Nino and AMO) on large-scale circulation, which subsequently modulate precipitation and extremes. 2. Impacts of climate modes (e.g., ENSO, Pacific Meridional Mode Atlantic Meridional Mode, Atlantic Nino and AMO) on tropical cyclones in terms of genesis, track and intensity, which modulate TC rainfall, in particular for the storms that make landfall. 3. The climate modes influence monsoonal circulations, which are responsible for changes in precipitation and extremes. 4. The influence of anthropogenic forcing on these climate modes and on the impacts of these climate modes on precipitation and extremes. <p>Page 11-38: Line 16: There is no reference for "Zhang et al. 2017" in the reference list. This should be "Zhang, W., G. A. Vecchi, H. Murakami, G. Villarini, T. L. Delworth, X. Yang, and L. Jia (2018), Dominant role of Atlantic Multidecadal Oscillation in the recent decadal changes in western North Pacific tropical cyclone activity, Geophysical Research Letters, 45(1), 354-362." Please double check.</p> <p>Page 11-40, Line 32-40: It might be helpful to discuss some efforts in GFDL to develop the 25-km HiFLOR model that improve simulation of Cat-4-5 storms (e.g., Murakami et al. 2015).</p> <p>Murakami, H., G.A. Vecchi, S. Underwood, T.L. Delworth, A.T. Wittenberg, W.G. Anderson, J. Chen, R.G. Gudgel, L.M. Harris, S. Lin, and F. Zeng, 2015: Simulation and Prediction of Category 4 and 5 Hurricanes in the High-Resolution GFDL HiFLOR Coupled Climate Model. J. Climate, 28, 9058–9079, https://doi.org/10.1175/JCLI-D-15-0216.1 [Wei Zhang, United States of America]</p>	<p>Taken into account. The text can be improved by taken into account of the reviewer's suggestion.</p> <p>For the second part, Zhang et al.(2017) was removed, it is not relevant here.</p> <p>For the third part, Murakami et al. (2015) should be more related to Section 11.7.1, and not cited here.]</p>
21708	37	46	38	9	Please clarify the topic of this paragraph. The first sentence, and indeed the first half of the paragh, is about SST. However, the conclusions raised at the end of the paragraph are about precipitation and dryness patterns. [Gwenaelle GREMION, Canada]	Noted. The paragraph was improved to more focus on the changes in large-scale circulation patterns.
50678	37	47	37	48	This sentence is unclear [Olivia Martius, Switzerland]	Accepted. The sentence is clarified.
8092	37	49	37	49	Acronym TC is not defined in the text [Soledad Collazo, Argentina]	Thank you. TC is defined above, but it should be re-defined here. The text has been modified to write out the acronym.
21710	37	49	37	49	Please define the abbreviation TC here. [Gwenaelle GREMION, Canada]	Thank you. TC is defined above, but it should be re-defined here. The text has been modified to write out the acronym.
50680	37	52	37	52	Repeated statement [Olivia Martius, Switzerland]	Considered. Text is modified.
13324	37	54			likely that [Mansoureh Kouhi, Iran]	accepted
46368	37	54			likely that [sadegh zeyaeyan, Iran]	accepted
57644	37	54			likely that [Sahar Tajbakhsh Mosalman, Iran]	accept
37958	37	54			"It is likely that SST is projected to increase ..." is presumably not the message it was intended to convey. Should this not read something like: "It is likely, from projections, that SST will increase ..."? [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. The sentence is modified.
48114	37		38		8.3.1.3.4 Precipitation intensities and extremes and section 11.4.1-aerosol-precipitation extremes seem to have overlaps. Please check. [WGI TSU, France]	Considered. This is being worked out with Ch8.
48760	38	2	38	2	In western tropical South America, strong eastern Pacific El Niño events are a key driver of extreme rainfall and model projections indicate that both would increase. I propose including: "Frequency of strong El Niño and associated extreme rainfall is projected to increase (Power et al 2013; Cai et al, 2014, 2018)". References: doi:10.1038/nature12580, doi:10.1038/ncimate2100, doi:10.1007/s00382-017-3745-3 [Ken Takahashi, Peru]	Reject. Projection of ENSO is assessed in Chap 4. Future change in amplitude of El Niño would decrease under some of the scenarios.
14206	38	2		4	native English speaker could check this section: the Indian; the western Indian Ocean; Central India (remove the); enhances of --> increases in [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. These are corrected.

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44592	38	4	38	4	Krishnan et al. 2016 is a relevant paper for high-resolution model (grid size < 35 km) attribution of the increasing trend of heavy precipitation (intensity > 100 mm per day) over Central India to climate change. Ref: Krishnan et al. 2016: Deciphering the desiccation trend of the South Asian monsoon hydroclimate in a warming world. <i>Clim Dyn</i> (2016) 47:1007–1027. [Krishnan Raghavan, India]	Accepted
37960	38	5			Change "it" to "there". [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Accepted
39084	38	11	38	29	I don't think you can compare the effect of aerosols with those of GHG. Aerosol act mainly locally, and this may be locally the case., often these studies are local studies, so it is mainly circumstantial evidence which cannot be compare to the changes aggregated over large continental areas (often following the CC rate), like those e.g. Aalbers E E, Lenderink G, van Meijgaard E and van den Hurk B J J M 2018 Local-scale changes in mean and heavy precipitation in Western Europe, climate change or internal variability? <i>Clim. Dyn.</i> 50 4745–66 Online: http://dx.doi.org/10.1007/s00382-017-3901-9 , Westra S, Alexander L V. and Zwiers F W 2013 Global Increasing Trends in Annual Maximum Daily Precipitation <i>J. Clim.</i> 26 3904–18 Online: http://journals.ametsoc.org/doi/abs/10.1175/JCLI-D-12-00502.1 [Lenderink Geert, Netherlands]	Taken into account. The text was modified. We need balance of the statement of Lin et al. (2016,2018), stating "the increased rate of precipitation extremes caused by aerosol forcing is significantly larger than that caused by GHG forcing."
52798	38	12	38	14	This statement lists (and mixes) causes of very different levels – should be rewritten. [Douglas Maraun, Austria]	Accept
50682	38	13	38	13	Please define dynamical adjustment [Olivia Martius, Switzerland]	Considered. Text is modified and there is no mentioning of dynamic adjustment.
52800	38	15			spell out tropical cyclones [Douglas Maraun, Austria]	Noted. TC is defined previously.
21712	38	16	38	19	Here, it can be beneficial to have a sentence or two explaining the reason for the difference in the effect of absorbing aerosols to the Northern Hemisphere rain and to the Southern Hemisphere rain. [Gwenaelle GREMION, Canada]	Noted. This is too detailed, and can be remove.
50684	38	18	38	18	Is this statement also valid for extreme precipitation? [Olivia Martius, Switzerland]	Noted. These are related to TCs, which affect extreme precipitation.
27888	38	18	38	19	Page 11-38, lines 18-19: What is the cause of this north-south distribution? [roderik van de wal, Netherlands]	Noted. This is too detailed, and may not be required to modify.
14208	38	18			Is this study related to extreme precipitation and if not perhaps it should not be discussed here [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. These are related to TCs, which affect extreme precipitation.
39086	38	23	38	23	increases in moisture content due to UHI appears rather unphysical as latent heat release is smaller over urban areas. Could be the results of convergence of air mass, which also leads to moisture convergence (but not near surface moisture as the text suggests) [Lenderink Geert, Netherlands]	Accepted. Change to "increase in atmospheric moisture due to horizontal convergence of air".
50686	38	25	38	25	Please define additional eddies, on what scale? Where? What kind of eddies? [Olivia Martius, Switzerland]	Noted. Text is modified to be specific (diffusion).
14210	38	26			"Other local factors such as reservoir operation may also have potential to impact heavy precipitation" does not make sense to me. Do you mean potential to modulate the impacts from heavy precipitation? [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Noted. A literature suggests this possibility. Texts are modified.
35350	38	32	39	40	Anything on subdaily precipitation from the INTENSE project (Hayley Fowler)? [Dunn Robert, United Kingdom (of Great Britain and Northern Ireland)]	Accepted and assessments of sub-daily precipitation are added
30182	38	34	38	39	Make it obvious that you are talking about changes to 'daily' extremes here. Most studies have been done at the daily level. [Hayley Fowler, United Kingdom (of Great Britain and Northern Ireland)]	Noted, assessments are made at daily level (unless otherwise mentioned) and this is now mentioned at the starting of 11.4
21716	38	34	38	44	This paragraph can be complemented by the following statement on the changes of extreme precipitation over the global monsoon regions: "The extreme precipitation index i.e. RX5day, areal averaged over the global monsoon region follows a near linear association with the global temperature increase at a rate of 5.17% per Kelvin, (Zhang et al., 2018). This response is nearly consistent with that from the Clausius–Clapeyron equation expected. The thermodynamic components estimates increases in intensity of heavy rainfall at a rate similar to the moisture increase of 7% per Kelvin, since heavy precipitation is mostly modulated by moisture convergence (Trenberth et al., 2003)". References: 1. Trenberth, K. E., Dai, A., Rasmussen, R. M. & Parsons, D. B. The changing character of precipitation. <i>Bull. Am. Meteorol. Soc.</i> 84, 1205–1217 (2003). 2. Zhang, W., Zhou, T., Zou, L., Zhang, L. & Chen, X. Reduced exposure to extreme precipitation from 0.5 °C less warming in global land monsoon regions. <i>Nat. Commun.</i> (2018). doi:10.1038/s41467-018-05633-3 [Gwenaelle GREMION, Canada]	Noted and added

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53014	38	34	39	32	Should consider Du et al. 2019 in GRL for this section. It discusses persistence of heavy precipitation. This section is also quite uneven in how it deals with regional studies. [Lisa Alexander, Australia]	Accepted, added and modified
21714	38	34	39	32	Briefly synthesise these examples at the end of the paragraph. E.g. Is there a region where overall most trends are toward heavier precipitation events, such as described in SREX, page 149 in the summary for North America? [Gwenaelle GREMION, Canada]	Noted
30194	38	34	39	40	You should add a section into the observed trends section for sub-daily extremes based on the information in the State of the Climate report 2019 (see comments above) [Hayley Fowler, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. In section 11.4.2 and 11.4.5, both, we have created 2 sub-parts, one on daily and the other on other time-scales
52802	38	34			on which time scales? This should be stated. [Douglas Maraun, Austria]	Noted
37962	38	35	38	37	Edit to delete the acronym HP. It is not used anywhere other than here. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Accepted
55952	38	38	46	46	Which characteristic of extreme precipitation is considered here? [Olga Zolina, France]	Noted, It is daily if the time duration is not explicitly mentioned
30184	38	40	38	43	You should think about this a bit more as there have been many more studies since Westra et al 2014 produced their review. The latest review of the literature is published as a supplement to the 2019 State of the Climate report as Online Figure 2.SB.5 and this shows increases in most regions. There seem to very few regions that show uncertain results. Put together with some regions that show huge increases (much larger than Clausius Clapeyron - i.e. Australia, Guerreiro et al. 2018 NCC) and I would have greater confidence that there have been increases - perhaps medium confidence? [Hayley Fowler, United Kingdom (of Great Britain and Northern Ireland)]	Accept and assessments of sub-daily precipitation are added
56456	38	43	38	43	"data are more limited data" reads "data are more limited" [Pierluigi Claps, Italy]	Accepted
54048	38	44	38	44	A significant number of studies have looked at trends/changes in sub-daily (mainly hourly) rainfall extremes though these continue to be constrained by both data availability and data quality. These have been collated in Fig S2.20 in the supplement to the BAMS State of the Climate 2017 report (https://www.ametsoc.net/sotc2017/2017_Supplemental_Figures.pdf) which shows positive trends/change in North America, Australia, and parts of Europe and Asia. REFERENCES Supplement to State of the Climate in 2017 by Gail Hartfield, Jessica Blunden, and Derek S. Arndt, Eds. (Bull. Amer. Meteor. Soc., 99(8), E51–E528) DOI:10.1175/2018BAMSStateoftheClimate.2 [Stephen Blenkinsop, United Kingdom (of Great Britain and Northern Ireland)]	Accepted and assessments of sub-daily precipitation are added
52804	38	46	38	52	Why is there so much focus on this paper? Can't this be integrated into the following discussions? Also "their 'wet' grid cells sounds very sloppy. Why not "regions of wetting/drying trends"? [Douglas Maraun, Austria]	Accepted and shortened with the key message
21718	38	46	38	52	It is not that important for which regions they identified "wet" or "dry" grid cells, so delete lines 48-52. Instead, focus on the main two results from this paper: 1) a robust increase can be found in dry and wet regions (as you already mentioned and in contrast to the disputed suggestion that changes will amplify differences between dry and wet regions) and 2) there are differences in aspects of precipitation such as totals and extremes. They found that in dry regions, the total annual and extreme have similar trends, while in wet regions, the increase in the extreme daily precipitation is stronger. [Gwenaelle GREMION, Canada]	Accept
30186	38	46	38	52	I would say that this is also true for sub-daily precip extremes (hourly extremes in the main in the studies). We were surprised at the coherent signal at the station level across Australia in Guerreiro et al. 2018 NCC (see their Figure 3). Dry and wet parts show similar signals of increase. It is the same in the review produced for the State of the Climate report. See where the studies are - there is a coherent upward signal which perhaps is only lost in the Tropics. [Hayley Fowler, United Kingdom (of Great Britain and Northern Ireland)]	Accept and assessments of sub-daily precipitation are added
30188	38	54	39	5	Note that the only season that shows significant upward trends in hourly precipitation extremes (ann max) in the US is winter. The other seasons show non-significant trends and the trend is much lower than the trend in daily extremes and lower than CC, at about 2-3%/degC (Barbero, R., Fowler, H.J., Lenderink, G., Blenkinsop, S. 2017. Is the intensification of precipitation extremes with global warming better detected at hourly than daily resolutions? Geophysical Research Letters, 44 (2), 974-983, DOI: 10.1002/2016GL071917.) [Hayley Fowler, United Kingdom (of Great Britain and Northern Ireland)]	Accept and modified
52806	38	54	39	32	What is the logic behind the ordering here? Please indicate and structure! [Douglas Maraun, Austria]	Accept. We have now ordered with respect to continents

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
21720	39	7	39	12	Discussion of the spatial pattern of the wetting trend needs to be improved. Include Include a mention that the spatial patterns for RX5DAY and RX1DAY are not very consistent (see Fig. 8),and then you can delte the last sentence of the paragraph. Further the handling of the SES patterns needs to be improved. SES only shows the highest rate for RX1DAY and RX5DAY, but not for R99p (table 3 in Skansi et al., 2013) [Gwenaelle GREMION, Canada]	Accept and modified
21722	39	9	39	9	The definitions of abbreviations AMZ, NEB, SES, and WSA are not provided until page 80. Please move the definitions of these acronyms to page 39, the first occurrence of use [Gwenaelle GREMION, Canada]	Accepted, definitions have been added at the beginning of the section
30190	39	14	39	19	I would like to see a caveat put in here as I think that in certain parts of Europe there can be quite long trends associated with for e.g. NAO variability/phases which produce trends that are not related to global warming. See for e.g. results in Kendon, E.J., Blenkinsop, S., Fowler, H.J. 2018: When will we detect changes in short-duration precipitation extremes? Journal of Climate, 31(7), 2945-2964, DOI: 10.1175/JCLI-D-17-0435.1. [Hayley Fowler, United Kingdom (of Great Britain and Northern Ireland)]	Accept and modified
50688	39	14	39	32	Please add the following reference: Scherrer, S. C., E. M. Fischer, R. Posselt, M. A. Liniger, M. Croci-Maspoli, and R. Knutti, 2016: Emerging trends in heavy precipitation and hot temperature extremes in Switzerland. Journal of Geophysical Research-Atmospheres, 121, 2626-2637. [Olivia Martius, Switzerland]	Accept and modified
54146	39	14	39	32	One can add studies conducted in the Southwest Asia (for example over Iran). Najafi and Moazemi, 2016 (https://doi.org/10.1002/joc.4465). [Husain Najafi, Iran]	Added
56458	39	17	39	17	change "Portugal, where a mixed trend is observed (Pedron et al., 2017)" in "Portugal, where a mixed trend is observed (Pedron et al., 2017) and Italy, with the same mixed trend obtained on sub-daily precipitation extremes (Libertino et al, 2019) [Pierluigi Claps, Italy]	Noted, now we modified based on regions
52808	39	17			Please delete the text on the number of precipitation days, this does not belong into this chapter! [Douglas Maraun, Austria]	Accept
8996	39	20			Increase in trend of extreme daily rainfall in south eastern France, where MCSs play a key role in this type of event: Ribes et al. Climate Dynamics (2019) 52:1095–1114 https://doi.org/10.1007/s00382-018-4179-2 Observed increase in extreme daily rainfall in the French Mediterranean ; Blanchet et al. 2016 https://link.springer.com/article/10.1007/s00382-016-3122-7 [Ségolène Berthou, United Kingdom (of Great Britain and Northern Ireland)]	Accept and modified
54054	39	28	39	29	The detected changes (not trends) identified in Guerreiro et al (see above) may be of relevance in discussing here in relation to the regional analyses. [Stephen Blenkinsop, United Kingdom (of Great Britain and Northern Ireland)]	Accepted and the regional information is added to 11.4
30192	39	28	39	29	"High spatial variability is also observed in the observed trends of extreme precipitation over Australia (Bao et al., 2017) with limited evidences since SREX." This is a bit of a misquote of this paper. Bao et al. looked at apparent scaling rates of daily extreme precipitation with surface air temperature in Australia for a very limited number of cities rather than looking at trends. So not the paper to quote here. There has also been a big debate in the literature over the validity of their approach. See: Lenderink, G., Barbero, R., Westra, S., Fowler, H.J. 2018. Reply to comments on "Temperature-extreme precipitation scaling: a two-way causality?" International Journal of Climatology, 38(12), 4664-4666, DOI: 10.1002/joc.5799. Barbero, R., Westra, S., Lenderink, G., Fowler, H.J. 2018: Temperature-extreme precipitation scaling: a two-way causality? International Journal of Climatology, 38, e1274-e1279, DOI: 10.1002/joc.5370. for e.g. Westra, S., Alexander, L. V. & Zwiers, F. W. Global increasing trends in annual maximum daily precipitation. J. Clim. 26, 3904–3918 (2013).show increasing trends in Australia for daily extreme precip. This is also shown in Guerreiro et al. 2018 NCC - daily extreme precip is increasing at approx CC rate over Australia as an average although individual stations show different patterns (this is obvious anyway, if you are interesting in trends then really you need to pool over a region - you could add something in here about the need for this as individual stations will show erroneous results - see supp info of Guerreiro et al for sensitivity study on this). Guerreiro, S., Fowler, H.J., Barbero, R., Westra, S., Lenderink, G., Blenkinsop, S., Lewis, E., Li, X.-F. 2018. Detection of continental-scale intensification of hourly rainfall extremes. Nature Climate Change, 8(9), 803-807, DOI: 10.1038/s41558-018-0245-3. [Hayley Fowler, United Kingdom (of Great Britain and Northern Ireland)]	Accept and modified
14212	39	30			"confidence in the observed trends of extreme precipitation over Africa." Taylor et al. (2017) Nature show an observed intensification of Sahelian storms and link this to heating of Sahara by rising greenhouse gases: http://www.nature.com/nature/journal/v544/n7651/full/nature22069.html [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accept and modified

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
44432	39	31	39	31	"while drcrasing trend" - change to "while decreasing trends" or "while a decreasing trend" [Morten Andreas Dahl Larsen, Denmark]	The sentence is now deleted to address anoother comment
50092	39	31	39	32	"while drcrasing trend in observed extreme precipitation is observed by (Tramblay et al., 2012)." There are 1) Typo in "decreasing" and 2) a need to add that it's in "Morocco". Otherwise it will be not clear and confusing with trend in Central Sahel. [ARONA DIEDHIOU, Cote d'Ivoire]	The sentence is now deleted addressing other comment
54050	39	32	39	32	<p>Related to the above point, Section 11.4.2 on observed trends might usefully comment on the potential for sub-daily precipitation extremes to increase more with warming than daily extremes - associated with Clausius-Clapeyron scaling and the higher scaling observed at sub-daily timescales e.g. Lenderink and van Meijgaard, 2008; Hardwick-Jones et al., 2010. (also relevant to Section 11.4.1). Guerreiro et al (2018) showed that at the continental scale, increases in daily rainfall extremes for Australia were consistent with CC scaling whilst changes in the magnitude of hourly rainfall extremes may exceed double the expected CC scaling. However, this has not been bourne out in other studies e.g. Barbero et al. (2017) and Kendon et al. (2018). Barbero et al. found for the US a greater number of significant increasing trends in annual and seasonal maximum daily precipitation were detected (except winter) than for hourly maxima, whilst for the UK, Kendon et al. found that despite a CPM simulation showing shorter detection times for projected future hourly extremes than for daily extremes, ground-based hidtorical rainfall observations show no such difference. The different results from the last two studies is likely due to a combination of the low probability of detection of sub-daily extremes due to the sparse station network given the local nature of convective storms that contribute significantly to such intense rainfall, and to natural variability (or at least large-scale drivers) dominating the signal over the relative short duration of sub-daily rainfall records.</p> <p>REFERENCES Lenderink, G., and E. Van Meijgaard (2008), Increase in hourly precipitation extremes beyond expectations from temperature changes, <i>Nat. Geosci.</i>, 1(8), 511–514. Hardwick-Jones, R., S. Westra, and A. Sharma (2010), Observed relationships between extreme sub-daily precipitation, surface temperature, and relative humidity, <i>Geophys. Res. Lett.</i>, 37, L22805, doi:10.1029/2010GL045081. Guerreiro SB, Fowler HJ, Barbero R, Westra S, Lenderink G, Blenkinsop S, Lewis E, Li X-F, 2018. Detection of continental-scale intensification of hourly rainfall extremes. <i>Nature Climate Change</i>, 8, 803-807, doi: 10.1038/s41558-018-0245-3. Kendon EJ, Blenkinsop S, Fowler HJ, 2018. When Will We Detect Changes in Short-Duration Precipitation Extremes? <i>Journal of Climate</i>, 31, 2945–2964, https://doi.org/10.1175/JCLI-D-17-0435.1. Barbero R, Fowler HJ, Lenderink G, Blenkinsop S, 2017. Is the intensification of precipitation extremes with</p>	Accepted and modified
54066	39	38	39	38	Units are incorrect here - should be mm raher than degC [Stephen Blenkinsop, United Kingdom (of Great Britain and Northern Ireland)]	Accepted, corrected
8234	39	43	39	43	At least some mention of convection-permitting simulations would seem important here. When they can be run for sufficiently long periods they often provide the most realistic representation of extreme rainfall. See https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2014RG000475 and recent simulations over Africa https://journals.ametsoc.org/doi/full/10.1175/JCLI-D-17-0503.1 [Declan Finney, United Kingdom (of Great Britain and Northern Ireland)]	Accept and modified

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
54056	39	43	40	40	Some further mention might be appropriate here (Section 11.4.3) of the state-of-the-art in evaluation of convection permitting models. This is mentioned briefly in Section 11.2.3 but some additional detail particularly in relation to sub-daily extremes might be appropriate in this section also e.g. improved representation of diurnal cycle, magnitude of extremes. The reviews by Prein et al and Kendon et al could be cited. Kendon et al indicate emerging consistencies in simulation of extremes by different models over the Alps and the UK and suggest that with increases in model resolution, climate projections from different models may show convergence in projection of precipitation extremes. The point may also be made that integrating the analysis of CPMs with new high resolution rainfall observations is offering potential for improved understanding of drivers/mechanisms; and the recent potential for ensemble CPM experiments e.g. UKCP19, to better understand uncertainties in extremes. REFERENCES Prein, A. F., Rasmussen, R., and Stephens, G.: Challenges and advances in convection-permitting climate modeling, B. Am. Meteorol. Soc., 98, 1027–1030, 2017 Kendon, E. J., Ban, N., Roberts, N. M., Fowler, H. J., Roberts, M. J., Chan, S. C., Evans, J. P., Fosse, G., and Wilkinson, J. M.: Do convection-permitting regional climate models improve projections of future precipitation change?, B. Am. Meteorol. Soc., 98, 79–93, https://doi.org/10.1175/BAMS-D-15-0004.1 , 2017. [Stephen Blenkinsop, United Kingdom (of Great Britain and Northern Ireland)]	Accepted and modified
54058	39	43	40	40	This section may be usefully cross referred with Section 11.7.3.3. [Stephen Blenkinsop, United Kingdom (of Great Britain and Northern Ireland)]	Noted. While convection is important aspect for extreme precipitation, most of the models evaluated here in 11.4.3 do not even resolve convection. Moreover, this is also limited by available literature. No action is taken.
14272	39	43	42	41	Borodina et al. (2017) GRL doi:10.1002/2017GL074530 find that observations indicate climate projections may underestimate heavy rainfall response to global warming so this may need assessing. [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted and added
52810	39	43			link to Chapter 10, we have a section on model evaluation looking into precipitation [Douglas Maraun, Austria]	Noted
21724	39	45	39	45	This sentence expresses that "extreme events" in general are "well" represented, but I couldn't find this statement in the report. On page 744 (AR5, chapter 9), the conclusions are not exactly stating this. This sentence also stands in contrast what the next sentences express (e.g. there are challenges to evaluate heavy precipitation). Please rephrase the first to more accurately reflect what is in the cited reference. [Gwenaëlle GREMION, Canada]	Accepted and rephrased
30196	39	45	40	2	There is a lovely summary in Kendon et al. 2017 BAMS (Kendon, E.J., Ban, N., Roberts, N.M., Fowler, H.J., Roberts, M.J., Chan, S. Fosse, G., Evans, J. and Wilkinson, J. 2017. Do convection-permitting regional climate models improve projections of future precipitation change? Bulletin of the American Meteorological Society, 98(1), 79-93, DOI: 10.1175/BAMS-D-15-0004.1.) which you should consider putting in here and expressing in the text that says what models do well in representing extreme precipitation changes across the range of resolutions but also points out what CPM is needed for. This appears to be missing at the moment. [Hayley Fowler, United Kingdom (of Great Britain and Northern Ireland)]	Accepted and added
26786	39	45			I would have my doubts that this is true in such general terms. Also making the statement is rather meaningless, and not needed. [Thorsten Mauritsen, Sweden]	Accepted and deleted
52812	39	48	39	50	This is a very sloppy and vague text. Please rewrite more precisely! [Douglas Maraun, Austria]	Noted and deleted
14214	39	53			the scale mismatch applies also between point measurements and satellite estimates as well as merged products which effectively smooth over space and time (e.g. Liu & Allan, 2012 JGR doi:10.1029/2011JD016568 [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted and added
14216	40	6			ETCCDI - I think this is only defined in supplementary isn't it?? [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Noted
21726	40	7	40	7	What does the abbreviation ETCCDI mean? The term is first used on page 26 line 48, but the only place it is defined is in Supplementary Text 1. Please spell out the acronym at first use. [Gwenaëlle GREMION, Canada]	Noted and done
48580	40	8	40	9	In the statement that "high resolution models reproduce extreme rainfall comparable with observation", how high resolution is necessary to reproduce extreme rainfall? It would be better to be indicated a necessary resolution here. [Kazuhisa Tsuboki, Japan]	Noted and added

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
52814	40	8	40	10	This is all very vague! What is "high resolution"? What is "comparable with observations"? And how can an improvement be a property of an ensemble when it is not a property of the individual models? This sentence is at best imprecise. [Douglas Maraun, Austria]	Noted, resolution added and the second sentence is deleted
21728	40	9	40	10	What does it mean that improvements are "more of a property of the ensemble than individual models"? Please provide further explanation to clarify. [Gwenaëlle GREMION, Canada]	Noted and deleted
38908	40	9	40	10	Please give a short explanation of the effect described in this sentence: how to imagine that an ensemble improves while individual models don't. [Uwe Ulbrich, Germany]	Noted and deleted
14218	40	9			I did not understand "These improvements appear more a property of the ensemble than of individual models." since ensembles average over extremes and variability. [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Noted and deleted
21730	40	13	40	14	Here, it might be important to mention where this statement is referring to, considering that the number of stations used in the HadEx2 dataset differs according to locations, especially over parts of Africa and south America where the number of available stations are substantially low. It is imperative that the readers have this caveat in mind when they are comparing the model results against results from HadEx2. [Gwenaëlle GREMION, Canada]	Noted and added a line.
56520	40	16	40	40	There are already several studies that show improvements in the simulation of heavy (sub-daily) precipitation at kilometer-scale resolution with explicitly resolved convection in decade-long simulations (Kendon et al., 2012, Ban et al., 2014, Leutwyler et al., 2017, Berthou et al., 2018a, Berthou et al., 2019, Prein et al., 2017), so it might be useful to add a paragraph on these results. This paragraph would then also support the summary provided on page 44 line 7-8. But if the focus should be on the multi-decadal simulations, please disregard my comment. [References Ban et al., 2014, Prein et al., 2017 are already cited in the chapter. The others are: Kendon, E.J., N.M. Roberts, C.A. Senior, and M.J. Roberts, 2012: Realism of Rainfall in a Very High-Resolution Regional Climate Model. J. Climate, 25, 5791–5806, https://doi.org/10.1175/JCLI-D-11-00562.1 ; Berthou, S., Kendon, E.J., Chan, S.C. et al. Clim Dyn (2018). Pan-European climate at convection-permitting scale: a model intercomparison study. https://doi.org/10.1007/s00382-018-4114-6 ; Berthou, S., Rowell, D.P., Kendon, E.J. et al. Clim Dyn (2019). Improved climatological precipitation characteristics over West Africa at convection-permitting scales. https://doi.org/10.1007/s00382-019-04759-4 ; Leutwyler, D., Lüthi, D., Ban, N., Fuhrer, O., and Schär, C. (2017), Evaluation of the convection-resolving climate modeling approach on continental scales, J. Geophys. Res. Atmos., 122, 5237– 5258, doi:10.1002/2016JD026013.] [Nikolina Ban, Switzerland]	Noted
28504	40	16		22	Provide some references for South East Asia region, if any. [Kanoksri Sarinnapakorn, Thailand]	Noted and added
44130	40	19	40	19	Diaconescu et al. 2018 only looks at part of North America [Michaela Dolk, United States of America]	Noted and added
21732	40	19	40	19	Please add clarification. Rainfall is better captured in RCMs as compared to what other kind of model, a GCM? [Gwenaëlle GREMION, Canada]	Noted and added
21734	40	24	40	24	Wehner et al., 2014b is not in reference list. Is this perhaps to meant to be simply Wehener et al 2014 which is in the reference list? [Gwenaëlle GREMION, Canada]	Accepted
21736	40	24	40	24	Please explain what HighResMIP-Class means to give this paragraph context. Add the following reference to do so: Haarsma, R. J., Roberts, M. J., Vidale, P. L., Senior, C. A., Bellucci, A., Bao, Q., Chang, P., Corti, S., Fučkar, N. S., Guemas, V., von Hardenberg, J., Hazeleger, W., Kodama, C., Koenigk, T., Leung, L. R., Lu, J., Luo, J.-J., Mao, J., Mizielinski, M. S., Mizuta, R., Nobre, P., Satoh, M., Scoccimarro, E., Semmler, T., Small, J., and von Storch, J.-S.: High Resolution Model Intercomparison Project (HighResMIP v1.0) for CMIP6, Geosci. Model Dev., 9, 4185-4208, https://doi.org/10.5194/gmd-9-4185-2016 , 2016. [Gwenaëlle GREMION, Canada]	Accepted
8998	40	30			You could add: 'Indeed, precipitation distribution are much improved with a convection-permitting model over West-Africa at both daily and subdaily time-scales Berthou, S., Rowell, D. P., Kendon, E. J., Rachel, R., Julia, S., & Catherine, C. (2019). Improved climatological precipitation characteristics over West Africa at convection-permitting scale. Clim. Dyn. https://doi.org/10.1007/s00382-019-04759-4 " [Ségolène Berthou, United Kingdom (of Great Britain and Northern Ireland)]	Accepted and added
52818	40	32	40	33	This is a general statement, not just about precipitation. Should be deleted here. [Douglas Maraun, Austria]	Rejected, not a generalized statement
21738	40	32	40	40	Please add references to support: confidence language in first sentence and the assertion in the third sentence. [Gwenaëlle GREMION, Canada]	Rejected, this is based on the assessment based on the literature cited in entire 11.4.3
52816	40	34			"considerably with more realism" sorry, but this is nonsense. Could this be written more precisely? [Douglas Maraun, Austria]	Thank you. Text has been revised

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
26242	40	36	40	37	I believe it is fairer to replace here with "However, representation of cumulus convection is a challenging issue". [Chihiro Kodama, Japan]	Accepted
48582	40	37	40	37	The statement that "current parameterizations are inadequate" seems to be too strong expression. Some successful results have been obtained with parameterizations. [Kazuhsa Tsuboki, Japan]	Noted and changed
30198	40	37	40	40	You could add a lot of information here on the benefits of convection permitting models for sub-daily extremes - Prein et al. 2015 for e.g. and there is loads of information in other paper such as Kendon et al. 2017 BAMS [Hayley Fowler, United Kingdom (of Great Britain and Northern Ireland)]	Noted and added now
54052	40	43	40	43	The heading for Section 11.4.4 refers to detection and attribution although this section is focused on attribution or more broadly drivers. I would surmise that the detection of trends is dealt with in Section 11.4.2 'Observed Trends' and so this sub-section could be retitled appropriately e.g. Attribution of observed changes / linking observed changes with drivers. The former has the advantage of being standard terminology in the field. [Stephen Blenkinsop, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. The title is consistent with other sections of this chapter
21740	40	49	40	50	Please clarify what would constitute direct evidence. [Gwenaelle GREMION, Canada]	Accepted, the word "direct" is deleted to avoid confusion.
27890	41	1	41	2	Page 11-41, lines 1-2: How is the anthropogenic signal separable from the external natural forcing? Page 11-41, lines 26-27: What are the implications of the significant response in extreme precipitation to volcanic forcing for geoengineering based on solar radiation management? Page 11-41, lines 44-46: What is the specific influence mentioned here? [roderik van de wal, Netherlands]	1. Accepted and rewritten 2. Accepted and deleted 3. Noted, it should be influences of anthropogenic activities.
43874	41	2	41	2	Here the C-C effect is assessed as ~5.2%/°C but on page 42 line 8 it is 6-7%/°C. [Joanna Wibig, Poland]	Accepted and modified
44132	41	2	41	2	Clausius-Clapeyron relationship magnitude differs from 7%/K discussed elsewhere [Michaela Dolk, United States of America]	Accepted and modified
37964	41	2			The Clausius-Clapeyron relationship is here stated to be 5.2%/K, whereas elsewhere (e.g. page 42, line 8) it is quoted to be 6-7%/°C. This should be reconciled. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Accepted and modified
14220	41	2			Perhaps "broadly consistent" is more appropriate since 5.2%/K is rather low? [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted and modified
21742	41	7	41	11	The first sentence of this paragraph indicates that it is about the anthropogenic signal. Please clearly state in the text that the work done by Donat et al 2016 was focussed on anthropogenic impacts. If this is not the case, consider finding a source that is about anthropogenic impacts for this paragraph. [Gwenaelle GREMION, Canada]	Accepted, Donat et al (2016a) is not really applicable here and deleted
30200	41	7	41	11	Note that other studies have also found this consistency of increases in daily amax precip with CC. for e.g. Westra et al. 2013 JoC looked globally at this and found consistency between AMAX daily precip trends and change in GMST (at about CC scaling rate). Fischer and Knutti looked at this for N America and Europe for observations (and or CMIP5 GCMs) and found both consistent with CC scaling rate on global mean temperature. Barbero et al 2017 (DOI: 10.1002/2016GL071917) found daily precip AMAX over N America show sig increases and this is consistent with CC. Guerreiro et al. 2018 (DOI: 10.1038/s41558-018-0245-3) showed that daily extremes increase at rate consistent with CC for GMST increases over Australia. there are lots of studies showing this. This is not an exhaustive list. Guerreiro et al 2018 also detected an increase in hourly heavy precip that was outside the range of natural variability (at 2-3x CC) for Australia which should be added here. [Hayley Fowler, United Kingdom (of Great Britain and Northern Ireland)]	Noted, Majority of the studies mentioned here are associated with consistency with CC and not applicable in the section detection and attribution. Guerreiro et al (2018) detected increase in hourly extremes in outside the range of natural variability and is mentioned.
28456	41	11	41	11	"Shiogama et al., (2016)found" -> "Shiogama et al., (2016) found" [HIDEO SHIOGAMA, Japan]	Accepted
40388	41	12	41	23	Minor comment: It would be recommendable for this phenomenon to specify the period of study or time scale of the results [Vanesa Pántano, Argentina]	Accepted and added
21744	41	14	41	18	This paragapgh is not about attribution. It might be better placed in 11.4.3. [Gwenaelle GREMION, Canada]	Accepted and added to 11.4.3
52820	41	26	41	28	This statement is about wider consequences, it does not belong here (one could write other statements of wider consequences in every paragraph). [Douglas Maraun, Austria]	Accepted
14222	41	27			I suggest either stating what the implications for geoengineering are precisely or remove the sentence [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	accepted

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
44594	41	31	41	31	Krishnan et al. 2016 attributed the observed decreasing trend of low and moderate rain (5 mm /day < intensity < 100 mm/day) occurrences and increasing trend of heavy rain events (intensity > 100 mm/day) in the post-1950s over Central India to the combined effects of GHG, aerosols, landuse / landcover changes and rapid warming of the equatorial Indian Ocean SST. Ref: Krishnan et al. 2016: Deciphering the desiccation trend of the South Asian monsoon hydroclimate in a warming world. Clim Dyn (2016) 47:1007–1027. [Krishnan Raghavan, India]	Accepted and added
21746	41	38	41	51	It could be mentioned here that over regions like Africa, although there are affected by a plethora of extreme events almost annually, attribution studies are substantially less compared to elsewhere in the world. One of the reason being limited observational data. [Gwenaelle GREMION, Canada]	Accepted and added
44526	41	39	41	39	Typo indentifies as 'durationsfrom' [Shaukat Ali, Pakistan]	Accepted
14224	41	40			I think understanding how extreme seasons change is policy relevant and may be covered in studies looking at seasonal mean precipitation (or record breaking monthly rainfall, e.g. Lehman et al. 2019 GRL doi:10.1029/2018gl079439) and if not perhaps it is a knowledge gap (or opportunity for a quick analysis!). There are of course event attribution on very wet season e.g. UK 2013/14 which are mentioned later [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Rejected: not relevant to heavy precipitation defined at the starting of section.
54344	41	41	41	51	As the BAMS SOTC studies form a relatively well-defined set, one could consider summarising what proportion of events show an anthropogenic signal for each type of event considered (although to some extent judgement of whether a paper does/doesn't show this will have some subjectivity). [Blair Trewin, Australia]	Noted, but the number of studies is too small to conclude on proportions
21748	41	50	41	51	Consider deleting this sentence; it does not seem relevant. [Gwenaelle GREMION, Canada]	Rejected, it is important to state that there are inconclusive studies
52822	41	53	41	54	The notion of "meteorological patterns" vs. dynamical processes implies that the meteorological patterns are not dynamical. This is a bit confusing. Why not focussing really just on the large-scale vs. local scale here and use dynamical for both cases? Also avoid this strange acronym (LSMP) [Douglas Maraun, Austria]	Noted and changed accordingly
21750	41	53	42	17	Consider splitting this paragraph after P42 Line 7 and moving the first part towards the beginning of this subchapter. [Gwenaelle GREMION, Canada]	Rejected, this would affect the flow
14226	41	53			I do not think an acronym LSMP is useful since it is not standard and should be removed [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Noted and done
52824	42	4			"evidence shows" This is trivial, evidence always shows. Rephrase. [Douglas Maraun, Austria]	Noted and done
43876	42	7	42	12	The references on C-C effect include papers from 2016-2018, but the paper by Lenderink, G. and van Meijgaard, E. 2008, Increase in hourly precipitation extremes beyond expectations from temperature changes. Nature Geoscience, 1, 511–514. should be addressed here also. [Joanna Wibig, Poland]	Rejected, this is Pre-AR5 article
30292	42	8	42	8	Notation check "6-7%/Clausius-Clayperonrate" [Nazan An, Turkey]	Accepted and modified
13100	42	9	42	9	Providing full citations here: [der Wiel et al., 2017; van Oldenborgh et al., 2017;Wang et al., 2018; Zhou and Wang, 2017].] Reference: Zhou, C., and Wang, K., (2017). Quantifying the sensitivity of precipitation to the long-term warming trend and interannual-decadal variation of surface air temperature over China. J. Clim., 30, 3687-3703. doi: 10.1175/JCLI-D-16-0702.1. [Zhou Chunlüe, United States of America]	Noted
30202	42	9	42	12	Also Guerreiro et al. 2018 NCC should be added here. And examine review of State of the Climate 2019 literature as stated previously. [Hayley Fowler, United Kingdom (of Great Britain and Northern Ireland)]	Accepted
39088	42	10	38	14	The text here is rather misleading and incomplete. It makes only a half reference to the literature on scaling, and does not reflect the full depth of the discussion. ON of the major factors here is that most of the older studies use temperature as a scaling variable, and only since a number of years it is appreciated that dew point is much better scaling variable (see e.g. Lenderink G, Barbero R, Westra S and Fowler H J 2018 Reply to comments on "Temperature-extreme precipitation scaling: a two-way causality?" Int. J. Climatol. 8–10 Online: http://doi.wiley.com/10.1002/joc.5799, and reference in this paper. I do not disagree with a statement that scaling is not a simple substitute for climate change, however, balancing the evidence, I think this sentence does not reflect current scientific understanding. [Lenderink Geert, Netherlands]	Noted and modified

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
50866	42	12	42	14	However, for Australia, Guerreiro et al (2018) showed that continental-averaged changes in magnitude of extreme hourly rainfall (1990–2013 Vs 1966–1989) are close to, or exceed, double the expected changes from CC scaling as a result of global mean surface temperature change - and exceed $CC \times 3$ in the tropical region (north of 23° S). These changes in hourly rainfall extremes are above the range of natural variability, could not be explained by changes in the El Niño–Southern Oscillation or in the seasonality of extremes. This contrasted with increases in daily rainfall extremes which are consistent with CC scaling, but are within the range of natural variability. Guerreiro, S.B., Fowler, H.J., Barbero, R., Westra, S., Lenderink, G., Blenkinsop, S., Lewis, E. and Li, X.-F. (2018) 'Detection of continental-scale intensification of hourly rainfall extremes', Nature Climate Change, 8(9), pp. 803-807. [Selma Guerreiro, United Kingdom (of Great Britain and Northern Ireland)]	Noted and added
30204	42	12	42	14	However, the super C-C scaling is 13 based on the day-to-day temperature variability and cannot provide a robust basis for the long-term attribution or projection of extreme precipitation changes (Zhang et al., 2017b). [Hayley Fowler, United Kingdom (of Great Britain and Northern Ireland)]	not applicable - comment unclear
30206	42	12	42	14	" However, the super C-C scaling is based on the day-to-day temperature variability and cannot provide a robust basis for the long-term attribution or projection of extreme precipitation changes (Zhang et al., 2017b). " The comment from the Zhang et al paper is a bit strong and rather misrepresents what they conclude in the paper. The conclusion of the paper states "However, the observed precipitation–temperature scaling relationships have been established almost exclusively by linking precipitation extremes with day-to-day temperature variations. These scaling relationships do not appear to provide a reliable basis for projecting future precipitation extremes. Until better methods are available, the relationship of the atmosphere’s water holding capacity with temperature provides better guidance for planners in the mid-latitudes, albeit with large uncertainties." This is not completely true now since Guerreiro et al 2018 have found evidence of short-duration hourly extreme precip increasing at super-CC rates in observations in Australia (you also see super CC apparent scaling with dew point T) in some parts of Australia. See the debate between Bao et al. 2017 (NCC), 2018 (international JoC) and Barbero et al.2017(international JoC) and Lenderink et al. 2018 (international JoC) for debate on the usefulness of scaling and the review by Lenderink and Fowler 2017 in NCC for some additional thoughts. I think that the Zhang et al 2017 paper does not disprove the usefulness of apparent scaling but neither has it yet been disproven. It can also be shown that you find super-scaling rates in modelling studies (convection-permitting- https://iopscience.iop.org/article/10.1088/1748-9326/ab214a) which seem to match observed scaling rates * over large regions rather than for individual locations to enhance the signal to noise ratio and also to remove spurious trends etc. (not yet submitted). So the jury for me is still out on this and there are definitely super-scaling changes in some regions. If you use dew point rather than SAT then it might be that you can reproduce these for regional changes. You need to read the recent literature in this area. [Hayley Fowler, United Kingdom (of Great Britain and Northern Ireland)]	Considered. The relevant text is removed.
52826	42	12	42	17	One may consider moving this to the mechanisms section. [Douglas Maraun, Austria]	Rejected, this would affect the flow of this sub-section
52828	42	19			Link to the floods section [Douglas Maraun, Austria]	Accepted
44596	42	23	42	23	Vellore et al. 2016 is a relevant citation. Flood producing extreme rainfall over Western Himalayas (eg. June 2013, September 1995) involve strong interactions between deep southward penetrating midlatitude westerly troughs and west-northwest propagating low-pressure systems from the Bay of Bengal across the Indian subcontinent. Separating the strong internal dynamics associated with these interactions and the climate change induced signal during extreme precipitation events in the Himalayan region can be challenging. Ref: Vellore, R.K., et al. (2016) Monsoon-extratropical circulation interactions in Himalayan extreme rainfall. Clim Dyn, Vol. 46: 517–3546. [Krishnan Raghavan, India]	Rejected, may be suitable for Himalayan box and the reference is added there
30082	42	27	42	28	This is incorrect. Schaller et al. found the contribution to additional properties at risk could be either positive or negative, depending on the forced circulation change (which depends on the choice of counterfactual SST). That is not a lack of statistical significance, since the uncertainty is epistemic rather than aleatoric. It is just that we don't know; the outcome is indeterminate in the present state of knowledge. [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	Noted and changed
7628	42	30	42	30	highconfidence (high confidence) [Guoping Li, China]	Accepted
21752	42	30	42	31	Please state explicitly that the human influence was raised from medium to high confidence from AR5 and SREX to AR6 due to multiple lines of new evidence [Gwenaëlle GREMION, Canada]	Accepted

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
44598	42	38			It would be useful to mention about the value additions from high-resolution models for attribution of changes in heavy precipitation occurrences at regional scales. [Krishnan Raghavan, India]	Accepted
8236	42	41	42	41	Convection-permitting simulations of future climate generally show that parametrised convection models generally underestimate the increase in extreme rainfall. This important caveat should really be stated here. https://www.nature.com/articles/s41467-019-09776-9 [Declan Finney, United Kingdom (of Great Britain and Northern Ireland)]	Noted and added in 11.4.3 in model evaluation
8284	42	41	43	46	Please add more references such as Guo X.J., Huang J.B., Luo, Y., Zhao Z.C. and Xu, Y., 2016, Projection of precipitation extremes for eight global warming targets by 17 CMIP5 models, Nat Hazards, doi: 10.1007/s11069-016-2553-0 [Zong Ci Zhao, China]	Accepted and added
14274	42	41	43	46	It is worthwhile assessing new evidence suggesting that the downturn in precipitation extremes for the highest temperatures noted in AR5 applies only for the present climate and not for future changes (e.g. Neelin et al. 2017 PNAS doi:10.1073/pnas.1615333114; Wang et al. 2017 Nature Clim. doi:10.1038/nclimate3239, Roderick et al. (2019) GRL, doi:10.1029/2018GL080833) [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted and added
14276	42	41	43	46	The role of cloud-cloud interactions, system size and convective organisation on projections and uncertainty in precipitation extremes could be assessed or left to Chapter 8 (e.g. Pendergrass et al., 2016, doi:10.1002/2016GL071285; Wasko et al., 2016, GRL, doi:10.1002/2016GL068509; Moseley et al., 2016, Nature Geosci, doi:10.1038/ngeo2789) [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Noted
28944	42	41	44	11	Projection results include that increasing rate is larger for more extreme events (i.e. longer return period) (O'Gorman 2012 NatureGeo; Kitoh and Endo 2019 JMSJ), and that increasing rate is larger for shorter-term events (e.g. Kusunoki and Mizuta (2013 JGR), also suggested by "super C-C" observations of section 11.4.4) [Ryo Mizuta, Japan]	Noted
30224	42	41	44	11	A section should be added here to talk about projections of changes to sub-daily rainfall extremes from the new generation of CPMs. Although the simulations are not very long as yet (generally 10 years for control and 10 year future) there are some indications that they may project different changes to coarser resolution (convection parameterised) RCMs and GCMs particularly in warm seasons. See Kendon et al. 2017 for a review of the literature in this area to 2017 (DOI: 10.1175/BAMS-D-15-0004.1.) Recent papers of interest: Chan, S.C., Kahana, R., Kendon, E.J., Fowler, H.J. 2018: Projected changes in extreme precipitation over Scotland and Northern England using a high-resolution regional climate model. Climate Dynamics, DOI: 10.1007/s00382-018-4096-4. Kendon, E.J., Blenkinsop, S., Fowler, H.J. 2018: When will we detect changes in short-duration precipitation extremes? Journal of Climate, 31(7), 2945-2964, DOI: 10.1175/JCLI-D-17-0435.1. European-scale changes have also been submitted to J Climate. for africa: https://www.nature.com/articles/s41467-019-09776-9 . for US: Increased rainfall volume from future convective storms in the US AF Prein, C Liu, K Ikeda, SB Trier, RM Rasmussen, GJ Holland, MP Clark Nature Climate Change 7 (12), 880 39 2017 Changes in the convective population and thermodynamic environments in convection-permitting regional climate simulations over the United States KL Rasmussen, AF Prein, RM Rasmussen, K Ikeda, C Liu Climate Dynamics, 1-26. Separating dynamic and thermodynamic impacts of climate change on daytime convective development over land WW Grabowski, AF Prein Journal of Climate. Simulating the convective precipitation diurnal cycle in North America's current and future climate L Scaff, AF Prein, Y Li, C Liu, R Rasmussen, K Ikeda Climate Dynamics, 1-14 [Hayley Fowler, United Kingdom (of Great Britain and Northern Ireland)]	Noted
46722	42	41	45	55	assessments on monsoon projection need coordination with chapter 4 to avoid duplication [WGI TSU, France]	Noted
52832	42	41			Again, the selection of regions appears somewhat arbitrary. Please motivate. [Douglas Maraun, Austria]	Noted
53824	42	43	42	44	At LAM1 and LAM2 we agreed to aim for using a common core set of scenarios across chapters - to the extent possible given the literature. Please keep this ambition in mind for SOD, and check consistency with ch1 and ch4. [Jan Fuglestedt, Norway]	Noted

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
40390	42	46	42	48	I disagree on giving global projections for such a spatial variable extreme index. I suggest focusing on regional results or specifying that global results are not representative since crucial decisions are taken based on these results. [Vanessa Pántano, Argentina]	Rejected. Global assessments may not be for regional decision making but have other scientific purposes
52830	42	47	42	48	Logic! There is medium to high confidence in the projectons, which is different from the statement made here. [Douglas Maraun, Austria]	Accepted. The statement is deleted
43368	42	48	42	48	Where you say "decrease" do you mean "increase"? The statement as it stands seems inconsistent with other chapters. [James Renwick, New Zealand]	Accept and deleted the statement related to total rainfall.
26244	42	48	42	48	"decrease" -> "increase"? [Chihiro Kodama, Japan]	Accepted and deleted the statement related to total rainfall
27892	42	48	42	49	Page 11-42, lines 48-49: Do the rare events not fall under the general 'changes in frequencies' mentioned on line 46 of the same page? Maybe try to rephrase so nothing is stated twice. Page 11-42, lines 50-52: What are the projections for the other RCPs? Page 11-43, line 27: What is the historic period? [roderik van de wal, Netherlands]	1. Accepted and deleted 2. Noted, and modified mentioning warming scenarios... 3. reject, not related
14230	42	51			unser --> under [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted
14232	42	52			See also Dunning et al. (2018) J. Clim https://doi.org/10.1175/JCLI-D-18-0102.1 which shows increased daily rainfall intensity but later end to the wet season over west Africa and the Sahel, linked to a strengtheining Sahara heat low. [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted and added
7190	42	55	43	2	Fujita et al. (2019) should be cited along with Endo et al. (2017). They evaluated heavy precipitation change under 2-K and 4-K GSAT warming based on the same lerage ensemble simulation database, respectively. Fujita, M., Mizuta, R., Ishii, M., Endo, H., Sato, T., Okada, Y., et al. (2019), Precipitation changes in a climate with 2-K surface warming from large ensemble simulations using 60-km global and 20-km regional atmospheric models, Geophys. Res. Lett., 45, doi:10.1029/2018GL079885. Endo, H., A. Kitoh, R. Mizuta, and M. Ishii, 2017: Future changes in precipitation extremes in East Asia and their uncertainty based on large ensemble simulations with a high-resolution AGCM. SOLA, 13, 7-12, doi:10.2151/sola.2017-002. [Shingo Watanabe, Japan]	Accepted and added
30208	43	2	43	3	Yet actually this is where very large changes have been seen at observation stations. See Guerreiro et al. 2018 NCC. Note that this was also found not to relate to phases of ENSO. Daily extremes increasing in line with CC and hourly extremes increasing at faster rate. [Hayley Fowler, United Kingdom (of Great Britain and Northern Ireland)]	Reject, this is about future projections, not about observed changes
28602	43	3			Part of the lack of consistency in Australia and Maritime Continent can be linked to that in the warming pattern of the equatorial Pacific and Indian oceans. Please see a revised manuscript submitted to Asia-Pacific J. of Atmos. Sci, by I. G. Watterson. [Ian Watterson, Australia]	Reject, do not have the full citation
54346	43	4	43	4	Should this read "significant observed changes in extreme rainfall?" [Blair Trewin, Australia]	Noted, significant future changes
38910	43	4	43	7	All references quoted look at observations, not projections as expected according to the title of this subsection! As an example for results on heavy rainfall signals in CMIP5 models, see for example Nissen and Ulbrich, NHESS 2017. https://doi.org/10.5194/nhess-17-1177-2017 . Note that this paper is focussing on the different RCP time slices rather than on specific temperature increases. [Uwe Ulbrich, Germany]	Noted and modified
30228	43	4	43	9	In the paper Christensen, O. B., S. Yang, F. Boberg, C. F. Maule, P. Thejll, M. Olesen, M. Drews, H. J. D. Sørup, J. H. Christensen 2015: Scalability of regional climate change in Europe for high-end scenarios. Climate Research 64 (1), 25-38 we summarized results from regional simulations in the ENSEMBLES project plus a few more and concluded a clear positive signal in extreme daily precipitation, particularly for Northern Europe. You may cite this as you see fit, and also consider whether the medium confidence in I7 could be changed to a high confidence. [Ole B. Christensen, Denmark]	Noted, Still, there are limited literature to have high confidence. The reference is added.
30230	43	4	43	9	The citations might be augmented from the current mainly hydrological papers to include e.g. Rajczak et al., 2013. [Ole B. Christensen, Denmark]	Accepted and added

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
38912	43	7	43	9	The references are not adequate: Donnelly provides just information on mean annual rainfall, while the statements on runoff may include some snow and ice melting and thus do not directly give evidence for changing heavy rainfall. Madsen et al provide statements on Europe in general, but not in particular on Northern Europe. Also, Thober et al refer to streamflow (and annual precipitation) rather than precipitation extremes. I don't think it is adequate to consider large annual rainfall as a heavy rainfall event. [Uwe Ulbrich, Germany]	Accepted, we changed to low confidence due to lack of literature available.
38914	43	9	43	10	The reference Wu investigates observations, not projections. [Uwe Ulbrich, Germany]	Accepted
52834	43	9			Again, logic! The projections are not likely. According to the projections, heavy rainfall will likely decrease. [Douglas Maraun, Austria]	Accepted and modified
21754	43	25	43	25	The term 'forcing' is not clear here (context is missing). Consider replacing it with "emission scenario in most models", such as is described in the abstract of the already cited Pendergrass et al. (2015). [Gwenaelle GREMION, Canada]	Noted and modified
52838	43	25	43	46	this paragraph requires substantial language editing. [Douglas Maraun, Austria]	Noted
52836	43	26			"not really on the forcings": replace by "not strongly on the specific types of forcings" - the forcings are of course important, without forcings there would be no temperature change (apart from int. var.). But is this statement actually true? Different forcings have very different fingerprints, in particular at the regional scale. [Douglas Maraun, Austria]	accepted, and modified
14234	43	26			Lin et al. (2018) JGR http://doi.org/10.1029/2018JD028821 find a larger precipitation extreme response to aerosol than greenhouse gas forcing since greenhouse gases suppress precipitation through their direct effect on the atmospheric energy budget but the discrepancy becomes negligible for more severe extremes. Declining aerosol also adds to warming and precipitation intensification Lin et al. (2016) GRL. [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accept and added
54348	43	31	43	31	"Additional half degree warming" - is this from 1.5 to 2C, or something else? [Blair Trewin, Australia]	Accept, yes
55954	43	43	30		Again which characteristic of extreme precipitation is considered? [Olga Zolina, France]	Accept, for RX5
52840	44	1	44	4	Can this statement be rendered more informative? At least giving some evidence on which regions? [Douglas Maraun, Austria]	Reject: this would be too detailed for summary. Details are in the entire section
15310	44	1	59	5	Floods and Droughts sections need to be more coordinated with Chapter 12 and WG2 perhaps. I can see some repetition in 12.5.1 (global summaries of hazards) and some impact talk may be left to WG2. I'm not sure where we should draw the line as far as physical impacts are concerned here, given the tight interplay with other factors. I don't have a solution but maybe discuss at LAM3? [Claudia Tebaldi, United States of America]	Taken into account - Specific sessions have been organised to avoid possible overlapping and inconsistencies with Chapter 12 but also Chapter 8. Really we agree that it is quite difficult to establish a line between physical/human processes and feedbacks and physically-based vs. human-driven impacts. The scientific community has been debating for years on this issue and probably will continue in the future given the strong complexity of floods and droughts. In any case, we believe that sections 11.5 and 11.6 are covering the key physical processes, and an updated assessment of the observations and projections that are analysing these extreme events.
52846	44	3	44	4	a confidence statement about a confidence statement does not make sense! [Douglas Maraun, Austria]	Accept
27034	44	14	44	14	urban flooding is missing in this section and papers exist in the literature about the interaction between floods and urbanization. Suggest to add a box on urban flooding [Mansour Almazroui, Saudi Arabia]	Accepted: Comments on urban flooding have been included in the different subsections.
48650	44	14	50	5	It would be better moved to the Chapter 12 - Hazard [Lincoln Alves, Brazil]	Rejected - In was agreed from the very beginning and included in the WGI framework document. There is a coordination effort with chapters 8 and 12 to avoid overlaps, repetitions and inconsistencies on this issue.
52842	44	14			I am wondering whether this section belongs here or into WG2. There was nothing in the scoping document. If floods are listed here, should Chapters 8, 10 and 12 also deal with runoff then? [Douglas Maraun, Austria]	Rejected - In was agreed from the very beginning and included in the WGI framework document. There is a coordination effort with chapters 8 and 12 to avoid overlaps, repetitions and inconsistencies on this issue.
14236	44	14			Section 11.5: 8.2.2.2.5 on "Expected drivers of flooding" can be cross checked and perhaps could be merged here or signposted [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - Coordination with chapter 8 has been considered in LAMIII in order to remove inconsistencies/duplications.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
21756	44	17	44	18	References on floods because of climate change, land-use change and rapid urban development: Aerts et al., 2018; Haer et al., 2017; Jenkins et al., 2016; World Bank, 2015 [Gwenaelle GREMION, Canada]	Accepted: partially, the reference of Aerts et al. 2018 has been included since we think it is relevant in the frame of the paragraph. The other references have not been included since they are much more specifically related to the risk framework.
21758	44	22	44	22	References on compound flood events: Bevacqua et al., 2018; Wahl et al., 2015; Wahl, 2017; Paprotny et al., 2018 [Gwenaelle GREMION, Canada]	Accepted: partially, Bevacqua et al. does not specifically relates to compound floods and Paprotny et al. 2018 mostly focus on economic evaluation of flood impacts. But we have included the suggested articles by T. Wahl that are excellent examples of compound flood events.
44134	44	31	44	31	restructure section? [Michaela Dolk, United States of America]	Rejected - Too vague comment. It is not detailed how the section should be restructured.
16292	44	31	46	1	Although further understanding of the flood characteristics vis-à-vis the confidence was highlighted, particularly considering the three main areas, there is need to come up with a visualization that can show different drivers and their interrelationship with flood characterization. Figure 11.11 and the explanation seems to be lost in translation, there is need for smooth transition when joining different reviews of literature. Further, this section is very descriptive where it needs kind of quantification and correlation in order to digest the different scenarios as mentioned and regression vis-a-vis the entire time period does not really tell the entire story on how precipitation is correlated with flooding in conservative way. Precise explanation is needed to discuss this point. [Tabassam Raza, Philippines]	Rejected - We consider that the chapter includes the relevant mechanisms of flood generation. Of course we agree that the processes and feedbacks are too complex and the variety of different flood generation processes cannot be explained/discussed in depth here, but we absolutely believe that the chapter includes the relevant mechanisms (mostly on the connection between precipitation and flooding). In relation to the Figure 11.11, the explanation has been qualified in the SOD following the comments of other reviewer (comment 27894).
35302	44	31	46	1	Shouldn't there be assessment of potential plant biophysical effects on the relationships between extreme rainfall and floods as well? E.g. Kooperman et al. https://doi.org/10.1029/2018GL079901 show in one ESM (CESM1) that the CO2 biophysical effects give rise to 50% of the increase in 99th percentile runoff in the tropics under elevated CO2. [Charles Koven, United States of America]	Accepted - We have assessed this topic in the section 11.5
21760	44	33	44	40	Reference on flash floods and climate change and its impacts: Hettiarachchi, Wasko, and Sharma, 2018; [Gwenaelle GREMION, Canada]	Accepted: Included to refer urban flood processes.
21762	44	34	44	34	increased in place of "increase" [Gwenaelle GREMION, Canada]	Accepted - Replaced word.
52844	44	34			I don't find the Hirabashi paper convincing. They use GCM grid box runoff, which does not consider the transport of water along a river (and its tributaries). Regional hydrological model simulations driven with GCM/RCM ensembles get qualitatively very different results. Please put this into context or consider deleting the paper. I found this paper one of the most disturbing and misleading references in AR5 WG2. [Douglas Maraun, Austria]	Rejected - The reference is maintained but compared with the findings or other studies based on different methodologies.
56460	44	40	44	40	change"(Berghuijs" in "(Allamano et al, 2009a, Berghuijs" [Pierluigi Claps, Italy]	Rejected - The reference to Berghuijs et al. 2016 is correct
21764	44	41	44	41	greenhouse gases in place of "greenhouse gas" [Gwenaelle GREMION, Canada]	Accepted - Replaced word.
27894	44	42	44	44	-Page 11-44, lines 42-44: where are these regional-scale similarities detected? Fig. 11.11 is only relative to the USA, but are they detectable also in other regions? -Page 11-45, lines 12-27: this section is about challenges for the attributions of single events, therefore it could be moved to paragraph 11.5.4. [roderik van de wal, Netherlands]	Comment 1 Accepted - Really this was only an example relative to the US of these regional-scale similarities. In the SOD we have included more examples in which these regional-scale similarities can be found: ...similarity in some regions like the US (Berghuijs et al., 2016; Peterson et al., 2013a), China (Zhang et al., 2015a) or the western Mediterranean (Llasat et al., 2016) . Comment 2 Rejected - This is mostly on mechanisms since here it is explained the possible mismatch between precipitation intensity and floods considering drivers related to snow, human management, etc.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
21766	45	9	45	10	Include references: Derek T. Robinson et al., 2018; Ortega, Razola, and Garzon, 2014 [Gwenaelle GREMION, Canada]	Reference 1. Rejected: There are more than 80 references published in 2018 with the name of D. Robinson and there is not any coincidence including the word flood, so we could not find the reference. Reference 2. Accepted. It has been included in the SOD.
32364	45	12	45	27	Teufel et al. (2019) attributed increased rainfall associated with a flood event, but suggest this was offset by the warming-related reduction in spring snowpack, resulting in no attributable effect on runoff. Teufel, B., Sushama, L., Huziy, O. et al. Clim Dyn (2019) 52: 4193. https://doi.org/10.1007/s00382-018-4375-0 [Megan Kirchmeier-Young, Canada]	Accepted - We agree to include between the areas necessary to understand the changing flood characteristics the precipitation/snow interactions. We have mentioned snow interactions and included the suggested references and some others.
7798	45	15	45	19	Unless the authors have different information, the Gale et al reference does not really say what they claim at all. There are only 2 sites at which they estimate river flow AEPs that are both pretty close together (not north and south) with one with a return period of 10-20 years and the other of about 10 years. I can't see any evidence of "between 5 and 6 years". A better example would be Ivancic and Shaw (2015; doi:10.1007/s10584-015-1476-1) who "found that 99th percentile precipitation only results in 99th percentage discharge 36% of the time" for a test case in the US. [Oliver Wing, United Kingdom (of Great Britain and Northern Ireland)]	Accepted, - Ivancic and Shaw indeed illustrate the point better and their analysis relies on much more data.
48762	45	21	45	27	The lack of association between extreme rainfall and extreme streamflow can be good, as adequate measures should prevent the latter in presence of the former, such in the case of the Rimac river in Peru, in which management reduced the extremes in streamflow over 90 years (Vega et al 2017, doi:10.1007/s00704-017-2084-y). I propose mentioning this example, as well as using more neutral language, i.e. replacing "failure of dams" with "effects of dams" and "mismanagement of reservoirs" with "management of reservoirs", [Ken Takahashi, Peru]	Accepted - We of course agree that the lack of association between rainfall and extreme streamflow can be good and usually dam management reduces flood frequency and severity. We agree on using the more neutral language related to the flood management and included the suggested reference as representative example.
6261	45	29	45	29	In Iran heavy rainfall caused flooding in north, west and south of the county in year 2019 with huge damages and casualties, which precipitation in few day were similar to the average annual rainfall (IRIMO, 2019). [Mostafa Jafari, Iran]	Rejected - It is not possible to review and cite every local/regional study that has analysed specific flood events.
48764	45	29	45	30	Please include reference to Schneider et al (2014, doi:10.5194/adgeo-35-145-2014), which analyses a case of glacier lake outburst in Peru [Ken Takahashi, Peru]	Accepted - We agree. This is an excellent example of glacier lake outburst. The reference has been included.
30210	45	29	45	31	see Archer, D.R. and Fowler, H.J. 2018. Characterising flash flood response to intense rainfall and impacts using historical information and gauged data in Britain. Journal of Flood Risk Management, 11, S121-S133, DOI: 10.1111/jfr3.12187 for a nice summary of flash flood definition and causes and Archer, D.R., Parkin, G. and Fowler, H.J. 2017. Assessing long term flash flooding frequency using historical information. Hydrology Research, 48(1), 1-16, DOI: 10.2166/nh.2016.031. for assessment of changes in flash flood frequency in different UK regions [Hayley Fowler, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - We agree that the first reference provides a nice summary of the complexity of definitions and causes of flash floods in connection to extreme precipitation. We have cited this reference. The second one is more regionally specific and it has not been included in this section.
21768	45	29	45	31	Include reference on flash flood in Uttarakhand, India (extreme precipitation, glacier lake outburst): Cho et al., 2016 [Gwenaelle GREMION, Canada]	Accepted- We think the reference is relevant to be cited in this frame.
54064	45	29	45	37	A link could be made in this section with earlier comments on changes in/current assessments of sub-daily precipitation extremes. [Stephen Blenkinsop, United Kingdom (of Great Britain and Northern Ireland)]	Rejected - This paragraph is simply to explain mechanisms of flash floods and urban flooding. We do not think necessary to focus on changes in precipitation intensity since here we are not assessing changes in flash/urban floods but only describing the main mechanisms.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
36512	45	31	45	34	<p>Urban floods not associated to a water course are termed pluvial floods (Falconer, 2009; Schmitt et al 2004)) as in 12.3.3.3</p> <p>Changes in urban flooding also have to do with the terrain shape of the city, increasing speed –and losses-with slope.</p> <p>The urban drainage system design has to do with the frequency and intensity of urban floods, as a conventional combined system draws more overflows, while dual drainage –wastewater and stormwater-systems reduces them.</p> <p>The use of green infrastructure or nature-based solutions, including green roofs, permeable pavements, rain gardens, or detention ponds, contributes to stormwater harvesting and to reduce runoff and concentration (Gill et al 2007). Combined use of green infrastructure and dual drainage builds an integrated urban water cycle management.</p> <p>Falconer RH, Cobby D, Smyth P, Astle G, Dent J, Golding B (2009) Pluvial flooding: new approaches in flood warning, mapping and risk management. Journal of Flood Risk Management 2(3):198 – 208.</p> <p>Gill, S.E; Handley, J.F; Ennos, A.R; Pauleit, S. 2007. Adapting Cities for Climate Change: The Role of the Green Infrastructure. Built Environment, 33(1): 115-133(19).</p> <p>Schmitt, T. G., Thomas, M., & Ettrich, N. (2004). Analysis and Modeling of Flooding in Urban Drainage Systems. Journal of Hydrology, 299, 300-311. [Urbano Fra Paleo, Spain]</p>	Accepted - We agree on the importance of urban drainage system design and the use of green infrastructures. We mentioned them in the SOD and included the suggested reference by Falconer et al. (2009).
21770	45	39	45	39	Change "temperature" to "air temperature" [Gwenaelle GREMION, Canada]	Accepted - reworded.
56462	45	40	45	40	after 2016). add "Global warming effects on the increase of snow line may also reduce the buffering effect of the higher fraction of mountain basins, causing increase of flood peaks (Allamano et al., 2009b)" [Pierluigi Claps, Italy]	Rejected - Reviewer's can suggest to include some ideas/new messages but we do not think reviewers may ask to add specific statements and citations. In addition, suggested citation is old and no literature is usually considered before AR5.
21772	45	41	45	41	Change "temperature" to "air temperature" [Gwenaelle GREMION, Canada]	Accepted - reworded.
50690	45	49	45	49	Please add snow melt to the list [Olivia Martius, Switzerland]	Accepted - added snow
14238	46	0			Section 11.5.2 - Regional changes are listed but could be better condensed to evidence supporting the key statements that are nicely summarised. [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted: The regional information has been reorganised in the chapter and it has been included in the specific sections.
21774	46	4	46	55	There is no references on South Asian countries esp. India. There seems to be an increment in flood trends in India. References to look into: Guhatthakurta, Sreejit and Menon, 2011; Kumar, Jain and Singh, 2010 [Gwenaelle GREMION, Canada]	Rejected: The study by Kumar is on precipitation trends and it does not consider a flood analysis. It was not possible to find the reference by Guhatthakurta et al.
16294	46	4	47	20	This section focused on the trends with lack of consideration on what are the potential/specific drivers for the observed scenarios that really makes a difference in these trends. If we know the potential of each driver, we can easily suggest what kind of adaptation and mitigation measures can be considered. [Tabassam Raza, Philippines]	Rejected: This section provides a diagnostic of the observed floods trends based on the literature review. The intention of this section is not to analyse/describe the possible drivers of these trends. Groups II and III are specifically focussed on drought impacts and adaptations.
25460	46	4			Section 11.5.2 - is any distinction made between managed and unmanaged basins? [Sharon Smith, Canada]	Not applicable - The literature review is mostly considered large spatial studies that do not make a careful assessment of the specific characteristics of the basins. The majority of these large scale studies are thus merging both managed and unmanaged catchments.
27896	46	9	46	12	<p>-Page 11-46, lines 9-12: I find these sentences a bit vague: in which regions did the SR15 report find an increase/decrease in flood frequency? Are they confirmed by the "new analyses available since the SR15", that are mentioned at line 14 of page 46?</p> <p>-I suggest adding a table to summarize the information described in this section, in order to make it easier to identify where the trends are significant. [roderik van de wal, Netherlands]</p>	<p>Comment 1: Accepted: the assessment of the flood section has been rewritten including specific reference to the regions in which decrease/increase of floods is recorded.</p> <p>Comment 2: Not applicable: tables with regional summaries and general assessment are included at the end of the chapter. We can probably refer to this table better.</p>

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
7804	46	33	46	34	The Shkolnik et al reference has nothing to do with the Amazon or the Walker circulation, but is about trends in northern Eurasia. [Oliver Wing, United Kingdom (of Great Britain and Northern Ireland)]	Accepted: It is true, there is an error in the reference. The correct reference should be Barichivich et al. 2018. It was an error with the Mendeley manager once the reference was included. Thanks to identify the mistake.
50094	46	34	46	34	At the end of the sentence, it is important to add : "Taylor et al. (2017) showed that frequency of extreme Sahelian storms has tripled since 1982 in satellite observations in relation with increase of global land temperatures and particularly with an enhanced Saharan warming". Taylor et al., (2017): Frequency of extreme Sahelian storms tripled since 1982 in satellite observations. Nature, 544(7651), 475. [ARONA DIEDHIOU, Cote d'Ivoire]	Rejected: The section is not focusing on extreme precipitation trends but on floods. The suggested article does not analyse flood changes in the Sahel but exclusively trends in storms. We agree that increased storm frequency would probably increase floods but really flood trends are not assessed in the manuscript.
21776	46	39	46	44	To reinforce the understanding of trends, in this sentence, he mentions the lack of homogeneous trends observed in Europe. What does this lack of continental confidence mean for global trends? [Gwenaelle GREMION, Canada]	Rejected: The sentence is focused on European trends, we do not think we can extract a message for the global trends. In addition, the results of the European studies do not mean a lack of continental confidence but simply that the regional trends show strong spatial differences so it is not possible to assess a general trend for the whole continent.
8918	46		47		The very recent study by Papalexiou and Montanari should be added here: Papalexiou, S. M., & Montanari, A. (2019). Global and Regional Increase of Precipitation Extremes under Global Warming. Water Resources Research, doi:10.1029/2018WR024067. [Luca Brocca, Italy]	Rejected: This study has been included in section 11.4.2, which focus on extreme precipitation trends. Sections 11.5.1. and 11.5.2 are focusing on floods.
14240	47	6			Section 11.5.4 - given the limited conclusions this section could perhaps be condensed [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - This section has been shortened to only discuss the key new developments.
30212	47	13	47	13	I don't disagree with your conclusions here but you should perhaps make it clear that you are talking about river out of bank flooding and not pluvial flooding (generally flash flood events in urban areas) which are uncertain (I would suspect that if we had the data these would actually show mostly increases) [Hayley Fowler, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - We agree. We have clearly stated that we refer here to high RIVER flows
7800	47	18	47	18	Southeast US is highlighted as having high confidence in a negative trend. This is the first time SE US is mentioned, and is unsupported by the preceding literature. Did the authors mean southwest US? [Oliver Wing, United Kingdom (of Great Britain and Northern Ireland)]	Rejected - Assessment of Southeast flood trends is based on Peterson et al. (2013a), and cited in Page 46: 35.
7802	47	18	47	19	I think stating "low confidence in global trends in floods" implies a lack of understanding, when in reality it is due to regional differences. I know this point is stated in the sentence in question, but surely we have high confidence that there is no trend in global floods rather than low confidence in a trend? [Oliver Wing, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - We agree on the assessment. We have rewritten the sentence according to the reviewer's suggestion. We think it maintains better the intended meaning.
54350	47	20	47	20	"influenced" by snowmelt may be better than "dominated" (the latter implies that non-snowmelt floods are rare, which is not true for Europe, at least). [Blair Trewin, Australia]	Accepted - reworded.
21780	47	25	47	25	I do not think "strongly depend on " is the right words as this may conflict with "Increases in heavy rainfall events in a warming environment do not necessarily increase the streamflow and flooding" in line 12 of page 11-45 [Gwenaelle GREMION, Canada]	Accepted - We agree. The sentence has been qualified, replacing "strongly" by "probably"
21778	47	30	47	30	separate the words in "floodsalsodepend" as "flood also depend" and "preventionmeasures" as "prevention measures" [Gwenaelle GREMION, Canada]	Accepted - words were separated.
36514	47	30	47	31	P73 L36-37. This is what Ulrich Beck has termed de-localization of risk. According to this, causes and consequences are not limited to one geographical location or space. Beck, U. 1992. Risk Society: Towards a New Modernity. London: Sage. [Urbano Fra Paleo, Spain]	Rejected - We think there is an error in the comment since it is not referring to page 47: lines 30-31 as indicated.
21782	47	39	47	40	I think you may need more explanations on why over-fitting is a source of uncertainty [Gwenaelle GREMION, Canada]	Accepted - This section has been rewritten.
7806	47	50	47	52	This point appears to repeat the point made at the opening of the paragraph. [Oliver Wing, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - We agree. This is repeating the same idea. The sentence has been removed.
56464	48	20	48	20	after "rainfall). Add "One is related to the effect of the increase in temperature in the flood mechanisms of mountain basins, (Allamano et al., 2009b). Overall, these studies are still insufficient to draw any global conclusions. [Pierluigi Claps, Italy]	Rejected - Reviewer's can suggest to include some ideas/new messages but we do not think reviewers may ask to add specific statements and citations. In addition, suggested citation is old and no literature is usually considered before AR5.
21786	48	34	48	34	There is a gap between the bibliographical citation and the text [Gwenaelle GREMION, Canada]	Accepted: Sentence has been corrected.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
21784	48	34	48	35	In this paragraph it would be prudent to add the attribution frameworks to be a frame of reference in later research. [Gwenaelle GREMION, Canada]	Accepted - we agree that it would be important to add the framework for further reference. This holds however not only for flood attribution but attribution frameworks in general we thus refer to section 11.2.4.
7808	49	10	49	11	This criticism of Hirabayashi et al's approach seems gratuitous, how does the use of a limited grid-box run-off model impact their results and so how should the reader interpret them? Does the lack of a criticism of other approaches (e.g. Alfieri et al's very coarse resolution) imply that these are better? [Oliver Wing, United Kingdom (of Great Britain and Northern Ireland)]	Accepted: criticisms have been removed in the SOD.
21792	49	28	49	31	There is a gap between the bibliographical citation and the text [Gwenaelle GREMION, Canada]	Accepted: typo corrected
21788	49	30	49	30	separate the words in "Similarlyinconsistentassessments" as "Similarly inconsistent assessments" [Gwenaelle GREMION, Canada]	Accepted: typo corrected
7810	49	36	49	36	Liu et al actually project increases in East Asia, not decreases. [Oliver Wing, United Kingdom (of Great Britain and Northern Ireland)]	Accepted: the reviewer is right. This has been corrected in the SOD.
21790	49	44	49	44	separate the words in "wasprojected" as "was projected" [Gwenaelle GREMION, Canada]	Accepted: typo corrected
7814	49	48	49	49	Stating the whole of Amazonia is projected to increase is not supported by the cited literature, who generally project increases in the west and decreases in the east. The Amazon as a "consistent regional projection ... in an projected increase" (page 50, line 4-5) is not supported [Oliver Wing, United Kingdom (of Great Britain and Northern Ireland)]	Accepted- We agree, the cited studies project the main increase of flooding in the West of the Amazon basin. This has been corrected in the SOD.
21796	50	1	50	1	I do not think "medium confidence" makes sense as the projections are so inconsistent [Gwenaelle GREMION, Canada]	Reject - While the projections disagree largely on the magnitude of change, most studies for large scales find an increase in flood risk. The statement also bases on the assessment of the SR1.5 report which concluded the same with 'medium confidence'. More recent studies do not provide evidence that suggest this assessment was wrong.
7812	50	3	50	3	Consistent projections of increases are stated for the Andes. There is only 1 reference (Bozkurt et al) supporting this, while virtually all of the global studies (Alfieri et al; Hirabayashi et al; Winsemius et al) project decreases. [Oliver Wing, United Kingdom (of Great Britain and Northern Ireland)]	Rejected - There are different projections in the West Amazon/East Andean region that support this assessment (Sorribas et al., 2016; Langerwisch et al., 2013; Guimberteau et al., 2013; Zulkafli et al., 2016)
7816	50	3	50	4	I don't think that just because there are consistent projections for some (very few) regions that this necessarily translates to high confidence. All modelling studies share the same fundamental constraints in their ability to resolve the relevant processes: taking an ensemble view of lots of models that don't work very well does not really increase confidence. [Oliver Wing, United Kingdom (of Great Britain and Northern Ireland)]	Agreed - While the projections are indeed consistent the frameworks are not necessarily we have thus changed this to medium confidence.
27036	50	8	50	8	Papers exist on drought in central Asia an assessment of these papers should be added [Mansour Almazroui, Saudi Arabia]	Rejected- The reviewer should be more specific on which papers and topics addressed. The report is considering a regional assessment in the section 11.9. Probably this comment would be more suitable there but specifying the studies and if they are covering recent trends, projections, model validation, etc.
48648	50	8	59	5	It would be better moved to the Chapter 12 - Hazard [Lincoln Alves, Brazil]	Rejected - The WGI framework clearly considered that Chapter 11 must cover droughts.
11628	50	8			Why are no pre-industrial baseline studies discussed here? It is important to initially establish the corridor of natural variability. Only once such data are available natural variability and anthropogenic influence can be distinguished. For example, for natural hydroclimate variability in Africa take a look at Lüning et al. 2018 who studied rainfall trends during the Medieval Climate Anomaly. Lüning et al. (2018): Hydroclimate in Africa during the Medieval Climate Anomaly. Palaeogeogr., Palaeoclimatol., Palaeoecol., 495: 309-322, doi: 10.1016/j.palaeo.2018.01.025. Laurenz et al. 2019 discuss solar influence on modern and pre-industrial rainfall variability in Europe: Laurenz et al. (2019): Influence of solar activity on European rainfall. J. Atmospheric and Solar-Terrestrial Physics, 185: 29-42, doi: 10.1016/j.jastp.2019.01.012. [Sebastian Luening, Portugal]	Rejected - This is out of scope of the drought section. There is a specific box (Box 11.2) specifically focussing on the paleoclimatic assessment of extremes in which an assessment of droughts is included.
55466	50	10	50	13	By stating "There is no definition for drought..." using a single reference, appears to be a contradiction with existing definitions of drought, which may vary sector by sector. [GENITO MAURE, Mozambique]	Accepted - This has been rewritten as follows: Drought cannot be provided for a single universal definition

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
54352	50	10	50	20	Something which could be discussed further here is the wide range of timescales over which drought can operate - from "flash droughts" on a scale of weeks which can have high impacts in some climates/seasons, to multi-year rainfall deficits (which, at the longer end, may be difficult to separate from longer-term downward rainfall trends). [Blair Trewin, Australia]	Accepted- We have included a sentence to stress this issue: Drought can operate with a wide range of timescales - from "flash droughts" on a scale of weeks to multi-year or decadal rainfall deficits.
52848	50	10			Sorry, but why are droughts an impact dependent phenomenon? It is impact relevant. And different types exist, according to the impact. In fact, these (meteorological, soil moisture, hydrological, agricultural) should be introduced here. [Douglas Maraun, Austria]	Accepted. This has been rewritten to clarify drought impacts and introduced drought types: Drought may refer to agricultural (e.g., crop yield reductions or failure), ecological (e.g., tree mortality), or hydrological impacts (e.g., reductions in streamflow, and storages such as reservoirs, soil moisture and groundwater), being common to identify different drought types (meteorological, agricultural, environmental, hydrological and socioeconomic).
44206	50	11	50	12	include drought disappearance of lakes and lagoons [angelica CASANOVA-KATNY, Chile]	Accepted - Included
52850	50	12			"cannot be defined": this depends on the type of drought. Meteorological drought can. [Douglas Maraun, Austria]	Rejected: We would refer here to Lloyd-Hughes (2014) in which it is widely discussed the impractical definition of drought since human intervention is intrinsic to the definition of drought. For meteorological droughts it is also complicated to provide an universal definition given the differences in climatology and the consideration of different meteorological variables to establish meteorological drought conditions (e.g. considering only precipitation or also temperature, atmospheric evaporative demand,...).
21794	50	18	50	18	separate the words in "remotesensingbasedmethods" as "remote sensing based methods" [Gwenaelle GREMION, Canada]	Accepted - Separated
27898	50	20	50	21	Page 11-50, lines 20-21: elaborate more on what are the limitations of these indices or add a reference to where in the chapter this topic is explained. [roderik van de wal, Netherlands]	Not applicable - This sentence has been removed in the SOD.
52852	50	25			Droughts are often accompanied by heat waves. Thus there should be a link to the compound event section here. In fact, I am wondering if it makes sense to have a conceptual discussion of CEs further up in the chapter, and then give the examples in those sections where one may expect them (e.g., drought + heatwave here, compound flooding in the flood section, etc.). [Douglas Maraun, Austria]	Rejected: Droughts can be accompanied or not by heat waves if they occur in summer season but the droughts may occur at any season and in both cold and warm regions so the term often should be qualified. This section is exclusively focusing on drought events and drought + heat events are discussing in an independent section that discusses in depth this phenomenon.
26788	50	28	52	12	This section would benefit from starting with more generalised view of droughts. At least those that are caused by a lack of precipitation. First there is the P-E contrasts enhancing in a warming climate due to thermodynamics (Held and Soden 2006), meaning that the dry regions get drier. By 'regions' one may though not necessarily think of a specific region, but rather the driest regions which may be shifting with the circulation. Another argument is that with warming precipitation, in particular weak precipitation, becomes less frequent (Pendergrass and Hartmann, 2014). This is because heavy extremes follow Clausius-Clapeyron, but global mean precipitation increases at a slower rate of 2-3 percent per K. Thus it has to rain less often, or there is longer time between precipitation events. [Thorsten Mauritsen, Sweden]	Rejected: We think that this section follows a coherent structure, starting with the dynamic mechanisms and then with thermodynamic processes. There are recent studies (see e.g. Greve et al., 2014 Nat. Clim Ch.) that do not support the hypothesis of dry regions get drier and in any case if this can be observed in some areas (e.g. in regions in which Epot has noticeably increased as a consequence of global warming and limited moisture supply: the Mediterranean- Vicente-Serrano et al., 2014 GPCh; Australia, Stephens et al., 2018) this is not related to precipitation processes. There are also studies that suggest the opposite of indicated by the reviewer, for example, in the semiarid Spain the weak precipitation events becomes more frequent under the current warming scenario (López-Moreno et al., 2010 IJC; Serrano-Notivol et al., 2018 IJC).
14242	50	28			As expected, some coordination with 8.2.2.2.6 may be required [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - This has been coordinated with chapter 8

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27900	50	31	51	30	- Page 11.50, lines 31-35 and following: aren't these considerations more appropriate to appear in paragraph 11.6.4, since they are about attributing changes in the drivers of drought to greenhouse gas forcing? -Page 11-51, line 5: The report states that Epot "can be estimated using different methods". Since Epot is a key variable, it could be interesting to elaborate more on this point. -Page 11-51, line 30: what are the "methodological limitations" the report refers to? I would suggest to explicitly point them out. [roderik van de wal, Netherlands]	Question 1. Rejected: Lines 31-35 are introducing dynamical and thermodynamic mechanisms of drought variability. We think more suitable that they appear in this section. Question 2. Accepted: We have included a reference to McMahon et al. (2013) which made a complete and comprehensive review on the available methods to calculate Epot. Question 3. Accepted: We have detailed why there are these limitations: ...given the small availability of observations worldwide (Miralles et al., 2018)
44872	50	37	50	53	I think this section can be further improved. Over the Maritime Continent, while Lestari et al. (2018), I would like to point to the LA a number of articles that prove comprehensive understanding of how ENSO influences climate variability in the region. 1. Supari, Tangang F, Salimun E, Aldrian E, Sopaheluwakan A, Juneng L (2018). ENSO modulation of seasonal rainfall and extremes in Indonesia, <i>Climate Dynamics</i> , 51: 2559-2580, DOI: 10.1007/s00382-017-4028-8., 2. Tangang F, Farzanmanesh R, Mirzaei A, Supari, Salimun E, Jamaluddin AF, Juneng L (2017). Characteristics of precipitation extremes in Malaysia associated with El Nino and La Nina events. <i>International Journal of Climatology</i> , 37 (Suppl.1): 696–716, DOI: 10.1002/joc.5032, 3. Salimun E, Tangang F, Juneng, Behera, S.K. and Yu W (2014), Differential Impacts of Conventional El Niño versus El Niño Modoki on Malaysian Rainfall Anomaly during Winter Monsoon, <i>International Journal of Climatology</i> , 34: 2763–2774, 4. Juneng, L and F.T. Tangang (2005). Evolution of ENSO-related rainfall anomalies in Southeast Asia region and its relationship with atmosphere-ocean variations in Indo-Pacific sector. <i>Climate Dynamics</i> , 25:337-350 [Fredolin Tangang, Malaysia]	Rejected - These studies are very specific geographically and not directly focused on drought issues. This paragraph is only mentioning the most general drought mechanisms at the global scale (including circulation) so it is not possible to introduce specific studies at the regional scale.
21798	50	38	50	39	I think you may need reference if you want to say "there is low confidence that changes in global circulation may explain long-term trends" [Gwenaelle GREMION, Canada]	Accepted: This has been detailed in the SOD. "...trends since there are not consistent trends in the large-scale atmospheric circulation over the last decades (Chapter 2)"
37966	50	39			Delete "may". [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - Deleted
48766	50	42	50	42	Before "In other regions...", please insert the following: "For instance, El Niño events and reduced incoming moisture transport have been linked to reduced rain in the Amazon during the last decade, while projections suggest that drought might intensify during the 21st century (Marengo and Espinoza, 2016)". Reference: doi:10.1002/joc.4420 [Ken Takahashi, Peru]	Rejected - The comments is very specific geographically. This paragraph is only mentioning the most general drought mechanisms at the global scale (including circulation) so it is not possible to introduce specific studies at the regional scale.
55956	50	51			Here there is a huge resource for shortening. [Olga Zolina, France]	Rejected - We think that among the drought mechanisms it is necessary to mention the possible changes in the Hadley circulation given it is one of the most relevant drivers of drought generation in tropical and subtropical latitudes.
21800	50	55	50	55	Check spelling and writing [Gwenaelle GREMION, Canada]	Accepted - The sentence has been rewritten.
44600	51	24			High-resolution simulations reveal that the land surface response to declining monsoon precipitation and associated soil moisture depletion over the Indian region have contributed to significant decrease of evapotranspiration during the post-1950s (Ramarao et al. 2015). (Ref: Ramarao MVS, Krishnan R, Sanjay J, Sabin TP (2015) Understanding inland surface response to changing South Asian monsoon in a warming climate. <i>Earth Syst Dyn Discuss</i> . 6:1–34. doi:10.5194/esdd-6-1-2015. www.earth-syst-dynam-discuss.net/6/1/2015/ [Krishnan Raghavan, India]	Rejected - The comment by the author is out of place. The paragraph is related to conceptual issues of land-atmosphere feedbacks related to thermodynamic processes but the reviewer is suggesting a dynamic study related to monsoon changes. Although the article includes an assessment of evapotranspiration in the region, this is a local assess that would be more suitable for the chapters that cover the monsoon system (e.g. Chapter 8).
21802	51	48	51	49	Add what could be the ENSO events to modify future global mechanisms of drought? [Gwenaelle GREMION, Canada]	Rejected: The comment is out of place. Page 51: 48-49 focusses on the effects of CO2 on stomatal conductance and water use efficiency and not on dynamic mechanisms and specifically ENSO.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
45984	52	1	52	12	Excellent Summary, with confidence levels assessed. What is the direction of change of the relative importance of drought measures under enhanced greenhouse gas concentrations? [Lourdes Tibig, Philippines]	Rejected - The use of different drought metrics for drought assessment under enhanced greenhouse gas concentrations is addressed in the section 11.6.5.
52854	52	1			consider to replace "definitions" by "types" [Douglas Maraun, Austria]	Accepted - Replaced word.
45986	52	15	52	40	It is being suggested that because droughts are increasingly becoming severe in most recent years in countries highly vulnerable to slow onset events associated with impacts of climate change, the assessments on droughts give more attention to regions where drought events are linked to El Niño, such as in the Philippines and parts of Australia, not withstanding that ENSO remains the most dominant mode of climate variability. [Lourdes Tibig, Philippines]	Rejected - We do not understand the reviewer's comment in the context of the section 11.6.2. The drought mechanisms and the assessment of the ENSO connections are explained/discussed in the section 11.6.1.
14532	52	29	52	30	Southwest China, rather than south China. Actually, some works have been published for mainland China in this regard. These found a significant upward trend of meteorological drought frequency in North China and Southwest China, and also in southern Northeast China (e.g. Wang and Zhai, 2003; Zou, X.K. et al., 2005, 2010; Ma and Fu, 2006; Ren, G.Y., et al., 2010, 2012). (CUG, Guoyu Ren) [Guoyu Ren, China]	Accepted - Southwest China has been added to refer the severe drought of 2009-2010.
44208	52	30	52	32	mega drought in Central Chile (Garreaud et al. 2017): The 2010–2015 mega drought in Central Chile: Impacts on regional hydroclimate and vegetation; https://doi.org/10.5194/hess-21-6307-2017 [angelica CASANOVA-KATNY, Chile]	Accepted - Reference to the 2010-2015 mega drought in Chile has been included.
27902	52	33	52	38	-Page 11-52, line 33: how is the SPI index defined? If the definition was included in the report, it would be easier to interpret Figure 11.12 -Page 11-52, line 37-38: this statement does not seem to correspond to what is shown in Figure 11.12, where trends are said to be significant the areas that are not in grey. From the figure, other regions of North America and Asia appear to be relevant, as well. [roderik van de wal, Netherlands]	First question: Rejected - There is a supplementary table that describes the most widely used drought metrics nowadays. We do not think necessary to describe the SPI here. This is a widely used drought index and currently the World Meteorological Organization recommends it as a standard drought index and provided standard calculation guidelines (http://library.wmo.int/pmb_ged/wmo_1090_en.pdf) Second question: Accepted - the reviewer is right. The corrected figure cited should be the 11.12. This has been corrected in the revised document.
43276	52	52	52	54	As Seneviratne et al. (2010) soil moisture is fundamental for agriculture, but the SPI index is still useful for the extraction of drought damages. Please see below article. Kim et al. (2019): Global Patterns of Crop Production Losses Associated with Droughts from 1983 to 2009. J. Appl. Met. & Clim., https://doi.org/10.1175/JAMC-D-18-0174.1 [Motoki Nishimori, Japan]	Accepted - A statement has been included on this issue: The SPI is useful to extract agricultural drought damages (Kim et al., 2019). Nevertheless...
25462	52	52	53	4	Is there anything that can be said about improvements since AR5 regarding measurements and trends - extension of satellite records, new sensors etc.? [Sharon Smith, Canada]	Rejected: This is specifically recorded in the section 11.2.1
21804	53	17	53	18	You may need reference if you want to say "regions showing dryness increases based on the SPI display higher dryness increases based on SPEI- or PDSI metrics" [Gwenaëlle GREMION, Canada]	Accepted - References have been included.
21806	54	18	54	18	"mean" and "temporal variability" are not comparable [Gwenaëlle GREMION, Canada]	Accepted - "temporal variability" has been replaced by "variance"
52856	54	18	54	32	The whole paragraph is about projection uncertainties, not model evaluation. Please move. [Douglas Maraun, Austria]	Rejected: We agree that it is containing the use of models for drought projections but the model evaluation in the different extreme events sections (temperatures, precipitation, floods, etc.) has been also considered an assessment of the models in relation to the generation of projections in extreme events.
21808	54	35	54	36	"high latitude" in the Southern Hemisphere or Northern Hemisphere or Both? [Gwenaëlle GREMION, Canada]	Accepted: It refers to the North Hemisphere. This has been replaced in the revised document.
43954	54	38	54	38	Suggest to add here: "Knutson and Zeng (2018) found a strong tendency for CMIP5 historical runs to simulate a drying precipitation trend bias compared to observed trends (1901-2010), particularly in mid- to high latitudes, where the observed increasing precipitation trends were significantly undersimulated by models." Reference: 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 . The statement and the reference cited have been included.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
27904	54	48	52	49	Page 11-54, line 48-49: I suggest improving the summary, as a key message from the paragraph seems to be the one at line 27-28 on page 54: "There is some evidence that models reproduce a consistent drought signal at the global or the hemispheric scales, but model disagreement at the regional scale is high". [roderik van de wal, Netherlands]	Accepted - the summary is indeed not worded well, we have modified it accordingly.
43370	54	48	54	49	You say "however" and then repeat "medium confidence". I get the sense that this second statement is expressing a higher level of confidence than the preceding one, yet they both have "medium confidence". Should one of the confidence statements be changed? [James Renwick, New Zealand]	Accepted. Rewritten in the SOD
16296	54	48	54	50	Since the confidence level in the overall trends and the regional trends are the same, the word "however" can be omitted. [Tabassam Raza, Philippines]	Accepted. Rewritten in the SOD
21810	54	49	54	49	I don't think "however" is logically right here. [Gwenaelle GREMION, Canada]	Accepted. Rewritten in the SOD
21812	55	1	55	55	Include reference: Loon et al., 2016; Wang et al., 2014 [Gwenaelle GREMION, Canada]	Accepted: We agree to include the review article of Anne Van Loon in this section. The reference of Wang et al. Has not been found.
43940	55	21	55	24	Suggest to modify as follows: "However, there is evidence that human emissions have contributed to drying trends in Southern Europe (Gudmundsson et al. 2017) and the Mediterranean region (Hoerling et al. ; Knutson and Zeng 2018). Additionally there is evidence for anthropogenic emission influence on the observed contrast in pan-European river flow..." Additional references: Hoerling, M., J. Eischeid, J. Perlwitz, X. Quan, T. Zhang, and P. Pegion, 2012: On the increased frequency of Mediterranean drought. J. Climate, 25, 2146–2161, https://doi.org/10.1175/JCLI-D-11-00296.1 . 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. The sentence was modified according to the reviewer's suggestion.
52858	55	26	55	42	The examples here are discussed as quite detailed regional showcases in Chapter 10. There should be a link to the corresponding sections. We should also be careful that the messages are not contradictory. [Douglas Maraun, Austria]	Accepted - There is a coordination with Chapter 10 in order to avoid possible overlaps/inconsistencies.
54354	55	33	55	37	It is not clear what example/s is/are being cited for the "contradictory results". The following sentences refer to 2014 droughts in the southern Levant and the Horn of Africa, which are different areas. [Blair Trewin, Australia]	Accepted - the results are indeed not contradictory, the paragraph has been changed to state this clearly.
43942	55	42	55	42	Suggest to add: "A regional precipitation trend assessment for 1901-2010 for limited African regions with sufficient data coverage suggested detectable anthropogenic drying trends in scattered regions of tropical northern Africa and the near-Mediterranean region, with little available evidence for long-term detectable decreasing rainfall trends elsewhere in Africa (Knutson and Zeng 2018)." Reference: 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 (See Fig. 3) [Thomas Knutson, United States of America]	Rejected: The paragraph is related to attribution of specific drought events and I do not think that a study of model assessment of observed precipitation here is suitable here. This article has been cited above as suggested by the same reviewer in a most adequate place.
43934	55	48	55	48	Suggest insert following sentence here, before the summary sentence beginning "Overall": "A detection/attribution study of precipitation trends finds over North America little evidence of detectable decreases in precipitation since 1900, but substantial areas with detectable anthropogenic increases in precipitaton (Knutson and Zeng 2018). This may be contributing to the decreasing trends in drought by some measures over parts of the continental U.S. (Wehner et al. 2017; Andreadis, K.M. and D.P. Lettenmaier, 2006). Overall..." Additional references cited: Andreadis, K.M. and D.P. Lettenmaier, 2006: Trends in 20th century drought over the continental United States. Geophysical Research Letters, 33, L10403. http://dx.doi.org/10.1029/2006GL025711 . 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 (See Fig. 3) [Thomas Knutson, United States of America]	Rejected: The paragraph is related to attribution of specific drought events and I do not think that a study of model assessment of observed precipitation here is suitable here. The article by Knutson and Zeng 2018 has been cited above as suggested by the same reviewer in a most adequate place.

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43936	55	52	56	4	Suggest to add at end of paragraph. "In these regions, no widespread attributable anthropogenic declines in annual mean precipitation since 1901 were inferred in an examination of regions having sufficient data for trend analysis (Knutson and Zeng 2018); this is qualitatively consistent with the lack of attributable anthropogenic increase in observed drought in these regions." Reference cited: 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 (see Fig. 3) [Thomas Knutson, United States of America]	Rejected: The paragraph is related to attribution of specific drought events and I do not think that a study of model assessment of observed precipitation here is suitable here. This article has been cited above as suggested by the same reviewer in a most adequate place.
28452	56	1	56	1	"Hideo et al. 2013" should be "Shiogama et al. 2013". Hideo is not the family name of the first author, Hideo Shiogama. [HIDEO SHIOGAMA, Japan]	Accepted: Corrected in the SOD
43938	56	14	56	14	Suggest to add at end of paragraph. Anthropogenic greenhouse gas and ozone influences on decreasing precipitation trends in southwest Australia over the 20th century were found by Delworth and Zeng (2012)." Add reference: 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. [Thomas Knutson, United States of America]	Rejected: The paragraph is related to attribution of specific drought events and I do not think that a study of model assessment of observed precipitation here is suitable here.
16298	56	23	56	24	The confidence level might be confused from the itemized influences versus the overall anthropogenic influence. I suggest recast the sentence to indicate that the overall anthropogenic influence on drought is of high influence prior to the itemization of the influences. [Tabassam Raza, Philippines]	Accepted: Confidence assessment has been removed.
26790	56	24			No reason to put a confidence statement here. [Thorsten Mauritsen, Sweden]	Accepted: confidence assessment has been removed.
27906	56	25	56	29	Page 11-56, line 25-29: some repetitions are present in these sentences. [roderik van de wal, Netherlands]	Accepted: last sentence has been removed
14244	56	32			Older studies by Prudhomme et al. (2014) PNAS doi/10.1073/pnas.1222473110 and Shewe et al. (2018) PNAS doi/10.1073/pnas.1222460110 show uncertainty in water scarcity and drought is strongly dependent on hydrological/impact models. [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted: included in the SOD
54356	56	43	56	43	"warmed between 60-80%" - does this mean "warmed at 60-80% of the rate of"? [Blair Trewin, Australia]	Accepted: Replaced in the revised document.
28506	57	10		18	More literature and some discussion for Asia and South East Asia regions. [Kanoksri Sarinnapakorn, Thailand]	Rejected: This paragraph stresses the regions in which the model ensemble displayed robust signal-to-noise ratio : the Mediterranean, South Africa, Southern North America, Central America and Northeast Brazil. If Asia and South East Asia would be between these regions they would have been included.
52860	58	33			Hydrological drought has not been introduced (if I am correct). [Douglas Maraun, Austria]	Accepted: According to the reviewer's comment and the comments by other reviewers a definition of the different drought types has been included at the beginning of the section 11.6.
54358	58	45	58	49	Some care needs to be taken here to distinguish between streamflow changes caused by an overall decline in precipitation, and those caused by precipitation which would previously have fallen as snow falling as rain instead (which will affect the timing of peak streamflows but not necessarily their magnitude). The question of streamflow downstream of declining glaciers is addressed at some length in SROCC and discussion here should cross-reference that. [Blair Trewin, Australia]	Accepted. We have addressed this issue in the SOD and referenced to SROCC but also to the Chapter 9 that it is also covering this topic.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
43944	58	51	59	5	An additional caveat to these drought projections is that in some regions where increased drought frequency and severity is being projected here (medium confidence), an analysis of precipitation trends 1901-2010 shows no detectable decrease in precipitation, and in some cases the precipitation trend is increasing. For example, in parts of southern US and central America, the 10-model ensemble of CMIP5 historical runs analyzed in Knutson and Zeng (2018) simulated a negative precipitation trend over 1901-2010, while in observations there was a significant increasing trend over this period in parts of these region and no substantial areas with significant decreasing precipitation trends. See Fig. 3 of Knutson and Zeng (2018) for details. According to that analysis, areas with historical precipitation behavior that seem inconsistent with these projections of future drought increase would include large-scale regions of southern Africa, southern North America, central America, and perhaps even the northeast Brazil projection (although just a few data points are available there). I recommend results be cited for context and considered in assessing confidence. Reference: 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 (See Fig. 3) [Thomas Knutson, United States of America]	Accepted: We agree with this concern, for this reason, in the general assessment we clearly state that the confidence of projections is medium since "there are uncertainties in drought representation in the climate models".
7578	59	8	69	2	I do not find any important issue regarding what it is written now. However, I miss information on Mediterranean tropical-like cyclones or Medicanes (Mediterranean Hurricanes), on which over the last years there has been growing literature talking on this phenomenon and how ACC could affect them. There is a concern on the increasing evidence that Global Warming could make Medicanes more hazardous (see e.g. González-Alemán, J. J., Pascale, S., Gutierrez-Fernandez, J., Murakami, H., Gaertner, M. A., & Vecchi, G. A. (2019). Potential increase in hazard from Mediterranean hurricane activity with global warming. Geophysical Research Letters, 46, 1754– 1764. https://doi.org/10.1029/2018GL081253). Please consider to include this information on either 11.7.1 (tropical cyclones) or 11.7.2 (extratropical cyclones) sections. Mediterranean hurricanes can be considered as tropical cyclones (indeed ACC projections are similar), but taking into account that they develop in the extratropics, I am doubting on which section it could better fit. In any case, in my opinion, it is important to make the public know on the impact of this phenomenon in the Mediterranean region. I also miss information on subtropical cyclones, a subset of cyclones sharing characteristics of tropical and extratropical cyclones. The first projection study is already available, which was published last year (see González-Alemán, J. J., Gaertner, M. A., Sánchez, E. and Romera, R. (2018), Subtropical cyclones near-term projections from an ensemble of regional climate models over the northeastern Atlantic basin. Int. J. Climatol, 38: e454-e465. doi:10.1002/joc.5383). It is important to note that subtropical cyclones can also make a big impact on the public. Please consider to include this information on 11.7.2 (extratropical cyclones) sections. [Juan Jesús González-Alemán, Spain]	Good suggestion. We have added text to discuss Mediterranean TCs.
28112	59	8	72	38	Compared to other topics (e.g., ETCs and ARs), the discussion of TCs in this section is much more extensive. Does this reflect that TCs were more extensively studied or indicate that the author team think that there are more important changes related TCs? [Gan Zhang, United States of America]	We don't make any judgements on the relative importance of the different phenomena. There is a broader range and amount of literature on TCs since the AR5 than on severe convective storms or ARs, and arguably more than on ETCs.
21814	59	8			Atmospheric rivers are not (necessarily) extreme storms. They are important atmospheric phenomena that can cause severe impacts if their amplitude is sufficient, i.e. they transport sufficient water vapour AND are accompanied by strong winds. While I agree that they should be included in this section 11.7, it should be highlighted that ARs are only damaging if the intensity of water vapour transport is high, which indicates a combination of high water vapour in combination with strong winds. An atmospheric river containing low amounts of water and is not accompanied by strong winds is virtually harmless and can even be beneficial. [Gwenaëlle GREMION, Canada]	Thank you. We have split the discussion of ARs to fit into extreme storms as well as precipitation extremes.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
46408	59	10	59	11	<p>The atmospheric river is a phenomenon defined as a long, narrow, and transient corridor of strong horizontal water vapor transport (Zhu and Newell 1994), and not a storm by itself. In this sense, it is different from other three phenomena (tropical and extratropical cyclones, and severe convective storms) assessed in this section. The atmospheric rivers are typically associated with a low-level jet stream ahead of the cold front of an extratropical cyclone, and often foster heavy precipitation in the presence of forced upward motion. The investigations of the climatology and its association with the severe weather have accumulated in these five years (e.g., Mundhenk et al. 2016; Baggett et al. 2017; Kamae et al. 2017a, b) and future projection is also discussed (e.g., Kamae et al. 2019 for the East Asian domain). Thus, it is worth reporting in the context of the extreme events. These can be mentioned in this section in a well-coordinated manner with the descriptions of the atmospheric rivers in other chapters (e.g., 10.3.3.5.6 page 55 of Chapter 10; 8.4.2.6.4 pages 91-92 in Chapter 8; 8.3.2.8 pages 64-65 in Chapter 8).</p> <p>Zhu, Y. and R. E. Newell, 1994: Atmospheric rivers and bombs, Geophysical Research Letters, 21, 1999-2002. DOI: 10.1029/94GL01710</p> <p>Mundhenk, B. D., E. A. Barnes, and E. D. Maloney, 2016: All-Season Climatology and Variability of Atmospheric River Frequencies over the North Pacific. J. Climate, 29, 4885–4903.</p> <p>Baggett, C. F., Barnes, E. A., Maloney, E. D. & Mundhenk, B. D. Advancing atmospheric river forecasts into subseasonal timescales. Geophys. Res. Lett. 44, 7528–7536 (2017)</p> <p>Kamae, Y., W. Mei, S.-P. Xie, M. Naoi, and H. Ueda, 2017: Atmospheric rivers over the Northwestern Pacific: Climatology and interannual variability. J. Climate, 30, 5605-5619.</p> <p>Kamae, Y., W. Mei, and S.-P. Xie, 2017: Climatological relationship between warm season atmospheric rivers and heavy rainfall over East Asia. J. Meteor. Soc. Japan, 95, 411-431.</p> <p>Kamae, Y., W. Mei, and S.-P. Xie, 2019: Ocean warming pattern effects on future changes in East Asian atmospheric rivers. Env. Res. Lett., 14, 054019, doi:10.1088/1748-9326/ab128a. [Tomoe Nasuno, Japan]</p>	<p>Agreed. There have been numerous discussions of how best to categorize atmospheric rivers, both here in the AR6 and in the recent U.S. National Climate Assessment. In the U.S. NCA, it was ultimately decided to place ARs in the Extreme Storms section, but we agree that this is not completely satisfying. We have incorporated some of your comments in the text. But we also note here that the AR6 is not designed to be a literature review, but rather an assessment of relationships between atmospheric phenomena and climate change using supporting literature. Most of the references listed here are not as relevant as others.</p>
27908	59	10	59	18	<p>Page 11-59, lines 10-18: Is there somehow an overall consensus in literature how to generally define extreme storms? If so, may be good to add to this section. [roderik van de wal, Netherlands]</p>	<p>Not really, no. The category has varied somewhat over past assessment reports. It's a somewhat subjective categorization, and can be modified. Here we are trying to maintain some consistency with past reports.</p>
14246	59	13			<p>"random variability" is probably OK but is it correct IPCC language (maybe double check)? [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]</p>	<p>We're not aware of any formal guidance or constraints on the way this is being used here.</p>
14248	59	17			<p>Can probably remove "Despite the challenges though, good progress has been and continues to be made." since it does not add any information. I guess some of the introductory discussion on TCs referring to SR1.5 and SROCC will be rewritten/summarised? Observed changes are also discussed in 8.3.2.10.1 [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]</p>	<p>Thank you. We prefer to keep it in. This is motivated by a somewhat contentious history of arguments regarding data quality and fidelity of trends discussed in the earlier literature. We feel that it is appropriate to point out that progress has been made in the face of the challenges. We have endeavoured to trim redundant text where ever possible.</p>
21818	59	18	59	18	<p>Add SREX, Chapter 3, section 3.4.4 for easier access to reference [Gwenaelle GREMION, Canada]</p>	<p>Good suggestion. We've added a reference to chapter 3. But the statement covers more than TCs, so referencing the section on TCs (3.4.4) by itself would be inappropriate here.</p>

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
46410	59	18	59	50	These paragraphs summarize assessment by SREX, AR5, SROCC, and SR1.5. Itemization by (1) observations, (2) projections or by (a) TCs, (b) ETCs, (c) severe convective storms is recommended to augment readability (especially for the SREX assessment). The low confidence in projection of global TC numbers is a major updates from the previous report, together with the evidence of past TC trends in the North Atlantic basin, the latter of which is distinguishable from low confidence in the past TC trends due to the heterogeneous quality of the available data. The former would be more clearly written (e.g., highlighting difference among the SREX, AR5, SROCC, and SR1.5 reports, adding appropriate references). Caution is also requested for the usage of "likely", and "low/medium/high confidence". Indicating a certain trend (weakening/strengthening or increase/decrease) or no detectable trend, with their confidence levels would be a readable format. The projected increase in the intense TCs, ETCs, and severe storms are generally common among the previous assessments and also in this report. Concise descriptions highlighting some specific aspects (e.g., SR1.5 reports on the heavy precipitation associated with the TCs) avoiding repetition are recommended. [Tomoe Nasuno, Japan]	Thank you for this suggestion. We have cleaned up the text to be closer to what you are suggesting, with a better sense of being itemized. The low confidence in projections of overall TC frequency is not an update, as we clearly state, so we have to reject this. We've added brief text to emphasize that we are providing only a capsule-summary of past reports here. Regarding the confidence language, we're only restating the language from the previous reports, so this is not something we can modify.
49374	59	20	59	24	Do include reference and evidence about statement "it is likely that extratropical storm tracks have shifted poleward in both the Northern and Southern Hemisphere and that heavy rainfalls and mean maximum wind speed associated with TCs will increase with continued greenhouse gas (GHG warming)". Additionally, does this statement fit better in next section? (i.e. section 11.7.2 Extratropical Cyclones) [Rafael Catany, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. We are only summarizing past statements from previous reports here. It's not necessary to provide the evidence and references again here. This is available in the past reports. We've added brief text to emphasize that we are providing only a capsule-summary of past reports. The ETC statement fits correctly here. This is an introductory section that summarizes a variety of extreme storms types (TC, ETC, etc).
46412	59	21	59	21	"hail" stands for one of cloud microphysical species. The "hail storms" would be more suitable to the descriptions in this chapter. [Tomoe Nasuno, Japan]	Accepted. "Hail" changed to "hail storms"
49376	59	26	59	28	add reference or at least refer to AR5, which was already mentioned. [Rafael Catany, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. We are only summarizing past statements from previous reports here. It's not necessary to provide the evidence and references again here. This is available in the past reports. In this case, we are summarizing the SREX, as stated clearly. We've added brief text to emphasize that we are providing only a capsule-summary of past reports.
21816	59	26	59	29	fully matches with SREX Full reports..but no "" used. [Gwenaelle GREMION, Canada]	Accepted. Texts are modified.
52862	59	32			"assessment of low confidence" :-) I guess you mean something else! [Douglas Maraun, Austria]	No, this is what we meant. The AR5 maintained the assessment of low confidence stated previously in the SREX. We could say "retained" instead of "maintained", but we feel that it's okay as is.
46414	60	5	60	28	Describing observed trend and projection separately would augment readability. (For example, I would suggest the first paragraph followed by descriptions in [page 60, lines 21-22] to summarize observations.) Summarizing projection of global TC numbers and that of intense TCs (with heavy precipitation) separately is also recommended. It reads that the SREX and AR5 state that under 3 to 4 degree of warming, the global TC number would decrease at medium confidence, while SR1.5 reports that the TC frequency change under 2 and 1.5 degree warming is uncertain with limited evidence. I would recommend the assessment beyond SR1.5 (11.7.1.5) to be more focused on this topic in support of the final remarks (page 66, lines 26-33). [Tomoe Nasuno, Japan]	This text has been deleted.
52248	60	5	60	31	This comments is both substantive and editorial. This section is underdeveloped and requires significantly more discussion to introduce the problem of TCs, how they were discussed in AR5, and how improvements in our understanding since AR5 have changed our thinking on TCs in a warming world. Transitions need to be added between sentences, more context on what we have learned is needed, and a roadmap for the following sections would be very helpful. [Daniel Gilford, United States of America]	This text has been deleted.
52254	60	5	66	45	Throughout this section, a more detailed literature review and discussion of changes in intensity (along with confidence statements) would be helpful, as damage and implications for policy are strongly linked to intensity. [Daniel Gilford, United States of America]	Rejected. We appreciate the request but we have a narrow purview here to work within, and space does not allow for a literature review.

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52864	60	5			There is substantial overlap (in particular of Section 11.7.1.3) with the evaluation section in Chapter 10. We should discuss jointly whether this is ok, or whether parts should be moved between the chapters. [Douglas Maraun, Austria]	Thank you. We plan to work with other chapters to reduce overlap.
26792	60	7	60	31	This is a severe example of first reporting what previous reports said, see my general comments. I suggest to first write about what TCs are and why they are important, then briefly mention what previous reports said. [Thorsten Mauritsen, Sweden]	This text has been deleted. Please also note that we have somewhat narrow parameters that we need to work within here. This is an assessment report, not a general introduction to a topic or a literature review.
16300	60	7	60	31	There is little discussion about Pacific tropical cyclones, like tropical cyclone Haiyan which devastated the Philippines and other Southeast Asian countries in 2013. Further, much of the discussion seems to be copied directly from the source literature. The author's overall interpretation or summarization is recommended or placing this in a box-quote instead of separate quoted statements like what is done in other sections. [Tabassam Raza, Philippines]	This text has been deleted. However please note that our purpose is not to review past events, and a discussion of Haiyan, although not unimportant in general, is well outside of our purview as a climate change assessment report. We listed two statements regarding Atlantic hurricanes because that is what the previous reports stated, and we were simply summarizing these past reports. The remainder of the statements are of a global nature and consequently include Pacific storms. We see no changes or further additions needed here.
52866	60	12			What about AMV forcing of these trends? [Douglas Maraun, Austria]	It's not clear what the question is referring to. AMV is a conflation of internal and external [natural (dust, volcanoes) and anthropogenic (GHG, sulphate aerosols)] forcing. The trends that are being assessed here are tested against these various forcings to arrive at detection and attribution confidences. We refer to multi-decadal variability in the text where prescribed/appropriate.
49378	60	14	60	22	It worth mentioning the work of Keery Emanuel, 2005. This work support the statement that in a "in a scenario of global warming" TC's frequency might remain the same or lower than current observations. But intensity of high TCs may increase. See suggested Refereces: (Emanuel, 2005; Mann and Emanuel, 2006; Knutson et al., 2010) Emanuel, K. (2005), Increasing destructiveness of tropical cyclones over the past 30 years, Nature, 436(7051), 686-688, doi: 10.1038/nature03906. Knutson, T. R., J. L. McBride, J. Chan, K. Emanuel, G. Holland, C. Landsea, I. Held, J. P. Kossin, A. K. Srivastava, and M. Sugi (2010), Tropical cyclones and climate change, Nature Geoscience, 3(3), 157-163, doi: 10.1038/ngeo779. Mann, M. E., and K. A. Emanuel (2006), Atlantic hurricane trends linked to climate change, Eos, Transactions American Geophysical Union, 87(24), 233-241, doi: 10.1029/2006EO240001. [Rafael Catany, United Kingdom (of Great Britain and Northern Ireland)]	This text has been deleted. However, please note that this reference is quite dated by now, and we are assessing recent literature. The concept of stronger storms getting stronger is covered in our text below. Knutson et al has also been updated and there have been many papers that have followed Mann and Emanuel, all of which have been assessed in previous reports.
28076	60	14	60	31	The information is somewhat scattered here. It might be helpful to present the information using in bullet points and/or under organized themes. [Gan Zhang, United States of America]	This text has been deleted.
21820	60	18	60	20	The authors use a direct quote from SR1.5 "Tropical cyclones are projected to increase intensity ...". I can't seem to find this exact passage in the referenced section of the document or anywhere else in the document itslef. Please confirm that this citation is correct [Gwenaelle GREMION, Canada]	This text has been deleted.
27910	60	18	60	22	Page 11-60, lines 18-22: As this small paragraphs does not add new statements but rather support statements in the 2 paragraphs before, one could merge this paragraph with the others. [roderik van de wal, Netherlands]	This text has been deleted.
43224	60	20	60	20	Add "at 2°C compared with 1.5 °C of global warming" after "in frequency". Conclusions of SR1.5 are for 2°C compared with 1.5 °C of global warming. [Masato Sugi, Japan]	This text has been deleted.
43226	60	24	60	24	"more likely than not" should be "likely" or "assessed" or "projected". "more likely than not" is not consistent with "medium confidence". In SR1.5, "assessed" is used in the sentence. [Masato Sugi, Japan]	This text has been deleted.

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21822	60	24	60	25	Reference to SR1.5 using a direct quote but the text does not match the original completely. The original text "under 3°C to 4°C of warming that the global number of tropical cyclones would decrease whilst the number of very intense cyclones would increase (medium confidence)." was adjusted to "Under 3 to 4°C warming it is more likely than not (medium confidence) that the global number of tropical cyclones would decrease [...]". The difference in text should be highlighted. [Gwenaëlle GREMION, Canada]	This text has been deleted.
46416	60	27	60	28	Is the low confidence in the increase in the number of very strong TCs consistent with the medium confidence in the higher precipitation associated with TCs under the 2 degree global warming than under the 1.5 degree warming (page 59, lines 49-50)? Providing some interpretations is recommended. [Tomoe Nasuno, Japan]	This text has been deleted.
21824	60	34	61	7	In the previous section the authors state that predicted changes in TCs have low confidence. This section "Mechanisms and drivers" makes it sound like the changes are well known and explained by those drivers. A statement that this is not the case, i.e. that the changes are uncertain and the drivers presented here are just possible influencers of this uncertainty, should be added. [Gwenaëlle GREMION, Canada]	Rejected. The low confidence relates to confidence that a trend is detectable and attributable to anthropogenic climate change. Here we are discussing well known and well understood relationships between TCs and their environment. It's not a useful statement to say that if ACC changes the environment, then TCs must also be changing, because this doesn't even provide a sign for the change.
52250	60	36	60	42	A thorough literature review and set of citations is needed to support the statements in this paragraph, and to clearly elucidate what we know about how intensities could change in future climate. For instance, on the topic of upper atmospheric temperatures limiting peak winds, supporting papers include, but are not limited to: Emanuel et al. 2013 Ramsay 2013, Wang et al. 2014, Wing et al. 2015, Gilford et al. 2017, Gilford et al. 2019, Vecchi et al. 2014, Polvani et al. 2016, Ge et al. 2018. In particular, the studies considering trends in these upper bounds (e.g. Emanuel et al. 2013) should be described and discussed. Furthermore, two recent studies have investigated the importance of the PI metric (and by extension upper tropospheric temperatures) for observed intensities: Wing et al. 2007 and Gilford et al. 2019. Finally, Wing et al. 2007 provided a theory, contingent on the findings of Emanuel (2000) for how future intensities should change with warming. Sobel et al. 2016 also discussed this. Full citations for these studies: -Emanuel, K. A., S. Solomon, D. Folini, S. Davis, and C. Cagnazzo, 2013: Influence of tropical tropopause layer cooling on Atlantic hurricane activity. <i>J. Climate</i> , 26, 2288–2301, https://doi.org/10.1175/JCLI-D-12-00242.1 . -Emanuel, K. A., 2000: A statistical analysis of tropical cyclone intensity. <i>Mon. Wea. Rev.</i> , 128, 1139–1152 -Ramsay, H. A., 2013: The effects of imposed stratospheric cooling on the maximum intensity of tropical cyclones in axisymmetric radiative–convective equilibrium. <i>J. Climate</i> , 26, 9977–9985, https://doi.org/10.1175/JCLI-D-13-00195.1 . -Wang, S., S. J. Camargo, A. H. Sobel, and L. M. Polvani, 2014: Impact of the tropopause temperature on the intensity of tropical cyclones: An idealized study using a mesoscale model. <i>J. Atmos. Sci.</i> , 71, 4333–4348, https://doi.org/10.1175/JAS-D-14-0029.1 . -Wing, A. A., K. Emanuel, and S. Solomon, 2015: On the factors affecting trends and variability in tropical cyclone potential intensity. <i>Geophys. Res. Lett.</i> , 42, 8669–8677, https://doi.org/10.1002/2015GL066145 . -Gilford, D. M., and S. Solomon, 2017: Radiative effects of stratospheric seasonal cycles in the tropical upper troposphere and lower stratosphere. <i>J. Climate</i> , 30, 2769–2783, https://doi.org/10.1175/JCLI-D-16-0633.1 . -Gilford, D. M., S. Solomon, and K. A. Emanuel, 2019: Seasonal Cycles of Along-Track Tropical Cyclone Maximum Intensity. <i>Mon. Wea. Rev.</i> , 147, 2417–2432. -Vecchi, G. A., and Coauthors, 2014: On the seasonal forecasting of regional tropical cyclone activity. <i>J. Climate</i> , 27, 2822–2836, https://doi.org/10.1175/JCLI-D-13-00752.1 .	Rejected. We appreciate your substantive comment, but we have somewhat narrow parameters that we need to work within here. This is an assessment report, not a general introduction to a topic or a literature review. We feel that the statements in this paragraph don't necessitate such a level of support as suggested. The theory of potential intensity is well-understood and well documented and our statement that the thermodynamic intensity limit (i.e., potential intensity) is modulated by upper-level temperatures is well supported. The details of how upper-level temperatures change and what its contribution might be to the changes in potential intensity is well beyond the scope of this basic introductory statement.
49380	60	36	60	42	There is an ocean to atmosphere energy exchange which limits the TC intensification (e.g. Price et al., 1981). This intensification mechanism by which the TC draws latent heat from the ocean is known as negative feedback. This is an example of exchange of energy between the atmosphere and the ocean. There are many studies aiming to understand the link between the TC intensification and TC induced changes in SST. More recent studies intended to observe TC induced changes in Sea Surface Salinity (SSS) (e.g. Grodsky 2012 and Reul 2014) and suggested TC crossing over the Amazon Plume in the North Atlantic increased SSS on its passage. Furthermore this TC increase SSS might be related to an observed TC intensification of about 50 % (Balaguru, 2014). [Rafael Catany, United Kingdom (of Great Britain and Northern Ireland)]	Thank you for this comment. After assessing these papers, as well as others, we've concluded that there is enough ambiguity between the offsetting effects of SST and salinity changes that the overall effect is most likely of secondary importance. This discussion would be appropriate for a literature review, but we have fairly rigid constraints on this and we've decided that space limitations do not allow for this discussion here.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
21826	60	36	60	50	Present organization has inconsistent flow. I strongly believe this part could be written in a better way with a logical and consistent organization for better readability. Such as genesis, development, and tracks (L44)--response to ambient environment (L36)--natural and external controls with example... [Gwenaelle GREMION, Canada]	Rejected. We appreciate the comment, but our purview, which is strictly defined, is to provide a confidence assessment based on literature published since the AR5, and not to provide a background on tropical cyclone science basics.
52868	60	36	60	51	I found this introduction of the mechanisms a bit weak. Warm core, Coriolis force, wind shear, WISHE feedback should all be mentioned. [Douglas Maraun, Austria]	Rejected. We appreciate the comment, but our purview, which is strictly defined, is to provide a confidence assessment based on literature published since the AR5, and not to provide a background on tropical cyclone science basics.
28078	60	37	60	37	"energy ... can be converted to wind" may confuse some readers, as the energy conversion often refers to the process of changing energy from one form to another. [Gan Zhang, United States of America]	We have modified the statement to read "...moist enthalpy that can be convert to wind..."
21828	60	39	60	39	local rainfall total >> local rainfall amount [Gwenaelle GREMION, Canada]	Accepted.
21830	60	40	60	42	Changes in ...characteristics. The sentence is not clear and should be split/modified. There is no description of the "other environmental factors". [Gwenaelle GREMION, Canada]	Rejected. We feel that the sentence is clear and achieves the appropriate level of detail and specificity. This is only meant to be a broad introductory section and specifying the exact environmental factors is not needed to accomplish this here.
21832	60	44	60	44	Sentence should be modified for better readability. Such as "The genesis, development, and tracks of Tcs depend on conditions of" [Gwenaelle GREMION, Canada]	Accepted. The sentence has been modified.
28080	60	44	60	44	The use of "and" in "(t)he genesis of TCs and their development and tracks" appears excessive. [Gan Zhang, United States of America]	Accepted. The sentence has been modified.
21834	60	44	60	52	No reference is provided [Gwenaelle GREMION, Canada]	Accepted. We added appropriate references.
49382	60	44	60	55	Further describe what are the ingredients to generate a TC (e.g. SST $\geq 26^{\circ}\text{C}$, Cyclonic wind ciruclation, etc...). Suggest to add TC ingredients necessary to have a TC (and to have TC intensification) in a form of shoping list (i.e. bullet points). [Rafael Catany, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. We appreciate the comment, but our purview is not to provide a background on tropical cyclone science basics. These are available in textbooks and many places on the web.
44656	60	44	61	7	I think the mechanism and frequency of typhoons in different regions should be added, after all, different regional impact factors and frequencies are different. [Liang Zhao, China]	Accepted. This point is added.
46418	60	46	60	48	The impacts of the MJO and BSISV on the TC activity are well established (Camargo et al. 2009; Klotzbach and Oliver. 2015; Yoshida et al. 2014). The MJO response of to the global warming (e.g., Maloney et al. 2019) is expected to affect the change in the TC activity in the future climate (related descriptions in 8.3.2.9.4, page 69 of Chapter 8). Camargo, S. J., M. C. Wheeler, and A. H. Sobel, 2009: Diagnosis of the MJO modulation of tropical cyclogenesis using an empirical index. J. Atmos. Sci., 66, 3061–3074, doi:10.1175/2009JAS3101.1. Klotzbach, P. J., and E. C. J. Oliver, 2015: Variations in global tropical cyclone activity and the Madden-Julian Oscillation since the midtwentieth century, Geophys. Res. Lett., 42, 4199-4207, doi: 10.1002/2015GL063966. Yoshida, R., Y. Kajikawa and H. Ishikawa (2014), Impact of Boreal Summer Intraseasonal Oscillation on Environment of Tropical Cyclone Genesis over the Western North Pacific. SOLA, 10, 15-18, doi: 10.2151/sola.2014-004. [Tomoe Nasuno, Japan]	Accepted. We refer to Chap 8 and cite specific papers here.
21836	60	48	60	48	Boreal Summer Intraseasonal Variabilities >> Boreal summer intraseasonal oscillations; it's better to use common terms rather than introducing a new term while denoting a known aspect [Gwenaelle GREMION, Canada]	Accepted. We changed the term.
46424	60	48	60	49	"TC also affect the large-scale circulations in various ways" This sentence does not fit the context of the previous and the following sentences. [Tomoe Nasuno, Japan]	Noted. The text was modified. Here we should note that TCs also feedback to the large-scale circulations.
21842	60	51	60	54	mention that the response of ENSO etc. to warming still remains unclear and further complicates any prediction to their influence on TC [Gwenaelle GREMION, Canada]	Rejected. Projection of ENSO is not an issue here, but refer to Chap 4.
28082	60	52	60	52	Should acronyms ("ENSO, PDO, and AMO") be spelled out here? [Gan Zhang, United States of America]	Accepted.
21838	60	54	60	54	Because >>As [Gwenaelle GREMION, Canada]	Accepted.
21840	60	55	60	55	...these modes is long such as multi-decadal.... Not totally correct, as you also mentioned about ENSO in the previous sentences, which is an interannual model of variability. Therefore, this sentence should be modified. [Gwenaelle GREMION, Canada]	Accepted. Modified to be more specific, such as decadal or multi-decadal modes.
55960	60	60	18	31	Too many citations of SR1.5. [Olga Zolina, France]	This text has been deleted.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
55958	60				11.7.1 Tropical cyclones. The whole section is generally well written, however see also my comment above. [Olga Zolina, France]	Unapplicable. Sorry, it's not clear which comment above is begin referred to here.
16080	61	1	61	1	The logic of the statement "it is highly uncertain that TC changes will be driven by projected changes of these modes" may not be entirely correct. As previous sentences in the same paragraph have clearly pointed out that these modes will affect the TC activities, it is suggested to rephrase the concerned statement as "it is uncertain how the projected changes of these modes will affect the future TC activities". [SAI MING LEE, China]	Accepted.
14250	61	3			does this refer to aerosol effect on SST or direct effects. There is some evidence since AR5 that aerosol can affect TCs e.g. 8.2.2.1.2: Increases in aerosols were found to enlarge tropical cyclone rainfall area and amount in the western North Pacific (Zhao et al., 2018a). [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. We added both aerosol effects on SST and cloud microphysics , to be consistent with Chapter 8.
26794	61	5			Is there a direction to this shift? [Thorsten Mauritsen, Sweden]	Noted. This indicates the poleward shift.
21844	61	7	61	7	whichishighly.... Typo [Gwenaelle GREMION, Canada]	Thank you. Fixed.
28084	61	7	61	7	Formatting issue with "whichishighlyuncertain" [Gan Zhang, United States of America]	Thank you. Fixed.
49384	61	11	61	11	TC is already defined above [Rafael Catany, United Kingdom (of Great Britain and Northern Ireland)]	Thank you, we modified the text.
49386	61	11	61	11	What is the effort of homogenizing the data? Do you mean the construction of homogeneous and consistent dataset like IBTrACS. If so just mention the datasources. [Rafael Catany, United Kingdom (of Great Britain and Northern Ireland)]	IBTrACS is neither homogeneous nor consistent. It's merely a concatenation of the raw data from various regions. There are multiple efforts toward homogenizing past data, and these are found in the references provided. There is not a single source that we can provide.
16082	61	11	61	21	This part likely overstated the uncertainty aspect and undermined the observed trend of some metrics in certain basins. For example, as stated in AR5, it is virtually certain that the frequency and intensity of strongest tropical cyclones in the North Atlantic has increased since the 1970s. Also, in the western North Pacific, there was encouraging research progress in improving the consensus between best track datasets and increasing use of homogenized ADT-HURSAT to investigate intensity trends since AR5. An increase in the number and intensification rate for intense TCs, such as Cat. 4-5, in this basin 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 (e.g. Kang and Elsner, 2012; Kishtawal et al. 2012; Holland and Bruyère, 2014; Mei and Xie, 2016; Zhao et al., 2018). 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. - 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. - Holland G.J., and C. Bruyère, 2014: Recent intense hurricane response to global climate change. Clim. Dyn., 42, 617-627, doi: 10.1007/s00382-013-1713-0. - Mei, W. and S.P. Xie, 2016 : Intensification of landfalling typhoons over the northwest Pacific since the late 1970s, Nature Geoscience, 9, 753-757. - 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. [SAI MING LEE, China]	Thank you for this comment. We have expanded the text to include these studies, but they are in fact incorporated in the stated/assessed level of confidence. We don't have space for a complete literature review, and these papers do not increase confidence, but rather are just part of a larger body of literature. The issue here is that while trends observed since the 1980s or late 1970s are of interest, the time period is too short for formal detection in the presence of strong multidecadal variability. We feel that this point is made well here in terms of emergence time scales. The ADT-HURSAT, in fact suggests that intensity-related trends in the best track are inflated which further reduces confidence in best-track trends. The statement of trends in the Atlantic is provided in the introductory text to this section, but we agree that it could be restated here, and we've done this. We discuss Holland and Bruyere and the effect of the ADT-HURSAT on their trends, so we don't feel that this needs further expansion. Ultimately, the low confidence for detectable (above natural variability) and attributable trends, which is consistent with the AR5 and the very recent WMO assessment reports published in BAMS, is our assessed level of confidence based on the literature.
29704	61	11	61	27	It should be mentioned that homogenisation efforts are also needed to establish consistency between the various national agencies responsible for data collection. To date, there exists a dearth of Southern Hemisphere observations. [Alexander Alexander Baker, United Kingdom (of Great Britain and Northern Ireland)]	Thanks for the comment, but we feel that this may be a bit too specific for our purposes as an assessment report.
21846	61	11	61	27	The following seminal paper should be mentioned here and other relevant texts; It is not cited anywhere in this chapter! Webster, P. J., Holland, G. J., Curry, J. A., & Chang, H. R. (2005). Changes in tropical cyclone number, duration, and intensity in a warming environment. Science, 309(5742), 1844-1846. [Gwenaelle GREMION, Canada]	Rejected. Space constraints do not allow us to perform a literature review and this reference is now quite dated, although it does live in the statements of the past assessment reports that we summarize in the intro of this section.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
52870	61	15			what are physical trends? [Douglas Maraun, Austria]	We meant this to distinguish from trends caused by data artefacts. We've modified this to "physical (real) trends"
21848	61	16	61	16	but rather >> rather [Gwenaelle GREMION, Canada]	Rejected. We prefer the original wording.
21850	61	19	61	21	The sentence should be modified and split for better readability. The sentence starts with an odd way "That is". It simply tells that 40 years is not enough for the identification of TC trends without present theoretical and observed understanding of background environmental trends". But it is written in a complicated way. Moreover, it is not mentioned in earlier sentences about the expected time to observe a TC trend. And then suddenly it is written that 40 years is not enough for TC trend –this is confusing!! [Gwenaelle GREMION, Canada]	Accepted. We have modified the text to be more clear.
21852	61	23	61	23	Less than 95%, although it is near 90% >> near 90%. It may be better to make things simple; there is no need to mention that 90 is <95, it is very natural! [Gwenaelle GREMION, Canada]	Accepted. We have modified the text to be more clear.
48584	61	23	61	25	With regard to increase of strong TCs, Tauvale and Tsuboki (2019) recently showed decreasing trend in total number of TC and increasing trend in strong TC number in the Southwest Pacific (Fig. 5) using the latest Southwest Pacific Enhanced Archive of TCs dataset. Tauvale, L., and K. Tsuboki, 2019: Characteristics of tropical cyclones in the Southwest Pacific. J. Meteor. Soc. Japan, 97, 711-731. DOI: https://doi.org/10.2151/jmsj.2019-042 . [Kazuhisa Tsuboki, Japan]	We have added the reference as part of a similar body of literature.
43228	61	26	61	27	Delete "and the frequency of very intense TCs". Increase in "proportion" of very intense TC and increase in "frequency" of very intense TCs are different. [Masato Sugi, Japan]	Thank you for this comment. We've changed "frequency" to "proportion"
21862	61	29	61	32	this could be shortened: Subsequent to the AR5, two new metrics (annual mean location and translation speed) which are comparatively less sensitive to data issues, were analyzed and trends have been identified for the 30 past ~70 years. [Gwenaelle GREMION, Canada]	We have modified the text to be more clear.
14252	61	32			The slower TC translation speed could be signposted to discussion of drivers for slowing of tropical circulation (8.2.1.3) or in relation to extreme precipitation drivers (8.2.2.1.2). [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Reference added.
21874	61	35	61	35	this reference (Knapp et al. 2018) is missing in bib [Gwenaelle GREMION, Canada]	Thank you. We have corrected the citations.
21854	61	35	61	36	The migration...most intense" . The sentence is poorly written. First, it is talking about the location of TC eyes then connecting "when" they are intense. It is confusing. It could be simpler like "The eyes are the most intense location of TCs which shows the apparent migration (references)". [Gwenaelle GREMION, Canada]	Rejected. Eyes are not the most intense location. Eyes occur when TCs are strongest. The suggested sentence does not make sense. We slightly modified the text to say "mean location", which hopefully makes this even more clear.
46420	61	37	61	38	Moon et al. (2015) and Moon et al. (2016) are not found in the reference list. [Tomoe Nasuno, Japan]	Thank you. We have corrected the citations.
21864	61	37	61	38	I cannot find this references (Moon et al., 2015, 2016) in the bibliography, listed is only Moon et al (2019) [Gwenaelle GREMION, Canada]	Thank you. We have corrected the citations.
21866	61	37	61	38	Kossin et al (2016b) is listed as 2016 only in bib, please double check if these references are missing in the bib: Kossin, J. P., K. A. Emanuel, and G. A. Vecchi, 2016: Comment on 'Roles of interbasin frequency changes in the poleward shifts of the maximum intensity location of tropical cyclones'. Env. Res. Lett., 11, 068001.; --- Kossin, J. P., and M. DeMaria, 2016: Reducing operational hurricane intensity forecast errors during eyewall replacement cycles. Wea. Forecasting, 31, 601-608 [Gwenaelle GREMION, Canada]	Thank you. We have corrected the citations.
21870	61	39	61	39	this reference (Tennile and Ellis, 2017) is missing in bib [Gwenaelle GREMION, Canada]	Thank you. We have corrected the citations.
21872	61	39	61	39	this reference (Zhan and Wang, 2017) is missing in bib [Gwenaelle GREMION, Canada]	Thank you. We have corrected the citations.
21856	61	39	61	44	Split the sentence for better clarity, otherwise confusing in which way it is written. [Gwenaelle GREMION, Canada]	Rejected. We don't see an obvious way to split this, and we feel that the sentence can be understood as written.
16084	61	40	61	43	Suggest also adding the following reference. - Li, C.Y., W. Zhou, C.M. Shun and T.C. Lee, 2017 : Change in Destructiveness of Landfalling Tropical Cyclones over China in Recent Decades, Journal of Climate, 30, 3367-3379, http://dx.doi.org/10.1175/JCLI-D-16-0258.1 [SAI MING LEE, China]	Accepted.
21876	61	41	61	41	this reference (Choi et al. 2016) is missing in bib [Gwenaelle GREMION, Canada]	Thank you. We have corrected the citations.
21878	61	41	61	41	this reference (Park et al 2014) is missing in bib [Gwenaelle GREMION, Canada]	Thank you. We have corrected the citations.
21880	61	41	61	42	this reference (Liang et al 2017) is missing in bib and double cited in this sentence [Gwenaelle GREMION, Canada]	Thank you. We have corrected the citations.
21882	61	42	61	42	this reference (Oey and Chou 2016) is missing in bib [Gwenaelle GREMION, Canada]	Thank you. We have corrected the citations.
21884	61	42	61	42	this reference (Daloz and Camargo 2018) is missing in bib [Gwenaelle GREMION, Canada]	Thank you. We have corrected the citations.

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21868	61	42	61	46	is this reference missing in the bib? Kossin, J. P., K. A. Emanuel, and G. A. Vecchi, 2016: Comment on 'Roles of interbasin frequency changes in the poleward shifts of the maximum intensity location of tropical cyclones'. <i>Env. Res. Lett.</i> , 11 , 068001. [Gwenaelle GREMION, Canada]	Thank you. We have corrected the citations.
27912	61	44	61	50	Page 11-61, lines 44-50: Under 8.5-CMIP5 projections a similar future poleward TC trend is seen as in observations from the past. Is the magnitude of forcing not too much different to make a statement that it supports a possible anthropogenic contribution to the observed trends? What about other Representative Concentration Pathways? [roderik van de wal, Netherlands]	Sorry, but we're not clear with what you are asking. We state that the RCP8.5 projected changes has similar spatial patterns and trend amplitude, which provides evidence that the past trend may have a similar forced component. We feel that this is clear. Regarding other pathways, we can only assess what is in the paper being cited, which only considered 8.5.
21858	61	45	61	45	Mention it is over "recent historical period" in addition to "(1980-2005)" in the bracket. [Gwenaelle GREMION, Canada]	Accepted.
40874	61	49		52	I am not sure that the increase of extreme precipitation applies to southern Europe. Examples: in DOI 10.5194/nhess-10-1037-2010 only 6 out of 20 stations show a significant negative tendency in the probability of observing an extreme event. in https://doi.org/10.5194/nhess-13-1707-2013 : no significant trends for intense precipitation for the period 1950-2010. Considering projections there is a strong seasonal connotation for southern Europe with robust/significant changes mostly only for the winter season (see DOI 10.1007/s10113-013-0499-2) [piro lionello, Italy]	Comment unclear. I think that the page and line numbers stated for this are wrong.
21860	61	55	61	55	Figure 11.17: It may be better to have a figure caption like "Long-term trend over ---- basin", rather than a caption with suspense and no specific indication. The caption shows it is for Atlantic and Pacific, but there is an only one-time series plot in the top panel. So it is confusing. [Gwenaelle GREMION, Canada]	Thank you, we plan to work on improving the figure and caption.
21886	62	6	62	7	he sentence could be modified for better readability. Such as " Another recently-analyzed metric shows global slow down of TC translational speed by 10% over 1949-2016 that is less sensitive to data issues than frequency and intensity based metrics (reference)." [Gwenaelle GREMION, Canada]	The text has been modified.
26796	62	8	62	10	On the other hand, a slower translation speed also means that they reside longer on their own cold wake, which could result in less precipitation. This is probably not taken into account in studies that use atmosphere-only models. [Thorsten Mauritsen, Sweden]	Noted, thank you. Although this would not be as important for tracks that slow or stall over land, where the signal is most relevant in terms of impacts.
52872	62	10	62	31	I would not expect such an introductory sentence in an evaluation section. In fact the whole paragraph seems to discuss projections rather than model evaluation. If this is to motivate the following paragraphs, it should be better written, otherwise this paragraph should be moved. [Douglas Maraun, Austria]	Noted. Text has been changed, so as to focus on model evaluations of projections of TC activities.
21888	62	13	62	15	It's confusing!! If the cause of TC translation slowdown is not clear, why suddenly weakening of atmospheric circulation is mentioned here in the same sentence? It is also not clear what kind of atmospheric circulation is mentioned here? Several recent studies showed that Walker circulation is strengthening in a warming climate. [Gwenaelle GREMION, Canada]	Accepted. We have substantially modified the text to be more clear.
21890	62	15	62	15	Moreover, Held and Soden (2005) argues an increase in lower-tropospheric water vapor and a decrease in extratropical sensible heat transport under global warming. Therefore, this reference may not be appropriate. Moreover, other cited paper (He and Soden, 2015) is based on model experiments, however, observations do not show any weakening of atmospheric circulation, rather it shows strengthening (e.g. of strengthening of Walker circulation). [Gwenaelle GREMION, Canada]	Accepted. We have substantially modified the text and have modified the references to be more appropriate. And we have added a recent paper by Chemke and Polvani that finds a slowing of the Hadley circulation. Regarding Held and Soden, they state that the change in energetics would necessitate a slowdown.
26246	62	15	62	15	Please consider adding something like "and poleward jet shift which steers TCs" [Chihiro Kodama, Japan]	Thank you for this comment. We have substantially modified the text here, but don't have any obvious references to apply for this statement. TCs are not generally steered by the jet, as ETC might be.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
49388	62	20	62	30	<p>Review most recent advancements about relevant environmental factors. Besides SST there are works suggesting that TC's intensity might be somehow related to Salinity stratification. So when TCs cross over fresh water river plumes (e.g. Amazon River in the North West Atlantic) there is a significant TC intensification of about 50% when compared to other TCs not crossing over this fresh water plume (Balaguru et al., 2012). This suggest that TC intensification might be linked to both ocean Temperature and Salinity at the top Surface. Hence why TC indices should start taking into account both variables (Price, 1981, 2009). Whilst it is understood the mechanism by which TC induced changes in SST may affect TC intensity. It is still an open debate how TC induced changes in SSS may be linked to evolution of a passing storm.</p> <p>Balaguru, K., P. Chang, R. Saravanan, L. R. Leung, Z. Xu, M. Li, and J.-S. Hsieh (2012), Ocean barrier layers' effect on tropical cyclone intensification, Proceedings of the National Academy of Sciences of the United States of America, 109(36), 14343-14347, doi: 10.1073/pnas.1201364109.</p> <p>Price, J. F. (1981), Upper ocean response to a hurricane, Journal of Physical Oceanography, 11(2), 153-175, doi: 10.1175/1520-0485(1981)011<0153:uortah>2.0.co;2.</p> <p>Price, J. F. (2009), Metrics of hurricane-ocean interaction: vertically-integrated or vertically-averaged ocean temperature?, Ocean Science, 5(3), 351-368. [Rafael Catany, United Kingdom (of Great Britain and Northern Ireland)]</p>	Noted Thank you for this comment. Although the effects of salinity are interesting, they don't have much relevance to our purview, which is to form an assessment on climate change impacts on TCs. These references would be appropriate for a literature review on TCs in general, but unfortunately we don't have space for this year.
21892	62	25	62	28	Please review and revise the sentence. As written, it is unclear what point is being made. [Gwenaelle GREMION, Canada]	Noted. It is unclear exactly what this comment is meant for as line #13 is not within 11.7.1.3. But text corresponding to line 28 is revised to improve readability.
21894	62	25	62	28	An example of the different metrics against which the TC simulations were assessed should be added. Was it just minimum central pressure, storm track, and/or maximum wind speeds? [Gwenaelle GREMION, Canada]	Accepted. Here examples of TC metrics used for evaluation of models are listed: (e.g. TC frequency, intensity (central sea surface pressure), winds, precipitation, size, tracks, and their seasonal and interannual changes).
21898	62	27	62	28	double check if references are missing in bib or wrong in text. Bib lists Knutson et al 2019 a/b not 2018 a/b [Gwenaelle GREMION, Canada]	Accepted.
43230	62	28	62	28	"2018a, 2018b" should be "2019a, 2019b" [Masato Sugi, Japan]	Accepted.
43232	62	28	62	28	"2018b" should be "2019b" [Masato Sugi, Japan]	Accepted.
28086	62	28	62	39	<p>Line 38-39 on Page 11-62: The convective parameterization also strongly affects simulations of TC statistics (Zhao et al. 2012; Zhang and Wang 2018).</p> <p>- Zhao, M., I.M. Held, and S. Lin, 2012: Some Counterintuitive Dependencies of Tropical Cyclone Frequency on Parameters in a GCM. J. Atmos. Sci., 69, 2272–2283, https://doi.org/10.1175/JAS-D-11-0238.1</p> <p>- Zhang, Chunxi, and Yuqing Wang, 2018: "Why is the simulated climatology of tropical cyclones so sensitive to the choice of cumulus parameterization scheme in the WRF model?. Climate dynamics 51, 9-10, 3613-3633. [Gan Zhang, United States of America]</p>	Accepted. Text already states this, but we added these citations to the list.
26248	62	30	62	30	"Kodama et al. 2014" -> "Kodama et al. 2015, doi:10.2151/jmsj.2015-024" [Chihiro Kodama, Japan]	Accepted and fixed.
26250	62	31	62	31	Please consider adding something like ", and PDF of TC intensity/category (Murakami et al. 2015, doi:10.1175/JCLI-D-15-0216.1; Yamada et al. 2017, doi:10.1175/JCLI-D-17-0068.1)" [Chihiro Kodama, Japan]	Accept.
21896	62	33	62	33	do not >> can not [Gwenaelle GREMION, Canada]	Accepted.
29706	62	33	62	38	It should be made clear that the gradients resolved by 10-60km models are insufficient to produce Cat 4 and Cat 5 storms, without model tuning. There are forthcoming papers from the PRIMAVERA project (HighResMIP) that will detail the added value of resolution alone. It should also be made clear here that this section discusses the role of atmospheric resolution, but increase in oceanic resolution (https://www.geosci-model-dev-discuss.net/gmd-2019-148/) show promise for reducing long-standing biases (e.g., sea surface temperature) that are important for tropical cyclones. [Alexander Alexander Baker, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. It is already stated. Role of ocean resolution is added.
26798	62	33			Perhaps it is worth first saying what this class of models actually do, i.e. represent weaker TCs, since sometimes studies using such models are assessed. [Thorsten Mauritsen, Sweden]	Noted.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
46422	62	36	62	36	Murakami et al. (2015) can be added to the reference. Murakami, H., G. A. Vecchi, S. Underwood, T. L. Delworth, A. T. Wittenberg, W. G. Anderson, J. -H. Chen, R. G. Gudgel, L. Harris, S. -J. Lin, and F. Zeng, 2015: Simulation and prediction of Category 4 and 5 hurricanes in the high-resolution GFDL HiFLOR coupled climate model. <i>J. Climate</i> , 28, 9058-9079. [Tomoe Nasuno, Japan]	Accepted. Reference added.
26800	62	36			Bengtsson et al. (2007) first showed this, I believe. [Thorsten Mauritsen, Sweden]	Noted. We only refer to papers after AR5.
52874	62	38			a reference for the statements about CPMs is required. [Douglas Maraun, Austria]	Noted. The references are added.
48586	62	41	62	46	It is true that regional high-resolution models (1~10km) without convective parameterizations capture more realistic structure of TCs and are becoming more useful for investigation of changes in TC structure. The reviewer also thinks that they are useful for investigation of maximum intensity of TC in the warmer climate as shown in Tsuboki et al. (2015) using 2 km resolution experiments of TCs. Tsuboki, K., M. K. Yoshioka, T. Shinoda, M. Kato, S. Kanada, and A. Kitoh, 2015: Future increase of super typhoon intensity associated with climate change. <i>Geophys. Res. Lett.</i> , 42, 646–652, doi:10.1002/2014GL061793. [Kazuhiisa Tsuboki, Japan]	Accept. Reference added.
26562	62	54	63	6	I would like to input the following information. "The high resolution MRI-AGCM coupled with ocean circulation model improved biases in the AGCM simulations such as the poleward shift of the maximum of intense TC distribution in the Northern Hemisphere, where active entrainment of subsurface cold water to ocean surface plays a key role under the observed monthly SST distribution kept in the coupled MRI-AGCM experiments through flux adjustment (Ogata et al. 2015, Ogata et al. 2016)." Corresponding references are Ogata, T., R. Mizuta, Y. Adachi, H. Murakami, and T. Ose (2015) Effect of air-sea coupling on the frequency distribution of intense tropical cyclones over the northwestern Pacific. <i>Geophys. Res. Lett.</i> , 42, 10,415-10,421, doi:10.1002/2015GL066774. Ogata, T., R. Mizuta, Y. Adachi, H. Murakami, and T. Ose (2016) Atmosphere-ocean coupling effect on intense tropical cyclone distribution and its future change with 60km-AOGCM. <i>Sci. Rep.</i> 6, 29800;doi:10.1038/srep29800. [Tomoaki Ose, Japan]	Accept. Reference added.
49390	62	54	63	6	There is enough evidence pointing out that TC intensification is linked to both ocean thermal structure (i.e. TC to ocean negative feedback) and to haline ocean structure (i.e. presence of Barrier Layers may aid TC intensification). Hence it is need to join efforts between meteorologist and oceanographers to understand how both SST and SSS may linked to TC intensification. So next generation of TC indices take into account both variables. Suggested reference Sea Surface Salinity. Suggest citing the following (also to clarify the difference between Salinity and Sea Surface Salinity): Reul N., Arias M., Boutin J., Catany R., Chapron B., D'Amico F., Dinnat E., Donlon C., Fore A., Fournier S., Grodsky S.A., Guimbard S., Hasson A., Kolodziejczyk N., Lagerloef G., Lee T., LeVine D., Lindstrom E., Maes C., Mecklenburg S., Meissner T., Olmedo E., Sabia R., Turiel A., Tenerelli J., Thouvenin-Masson C., Vergely J.L., Vinogradova N., Wentz F., and Yueh S. (2019) Sea Surface Salinity estimates from Spaceborne L-band radiometers: an overview of the first 9 years of observations (2010-2018). <i>Remote Sensing of Environment</i> , Special issue on 50 years of Sea Surface Salinity, in review; Balaguru, K., P. Chang, R. Saravanan, L. R. Leung, Z. Xu, M. Li, and J.-S. Hsieh (2012), Ocean barrier layers' effect on tropical cyclone intensification, <i>Proceedings of the National Academy of Sciences of the United States of America</i> , 109(36), 14343-14347, doi: 10.1073/pnas.1201364109. Price, J. F. (1981), Upper ocean response to a hurricane, <i>Journal of Physical Oceanography</i> , 11(2), 153-175, doi: 10.1175/1520-0485(1981)011<0153:uortah>2.0.co;2. [Rafael Catany, United Kingdom (of Great Britain and Northern Ireland)]	The same as #49388. Noted, Although the effects of salinity are interesting, they don't have much relevance to our purview, which is to form an assessment on climate change impacts on TCs. These references would be appropriate for a literature review on TCs in general, but unfortunately we don't have space for this year. Salinity effect is too specific.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
48588	62	55	63	2	If a specified SST experimental design is used, the atmosphere will not change the surface ocean. I suppose that the statement "the atmosphere does affect the surface ocean" may be "the atmosphere does not affect the surface ocean". Therefore, the lack of a trailing cold wake in SST could be an important limitation. Actually, for example, Kanada et al. (2017) showed that a coupled atmosphere-ocean model simulates better intensity of an intense TC. Kanada, S., S. Tsujino, H. Aiki, M. Yoshioka, Y. Miyazawa, K. Tsuboki, and I. Takayabu: Impacts of SST patterns on rapid intensification of Typhoon Megi (2010). J. Geophys. Res. Atmos., 122, doi:10.1002/2017JD027252, 2017. [Kazuhiisa Tsuboki, Japan]	Taken into account. Importance of atmosphere-ocean coupled model is added by referring to the suggested paper. This part is split to description of atmosphere-ocean coupled models and other uncertainties.
55962	62	62	32	36	Statements on the resolution requirements for simulating such and such cyclones look too optimistic. Probably need more independent confirmations. [Olga Zolina, France]	Rejected. Many studies show evidences that higher resolution is a key to represent more realistic TC behaviours.
43234	63	1	63	1	"does affect" should be "does not affect" [Masato Sugi, Japan]	Accepted. And phrase deleted anyway as it was redundant to the earlier part of the sentence. The sentence containing this phrase was deleted.
21900	63	8	63	8	suggest >> suggested [Gwenaelle GREMION, Canada]	Accepted
26802	63	8	63	10	This paragraph does not seem to make a point. [Thorsten Mauritsen, Sweden]	Taken into account. This paragraph is merged with the paragraph describing the importance of ocean.
28088	63	8	63	10	The paragraph appears out of context. Perhaps it can be integrated into the previous paragraph? [Gan Zhang, United States of America]	Noted. This is a reference to atmosphere-ocean coupled modelling of TC.
28090	63	13	63	13	The section title used "attribution" twice and is not a phrase that conforms to grammatical rules. [Gan Zhang, United States of America]	changed to "11.7.1.4 Detection and attribution of trends and event attribution" as it is two subjects
54360	63	23	63	23	Suggest inserting "in some basins" after "active TC seasons" - these seasons were very active in some individual basins though not globally (2018 was a notably active year across multiple basins, but as yet is likely to have limited discussion in the literature). [Blair Trewin, Australia]	Change accepted. Thank you.
43280	63	24	63	24	"(Murakami et al., 2017)(Murakami et al., 2017)Murakami et al. (2017)" [Yongjie Huang, United States of America]	Accepted
28092	63	24	63	24	Murakami et al. 2017 appears three times, and two of them are redundant here. [Gan Zhang, United States of America]	Accept
16086	63	24	63	24	Please remove the duplicated "(Murakami et al., 2017)" [SAI MING LEE, China]	Accepted
21902	63	31	63	31	Review the location. Which region does "the southeastern western North Pacific" refer to? [Gwenaelle GREMION, Canada]	Taken into account. The text was modified as "the southeastern region of the western North Pacific".
28094	63	35	63	35	Something missing after "Hurricane Sandy's"? [Gan Zhang, United States of America]	Corrected, thank you. Text modified to "...Hurricane Sandy (2012)..."
52876	63	36			I struggle calling this a projection – it is a pseudo global warming study, which is something different. [Douglas Maraun, Austria]	Noted. This section is for the model evaluation, and describes models used both projection and pseudo global warming studies.
52878	63	55			"large-scale environment": more precisely, please! [Douglas Maraun, Austria]	Changed to "large-scale ocean and atmosphere characteristics". But note that it is hard to be more specific as the seeds were embedded in simulated transient climates with many things changes. Clearly temperature and moisture conditions were a big factor. Presumably changes in wind profiles were a lesser factor. But Emanuel's study did not go into such details.
54362	64	1	64	7	It would be useful to cite the magnitude of the increases found (as a central estimate or range) rather than just saying "large". [Blair Trewin, Australia]	Accepted. Text modified to have numbers.
21904	64	2	64	2	TX >> Texas [Gwenaelle GREMION, Canada]	Fixed
28096	64	5	64	5	"scalingwere" should be separated. [Gan Zhang, United States of America]	Accepted
46426	64	12	64	28	"Projections of future changes in the frequency of TCs are highly uncertain." This sentence does not seem to be consistent with the description in the precious paragraph. If the rationale for the "highly uncertain" is given by a recent high-resolution coupled model result, its significance to the results of the rest majority of the simulations should be explained. [Tomoe Nasuno, Japan]	This sentence is deleted. Assessment is summarized in the summary paragraph.
21906	64	13	64	13	reference Knutson et al 2018 b is missing in bib [Gwenaelle GREMION, Canada]	Accepted. The reference is corrected as Knutson et al. (2019b).
43236	64	16	64	16	"slightly less" should be "considerably less". Uncertainty is particularly large for frequency in North Atlantic and Eastern North Pacific" [Masato Sugi, Japan]	Accepted.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
43238	64	18	64	22	It is not appropriate to conclude that “the future changes in the frequency of TCs are highly uncertain because GPI fails to predict the decreased TC frequency found in warmer simulations of majority of TC permitting global models.” GPI prediction is an empirical prediction and applicability of the statistical relation to the future climate is questionable. It should not be considered to be a reliable projection compared with high resolution model projections. [Masato Sugi, Japan]	This sentence is deleted. Assessment is summarized in the summary paragraph
16088	64	18	64	28	In addition to the figure 11.X which shows the summary of projection of TC characteristics, it is strongly recommended including a concise summary table which provides the quantitative range of the projection of some of the key metrics (e.g. TC intensity, proportion of Cat 4-5 TCs, precipitation rate, TC size, etc.). [SAI MING LEE, China]	Accepted. These references are added.
43240	64	25	64	27	Not most of the simulations project an increase in the “numbers” of intense TC, although most of them project an increase in the “proportion” of intense TCs. (See Fig.2a and 2c in Knutson et al. 2019b). [Masato Sugi, Japan]	Accepted.
43242	64	27	64	28	For the summary of projection of TC characteristics, Fig.11.X should be the Fig. 5 of Knutson et al. 2019b, in which more than hundred simulation results are summarized, rather than Figure from HighRes MIP results. [Masato Sugi, Japan]	Accepted. The present figure is from Knutson et al. (2019b). The final figure will be a combination of the HighResMIP results and the existing literature.
26804	64	27			Bengtsson et al. (2007) first showed this, I believe. [Thorsten Mauritsen, Sweden]	Rejected. This comment is not appropriate for this sentence. [Maybe confused with #26800]
49250	64	28	64	28	PRIMAVERA-HighResMIP are currently writing a paper to summarise TC performance and hopefully there will be time to add projected change results. [Malcolm Roberts, United Kingdom (of Great Britain and Northern Ireland)]	Noted. We look forward to the HighResMIP results.
43282	64	30	64	30	"Figure 11.X" should be "Figure 11.18"? [Yongjie Huang, United States of America]	Accepted.
28098	64	31	64	31	A degree sign is missing in “1.5, 2 and 3C”. [Gan Zhang, United States of America]	Accepted.
43244	64	38	64	39	It is not appropriate to conclude that “This disparity is a reflection of the lack of a generally accepted theory”. GPI-prediction is an empirical prediction and Emanuel (2013) projection is based on a questionable “constant seeding assumption”. They are not reliable projections as compared with high resolution model projections. [Masato Sugi, Japan]	Accepted. Texts are modified.
46428	64	38	64	42	The remote as well as the local responses to the given SST forcing should be taken into account to interpret the global TC frequency projection. Moreover, the dynamical and thermodynamical large-scale atmospheric response may vary depending on the model physics. These can lead to the disparity among the simulations. [Tomoe Nasuno, Japan]	Taken into account. Texts were modified.
21908	64	44	64	44	Satoh et al. 2015a only listed as Satoh et al. 2015 in bib [Gwenaëlle GREMION, Canada]	Accepted.
29708	64	48	64	51	It should be mentioned here that atmospheric resolution impacts the number seeds (again, see forthcoming HighResMIP results). [Alexander Alexander Baker, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Vechi et al.(2019) is referred to here.
48590	64	53	65	4	The theoretical model provides the increase of the maximum intensity of TC rather than the increased number of intense TC. These problems are similar and related each other but they should be considered separately. This point is also mentioned in the summary of this subsection at page 11-66 and line 28 as “Confidence is very high that the global frequency of intense TC will increase and the most intense TCs will become yet more so.” The increase of maximum TC intensity is important for future disaster prevention planning. Tsuboki et al. (2015) indicates that the intensity of the most intense TC will increase around the end of twenty-first century using a high-resolution (2 km) cloud-resolving model. Tsuboki, K., M. K. Yoshioka, T. Shinoda, M. Kato, S. Kanada, and A. Kitoh, 2015: Future increase of supertyphoon intensity associated with climate change. Geophys. Res. Lett., 42, 646–652, doi:10.1002/2014GL061793. [Kazuhsa Tsuboki, Japan]	Accepted. Tsuboki et al. (2015) is referred to. In this paragraph, the description of the “number” of the strongest TCs is deleted.
43246	64	53	65	4	The MPI theory only tells us the “intensity” of the strongest TC. It does not tell us the “number” of intense TCs. Note that the “number” depends not only on the MPI but also the genesis number. So, the confidence in projections of the increase in “proportion” of Category 4-5 is high, but the confidence in projections of the increase in the “number” of Category 4-5 is NOT high. [Masato Sugi, Japan]	Accepted. In this paragraph, the description of the “number” of the strongest TCs is deleted.
52252	65	1	65	4	Furthermore, if lower stratospheric temperatures fall in response to increased CO2 values, these maximum intensities will also decrease (there is some evidence for this already, Emanuel et al. 2013). [Daniel Gilford, United States of America]	Noted. The exact meaning of the comment is unclear since if lower stratospheric temperatures fall in response to increased CO2 values, these maximum intensities will increase rather than as suggested in the comment to decrease. No action is taken.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
26806	65	1			Perhaps you mean to say 'high moist static energy'? [Thorsten Mauritsen, Sweden]	Noted. It is not meant to be moist static energy but high SST and sufficient evaporation from the surface. The text is modified to make this clear.
46430	65	3	65	3	"TC permitting simulation" Providing a clear definition of this term is recommended (in conjunction with the description in lines 33-52, page 62). [Tomoe Nasuno, Japan]	Accepted. This term is not used. This means both high-resolution GCMs and convection-permitting models.
43916	65	4	65	4	This is very confusing. What does "this part of the projection" mean? This would confuse readers, as confidence in an increase of TC intensity is medium-to-high, not high, as stated elsewhere. Suggest deleting this sentence. [Thomas Knutson, United States of America]	Accepted. This sentence is deleted.
9802	65	8	65	9	"Intense TCs are generally defined as stronger categories such as Category 4-5 of the Saffir-Simpson scale, which is based on maximum sustained wind speeds of a TC." What is the source(s) for this statement? Some would consider Category 3 storms in this category--for example, in the U.S., the National Weather Service defines storms of Category 3-5 on the Saffir-Simpson scale as "Major Hurricanes". Because of potential ambiguities such as this, I think a reference (or references) need to be included with this statement in the text. [Andra Garner, United States of America]	It is within the TC modelling community that this has largely manifested, and many of the numerical modelling studies make this delineation, including those assessed in the AR5. To be more clear about this, the text has been modified to "Intense TCs are generally defined in numerical modelling studies as stronger categories such as Category 4-5 of the Saffir-Simpson scale"
26808	65	9	65	12	Which scenario is this? [Thorsten Mauritsen, Sweden]	Noted. This is a response to +2K increase.
43248	65	9	65	12	In the last version of Knutson et al. 2019b (submitted to BAMS in March 2019) the median ("median" is used instead of "mean" considering that the distribution is highly skewed) projected increase in the proportion of Category 4-5 TCs is 13% and the median projected decrease in global TC frequency is -13%. Then, only a minor decrease -2% in the frequency of Category 4-5 TCs is inferred. [Masato Sugi, Japan]	Accepted. Knutson et al. 2019b projected increase in the proportion of Category 4-5 TCs is 13% and the median projected decrease in global TC frequency is -14%.
28100	65	20	65	20	Perhaps "in each basin" should be replaced with "in some basins" or "in individual basins"? The phrase "each basin" might imply "every basin", which seems too assertive given the large and uncertain impacts of SST changes. [Gan Zhang, United States of America]	Accepted. The texts are modified.
46432	65	22	65	22	"TC-resolving simulations" Providing a clear definition of this term is recommended (in conjunction with the description in lines 33-52, page 62). [Tomoe Nasuno, Japan]	Accepted. The term is clearly replaced.
9804	65	39	65	48	Garner et al., 2017, notes a shift in TC storm tracks in the North Atlantic in future simulations that may be worth mentioning here. [Andra Garner, United States of America]	Accepted. The North Atlantic projection is also added.
26564	65	39	65	48	I would like to input the following information. "Future change of intense TC distribution using the high resolution MRI-AGCM coupled with ocean circulation model is significantly different from that in the AGCM despite the same monthly SST prescribed. The future subsurface warming causes larger increase in frequency of intense TCs over the north Atlantic in the AOGCM compared with the AGCM experiment. (Ogata et al. 2016)." Corresponding reference is Ogata, T., R. Mizuta, Y. Adachi, H. Murakami, and T. Ose (2016) Atmosphere-ocean coupling effect on intense tropical cyclone distribution and its future change with 60km-AOGCM. Sci. Rep. 6, 29800;doi:10.1038/srep29800. [Tomoaki Ose, Japan]	Accepted. The difference between AGCM and AOGCM is noted.
28102	65	40	65	42	It might be helpful to offer citations of the studies. [Gan Zhang, United States of America]	Noted. Citations are corrected.
48592	65	40	65	42	Relating to the poleward migration of the maximum intensity of TC, Tsuboki et al. (2015) also showed that the northern limit of supertyphoon will extend northward to the mid-latitude in the western North Pacific by using a high resolution (2 km) downscaling simulations in the warmer climate at the end of the twenty-first century. Tsuboki, K., M. K. Yoshioka, T. Shinoda, M. Kato, S. Kanada, and A. Kitoh, 2015: Future increase of supertyphoon intensity associated with climate change. Geophys. Res. Lett., 42, 646–652, doi:10.1002/2014GL061793. [Kazuhsa Tsuboki, Japan]	Noted. Refer to Tsuboki et al. (2015)
43250	65	44	65	44	The changes in TC tracks and TC areas of occurrence depend very much on projected SST change pattern. Fig.11.X showing the geographical distribution of these changes should be from ensemble mean of the many model results rather than from single model results. Fig. 2e and 2f in Yoshida et al. (2017), which are based on a large-ensemble experiment with six different SST change patterns, are most appropriate for Fig.11.X. [Masato Sugi, Japan]	Noted.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
43252	65	44	65	44	It is very important to show that the track density of overall TCs and Category 4-5 TCs will likely increase in "some regions" (and "where" if possible) even though they will decrease in some other regions or most other regions. The geographical distribution for the overall TC occurrence frequency change shown in Fig.2e of Yoshida et al. is generally consistent with many other studies (e.g. increase in the central North Pacific is projected by Murakami et al. 2013, Roberts et al. 2015, Knutson et al. 2015). The geographical distribution for the Category 4-5 TC occurrence frequency change shown in Fig.2d is also consistent with a few other studies (e.g. increase in northern part of North Pacific is also projected by Knutson et al. 2015 and Sugi et al. 2017). [Masato Sugi, Japan]	Noted. This is already described in the text (p.65, L40-41).
43918	65	46	65	46	The statement "...as warmer SST will support TC-class wind speeds further north..." seems speculative and I doubt that it is correct. I don't think there is evidence from models that the area with TC-level winds in climate change projections will expand along with the region enclosed by some given isotherm. We know that genesis does not behave this way in models, and I don't believe that TC occurrence does either. Suggest to delete this phrase. [Thomas Knutson, United States of America]	Accepted. This phrase was deleted.
48594	65	47	65	48	The statement mentioned about the southern hemisphere change of cyclogenesis. On the other hand, Tauvale and Tsuboki (2019) showed that annual average locations of TC genesis and lifetime-maximum intensity in the Southwest Pacific show very little change during the last 47 years (1970-2017) using the latest Southwest Pacific Enhanced Archive of TCs dataset. Tauvale, L., and K. Tsuboki, 2019: Characteristics of tropical cyclones in the Southwest Pacific. J. Meteor. Soc. Japan, 97, 711-731. DOI: https://doi.org/10.2151/jmsj.2019-042 . [Kazuhisa Tsuboki, Japan]	Noted. This paper is for the observation and should be considered in the section of the observed trend 11.7.1.2.
28104	65	52	65	53	Which studies? Any citations? [Gan Zhang, United States of America]	Noted. Citations are corrected.
55964	65		46		Now only HC extent but also intensity should be considered. See comment above: Expanding of Hadley circulation and changes in its intensity (not mentioned here) also (and likely first of all) results in poleward deflection of tropical cyclone tracks and moving to the north the locations of tropical cyclone max intensity (Studholme and Gulev 2018, J. Climate, doi:10.1175/JCLI-D-17-0852.1, Sharmila and Walsh, 2018, Nature Climate Change, doi:10.1038/s41558-018-0227-5, Altman et al., 2018 PNAS, DOI: 10.1073/pnas.1808979115). In general concurrency between TC poleward migration and tropical expansion, especially with regard to tropical expansion re-evaluations (i.e. Staten et al., 2018) should be put in a better context. The 2018 North Atlantic hurricane season saw the most equatorward cases of tropical cyclogenesis since 1902. Due to superficial simplicity ('warmer climate' - 'wider tropics' - 'poleward migration of cyclones') sloppy interpretations abound: HC changes are NOT driving SST changes (Alman et al. 2018), it's the other way around. [Olga Zolina, France]	Noted. This is related to the driver, 11.7.1.1.
49392	66	1	66	9	TC size is an important parameter to study TC induced destructiveness but also to understand the TC intensification. However there is still not a strong consensus within the community to define the size of a TC. AR6 should catalyze this consensus and unify agencies using diffent metrics (e.g. R0, Rmax, etc.). This would allow to compare better results between different model simulations [Rafael Catany, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Note that there are various definitions of TC sizes.
29712	66	2	66	10	The role of extratropical transition of tropical cyclones, related to poleward shift of tropical cyclone tracks, location of maximum intensity, and the independent expansion of the Hadley Cell, is also uncertain and has implications for overall summertime storm risk in the mid-latitudes. [Alexander Alexander Baker, United Kingdom (of Great Britain and Northern Ireland)]	Noted. This aspect is described in Section 11.1.5.
46434	66	5	65	5	"the eye walls are inclined to the tropopause" This description can be reworded as "the eye walls are inclined outward with height to the tropopause" to improve clarity. [Tomoe Nasuno, Japan]	Accepted.
16090	66	11	66	24	The plausible increase in TC induced extreme wind waves due to the projected increase in TC intensity may further aggravate the impacts of storm surge and sea level rise on coastal structures (Timmermans et al., 2017, 2018) References : - Timmermans, B., D. Stone, M. Wehner, and H. Krishnan, 2017: Impact of tropical cyclones on modeled extreme wind-wave climate. Geophys. Res. Lett., 44, 1393–1401, doi:10.1002/2016GL071681 - Timmermans, B., C.M. Patricola, and M.F. Wehner, 2018: Simulation and analysis of hurricane-driven extreme wave climate under two ocean warming scenarios. Oceanography, 31, DOI: 10.5670/oceanog.2018.218. [SAI MING LEE, China]	Accepted. These references are added.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
29710	66	12	66	12	Change "transition" to 'translation'. [Alexander Alexander Baker, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. We use transition speed of TCs.
43920	66	22	66	24	Suggest changing to: "Among various storm surge risk factors, there is high confidence that sea level rise will lead to higher risk of extreme coastal water levels in most regions, all other factors assumed equal." Comment: we don't know how all of the other factors (especially TC frequency and track) are going to contribute to overall changes in TC surge risk at various locations, or even globally. [Thomas Knutson, United States of America]	Accepted.
28106	66	23	66	23	"highconfidence" should be separated. [Gan Zhang, United States of America]	Accepted.
46438	66	26	66	33	These descriptions can be re-organized as "Summary" in a separate subsection (as seen in the other sections). [Tomoe Nasuno, Japan]	Taken into account. Here is summary of this subsection of projection. We added 11.7.1.6 Summary of TCs.
21914	66	26	66	33	If a short summary of observed trends is added, this paragraph could be used as a summary of 11.7.1 [Gwenaelle GREMION, Canada]	Taken into account. We added 11.7.1.6 Summary of TCs.
46436	66	27	65	27	"confidence is very low that the global frequency of TCs over all categories will decrease." Even the AR5 assessment did not state that the projected TC frequency decrease in all categories under global warming. I would recommend focusing on the high confidence aspects: the reduction in the number of weak TCs and the increase in the fraction of the intense TCs, with addressing the updates from the AR5 assessment (uncertainty in the total number of TCs with regarding the underlying processes and the model abilities.) [Tomoe Nasuno, Japan]	Accepted. The assessment was moderated.
43922	66	27	66	33	This paragraph has several major problems and is inconsistent with the executive summary. Suggested word changes (beginning with 2nd sentence): "...explained by a plausible theory. Confidence is also greater in cases where a detectable anthropogenic influence in the metric has also been robustly identified using past observations and models. Hence, confidence is very low that the global frequency of TCs over all categories will decrease. Confidence is medium-to-high that the global proportion of TCs that reach very intense levels will increase, and that the average intensity of TCs will increase. Confidence is also medium-to-high that average TC precipitation rates will increase globally; the median projected increase across available studies scales with the rate of increase of tropical atmospheric water vapor (i.e., Clausius-Clapeyron scaling), or about 7% per degree Celsius warming. Local TC precipitaton rates will increase in some TC basins at rates greater than the Clausius-Clapeyron rate, with medium confidence. A slowdown in TC translation speed and an increase in TC size are projected with low confidence." Further comment: I'm not sure how firm the basis is for the projected poleward shift in tropical cyclogenesis: is this a projection based on agreement across a wide range of studies? How many independent studies? Are there any studies reporting on it that are not showing it? [Thomas Knutson, United States of America]	Accepted. The summary paragraph is rewritten.
43254	66	28	66	28	"confidence is very low" should be "confidence is MEDIUM" (See the summary of section 3b in Knutson et al. 2019b). In Knutson et al. (2019b), the model consensus for the global TC frequency decrease is 87% (118 models out of 136 models) with Emanuel 2013 results included, and 91% (114 models out of 125 models) without Emanuel 2013 results. As the method of Emanuel 2013 is different from the other models (and based on a questionable assumption of constant seeding), it is appropriate to exclude them from the "model consensus". [Masato Sugi, Japan]	Accepted. The summary paragraph is rewritten.
43256	66	28	66	28	After excluding the results from Emanuel 2013, there are 11 models that projected increase in global TC frequency. Among the 11models 10 models are low resolution models. Only one high resolution model that projected an increase in global TC frequency is model of Bhartia et al. (2018). Among the 10 low resolution models, 9 models are CMIP5 models. For the 5 models out of 9 CMIP5 models, different authors project opposite sign of the frequency change (e.g. for CCSM4, 8% decrease in Tory et al. 2013 but 8% increase in Murakami et al. 2014, and for MPI-ESM-LR 15% increase in Camargo et al. 2013 but 15% decrease in Murakami et al. 2014), indicating a problem of TC detection in these low resolution models. [Masato Sugi, Japan]	Accepted. The summary paragraph is rewritten.
43258	66	28	66	28	Considering that the results of Emanuel 2013 and the low resolution models are not reliable, the model consensus should be "decrease in global TC frequency with HIGH confidence". And then, by considering the lack of "theory" for the TC frequency decrease, the confidence level may decrease from "HIGH" to "MEDIUM". [Masato Sugi, Japan]	Accepted. The summary paragraph is rewritten.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
43260	66	28	66	28	The "mass flux hypothesis" is not a "theory" but it is demonstrated that the hypothesis can reasonably explain the reduction of the TC frequency in the US Hurricane Working Group experiments, in both P2K and 2XCO2 experiments (Walsh et al. 2015). It is reasonable to expect a strong relationship between the upward convective mass flux and the overall global TC frequency, considering a strong relationship between TC upward mass flux (secondary circulation) and TC maximum wind (primary circulation). [Masato Sugi, Japan]	Noted. The summary paragraph is rewritten.
43262	66	28	66	28	"very high" should be "high". [Masato Sugi, Japan]	Noted. The summary paragraph is rewritten.
43264	66	28	66	29	"global frequency of intense TC" should be "global proportion of Category 4-5 TCs" or "average intensity of TCs" [Masato Sugi, Japan]	Accepted. The summary paragraph is rewritten.
21910	66	38	66	38	Figure11.18: Figure not clear [Gwenaelle GREMION, Canada]	Thanks you. The figure is being modified to be more clear.
24412	66	47			The discussion is limited almost exclusively on reanalysis. I don't understand why other information (observations, proxies) are excluded. They were essential parts in earlier IPCC assessments. There are also recent updates and reviews such as by Krueger 2019 (doi: 10.1175/JCLI-D-18-0505.1) and Feser 2015 (doi: 10.1002/qj.2364) which would broaden the perspective. [Ralf Weisse, Germany]	Taken into account. Thanks for suggesting some missing references. Storm track and storminess changes were covered in Chapter 8.
24414	66	47			Generally, all trends, changes, shifts etc. should be accompanied with a reference period or period for which statements are valid, in particular to separate long-term changes from shorter-term variability [Ralf Weisse, Germany]	Accepted. Periods are now given for each statement.
28108	66	49	66	50	The relevant discussion in Section 8.3.2.10 of Chapter 8 is rather brief. Please consider coordinating with authors of that section to ensure that these important topics are properly covered by the final report. [Gan Zhang, United States of America]	Noted
21912	66	49	69	2	The authors state that they only refer to the most extreme extratropical cyclones to avoid overlap with Section 8.3.2.10, however there is no indication of how they define "most extreme". Is it based on the minimum central pressure, wind speeds, impact, or another measure? Further it is not clear what the differences in the presented trends, model performance and projections is between "the most extreme" ETCs and other "less extreme" ETCs that are covered in Chapter 8. [Gwenaelle GREMION, Canada]	Accepted. We have now included a definition of what we mean by extreme storms at the beginning of the section.
27914	66	50	66	50	Page 11-66, lines 50-10: "In this section we focus on trends and future changes related with the most 50 extreme ETCs". This focus is not clear from the section itself. [roderik van de wal, Netherlands]	Accepted. We have now re-structured this section trying to focus on the most extreme storms but also highlighting that there is some ambiguity on the way extreme ETCs are defined.
14254	66	55			11.7.2.1 seems very brief compared with other sections. Perhaps this can refer to/coordinate with 8.3.2.6/8.3.2.8 (actually I think Atmospheric Rivers should be considered within Extratropical cyclones/storms (8.3.2.10.2)) [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. We have merged ETCs and ARs in a single section called "Midlatitude storms".
24416	67	1	67	5	There are other sources such as proxies that allow for estimation of trends but which are ignored. [Ralf Weisse, Germany]	Noted
24418	67	1	67	5	The homogeneity issue in reanalyses was identified much earlier. For fairness, such early and fundamental references should be included (Examples: Bengtsson, 200, doi:10.1029/2004JD004536; Krueger, 2013, doi:10.1175/JCLI-D-12-00309.1). [Ralf Weisse, Germany]	Taken into account. Some of these references has been cited in Chapter 8. The earliest references are not necessarily included as this is not a review paper but an assessment of the literature mostly since AR5/SREX.
27920	67	1	68	50	Page 11-67&11-68. Overall, the discrimination between ETC's and Extreme ETC's of other not made, or unclear. The confusion may arise from the fact that TC's are considered to be extreme itself, and ETC's not. Maybe elaborate more on that. [roderik van de wal, Netherlands]	Accepted. This is a good point and we have added a discussion about how extremes ETCs are defined and some key differences with TCs.
38924	67	2	67	5	The cited references miss a comparison of reanalysis derived cyclones covering the complete 20th century. Thus, I recommend to add a respective reference, e.g. Befort et al. 2016, DOI: 10.1002/asl.694 [Uwe Ulbrich, Germany]	Accepted. The Befort et al reference has been added.
54364	67	7	67	8	"increase trend" (sic) - over what period? [Blair Trewin, Australia]	Not Applicable. A new section covers near-surface wind speeds.
21916	67	7	67	9	Over what time span did the mentioned trend in extreme winds occur? Please include this information here to give better context. [Gwenaelle GREMION, Canada]	Not Applicable. A new section covers near-surface wind speeds.
21918	67	7	67	9	Why are the two studies mentioned in the context of ETCs if they did not deal with ETC dynamics and trends? The authors should provide an explanation of why they choose to mention the studies in this context. [Gwenaelle GREMION, Canada]	Not Applicable. A new section covers near-surface wind speeds.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
38916	67	7	67	10	This section is on ETCs, not surface winds! [Uwe Ulbrich, Germany]	Accepted. A new section covering surface winds was added.
27916	67	7	67	10	Page 11-67, lines 7-10: Does this at least imply that these winds can be associated with ETC? If this study did not focus in ETC's what does that mean for the interpretation of the statement that the strongest winds increased? [roderik van de wal, Netherlands]	Not Applicable. A new section covers near-surface wind speeds.
21920	67	9	67	10	Which tropical region are the authors referring to? Only in the Pacific Ocean? And if so I recommend reformulating the previous sentence to make clear that the increase is only found in regions outside the tropics. [Gwenaelle GREMION, Canada]	Not Applicable. A new section covers near-surface wind speeds.
38926	67	15	67	16	If results not exclusively covering CMIP5 data based results are wanted, there is a frequently cited review paper by Ulbrich et al., 2009, DOI 10.1007/s00704-008-0083-8 [Uwe Ulbrich, Germany]	Noted
27918	67	15	67	26	Page 11-67, lines 15-26: Written text in this section does not specify on the extreme ETC's. For that reason, one can leave this section to Chapter 8 Section 8.3.2.10.2. [roderik van de wal, Netherlands]	Noted. We have substantially revised the evaluation section including new literature and trying to focus more on the most extremes storms.
38918	67	16	67	17	The reference Di Luca is specific for one region. Either name the specific region, or mention studies for a couple of other regions. [Uwe Ulbrich, Germany]	Accepted. We have substantially revised this section and included references from other regions.
24420	67	20	67	21	This statement contradicts the statement made earlier on page 67, lines 1-5. [Ralf Weisse, Germany]	Accepted. By homogeneous data we meant data that are regularly distributed in time and space. We have revised the text clarifying this.
38928	67	21	67	26	Given the same data resolution (other than model resolution), the frequency and intensity of detected ETCs also depend on the manual or automatic detection algorithms used, see Neu et al., 2013 (https://doi.org/10.1175/BAMS-D-11-00154.1) for an intercomparison. [Uwe Ulbrich, Germany]	Accepted. We have revised this section and we now discuss in more detail the issue of identifying ETCs using objective algorithms.
21922	67	22	67	22	The authors should mention more details on the tuning of algorithms, i.e. what the algorithms are tuned to, e.g. observations, reanalysis(?), which variables need to match in the tuning and what is (are) the tuning parameter(s)? [Gwenaelle GREMION, Canada]	Accepted. We have revised this section and we now discuss in more detail the issue of identifying ETCs using objective algorithms.
38920	67	23	67	26	It is not clear why one would just mention a methodology that does NOT use MSLP as the common parameter to identify cyclones. You can refer to Neu et al., 2013 (https://doi.org/10.1175/BAMS-D-11-00154.1) for an intercomparison study with respect to cyclone identification and tracking programs, and to Ulbrich et al 2013 (https://dx.doi.org/10.1127/0941-2948/2013/0420) for a multi-method climate change signal intercomparison [Uwe Ulbrich, Germany]	Accepted. We have now included a more detailed discussion about identifying and tracking ETCs and we have mentioned the use of several variables including MSLP.
37968	67	25	26		The information given here duplicates information given in the paragraph that spans lines 2-5 of this page. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. This line has been removed.
21924	67	25	67	25	Consider deleting "... spectral components of total wavenumbers larger than T42." This is very technical and might not be useful for non-expert reader, i.e. reader not in the field of ETCs [Gwenaelle GREMION, Canada]	Accepted. We have changed this sentence to "For example, Zappa et al. (2013a) identify and track ETCs in 850-hPa vorticity fields from CMIP5 models and the ERA-Interim reanalysis after removing fine-scale variability that is not available in all datasets."
24422	67	29	67	31	This needs to be elaborated. Cross-reference not exhaustive. In Chapter 8 there are only 8 lines of text for the southern hemisphere. There is no information for the northern hemisphere and nothing on event attribution. [Ralf Weisse, Germany]	Accepted. This section has been removed.
14256	67	29			This referal to Chapter 8 may be fine but seems inconsistent with other subsections. Some overlap is OK I think so long as there is consistency in the summary of the key findings. [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. We have now re-structured this section trying to focus on the most extreme storms but also highlighting that there is some ambiguity in the way extreme ETCs are defined.
52880	67	31			This is weird and should be reconsidered! [Douglas Maraun, Austria]	Noted.
21926	67	36	69	3	Check all of these paragraphs carefull for grammar and syntax. There are many instances of misplaced or missing articles in front of nouns, and wrong collocations/prepositions. [Gwenaelle GREMION, Canada]	Noted
21928	67	40	67	44	Please add references for the statements about the changes in zonal-mean equator-to-pole temperature gradient [Gwenaelle GREMION, Canada]	Taken into account. This paragraph has been reduced here and merged within Chapter 8 where storm tracks are discussed in detail.
55966	67	67	21	22	Should be reformulated. [Olga Zolina, France]	Noted
48468	68	3	68	4	ozone opposes greenhouse gases in all scenarios, rephrase [Julie Arblaster, Australia]	Accepted. The sentence has been revised to clarify the effect of ozone.
26810	68	12	68	16	Which scenario is this? [Thorsten Mauritsen, Sweden]	Accepted. We have added the scenario used in the study.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
24424	68	13	68	16	Talking about rare events and small samples, percentages need to be accompanied by a total (baseline). What are the 50% referring too? How much is 50% in total? [Ralf Weisse, Germany]	Accepted. The text has been revised and absolute changes specified in more detail.
52882	68	20	68	32	Here you should consider discussing the Zappa and Shepherd storylines. They have, e.g., also been used by Manzini et al (2014) in an earlier study. The reason is that dynamical changes might be substantial, but not include the MMM. [Douglas Maraun, Austria]	Accepted. We have discussed added this reference.
28110	68	24	68	25	Please consider adding citations to the argument ("In summer..."). [Gan Zhang, United States of America]	Taken into account. We have merged the text of the storm tracks with the corresponding section in Chapter 8.
24426	68	35	68	36	The cited reference only shows this for the A1B scenario. Either include more references for other scenarios/models to consolidate the statement or be explicit about assumptions and limits. [Ralf Weisse, Germany]	Accepted. A new section covering surface winds was added.
21930	68	38	68	38	reference should be without bracket [Gwenaelle GREMION, Canada]	Accepted. Text has been revised accordingly.
54366	68	45	68	46	The statement on ozone forcing a poleward trend in the SH summer contradicts statements elsewhere (including later in this paragraph). [Blair Trewin, Australia]	Rejected. We could not find a contradiction. Text mention that ozone depletion causes a poleward shift while ozone recovery leads to an equatorward shift.
27038	69	5	69	5	effect of land use on triggering convective storm is missing. Should be added [Mansour Almazroui, Saudi Arabia]	Noted. No reference on this issue related to changes in severe convective storms.
27922	69	7	69	20	Page 11-69, line 7-20: As this is an introduction of this section, make clear what we can expect from this section. So far, it only contains three quotes from past reports. [roderik van de wal, Netherlands]	Accepted. Quoted sentences are shortened.
54368	69	10	69	10	CSSR needs to be defined. [Blair Trewin, Australia]	Accept. Climate Science Special Report.
21932	69	28	69	28	not clearly embedded >> without clearly embedded [Gwenaelle GREMION, Canada]	Accepted.
54370	69	28	69	29	The paragraph's context suggests that MCSs and MCCs are not considered "larger-scale weather systems", but this is not obvious to the reader. [Blair Trewin, Australia]	Accepted. Texts are modified to avoid this confusion.
38930	69	32	69	32	I am not aware of major initiatives to create widespread mesoscale-observing networks. Either give references or discard. [Uwe Ulbrich, Germany]	Noted. Satellite observation is referred to.
27924	69	41	69	41	Page 11-69, line 41: "It is unknown whether these types of MCSs are becoming more frequent in recent periods nor observed ubiquitously all over the world." In context of Mechanisms and drivers this statement seems not in the right section and feels to come out of nowhere in the absence of a reference. [roderik van de wal, Netherlands]	Rejected. This is a necessary information of the new types of MCS.
50692	69	46	69	46	Please add that there is quite some regional variability in the relative relevance of these factors, in Europe you can get severe convection with relatively low CAPE values compared to North America and also without large shear. [Olivia Martius, Switzerland]	Accepted.
21934	69	46	69	46	necessary conditions for the? -- sentence incomplete and does not make any sense [Gwenaelle GREMION, Canada]	Accepted. The sentence is completed.
7632	69	46	69	46	conditionsfor (conditions for) [Guoping LI, China]	Accepted. The sentence is completed.
7634	69	48	69	48	theresulting (the resulting) [Guoping LI, China]	Accepted.
7636	69	49	69	49	conditional available potential energy (CAPE) /correction : convective available potential energy (CAPE) [Guoping LI, China]	Accepted. Corrected to convective ...

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
8968	69		71		<p>My comment is about the section 11.7.3 Severe convective storms. Recently Allen 2018 wrote an insightful review on this topic with many important aspects that could be mentioned in the report such as the uncertainty that arises from the balance between factors affecting thunderstorm occurrence (e.g. “ for example hail, the warming of mid-tropospheric temperatures likely leads to an increase in the freezing level, which leads to increased melting of smaller hailstones. However, there may be some offset, as stronger updrafts driven by increasing CAPE would favor the growth of larger hailstones, which melt less when falling”). Also, several references found in Allen 2018 are missing in the IPCC report. Especially in section Assessing a Changing Frequency / Observed and Environmental Trends, numerous papers that assess past trends for convective storms frequencies (mainly by analyzing hail) are listed (see table 3). In addition, two sections are dedicated to future severe convective storms changes : Future Projections Using Proxy Environments and Future Projections on the Convective Scale that are insightful.</p> <p>Discussion of Allen 2018 is also helpful e.g. : “There are large differences within the CMIP5 ensemble for environments, which contributes to some degree of uncertainty. Despite this limitation, an increase in the frequency of SCS favorable environments (e.g. SEV) in the spring appears likely, accompanied by perhaps a less significant increase, or even decrease, into the summer months. These changes manifest most strongly as the season elongates, juxtaposing a greater degree of instability on the deep-layer vertical wind shear favorable conditions of the late winter and early spring (Diffenbaugh et al., 2013; Gensini & Mote, 2015; Hoogewind et al., 2017).”</p> <p>Climate Change and Severe Thunderstorms John T. Allen Online Publication Date: Jul 2018 DOI: 10.1093/acrefore/9780190228620.013.62 [Jean-François Rysman, France]</p>	Accepted. Refer to Allen (2018) and add discussions based on this reference.
8992	70	3			<p>topographical effects also shown in Ducrocq, V., Nuisssier, O., Ricard, D., Lebeaupin, C., & Thouvenin, T. (2008). A numerical study of three catastrophic precipitating events over southern France. II.: Mesoscale triggering and stationarity factors. Q. J. R. Meteorol. Soc., 134(630), 131–145. https://doi.org/10.1002/qj.199 [Ségolène Berthou, United Kingdom (of Great Britain and Northern Ireland)]</p>	Accepted. This reference is added.
21936	70	9	70	10	<p>Because definition of MCSs depends on literatures >> As MCS definition varies depending on literatures [Gwenaëlle GREMION, Canada]</p>	Accepted. The text is changed.
15610	70	13	70	26	<p>Please consider adding a study using TRMM which pointed out the MCS number decreased recently around South Asia. (1) Habib, S. M. A., T. Sato, and D. Hatzuzuka, 2019: Decreasing number of propagating mesoscale convective systems in Bangladesh and surrounding area during 1998-2015. Atmos. Sci. Lett., 2019:e879. DOI: 10.1002/asl.879 [Tomonori Sato, Japan]</p>	Accepted. The reference is added.
21938	70	28	70	38	<p>Nothing is mentioned in Asia, except one study for Japan [Gwenaëlle GREMION, Canada]</p>	Taken into account. Bangladesh example is added.
21940	70	28	70	38	<p>This para is written poorly. Sentences should be rephrased for better readability and flow. [Gwenaëlle GREMION, Canada]</p>	Noted.
29094	70	30	70	31	<p>In addition to Zipser et al. (2006), it is suitable to cite Liu and Zipser (2015, GRL) which classified severe convective storms using the Global Precipitation Measurement (GPM) Ku-band precipitation radar. Hou et al. (2014) is suitable for citing the GPM/DPR. [Takuji Kubota, Japan]</p>	Accepted. The reference is added.
54372	70	33	70	33	<p>The density of observations (as well as awareness of tornadoes) would certainly influence the results here. Did the studies cited attempt to address this issue in any way? [Blair Trewin, Australia]</p>	Noted. The references cover the issue of the density of observation.
27926	70	33	70	34	<p>Page 11-70, line 33-34: " Thunderstorm climatology in the Mediterranean is analyzed by Galanaki et al. (2018)" What should we do with this without discussing any observation? [roderik van de wal, Netherlands]</p>	Noted. Galanaki et al. (2018) did not discuss about trends.
8994	70	34			<p>Increase in trend of extreme daily rainfall in south eastern France, where MCSs play a key role in this type of event: Ribes et al. Climate Dynamics (2019) 52:1095–1114 https://doi.org/10.1007/s00382-018-4179-2 Observed increase in extreme daily rainfall in the French Mediterranean ; Blanchet et al. 2016 https://link.springer.com/article/10.1007/s00382-016-3122-7 [Ségolène Berthou, United Kingdom (of Great Britain and Northern Ireland)]</p>	Accepted. These references are added.

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52886	70	41			Much of the section is on projections rather than model evaluation. Please move and fill with appropriate material. Also add Coppola et al., <i>Clim. Dynam.</i> , 2019. [Douglas Maraun, Austria]	Taken into account. This reference is not identified.
21942	70	43	70	55	11.7.3.3: Either use convection-permitting or convective-permitting; maintain consistency. [Gwenaelle GREMION, Canada]	Accepted. Convection-permitting is consistently used.
48396	70	44	70	44	Model evaluation section would benefit from a discussion on contribution of high resolution doppler weather radar in improving the forecast skill of severe convective events. (Ref: http://dx.doi.org/10.1175/WAF-D-16-004); https://doi.org/10.1016/j.advwatres.2019.02.004 ; https://doi.org/10.1007/s00376-010-9162-8 [Indu Jayaluxmi, India]	Noted. These references are assimilation studies which are too specific for this section.
21944	70	44	70	44	section X =? [Gwenaelle GREMION, Canada]	Accepted. Insert Section 10.3.3.
52884	70	46			delete "for climate projection purposes" [Douglas Maraun, Austria]	Accepted.
8230	70	48	70	48	There are convection-permitting studies over Africa https://journals.ametsoc.org/doi/full/10.1175/JCLI-D-17-0503.1 and https://www.nature.com/articles/s41467-019-09776-9 , including evaluation of MCSs https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2018EA000491 [Declan Finney, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Refer to these papers to describe African region.
8988	70	48			Study of MCSs in West Africa too: Statistics of organized convective lifecycles in West Africa are largely improved by using convection-permitting models (Crook, J., Klein, C., Folwell, S., Taylor, Christopher M. Parker, D. J., & Stein, T. (2019). Assessment of the Representation of West African Storm Lifecycles in Convection-Permitting Simulations. <i>J. Climate.</i>) and future changes in Fitzpatrick et al. submitted to <i>J. Clim.</i> [Ségolène Berthou, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Crook is referred to.
38932	70	52	71	1	Examples of such studies for Europe are available and should be mentioned. Examples are: N. Ban, J. Schmidli, and C. Schär. Evaluation of the convection-resolving regional climate modeling approach in decade-long simulations. <i>J. Geophys. Res.-Atmos.</i> , 119(13):7889-7907, 2014. N. Ban, J. Schmidli, and C. Schär. Heavy precipitation in a changing climate: Does short-term summer precipitation increase faster? <i>Geophys. Res. Lett.</i> , 42(4):1165-1172, 2015. E. J. Kendon, N. M. Roberts, H. J. Fowler, M. J. Roberts, S. C. Chan, and C. A. Senior. Heavier summer downpours with climate change revealed by weather forecast resolution model. <i>Nat. Clim. Change</i> , 4(7):570-576, 2014. [Uwe Ulbrich, Germany]	Accepted, Ban et al. (2014) and Kendon et al. (2014) are added for model evaluations in the European region. Ban et al (2015) is referred to in the projection section.
21946	70	53	71	1	add success rate/results of Prein et al., 2017 and Murata et al., 2015, 2017 [Gwenaelle GREMION, Canada]	Taken into account. Both references are moved to the projection sections, and added the results from these studies.
8990	70	55			Also in large domain over Europe, showing a shift of intense hourly precipitation from summer to autumn with future projection by Chan, S. C, Kendon E. J., Berthou S., Fossier G., Lewis E. & Fowler H. J. (submitted). Europe-wide climate change projections at convection permitting scale with the Unified Model. <i>Climate Dynamics</i> [Ségolène Berthou, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The reference is not available.
21956	71	1	71	1	this reference (Murata et al., 2017) is not listed correctly in bib [Gwenaelle GREMION, Canada]	Noted. The reference is already listed: Murata, A., Sasaki, H., Kawase, H., Nosaka, M., Aoyagi, T., Oh'izumi, M., et al. (2017). Projection of Future Climate Change over Japan in Ensemble Simulations Using a Convection-Permitting Regional Climate Model with Urban Canopy. <i>SOLA 13</i> , 219–223. doi:10.2151/sola.2017-040.
48398	71	11	71	11	An extreme mesoscale convective heavy rainfall event occurred over chennai city, India would be an appropriate case study to detection and attribution section. The occurrence of this severe convective event can be attributed to the increasing trend of the Bay of Bengal sea surface temperature (https://doi.org/10.1007/s00382-017-3778-7) and aerosol pollution (https://doi.org/10.1175/BAMS-D-16-0129.1) [Indu Jayaluxmi, India]	Noted. These references are not explicitly evaluation attribution of mesoscale convective events. As case study, Boyaj et al. (2013) and van Ordelborh et al. (2016) are referred to.
27928	71	16	71	16	Page 11-71, line 16: "Only a limited number of papers is published on the projection of MCSs" Does this statement hold for severe convective storms in general. If so, I suggest to swap with MCS. [roderik van de wal, Netherlands]	Accepted. MCSs are changed to severe convective storms.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
8986	71	22			Kendon et al. also show an increase in sub-daily extreme precipitation in Africa with a convection-permitting model. Although not directly linking this with MCSs and their dynamics. This study on MCSs in the Sahel is done in a piece of work by Fitzpatrick R., Parker D., et al. submitted to J. Climate, which should come out before this report. Kendon, E. J., Office, M., Centre, H., Stratton, R. A., Office, M., Office, M., ... Centre, H. (2019). Enhanced future changes in wet and dry extremes over Africa at convection-permitting scale. Nat. Comm., 10(1), 1794. https://doi.org/10.1038/s41467-019-09776-9 [Ségolène Berthou, United Kingdom (of Great Britain and Northern Ireland)]	Noted for Fitzpatrick et al.: The reference is not available. Accepted for Kendon et al. (2019).
8232	71	24	71	24	The flow of this paragraph is a bit strange, jumping from thunderstorms to tornados, as though they are the same thing. [Declan Finney, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. The paragraph is corrected.
44162	71	24	71	24	This sentence is incorrect. Severe convective storms occur in a range of CAPE and shear combinations. In fact, there is a class of storms called low-CAPE-high-shear, which is common in strongly forced synoptic situations. [David Schultz, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. We modified the sentence.
44164	71	25	71	26	Please provide a citation for this statement. CAPE will not increase uniformly across regions experiencing convective storms. This statement is too general to be meaningful. [David Schultz, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. This statement is for the United States.
21948	71	26	71	26	change the sentence as follows "...., suggesting favorable conditions for an increase in tornadoes and hails in the future" ...for better readability. [Gwenaëlle GREMION, Canada]	Accepted.
7638	71	26	71	26	thatfavorable (that favorable) [Guoping LI, China]	Accepted.
21950	71	27	71	28	After stating an increase in tornadoes in the last sentence, the present sentence, as written here looks odd and should be modified. [Gwenaëlle GREMION, Canada]	Accepted. The sentence in this paragraph are rewritten.
44166	71	34	71	37	These sentences don't make any sense. See previous comment on page 9, lines 7-10. [David Schultz, United Kingdom (of Great Britain and Northern Ireland)]	Noted.
21952	71	36	71	37	Sentence should be modified. See comment P70.L9-10 above. [Gwenaëlle GREMION, Canada]	Accepted.
44168	71	37	71	38	This statement is too general to be meaningful. The evidence is related to only one country: the United States, so trying to generalize beyond that is not justified. Furthermore, there will be winners and losers. Some places will experience more intense convective storms and some will experience less. It is not logical that all locations will experience more convective storms. [David Schultz, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account.
54374	71	38	71	38	Would read better as "some" rather than "different" regions. [Blair Trewin, Australia]	Noted. The text is modified to be specific that this is for the USA..
26812	71	38	71	41	See comment on page 9, line 11 [Thorsten Mauritsen, Sweden]	Taken into account.
39090	71	39	71	42	The characterisation of low to medium appears to be rather low. All of the convection permitting model simulation I have seen project increases in intensity of convective storms. Of course they do not cover the full depth of the CMIP5/6, but still the signal appears very robust in these model simulations. [Lenderink Geert, Netherlands]	Taken into account. Intensification is specific to precipitation.
54376	71	41	71	41	This makes no sense - are there words missing? [Blair Trewin, Australia]	Accepted. This sentence is deleted.
52888	71	44			There is some overlap with Chapter 10. This may be justified, but this should be checked amongst the chapters. [Douglas Maraun, Austria]	accepted. The Atmospheric River related materials are consolidated into Chapter 8 in SOD"
21954	71	51	71	51	with this class of storm >> with ETC [Gwenaëlle GREMION, Canada]	Editorial - copyedit to be completed prior to publication
21958	72	1	72	4	AR extreme precipitation is robustly projected to increase [...] This statement is neglecting the work of Dominguez et al. 2018 who state: "In the warming scenario, AR integrated vapor transport increases; however, these changes do not translate into generalized increases in precipitation [...]" see Dominguez, Francina, et al. "Tracking an atmospheric river in a warmer climate: from water vapor to economic impacts." Earth System Dynamics 9.1 (2018): 249-266, https://doi.org/10.5194/esd-9-249-2018 . Please amend text to reflect this work. [Gwenaëlle GREMION, Canada]	This subject is now covered in Chapter 8
21960	72	7	72	7	IVT- write the full form, as not defined in this chapter [Gwenaëlle GREMION, Canada]	Editorial - copyedit to be completed prior to publication
21962	72	9	72	9	to increases >> to increase [Gwenaëlle GREMION, Canada]	Editorial - copyedit to be completed prior to publication
21964	72	15	72	15	C-C relationship—write a full form, as not defined in this chapter [Gwenaëlle GREMION, Canada]	Editorial - copyedit to be completed prior to publication

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
30084	72	30	72	31	It is surely not correct to associate poleward shifts of the storm track (and the midlatitude jet) with expansion of the Hadley cell (and a poleward shift of the subtropical jet). Manney & Hegglin (2018 J.Clim. doi: 10.1175/JCLI-D-17-0303.1) show that in many longitudes of the NH, the observed subtropical jet has shifted poleward even while the midlatitude/polar jet has shifted equatorward. Also, Zappa et al. (2018 GRL doi: 10.1002/2017GL076096) show that the equatorward North Atlantic wintertime jet shift in response to sea-ice loss is robust across the CMIP5 models, with a net shift close to zero even while the Hadley cell is expanding. In single-forcing experiments it is true that the two circulation features tend to be coupled, but they are affected differently by different forcings, so can respond differently to climate change. [Theodore Shepherd, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. This sentence was removed.
43946	72	32	72	33	This statement: "It is likely that increased specific humidity due to anthropogenic global warming leads to more frequent intense TCs (categories 4 and 5)..." is confusing and misleading. First, an increase in Cat 4-5 TCs is not "likely" as it has only low confidence according to Knutson et al. (2019). It is the proportion of TCs that reach category 4-5 where confidence is medium-to-high and an assessment of likely seems more appropriate. In any case, the increase in proportion of TCs reaching Cat 4-5 levels depends on a number of factors (SST, potential intensity, vertical temperature structure) as well as increases in specific humidity. To attribute the projected increase to increased specific humidity is oversimplified and not correct. [Thomas Knutson, United States of America]	Taken into account. This sentence was removed. We now have "There is high confidence that the proportion of Category 4-5 tropical cyclones will increase globally."
54378	72	34	72	36	Need to qualify that this increase only applies to some regions. Also suggest rearranging sentence so that the reference to short data records comes after the confidence statement. [Blair Trewin, Australia]	Taken into account. This text was modified as "Observation shows that there is medium confidence that tornado activity has increased in the United States over the 2000s with a decrease in the number of days per year when tornadoes are observed. Detected tornadoes are also increased in Europe, but its trend depends on density of observation."
43948	72	36	72	38	"Both observation and modeling show a reduction of extreme winds in the and an increase in high-latitudes. It is likely that these changes are driven by a weakening of tropical overturning circulation..." This is confusing, as there is separately discussion of increasing extreme TC winds. At least one of the studies cited is based on coarse grid climate models. How reliable are such models for simulating extreme surface windspeeds in the tropics if they simulate such weak TCs? This statement needs to be revisited and justified or modified (deleted?) [Thomas Knutson, United States of America]	Taken into account
15386	72	41	73	45	Please add some information about mudflows/mudslides/landslides, which have dramatic compaund effects in mountains. Gariano, S. L., & Guzzetti, F. (2016). Landslides in a changing climate. Earth-Science Reviews, 162, 227-252. Mamadjanova, G., Wild, S., Walz, M. A., & Leckebusch, G. C. (2018). The role of synoptic processes in mudflow formation in the piedmont areas of Uzbekistan. Natural Hazards and Earth System Sciences, 18(11), 2893-2919. Reyer, C. P., Otto, I. M., Adams, S., Albrecht, T., Baarsch, F., Carlsburg, M., ... & Mengel, M. (2017). Climate change impacts in Central Asia and their implications for development. Regional Environmental Change, 17(6), 1639-1650. Bolashvili, N., Karalashvili, T., Geladze, V., Machavariani, N., Karalashvili, A., Chikhradze, N., ... & Kartvelishvili, D. (2017). Sustainable Management of Water Resources on the Background of Current Climate Change. Earth Sciences, 6(5), 75. [Oksana Lipka, Russian Federation]	Rejected - this chapter focuses only on a small number of compound extremes with meteorological drivers. Mudflows and landslides fall beyond the scope of Chapter 11
21966	72	41	76	5	The authors address compound events only from the view point of multiple hazards co-occurring in space and time. However, the field of compound events also include (i) events that co-occur only in space (with a temporal lag) or time (events affecting different regions), (ii) events caused by the prolonged occurrence of one or multiple hazards in one region, and (iii) events that are caused by the sequential occurrence of hazards (e.g. a train of storms hitting the same coastal region; van den Hurk et al., 2014). This should be included into the discussion of compound events. Possible literature for this: Röthlisberger, Matthias, et al. "Recurrent synoptic-scale Rossby wave patterns and their effect on the persistence of cold and hot spells." Journal of Climate 32.11 (2019): 3207-3226.; Come et al., Nat. Comm. 2018 Nature Communications 9, Article number: 2959 (2018); Wu et al., JGR 2018; Haigh et al., 2019, "Assessing the characteristics and drivers of compound flooding events around the UK coast" Hydrology and Earth System Sciences Discussions.; [Gwenaelle GREMION, Canada]	Accepted - a more complete description of types of compound events is now provided
15312	72	41	76	11	Some paragraphs within this section read a lot like WG2 type speech. I would think best to limit the analysis to concurring extremes in the physical climate. It is already the majority of the discussion, but may use some further "sterilization" :-). [Claudia Tebaldi, United States of America]	Accepted - the section now focuses more on the meteorological drivers and impacts, rather than

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
15314	72	50	72	51	The reasoning here is not clear to me: if the driving variables are dependent I can see perhaps their happening with higher frequency than if they are independent, but the connection to impacts seems unsubstantiated here. [Claudia Tebaldi, United States of America]	Not applicable - section significantly revised
21968	72	51	72	51	Add van den Hurk et al. 2015 (already in the reference list at the end of the chapter) to the list of citations at the end of this paragraph. [Gwenaelle GREMION, Canada]	Accepted - reference added
21972	73	19	73	19	Zscheischler 2018a or b? [Gwenaelle GREMION, Canada]	Accepted - references have been corrected
54380	73	28	73	31	What does "spatial dependence" mean in this context? If it means that declining spatial dependence means that extremes are less likely to occur over large areas simultaneously (i.e. are more localised), it would be better to say so directly. [Blair Trewin, Australia]	Not applicable - section significantly revised
21970	73	50	74	36	The section of coastal compound events should also include a discussion of compound events in terms of coastal erosion (e.g. Corbella, S., and D. D. Stretch. "Multivariate return periods of sea storms for coastal erosion risk assessment." Natural Hazards and Earth System Sciences 12.8 (2012): 2699-2708. https://doi.org/10.5194/nhess-12-2699-2012) [Gwenaelle GREMION, Canada]	Accepted - coastal erosion discussed
52890	74	21	74	24	The Bevacqua paper is not yet published, should be out soon (i.e., 2019) [Douglas Maraun, Austria]	Accepted - reference added
21974	74	29	74	29	Add reference to Klerk, Wouter-Jan, et al. "The co-occurrence of storm surges and extreme discharges within the Rhine–Meuse Delta." Environmental Research Letters 10.3 (2015): 035005. [Gwenaelle GREMION, Canada]	Accepted - reference added
41282	74	32	74	34	There seems to be a confusion between the definition of compound events provided earlier in this section and the description given in these lines which seems to refer more to cascading processes (which are not necessarily related to compound events). There is a broad literature on cascading processes and impacts (see for example Pescaroli, G. (2018). Perceptions of cascading risk and interconnected failures in emergency planning: Implications for operational resilience and policy making. Int. J. Disaster Risk Reduct., 30, 269–280 and Nones, M. & Pescaroli, G. (2016). Implications of cascading effects for the EU Floods Directive. Int. J. River Basin Manag., 14, 195–204. doi:10.1080/15715124.2016.1149074) . It will maybe be helpful to provide a more precise description/distinction as well as clarify the relevance of cascading processes in the context of compound events. [Veruska Muccione, Switzerland]	Accepted - a more complete description of types of compound events is now provided
21976	74	35	74	36	Mention that atmospheric rivers are closely related to compound events (CEs) consisting of extreme precipitation and storm surge as shown by Ridder et al. (2018) who show that "[along the Dutch coast] CEs have a 3 to 4 times higher chance of occurrence on days with an AR over the Netherlands compared to any random day (i.e. days without knowledge on presence of an AR). In contrast, the occurrence of a CE on a day without AR is 3 times less likely than on any random day." (Ridder, Nina, Hylke De Vries, and Sybren Drijfhout. "The role of atmospheric rivers in compound events consisting of heavy precipitation and high storm surges along the Dutch coast." Natural Hazards and Earth System Sciences 18.12 (2018): 3311-3326. https://doi.org/10.5194/nhess-18-3311-2018) [Gwenaelle GREMION, Canada]	Rejected - see response to Richard Allan's comment above
21978	74	35	74	36	Also add the work of Waliser and Guan on the co-occurrence of extreme precipitation and winds in relation to landfalling atmospheric rivers (Waliser, Duane, and Bin Guan. "Extreme winds and precipitation during landfall of atmospheric rivers." Nature Geoscience 10.3 (2017): 179. https://doi.org/10.1038/ngeo2894) [Gwenaelle GREMION, Canada]	Rejected - the paper analyses precipitation and wind extremes separately but not in combination. See also Richard Allan's comment on atmospheric rivers higher up.
46166	74	37	74	37	Co-occurring wind and precipitation extremes in European Alps are more frequent in recent years: is it worth to add a sentence and a reference? See, for example (and references therein): Badoux, Alexandre, et al. "Natural hazard fatalities in Switzerland from 1946 to 2015." Natural Hazards and Earth System Sciences 16.12 (2016): 2747-2768. I also suggest to add a short sentence on the last (end October - beginning November, 2018) windstorm and heavy rain in Southern EU and Alps. [Marina Baldi, Italy]	Rejected - not relevant to coastal extremes
52892	74	39			Please refer to the paper by Manning et al., Env. Res. Lett., 2019. They found an increase of co-occurring long duration meteorological drought with heatwaves (due to more likely heatwaves) as a driver of soil moisture drought in Europe over the last 5 decades. [Douglas Maraun, Austria]	Accepted - reference added
14258	74	44			11.7.4 Atmospheric rivers are part of extra-tropical storms/cyclones and recent research suggests they are a diagnostic of extreme moisture transport into the storm rather than a driver of the extreme rainfall (Dacre et al. 2019 J Hydromet doi:10.1175/JHM-D-18-0175.1) [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - reference to atmospheric rivers as a driver has been removed

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54384	74	46	74	47	While land-atmosphere interactions are definitely important, another major factor is that (in most regions) the synoptic-scale weather systems favourable to extreme heat are also unfavourable for rain - the way I would tend to look at it is that in many areas, land surface conditions associated with pre-existing drought will tend to amplify the temperature extremes experienced in a given synoptic-scale heat event (to a greater or lesser extent depending on the region). One also needs to consider the potential influence of broader-scale climate drivers (such as ENSO) which may affect both temperature and precipitation. Untangling all this is challenging. [Blair Trewin, Australia]	Accepted - A sentence has been added with reference to Berg et al, 2015: Interannual Coupling between Summertime Surface Temperature and Precipitation over Land: Processes and Implications for Climate Change. J. Clim., 28, 1308–1328, doi:10.1175/JCLI-D-14-00324.1.
14534	75	1	75	6	Li et al. (2018) shows an increasing trend of concurrent droughts and hot extremes in Northwest China from 1961 to 2014, with the most significant increase occurring after 1994. (Li, Xin, Qinglong You, Guoyu Ren, Suyan Wang, Yuqing Zhang, Jianling Yang and Guangfen Zheng, 2018, Concurrent droughts and hot extremes in Northwest China from 1961 to 2014, Int J Climatol. 2018; 1–11. doi.org/10.1002/joc.5944) (CUG, Guoyu Ren) [Guoyu Ren, China]	Accepted - reference added
30214	75	10	75	13	Note that we have submitted a study showing the same co-occurrence for China - Kong, Q., Guerreiro, S., Blenkinsop, S., Li, X.-F., Fowler, H.J. Increases in concurrent drought and heatwave in eastern China. Submitted to Weather and Climate Extremes. [Hayley Fowler, United Kingdom (of Great Britain and Northern Ireland)]	Noted - reference noted for citation after acceptance
55768	75	46	76	5	Could you speak to the effect of increased humidity during heat waves on humans here? [Ariane Middel, United States of America]	Accepted. This is now mentioned in Section 11.8
12898	75	48	76	5	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- beyond mandate of WG1
12900	75	48	76	5	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 CO ₂ -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 CO ₂ in 2030, ~33 billion in 2040, and ~40 billion in 2050, i.e. cumulative savings up to 98 billion tonnes of CO ₂ by 2050.”). [Durwood Zaelke, United States of America]	Rejected- beyond mandate of WG1
12902	75	48	76	5	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- beyond mandate of WG1

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12904	75	48	76	5	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- beyond mandate of WG1
12906	75	48	76	5	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- beyond mandate of WG1
42362	75	48	76	5	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- beyond mandate of WG1
42364	75	48	76	5	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 CO ₂ -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 CO ₂ in 2030, ~33 billion in 2040, and ~40 billion in 2050, i.e. cumulative savings up to 98 billion tonnes of CO ₂ by 2050.”). [Gabrielle Dreyfus, United States of America]	Rejected- beyond mandate of WG1
42366	75	48	76	5	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- beyond mandate of WG1

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
42368	75	48	76	5	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- beyond mandate of WG1
42370	75	48	76	5	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- beyond mandate of WG1
12726	75	48	76	5	With added heat comes increased demand for air conditioning and other cooling strategies, which will require additional energy usage. The mandatory replacement of high-GWP HFCs under the Kigali Amendment provides an opportunity to increase the energy efficiency of cooling appliances utilizing refrigerants. Improving air conditioner energy efficiency 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. 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 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.”). [Kristin Campbell, United States of America]	Rejected- beyond mandate of WG1
46396	75	50			measured [sadegh zeyaeyan, Iran]	Accepted- text corrected
57672	75	50			measured [Sahar Tajbakhsh Mosalman, Iran]	Accepted- text corrected
14002	75	50			measured [saeedeh Kouzegaran, Iran]	Accepted- text corrected
54386	75	52	75	53	It would be useful to include a definition of "uninhabitable" here, or perhaps better still to use an alternative term - affected regions might still be able to be inhabitable with extreme adaptation measures (e.g. remaining indoors on affected days). [Blair Trewin, Australia]	Not applicable - section significantly revised
28940	75	52	75	54	"Uninhabitable" is being used in a technical sense and should be defined. It will not be impossible for humans to live in the Arabian Gulf by 2100 [Matt Tully, Australia]	Not applicable - section significantly revised
36696	75	53	75	53	Persian Gulf [Pakdaman Morteza, Iran]	Not applicable - section significantly revised
40574	75	53	75	53	Please use "Persian Gulf" instead of "Arabian Gulf" [Yashar Falamarzi, Iran]	Not applicable - section significantly revised
46282	75	53	75	53	Please change the wrong phrase of the "Arabian Gulf" to "Persian Gulf" [sadegh zeyaeyan, Iran]	Not applicable - section significantly revised
57558	75	53	75	53	Please change the wrong phrase of the "Arabian Gulf" to "Persian Gulf" [Sahar Tajbakhsh Mosalman, Iran]	Not applicable - section significantly revised
46394	75	53			According to Official documents of the United Nations (e.g. AD/311/1/GEN, ST/CS/SER.A/29/ADD.1, ...), the Arabian Gulf should be changed to "Persian Gulf". [sadegh zeyaeyan, Iran]	Not applicable - section significantly revised
57670	75	53			According to Official documents of the United Nations (e.g. AD/311/1/GEN, ST/CS/SER.A/29/ADD.1, ...), the Arabian Gulf should be changed to "Persian Gulf". [Sahar Tajbakhsh Mosalman, Iran]	Not applicable - section significantly revised
26184	75	53			Persian Gulf [iman babaeyan, Iran]	Not applicable - section significantly revised
14000	75	53			According to Official documents of the United Nations (e.g. AD/311/1/GEN, ST/CS/SER.A/29/ADD.1, ...), the Arabian Gulf should be changed to "Persian Gulf". [saeedeh Kouzegaran, Iran]	Not applicable - section significantly revised
13292	75	53			Persian Gulf [Mansoureh Kouhi, Iran]	Not applicable - section significantly revised

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
43950	76	5	76	5	Suggest to add this sentence to end of paragraph here: "WBGTT has had a detectable anthropogenic increase over many land regions since the 1970s (medium confidence), driven by anthropogenic increases in temperature (Knutson and Ploshay 2016; Li et al. 2017)." References cited: 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 Li, C., Zhang, X., Zwiers, F., Fang, Y. and Michalak, A. M. (2017), Recent Very Hot Summers in Northern Hemispheric Land Areas Measured by Wet Bulb Globe Temperature Will Be the Norm Within 20 Years. Earth's Future, 5: 1203-1216. doi:10.1002/2017EF000639 [Thomas Knutson, United States of America]	Accepted - text changed
46168	76	8	76	8	Good: I strongly recommend to include geomorphological extremes. Some recent literature is available on the subject, which might be cited. [Marina Baldi, Italy]	Rejected - the section focuses on a small number of compound event types with meteorological/climatological foci and where literature has been published
15388	76	8	76	11	Please add some information about mudflows/mudslides/lanfslides, avalanches, wildfires, pest outbreaks etc. [Oksana Lipka, Russian Federation]	Rejected- beyond mandate of WG1
35324	76	8	76	11	Another type of compound event is heat waves and extreme surface ozone. There is evidence that heat waves and high ozone events co-occur with severe impacts; interestingly, as future heat waves become more intense, all the scenarios have ozone precursors going down in regions of North America and Europe, such that future heat waves in those regions have actually lower surface ozone; however, in areas of Asia and Africa where ozone precursors are not projected to decrease, future more intense heat waves produce ever more severe surface ozone events: Meehl, G.A., C. Tebaldi, S. Tilmes, J.-F. Lamarque, S. Bates, A. Pendergrass, and D. Lombardozzi, 2018: Future heat waves and surface ozone. Env. Res. Lett., http://iopscience.iop.org/article/10.1088/1748-9326/aabdc . [Gerald Meehl, United States of America]	Accepted - ozone discussed
53870	76	8			Could you consider flash floods within droughts? This is a topic of interest within the humanitarian community. [Erin Coughlan de Perez, United States of America]	Rejected - literature not available to support such an assessment.
48742	76	14	76	14	There is potential or actual overlap with findings presented here and in Ch 12 and the Atlas which should be addressed in the SOD. [Richard Jones, United Kingdom (of Great Britain and Northern Ireland)]	Accepted: The references on extremes from Atlas and Chapter 12 were moved to Chapter 11.
48652	76	14	76	20	Regional Information - subsection.11.9 overlap with Atlas.5 [Lincoln Alves, Brazil]	Accepted: The references on extremes from Atlas and Chapter 12 were moved to Chapter 11.
54306	76	14	83	35	There is currently substantial overlap between the regional section of Chapter 11 and the relevant parts of the Atlas. I will leave it to those chapters to resolve what goes where (and to check the consistency of any material which does appear in both chapters). [Blair Trewin, Australia]	Accepted: The references on extremes from Atlas and Chapter 12 were moved to Chapter 11.
26814	76	14	83	35	I was unable to motivate myself to read all this, but as this seems to repeat much of the information already given, it will be essential that the authors make revisions consistently. [Thorsten Mauritsen, Sweden]	Accepted: Section 11.9 was restructured.
46170	76	23	76	23	[PLACEHOLDER for SOD: Possibly include Middle East: a lot of literature is now available] [Marina Baldi, Italy]	Accepted.
21980	76	27	76	35	When stating the assessments from SREX throughout Section 11.9, should some context of what is meant by "future" or "projected"? That is, is it clear elsewhere in AR6 what the future scenarios used in SREX are? As currently written "in the future" is vague (is it RCP8.5?). [Gwenaelle GREMION, Canada]	Not Applicable: The Section was restructured. We kept only Tables in Section 11.9
21998	76	30	76	31	Missing level of confidence. Text should be: "With high confidence, this warming is likely to continue ..." [Gwenaelle GREMION, Canada]	Accepted: we have added the confidence level in the SOD.
22000	76	40	77	8	The level of confidence in the assessments is not stated in the text. It should be derived from Table 11.3 [Gwenaelle GREMION, Canada]	Not Applicable: The Section was restructured. Only tables are kept
44152	76	51	76	52	In regional tables (table 11.3) several heavy rain-indices such as 'R10mm', 'R20mm', SDII, RX5day' are highlighted but an explanation of these indices is lacking (see 11.9.1 on p 76, line 51-52). 'Chapter 11, page 76, line 51-52: Please explain the definitions of the heavy rain indices R10mm, R20mm, SDII and RX5day' [Dorcas Kalele, Kenya]	Noted: All acronyms were added to in Annex 7 (AVII.2)
50096	76	55	76	55	"consistent with a wetting tendency." I would add at the end and continue the sentence with "except for the western side (Sénégal) where significant increase of CDD has been reported." [ARONA DIEDHIOU, Cote d'Ivoire]	Not applicable. The section was restructured. Only tables are kept

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
21996	76		77		Text on changes in drought not consistent with table 11.3. e.g. "West and South Africa, projections show an increase in precipitation intensity and drought duration and intensity" vs "Lack of agreement in sign of change of CDD" in table 11.3; "increase in length of dry spells (CDD) projected with exception of central and eastern Africa. Table 11.3 says insufficient evidence to assess trends for SAH and West Africa as well as central Africa, NEAF and CEAF. [Gwenaelle GREMION, Canada]	Not Applicable: During LAM3 we decided to keep only Tables at Section 11.9
21982	76		82		After the SREX Ch3 summary for each region consider including 2-3 sentences summarizing updates/changes since the SREX, e.g. increases in data coverages, changes in confidence generally, number of new studies for the region. For some regions these could be moved from the following paragraph (which otherwise focuses on observed temperature trends). This would help connect the paragraph on SREX with the subsequent summaries from this report. E.g. for Africa, "Since the SREX report, more than 15(?) new studies have been published on extremes over Africa. This has led to increased confidence in observed increases in warm temperature extremes across much of Africa; although confidence in observed trends in extreme precipitation and droughts remains low to medium." [Gwenaelle GREMION, Canada]	Not Applicable: During LAM3 we decided to keep only Tables at Section 11.9
21984	76		82		The use of metrics is quite inconsistent across these regional sections, ranging from very general, (e.g. "temperature extremes" in Australasia section), to very specific (e.g. "Excess Heat Factor" in Asia section; 'RX5day, PRCPOT' etc in Australasia). In addition even general terms are not used consistently, with 'Extreme precipitation' used in Africa section, vs 'heavy precipitation' in Australasia, although the indices then referred to are very similar (e.g. R20mm, R95p) suggesting the terms are interchangeable? Suggestion to define common, relatively general terms to use consistently throughout the text (e.g. hot/cold temperature extremes, heat waves, heavy precipitation extremes) and leave specific details for the tables. [Gwenaelle GREMION, Canada]	Accepted and corrected.
21986	76		82		Including changes in specific indices (e.g. page 76, line 52; page 79, line 4) leaves ambiguity on whether these are the only indices in which changes were detected (i.e. low agreement across different extreme indices), or whether these were the indices that analysis has been performed for. If the latter, using more general terms in the text (with details in tables 11.4 to 11.8) would help this. If the former, this should be explicitly stated. [Gwenaelle GREMION, Canada]	Not Applicable: During LAM3 we decided to keep only Tables at Section 11.9
21988	76		82		There is often ambiguity about whether changes are referring to a change in frequency, amplitude, duration, or all. Clarifying consistent language across the chapter would be useful. [Gwenaelle GREMION, Canada]	Accepted and corrected.
21990	76		82		In the SREX Ch3 summaries, it is sometimes ambiguous whether changes refer to observed or projected. E.g. Page 11-76, line 27-29. [Gwenaelle GREMION, Canada]	Not Applicable: During LAM3 we decided to keep only Tables at Section 11.9
21992	76		82		Exceptions are often mentioned, without clarifying whether the exception is referring to the confidence, likelihood, or sign of the change. [Gwenaelle GREMION, Canada]	Accepted and corrected.
21994	76		82		Confidence and likelihood statements are used rather inconsistently throughout. E.g. page 11-76, lines 40-55; no confidence or likelihood statements included; page 11-77, lines 34-55, confidence statements used but only one likelihood statement (with no confidence statement); page 11-78, lines 31-55, two likelihood statements without confidence estimates. Suggest to include more confidence statements, and leave the likelihood statements for tables 11.3-11.8. [Gwenaelle GREMION, Canada]	Not Applicable: During LAM3 we decided to keep only Tables at Section 11.9
22004	77	7	77	8	Text is inconsistent with Table 11.3, which states that for West Africa there is lack of agreement in the sign of change of CDD. [Gwenaelle GREMION, Canada]	Not Applicable: The Section was restructured. Only tables are kept
55916	77	9	77	9	...did not focus... [Martin Stendel, Denmark]	Section 11.9 was restructured. We kept only the tables.
46384	77	19			It should be noticed that despite the regional warming, there is still a potential for cold extreme events. Kouzegaran et al, in the paper(2015, statistical period:1992-2012) and PhD thesis (2018, Statistical period:1991-2015) (for the East of Iran) demonstrated that global warming has caused significant changes in the number of summer days, number of tropical nights, and number of warm nights at the regional scale, but it has hardly affected the warming of the coldest minimum temperatures and this shows that, in general, despite the regional warming, there is still a potential for cold extreme events. [sadegh zeyaeyan, Iran]	Taken into account: combined with comment for the middle-east (comment ID: 4170)

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
57660	77	19			It should be noticed that despite the regional warming, there is still a potential for cold extreme events. Kouzegaran et al, in the paper(2015, statistical period:1992-2012) and PhD thesis (2018, Statistical period:1991-2015) (for the East of Iran) demonstrated that global warming has caused significant changes in the number of summer days, number of tropical nights, and number of warm nights at the regional scale, but it has hardly affected the warming of the coldest minimum temperatures and this shows that, in general, despite the regional warming, there is still a potential for cold extreme events. [Sahar Tajbakhsh Mosalman, Iran]	Taken into account: combined with comment for the middle-east (comment ID: 4170)
9820	77	19			it should be noticed that despite the regional warming, there is still a potential for cold extreme events. Kouzegaran et al, in the paper(2015, statistical period:1992-2012) and PhD thesis (2018, Statistical period:1991-2015) (for the East of Iran) demonstrated that global warming has caused significant changes in the number of summer days, number of tropical nights, and number of warm nights at the regional scale, but it has hardly affected the warming of the coldest minimum temperatures and this shows that, in general, despite the regional warming, there is still a potential for cold extreme events. [saeedeh Kouzegaran, Iran]	Taken into account: combined with comment for the middle-east (comment ID: 4170)
14536	77	21	77	32	In East Asia, the Qinghai-Tibetan Plateau, South Asia, the Hindu Kush Himalaya, Central Asia or Northwest China, Asian continent on a whole, the East China and Yellow Seas, and some other regions of Asia, many studies reported significant change in extreme climate events frequency, and you may hope to make a new search and review of the publications (e.g. Zhan YJ et al., 2016-2019; You QL et al., 2007-2017; Choi et al., 2007; Klein Tank et al., 2006; Chen YN et al., 2010-2018; Sun XB et al., 2017; K.-C. Om et al., 2018-2019; Li Y. et al., 2015-2019). (CUG, Guoyu Ren) [Guoyu Ren, China]	Accepted, many new references are added for this region. We note that quite a few papers cited by the reviewer are old and are not included in this assessment.
22006	77	25	77	25	Missing likelihood. Should be: "to project a likely increase" [Gwenaelle GREMION, Canada]	Accepted: text revised
22002	77	36	77	36	It is unclear from these text what the Ecess Heat Factor (EHF) is. How is it different than a maximum temperature metric? Does it take into account duration? [Gwenaelle GREMION, Canada]	Accepted: The EHF is a metric for heatwave intensity which is calculated based on a three-day-averaged daily mean temperature.
28462	77	41	77	44	Imada et al. (2019) also found substantial impacts of human activity on the July 2018 heat wave in Japan. Imada Y., M. Watanabe, H. Kawase, H. Shiogama, and M. Arai (2019) July 2018 heat waves in Japan could not have happened without human-induced global warming. SOLA, in press https://www.jstage.jst.go.jp/article/sola/advpub/0/advpub_15A-002/_article [HIDEO SHIOGAMA, Japan]	Accepted: Defined in SOD
54388	77	46	77	47	What does "140% increase of urban heat island" mean - is it magnitude (and if so, mean or extreme?), area affected or something else? [Blair Trewin, Australia]	Accepted: This is related to a projection of heatwaves showing an increase of heat accumulation by 140% under RCP 8.5 scenario.
22010	77	49	77	55	No assessment is given with respect to dryness. Projections are missing confidence levels. [Gwenaelle GREMION, Canada]	Accepted: text revised
44870	77	49	78	5	This section requires further improvement, especially Line 49 - 55 of page 77, line 1-5, page 78. No or very minimal coverage for Southeast Asia region. I would like to point to an article Tangang et al. (2018) on future projection of annual precipitation extremes over Southeast Asia under global warming of 2oC. The key finding was, significant increases of CDD are projected over Indonesian region, especially, central-southern Sumatra, Java and Kalimantan. This is also consistent a recently published article Ge (2019). 1. Tangang, F., Supari, S., Chung, J., Cruz, F., Salimun, E., Ngai, S., . . . Hein-Griggs, D. (2018). Future changes in annual precipitation extremes over Southeast Asia under global warming of 2°C. APN Science Bulletin, 8(1). doi:10.30852/sb.2018.436, 2. Ge et al. (2019), Risks of precipitation extremes over Southeast Asia: does 1.5 °C or 2 °C global warming make a difference?, Environ. Res. Lett. 14 (2019) 044015. [Fredolin Tangang, Malaysia]	Accepted: the discussion on the Southeast Asia has been improved in the SOD
22008	77	51	77	53	Changes at the medium confidence level are described in the text, but not reflected by Table 11.4. [Gwenaelle GREMION, Canada]	Accepted: It has been revised in the SOD
48118	77		78		10.4.2.2.9 and 11.9.2 both cover urban heat island effect including heat and precip extremes. Additionally, section 8.2.2.2.7 discusses direct anthropogenic influence on the water cycle (precipitation modification). Please ensure correct cross-references where appropriate and minimise overlaps where possible. [WGI TSU, France]	Accepted: Section 11.9 was restructured.
22012	78	2	78	5	Paragraph too short. Should be made longer based on Table 11.4 [Gwenaelle GREMION, Canada]	not applicable. The text and tables are restructured in SOD and the relevant text is removed.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
46296	78	5	78	5	propose to add "some evidence show that during last decade, maximum temperature values have increased significantly in many regions of the Middle East countries such as Iran. also, decreasing rainfall (except in the northern and western parts of Iran) has led to severe drought in most parts of these countries." [sadeh zeyaeyan, Iran]	Rejected: this is to specific (literature is not available)
57572	78	5	78	5	propose to add "some evidence show that during last decade, maximum temperature values have increased significantly in many regions of the Middle East countries such as Iran. also, decreasing rainfall (except in the northern and western parts of Iran) has led to severe drought in most parts of these countries." [Sahar Tajbakhsh Mosalman, Iran]	Rejected: this is to specific (literature is not available)
30216	78	20	78	22	You should examine this statement again in light of results from Guerreiro et al. 2018 NCC (DOI: 10.1038/s41558-018-0245-3.) as this shows increases in heavy rainfall at daily and sub-daily scales. [Hayley Fowler, United Kingdom (of Great Britain and Northern Ireland)]	Noted: However this comment does not apply here as this paragraph refers to what was stated in the SREX report. This reference was considered in the current AR6 assessment.
28942	78	20	78	33	Note that "South Australia" as a proper noun is a particular state of Australia, but there is no state of "North Australia". I don't think you mean "South Australia" but southern Australia and northern Australia. [Matt Tully, Australia]	Noted: The confusion comes from the fact that the text refers to the name of the region "South Australia" and that is why is written in upper case.
54392	78	31	78	44	Note for reference (no action required at this stage) that a further overview paper on observed temperature extremes over Australia (including some extreme types not currently assessed in the literature) should be submitted by the December 2019 deadline. [Blair Trewin, Australia]	Noted
54390	78	40	78	41	"usually linked to changes in precipitation" - might be clearer if stated as "mostly in areas which have experienced decreased cool-season precipitation" [Blair Trewin, Australia]	Accepted: text revised
43118	79	12		13	I would dispute the New Zealand bit of "There is low confidence in projected changes in extreme precipitation over Australia and New Zealand for the future by the end of the 21st century." Rosier et al 2015 and work currently under review show that there is a fairly strong increase in extreme precip in the west of the South Island and in the Northern half of the North Island. There are competing effects on the east coast of the South Island. [David Frame, New Zealand]	Noted: It should be clear however that the statement refers to future changes while the reference provided by the reviewer refers to the attribution of present events. We considered this reference and subsequently published work in our assessment. While Rozier et al (2015) shows an increase in 5-day total precipitation as simulated using a "natural" and "all" forcings, the study uses a single model that overall performs quite poorly (large dry bias compared to observations). It is unlikely that this will change the overall assessment. The paper is only restricted to Northland.
48596	79	22	79	23	With regard to the frequency of TCs affecting the northern Australian region, Tauvale and Tsuboki (2019) also showed decreasing trend in total number of TC and increasing trend in number of strong TC in this region using the new dataset (Figs. 6a and 6d). Tauvale, L., and K. Tsuboki, 2019: Characteristics of tropical cyclones in the Southwest Pacific. J. Meteor. Soc. Japan, 97, 711-731. DOI: https://doi.org/10.2151/jmsj.2019-042 . [Kazuhiisa Tsuboki, Japan]	Accepted: text has been revised and it now includes this reference.
22014	79	22	79	23	There are additional studies that suggest a decrease in tropical cyclones in this region under future warming scenarios, e.g. Yoshida et al., 2017; doi: 10.1002/2017GL075058. [Gwenaelle GREMION, Canada]	Accepted: text has been revised as follows: "There is low confidence in a future decrease of the total number of tropical cyclones over northeast Australia (Yoshida et al., 2017)".

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
46172	79	35	79	35	Regarding EU, I suggest to add and cite in the text some more recent literature, and, among others, the following: - Zollo, Alessandra Lucia, et al. "Extreme temperature and precipitation events over Italy: assessment of high-resolution simulations with COSMO-CLM and future scenarios." International Journal of Climatology 36.2 (2016): 987-1004. - Santos, Mónica, Marcelo Fragoso, and João A. Santos. "Regionalization and susceptibility assessment to daily precipitation extremes in mainland Portugal." Applied Geography 86 (2017): 128-138. - Samuels, Rana, et al. "Evaluation and projection of extreme precipitation indices in the Eastern Mediterranean based on CMIP5 multi-model ensemble." International Journal of Climatology 38.5 (2018): 2280-2297. - Tölle, Merja H., Lukas Schefczyk, and Oliver Gutjahr. "Scale dependency of regional climate modeling of current and future climate extremes in Germany." Theoretical and applied climatology (2017): 1-20. - Nastos, P. T., and J. Kapsomenakis. "Regional climate model simulations of extreme air temperature in Greece. Abnormal or common records in the future climate?." Atmospheric Research 152 (2015): 43-60. - Pakalidou, Nikoletta, and Petroula Karacosta. "Study of very long-period extreme precipitation records in Thessaloniki, Greece." Atmospheric Research 208 (2018): 106-115. [Marina Baldi, Italy]	Accepted: with the exception of the study of M. Santos was not included since it does not focus on recent trends and/or projections
51434	79	35	79	35	this section could use a reference to the Atlas chapter, for instance to Figure Atlas.59 that shows projected changes in extreme precipitation and min/max temperature in Europe [Bart Van den Hurk, Netherlands]	Accepted: References to Figure 59 of the atlas has been included.
15390	79	35	80	24	Eastern Europe in SREX is in NAS (merged with Northern Asia). Please add relevant information about extreme events in Eastern Europe as this subchapter is describing Europe. Eurasian Arctic, including European part, is out of SREX report. Please add relevant information here. [Oksana Lipka, Russian Federation]	Rejected: The references included for the European continent include both Western and Eastern Europe. There are citations to studies Northern Europe as well
24428	79	35			All statements on trends, increases, changes etc. should be accompanied with a period for which they are valid. Summarizing trends and changes over very different periods without explicitly mention periods is misleading and should be avoided. [Ralf Weisse, Germany]	Accepted: In general the trends refer to the period that expand from 1950 to the present throughout the chapter and the Figures cover this period. In the cases in which very different periods are used, this is stated in the chapter.
22016	79	49	79	49	NEU, and other European regions, are not defined in this section. [Gwenaëlle GREMION, Canada]	Accepted: Defined in the SOD
30218	80	7	80	9	I find the wording here curious. I don't think you can make statements about rainfall extremes for summer without disentangling the duration aspect. Studies show that short-duration extremes are likely to increase (at least from CPMs) see Kendon et al 2014 NCC etc. But in general you have a reduction in summer mean rainfall and therefore by definition the longer duration extremes decrease. But you have them bundled up into one sentence about rainfall extremes! [Hayley Fowler, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - Most studies on summer are indeed based on short duration extremes, we have added this fact to the statement.
32390	80	9			The paper below found that including the impact of NAO can alter the magnitude and significance of any measured trend in extreme 1 day rainfall in the UK. They also found that +ve NAO in winter does not increase the extreme rainfall as much as expected, potentially due to the higher transit speed of extra-tropical cyclones in +va NAO conditions. Such NAO effects and ETC changes would affect most of N Europe. The drivers of variability in UK extreme rainfall, Brown, Simon J. INTERNATIONAL JOURNAL OF CLIMATOLOGY Volume: 38 Supplement: 1 Pages: E119-E130 Published: APR 2018 [Simon Brown, United Kingdom (of Great Britain and Northern Ireland)]	Rejected: We think that the suggested reference would be more suitable in the section 11.4.1 in which the mechanisms and drivers of extreme precipitation are discussed. In any case, we find the topic of the article very regionally focussed for the section.
48668	80	27	80	27	for South America there is a lack of references. There are more references that must be included as for example there are papers from Marengo that studies the drought in the Amazon, for Southern SA there is a paper Coelho et al. (2014) that shown the mechanism for the dry during 2014-2015 and Zili et al. (2017) [Lincoln Alves, Brazil]	Accepted: Most of our references are inside the tables. Zilli et al. (2017), Marengo and Bernasconi (2015), Marengo et al. (2016), Marengo and Espinoza (2016) are in Table 11.7. Coelho et al. (2016) was not included because it only investigates the JFM 2014 drought, there is nothing about present or future drought's tendencies over SA. It was included in Table 11.7: Marengo et al. (2017), Brito et al. (2018).

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
48654	80	27	81	38	Central and South America (11.9.5) overlaps with Atlas.5.5 [Lincoln Alves, Brazil]	Accepted: The references on extremes from Atlas and Chapter 12 were moved to Chapter 11.
48658	80	27	81	38	add more references [Lincoln Alves, Brazil]	Accepted: The following papers were included in Table 11.7: Diffenbaugh and Giorgi (2012); Teichmann et al. (2013); De Barros Soares et al. (2017); Rusticucci et al. (2017);
48656	80	44	80	44	replace for South America [Lincoln Alves, Brazil]	Accepted: Replaced by Central and South America
54394	80	44	80	44	Replace "Asia" with "Central and South America" [Blair Trewin, Australia]	Accepted: Replaced by Central and South America
40392	80	44	80	44	Minor comment: "South America" instead of "Asia" [Vanessa Pántano, Argentina]	Accepted: Replaced by Central and South America
31822	80	54	81	2	Check for consistency with 10.4.2.2.4 (please see my comments to the tables) [Anna Sörensson, Argentina]	Accepted: The phrase was changed and Figure 10.19 was used to explain the mechanisms contributing to SESA summer wetting.
31820	81	25	81	25	Check for consistency with 10.4.3.2.4 (please see my comments to the tables) [Anna Sörensson, Argentina]	Accepted: The text 10.4.3.2.4 is being called now in the end of the phrase.
48768	81	25	81	31	This paragraph on the projections of rainfall extremes is lacking on the robust model projections for increased rainfall in coastal Ecuador and northern Peru reported in AR5 (Fig. 12.22 in the AR5 WG1 report). The SREX report lumped all of coastal South America into a single index, despite strong differences between the equatorial and subtropical regions and this WG1 report should be more nuanced. Enhanced rainfall in the near-equatorial region is contributed by both mean warming (Power et al 2013, doi:10.1038/nclimate2100; Cai et al, 2014, doi:10.1038/nclimate2100; Jauregui and Takahashi, 2017, doi:10.1007/s00382-017-3745-3) and increased frequency of El Niño-related strong eastern Pacific warming (Cai et al, 2018, doi:10.1038/nature12580). [Ken Takahashi, Peru]	Rejected: Although it is clear in the Figure Atlas.57 (AR5 global models), it is not a clear sign among other regional projections.
9806	81	41	82	19	Given that tropical cyclones are one of the costliest natural disasters that impact North America in general, and the United States in particular, it is disappointing and a bit confusing that a summary of the regional weather and climate extremes facing North America now and in coming decades/centuries would not specifically mention changes to these types of storms and the coastal risk they imply. Although precipitation extremes are discussed, I think that this section needs to include some discussion of tropical and extra tropical cyclones as well. [Andra Garner, United States of America]	Not Applicable: In Section 11.9 we kept only Tables (11.3-11.8), with the same structure for all continents: Temperature Extremes, Precipitation Extremes and Droughts, dryness and aridity. The text about tropical cyclones is in Section 11.7 (Extreme Storms).
54396	81	46	81	46	"cooling of average temperatures" - the current wording makes it look more widespread than it actually was (presumably this is a reference primarily to the southeast US "warming hole"?) [Blair Trewin, Australia]	Accepted: Changed "Changes in temperature extremes over central North America and the eastern United States was consistent with the cooling of average temperatures" to Changes in hot days, and to a lesser extent warm nights, over central North America and the eastern United States was consistent with the observed cooling of average summer temperatures (figure 11.3)
22018	82	12	82	15	Why is Hurricane Harvey the benchmark here? What about Hurricane Florence-like events in the Carolinas? This seems very specific - and limiting. [Gwenaëlle GREMION, Canada]	This is because there have been a number of papers specifically about Harvey and Texas. We don't have a similar body of literature for Florence or other similar events. We feel that "Harvey-like" extreme events is a reasonable way to couch things.
43952	82	18	82	19	"There is also high confidence for future increases in agricultural drought through North America". I did not see convincing evidence to support this conclusion. Models consistently project a decrease in soil moisture in the top 10 cm, but for deeper levels, the sign of change varies regionally and seems to follow precipitation trends. [Thomas Knutson, United States of America]	Accepted. The assessment of drought projections have been rewritten. We fully agree that the increase of agricultural drought in North America is not fully supported by the existing literature.
22020	82	29	83	35	This synthesis section is very similar to the discussion on pages 11-27 to 11-29. Whilst this text is useful in the Executive Summary, here it is rather repetitive from the previous sections. I would suggest to create more of a synthesis that provides a different perspective rather than repeating the information with less details. E.g. maybe organize by present temperature extremes, future temperature extremes, present precip etc, and pull together information from all the different regions to synthesise similarities and variability in regional changes. [Gwenaëlle GREMION, Canada]	Not Applicable: The Section was restructured. We kept only Tables in Section 11.9

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
22022	82	29	83	35	Needs to be updated with new information to be consistent with the regional tables table 11.1 - 11.8. For example, Table 11.3 suggests no agreement for a projected increase in dryness, whereas 11-82 line 41 suggests medium to high confidence in an increase (only north and south Africa show medium - high confidence). [Gwenaëlle GREMION, Canada]	Not applicable. The section was restructured. Only tables are kept
22024	82	29	83	35	Language could be clearer on whether it refers to observed extremes or projected extremes. [Gwenaëlle GREMION, Canada]	Not Applicable: The Section was restructured. We kept only Tables in Section 11.9
14260	82	40		50	A summary section is useful but some physical insight would make this more interesting and I think it is simpler to read if we avoid the syntax "increase (decrease) of CDD over South Africa (West Africa)" and write out sentences in full rather than as logical code. The English in paragraph 2 of this section also just needs checking. [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted
50098	82	41	82	41	"exceptSahara" change to "except Central Sahel and Sahara" [ARONA DIEDHIOU, Cote d'Ivoire]	Not applicable. The section was restructured. Only tables are kept
15392	82	44	82	50	It is crucially important to understand with hot temperature extrem rising and general wetting: how will it affect, for example, probability of droughts in the arid parts of Asia. Please add the information. Other issue - how summer hot extremes may affect permafrost in Siberia and high Asian mountains, because this is closely connected to compound effects? [Oksana Lipka, Russian Federation]	Noted. These regional and local specific details are beyond the scope of this assessment and are not included in the assessment.
44874	82	45	82	50	There is no mentioning of changes in East Asia and Southeast Asia. How come? [Fredolin Tangang, Malaysia]	Taken into account: combined with comment ID 44870
48666	83	17	83	17	"The hot extremes have decreased during austral summer" - What is the reference? There are some papers concerning this issue, but in annual scale, not by seasonal. [Lincoln Alves, Brazil]	Rejected: See Figure 4 in Rusticucci et al. (2017)
26816	83	38	85	13	This section is actually really nicely written and I was happy to actually make it all the way to it. I personally do not understand why this discussion is kept at the end of the chapter? I would recommend moving it to the framing. [Thorsten Mauritsen, Sweden]	ACCEPTED. The section has been moved towards the beginning of the chapter and is now part of section 11.2
52894	83	38			The discussion of storylines (in the sense of Zappa and Shepherd, J Climate, 2017) should be an integral part of all the previous projection discussions, where appropriate. [Douglas Maraun, Austria]	ACCEPTED. The method of storylines following Zappa and Shepherd is now introduced in section 11.2.
7034	83	40	83	40	"The SREX assessed" what is the reference? year? 2012? Missing reference to this SREX document in bibliography. Reference could be added here inline (or in footnote) : Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX). [Elena Maksimovich, France]	REJECTED. This is introduced at length in the beginning of the chapter, and mentioned in every section as a point of departure. The section is now part of section 11.2 so closer to the framing which should make the context clear.
7036	83	40	83	40	auto reference by IPCC AR6 to IPCC-SREX is not a great idea, especially if the referenced document is 7-years OLD [Elena Maksimovich, France]	REJECTED. The authors have decided that it is helpful to mention the SREX at the beginning of every section as a point of departure given that SREX was the last comprehensive IPCC assessment of extremes. This framing is introduced in section 11.1.
6944	83	40	83	43	Nothing is written in SREX-2012 regarding "low confidence for potential surprises due to tipping points"! Nothing is written in SREX-2012 regarding "thermohaline circulation"! This phrase is WRONG [Elena Maksimovich, France]	ACCEPTED. This sentence has been rephrased.
6946	83	40	83	43	infact, this introductory sentence brings NOTHING interesting or new into this IPCC report. And as I said : the content off this sentence is wrong. [Elena Maksimovich, France]	ACCEPTED - The sentence has been rephrased and the whole section included in the methods section 11.2.
22026	83	40	83	45	I would completely rephrase this paragraph. I needed to stop and re-read the first sentence three times to be sure that I was understanding it correctly. "Following the SREX results, there is low confidence for rare high-impact events. The low confidence does not by itself exclude the possibility of such surprises or neither implies that abrupt and thus surprising changes in climate extremes will occur, it is instead an indication of the poor state of knowledge. At this point, we cannot give a precise probability of potential surprises resulting from tipping points of the global climate system (such as the shutdown of the Atlantic thermohaline circulation) or from poor understanding of climate processes (including climate feedbacks affecting the extremes values of the variables)." [Gwenaëlle GREMION, Canada]	ACCEPTED. These sentences have been rephrased for clarity.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
6948	83	40	83	45	The entire introductory paragraph just says: "we know nothing and we have nothing to say". Why do we write this AR6 report then? [Elena Maksimovich, France]	Not applicable - The paragraph says that our knowledge is very limited which is true for this particular category of climate and weather extremes. There is however new knowledge on particular low-probability events and new methods are suggested which is discussed. As the knowledge is indeed very limited the topic is now part of section 11.2 and not addressed in a separate section.
6950	83	40	83	45	The possible introductory paragraph could be for example, the following. "The major economic and political journals publish more and more climate stories of local extremes and unprecedented events. New York Times, Bloomberg, Reuters, all recognise that changes are of major concern for society and environment. Here we apply the quantitative scale in order to regroup and classify the facts, the scientific evidence and the probabilities of occurrence in future. Past 100 years of observations cannot enough representative of all possible climate extremes which might happen further. Deregulation of climate could only amplify the uncertainty and increase the risk. Air and water pollution, dramatic GHG emissions and global deformation of the surface by the extensive land use - all these changes will certainly affect the vulnerability of ecosystems to extreme events and likely to amplify the extremes itself". [Elena Maksimovich, France]	REJECTED. This would be a great introduction for a scientific paper, but we do not do analysis here, but assess the literature.
6952	83	40	83	45	The possible introductory paragraph could be for example, the following. "Recent extreme events have drawn significant attention while causing unprecedented climate related losses and damages. However, the attribution of local anomalies to natural regional and various anthropogenic factors is not straightforward. [Elena Maksimovich, France]	REJECTED. The intention of the AR6 is to assess new literature since SREX. Hence it is important to provide the context from that report. The attribution is indeed rarely straightforward, this now discussed in the section directly following this section.
22030	83	40	84	12	Consider adding a short description of the concept of 'grey swan' events - events that would not be predicted by historical observations, but can be foreseeable to some degree by adding physical knowledge of the climate system to historical observations (e.g. Lin and Emanuel 2016) Such events are discussed in section 11.10.1 but I think a introduction to the concept in this introductory section would aid understanding here. [Gwenaelle GREMION, Canada]	ACCEPTED
7038	83	42	83	43	please remove "in several climate variables". First of all, there exist only meteorological, but not climate variables! seem like there is a problem with terminology usage. Second comment: by definition we talk about climate and weather extremes, so we don't have to add to "extremes" such kind of precision. [Elena Maksimovich, France]	ACCEPTED
22028	83	47	83	54	rephrase "Likelihood of occurrence and timeframe of potential tipping points and surprises is still difficult to determine, hence there is still low confidence in this area. However, new literature has emerged on surprises and low-probability events. There are events that are sufficiently rare to not have been observed in the historical climate, but whose occurrence is nonetheless plausible within the current state of the climate system. These events can be surprises to many in that the events have not been experienced, although their occurrence could be inferred by statistical means or physical modelling approaches which take the non-stationarity of the distribution of many extremes in a changing climate into account (Chen et al., 2017; Harrington and Otto, 2018a; van Oldenborgh et al., 2017)." [Gwenaelle GREMION, Canada]	ACCEPTED. Slightly rephrased but simplified as suggested.
7040	83	49	83	49	please add after "low probability" the term "rare" events. [Elena Maksimovich, France]	REJECTED. Low-probability is the definition of rare.
7054	83	49	83	49	we read here "one category" BUT where is the phrase with "another category" then? [Elena Maksimovich, France]	ACCEPTED. This has been rephrased.
7042	83	50	83	50	problem with terminology : "historical climate". Please, write instead "have not been observed in the past century". [Elena Maksimovich, France]	ACCEPTED. Replaced with meteorological record which was meant.
7044	83	52	83	52	"have not been experienced" add "yet" = within observational period. Stop phrase before "although" [Elena Maksimovich, France]	ACCEPTED. The sentences have been rephrased for better readability.
7046	83	52	83	53	please, reformulate starting from "although" into a more simple & clear sentence, for ex: "Occurrence of unprecedented events in a changing climate is assessed via stochastic (statistical) and also dynamic process modeling. [Elena Maksimovich, France]	ACCEPTED, this has been done by accepting the suggestion above.
7052	83	53	83	53	please remove the excessive piece of text "which take the non-stationarity ... in a changing climate into account" [Elena Maksimovich, France]	ACCEPTED
7048	83	54	83	54	please, remove all three references: because there is no statement here to justify or prove. The sentence is self explanatory enough. [Elena Maksimovich, France]	REJECTED. The references provide examples of where this method has been applied.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
7050	83	54	83	54	reference to Chen et al (2017) : this study is a mathematical exercise (experiment). It does not improve the knowledge of past or future extremes. And there is nothing useful in this article for this Ch. 11, section 10 "storyline ..." [Elena Maksimovich, France]	REJECTED. The study gives an example of a methodology.
7056	83	54	83	54	replace "approach" by "category" to keep the consistency with the previous text [Elena Maksimovich, France]	ACCEPTED - The term category has been removed from the sentence for clarity, hence approach is kept as it's the better term.
15316	83	54	83	54	I wonder if this idea could be strengthened also by citing those event attribution studies that have assessed unprecedented extremes and concluded they could not have occurred without anthropogenic influence. [Claudia Tebaldi, United States of America]	NOT Applicable - the section has been shortened & incorporated in 11.2, as there are two few studies to make an assessment
7058	83	55	83	55	replace "consequences" by "possibility" [Elena Maksimovich, France]	REJECTED. Consequence is correct here as the literature indeed assesses the consequences for e.g. extreme rainfall following an extreme circulation state.
38934	84	5	84	12	While the statements are true, it should also be mentioned that climate change induced systematic shifts in the location where certain extremes occur can lead to particularly large impact, as population and infrastructure are not adapted to their occurrence. [Uwe Ulbrich, Germany]	ACCEPTED. We agree, that this is important, but it is a point made extensively in WG2, we included a reference to the relevant chapter.
27866	84	5	84	12	Page 11-84 lines 5-12: This paragraph seems to be beyond the scope of WGI as mentioned in this paragraph already. Maybe it is better to leave it out then. [roderik van de wal, Netherlands]	REJECTED - As this is not an assessment but an important contextualisation we think it important to leave this information, we have added a pointer to the relevant chapter of WG2.
22034	84	6	84	7	add the information in parenthesis "(see discussion of risk framework in chapter 7 1)" at the end of the sentence, not in the middle. [Gwenaelle GREMION, Canada]	ACCEPTED
54398	84	14	84	24	Another way of looking at very low-probability events may be to look over a broad spatial area (particularly for events which typically affect relatively small areas, such as extreme precipitation) - e.g. an extreme precipitation event may be a one in several hundred/thousand year event at a specific location but may occur several times per century over a wide region. (One example here is the January/February 2019 rain event centred on Townsville, Australia - it was well beyond previous records in the Townsville area, but broadly comparable events had occurred twice in the 20th century elsewhere along the tropical Queensland coast). [Blair Trewin, Australia]	ACCEPTED - A sentence to this effect has been added in the new section 11.2.4, including the example of Queensland.
22046	84	27	84	27	1980-2005, not 1985-2005 [Gwenaelle GREMION, Canada]	ACCEPTED
22048	84	27	84	27	Replace "low probability of over 10,000 years" with "low probability of less than 1 in 10,000 years". [Gwenaelle GREMION, Canada]	Not applicable - This section did not add enough to the assessment, so has been removed.
38936	84	31	84	31	Rather say: resulting in an increased likelihood of unprecedented events and surprises [Uwe Ulbrich, Germany]	ACCEPTED
22044	84	33	84	36	The values of 6 to 13 °C are derived from an ensemble of simulations of a regional climate model, not CMIP models as the current text implies. Cited reference focuses on France, not whole of Europe, which makes the current text misleading. [Gwenaelle GREMION, Canada]	Not applicable -This section did not add enough to the assessment, so has been removed.
22042	84	34	84	34	CMIP5, not CMIP6 [Gwenaelle GREMION, Canada]	ACCEPTED
22036	84	36	84	39	Combining quantitative (5000-150,000 year event) with qualitative (negligible probability) is somewhat confusing without the graphs of Lin and Emanuel for context. Suggest to add a quantifier after negligible, e.g. (less frequent than 1 in 1 million years) [Gwenaelle GREMION, Canada]	Not applicable - This section did not add enough to the assessment, so has been removed.
51438	84	37	43	0	"probabilities" -> "probability" [Bart Van den Hurk, Netherlands]	ACCEPTED
22038	84	37	84	37	late 21st century, not 20th [Gwenaelle GREMION, Canada]	ACCEPTED
22050	84	37	84	37	Replace "20th" with "21st" [Gwenaelle GREMION, Canada]	ACCEPTED
7060	84	38	84	38	"... to the events ... " : what events ? [Elena Maksimovich, France]	ACCEPTED. This sentence has been rephrased.
22032	84	38	84	39	The reference to Chennai and Houston is unclear and vague. It would be encouraged to reference the event and study the authors are referring to. [Gwenaelle GREMION, Canada]	ACCEPTED. The events are now introduced with year, city, state and reference.
54400	84	38	84	39	This statement seems out of context since Houston and Chennai were primarily extreme rainfall events (assuming the Chennai reference here is to the floods of late 2015, which is not stated) - although storm surge was a contributor in Houston, at least - and this paragraph is focused on storm surge. [Blair Trewin, Australia]	ACCEPTED. The sentence has been deleted.
22040	84	39	84	39	The events mentioned were not previously introduced. It is not obvious for the reader that hurricane Harvey affected Houston. The event at Chennai appears here for the first time. [Gwenaelle GREMION, Canada]	ACCEPTED. The events are now introduced with year, city, state and reference. The whole section has been considerably shortened.
7062	84	39	84	39	please, add info (country+year) "in Chennai (India, 2015) or Huston (USA, Texas, August 2017 - right ??) [Elena Maksimovich, France]	ACCEPTED. These sentences have been rephrased for clarity.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
6954	84	44	84	46	please, remove the phrase "Additionally, there is a limitation ... computing capability .. the climate system" : it is a fake limitation due to limited financial investment or few people to process/analyse/publish the results. [Elena Maksimovich, France]	ACCEPTED. We removed the computing limitations, but there will not be resources to analyse all possible events.
9986	84	51	84	55	Authors should also make reference to South Asian Monsoon,Lenton T. et al. PNAS 105 (6) 1786-1793 (2008); see also criticisms in W. R. Boos, T. Storelmoa Proc Natl Acad Sci U S A.; 113(6): 1510-1515 (2016) [Valerio Lucarini, United Kingdom (of Great Britain and Northern Ireland)]	REJECTED. This is indeed a very relevant reference for an assessment of tipping points in the hydrological cycle (Chapter 8) but not here where we only discuss those that have been analysed with respect to their relevance for unprecedented extremes since AR5.
38938	84	51	85	13	It does not become clear in how far you really refer to tipping points (depending on what the definition of tipping points is). The occurrence of single events of unprecedented intensity is not necessarily a tipping point! [Uwe Ulbrich, Germany]	ACCEPTED - In the literature the use of the term tipping point has evolved since previous assessments. This is reflected in the know broader definition in the glossary. This new use is also introduced in chapter 1. A reference to chapter 1 has been included in this section.
48770	84	54	84	54	The potential for savannization or dieback of the Amazon was reported in AR5 and should also be mentioned as a tipping point that could affect extremes, such as the occurrence of droughts in the Amazon (see review by Marengo and Espinoza, 2016, doi:10.1002/joc.4420). [Ken Takahashi, Peru]	Section 11.10 has been shortened and incorporated into section 11.2, this part of the assessment has been removed as the available literature was too sparse to make an assessment.
7064	85	1	85	2	reference needed after "HECC" abbreviation. For example : Harrison, P.A., Dunford, R.W., Holman, I.P. et al. Reg Environ Change (2019) 19: 695. https://doi.org/10.1007/s10113-018-1352-4 [Elena Maksimovich, France]	Not applicable - Section 11.10 has been shortened and incorporated into section 11.2, this part of the assessment has been removed as the available literature was too sparse to make an assessment.
6956	85	2			reference needed after "HECC" abbreviation. For example : Harrison, P.A., Dunford, R.W., Holman, I.P. et al. Reg Environ Change (2019) 19: 695. https://doi.org/10.1007/s10113-018-1352-4 [Elena Maksimovich, France]	Section 11.10 has been shortened and incorporated into section 11.2, this part of the assessment has been removed as the available literature was too sparse to make an assessment.
52896	85	4	85	13	This seems to be a rather arbitrary example of a tipping point. Is there any reason for this selection? If yes, please state. If no, please add further examples. [Douglas Maraun, Austria]	ACCEPTED. The reason for including it in the FOD was that new literature about this particular topic was available. However, given the very patchy nature of the literature overall the section has been shortened and the mentions removed.
22074	85	5	85	6	"... triggered extreme ice loss over Greenland (Bevis et al., 2019) which can lead to extreme ice loss and thus fresh water intrusion ..." should be replaced by "... triggered extreme ice loss over Greenland (Bevis et al., 2019) which can lead to fresh water intrusion ..." [Gwenaelle GREMION, Canada]	ACCEPTED
7066	85	6	85	6	remove "which can lead to extreme ice loss" : repetition of previous line [Elena Maksimovich, France]	Not applicable - Section 11.10 has been shortened and incorporated into section 11.2, this part of the assessment has been removed as the available literature was too sparse to make an assessment.
7068	85	6	85	6	add "additional" or "supplementary" before "fresh water" [Elena Maksimovich, France]	ACCEPTED
6958	85	6			remove "which can lead to extreme ice loss" : repetition of previous line [Elena Maksimovich, France]	Not applicable - Section 11.10 has been shortened and incorporated into section 11.2, this part of the assessment has been removed as the available literature was too sparse to make an assessment.
6960	85	6			add "additional" or "supplementary" before "fresh water" [Elena Maksimovich, France]	ACCEPTED
7070	85	8	85	8	confusion with terminology "tipping elements" : "elements" should be replaced by "points" . Otherwise - what are these "elements"? [Elena Maksimovich, France]	Not applicable - Section 11.10 has been shortened and incorporated into section 11.2, this part of the assessment has been removed as the available literature was too sparse to make an assessment.
6962	85	8			confusion with terminology "tipping elements" : "elements" should be replaced by "points" . Otherwise - what are these "elements"? [Elena Maksimovich, France]	REJECTED. Element is correct, as it is the system that could become a tipping point.
22072	85	10	85	13	Given that very negative NAO might be a trigger for these extreme events (i.e. the potential occurrence of the events is conditional on the negative NAO), the likelihood of a very negative NAO would provide an upper bound (not a lower bound) on the likelihood of the event. [Gwenaelle GREMION, Canada]	Section 11.10 has been shortened and incorporated into section 11.2, this part of the assessment has been removed as the available literature was too sparse to make an assessment.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
22076	85	10	85	13	This section appears to be highly speculative and not well supported by the four references cited. A reference that might provide additional evidence is: Bryden, H. L., King, B. A., McCarthy, G. D. & McDonagh, E. L. Impact of a 30% reduction in Atlantic meridional overturning during 2009–2010. <i>Ocean Sci.</i> 10, 683–691 (2014). [Gwenaelle GREMION, Canada]	Section 11.10 has been shortened and incorporated into section 11.2, this part of the assessment has been removed as the available literature was too sparse to make an assessment.
52898	85	16			I would add that understanding of changes in the large-scale circulation leading to extreme events is still a key knowledge gap. Similarly, changes in convection under CC are still poorly understood. [Douglas Maraun, Austria]	Noted. This section will be renamed as Limit to the assessment in FGD.
22052	85	20	85	24	Suggestions to include: Understanding of projected changes in severe thunderstorms/tornadoes (Trapp et al 2007, Brooks 2013, Diffenbaugh et al. 2013, Tippet et al. 2015, Brooks et al. 2014), and understanding of projected changes in storm clustering (Mailier et al. 2006, Vitolo et al. 2009, Priestly et al 2018, Walz et al. 2018) [Gwenaelle GREMION, Canada]	Noted. This section will be renamed as Limit to the assessment in FGD.
7072	85	21	85	21	"such AS" instead of "such HAS" [Elena Maksimovich, France]	Editorial - copyedit to be completed prior to publication
7074	85	21	85	21	after "hail" you can add "thunder storms and lightnings" [Elena Maksimovich, France]	Considered but no change is made. We would consider hail as a phenomena of kind extremes as hail is often related to server storm. Thunder storms and lightnings are more a very day phenomena and are not considered as extreme.
6964	85	21			"such AS" instead of "such HAS" [Elena Maksimovich, France]	Editorial - copyedit to be completed prior to publication
6966	85	21			after "hail" you can add "thunder storms and lightnings" [Elena Maksimovich, France]	Considered but no change is made. We would consider hail as a phenomena of kind extremes as hail is often related to server storm. Thunder storms and lightnings are more a very day phenomena and are not considered as extreme.
22054	85	29	88	4	This is a very long and detailed section, but the take-home point is not terribly clear - most of the box focuses on times when current observed values have been exceeded in the past, but then the summary paragraph at the end focuses on the idea that some recent extremes may not have been exceeded in the past 2000 years. I suggest removing some of the more detailed sentences, in favour of a synthesis of results, and expanding on the last paragraph to discuss more about the implications of this research, perhaps including potential implications in terms of attribution of recent extremes to anthropogenic climate change [Gwenaelle GREMION, Canada]	Noted - the box has been restructured and focused
46174	85	29	88	4	I suggest to shorten, if not delete completely, the BOX 11.2: Extremes in palaeoclimate archives [Marina Baldi, Italy]	Rejected - box has been shortened but not deleted
22062	85	31		51	Please consider adding a sentence at the end of these lines to provide an outline of BOX 11.2. such as '(i) AR5 recall, (ii) droughts worldwide, (iii) temperature extremes from synthesizing proxy records, (iv) paleoflood records, (v) past cyclone reconstruction, (vi) discussion about challenges in compilation of long-term changes in extremes, (vii) discussion about challenges in compilation of short-term changes in extremes, (viii) wrapping comments [Gwenaelle GREMION, Canada]	Accepted -text revised
22070	85	31		55	Avoid using the term 'we' [Gwenaelle GREMION, Canada]	Accepted - text revised
22064	85	33		36	Consider removing the last part of the sentence from 'even though human influence' to 'difficult to quantify' as anthropogenic impact remains not (or less) significant before ca.1920 [Gwenaelle GREMION, Canada]	Rejected - anthropogenic influences has been demonstrated in several studies prior to 1920.
22060	85	34	85	34	Suggestion: ...occurring in the instrumental records (referred to here as 'observed extremes'). Perhaps a useful reiteration that observed refers to instrumental records only, in contrast to paleoclimate data and documentary evidence, since this term "observed extremes" is used a lot in this box. [Gwenaelle GREMION, Canada]	Accepted - text revised to include clarity of terms 'observed extremes'
7076	85	42	85	42	replace "quality" by "precision" [Elena Maksimovich, France]	Not applicable - section deleted
6968	85	42			replace "quality" by "precision" [Elena Maksimovich, France]	Not applicable - section deleted
22056	85	44	85	51	Following the summary of the AR5, I suggest including a short summary of how and why there are changes to these conclusions in this report, before going into the details of the studies. [Gwenaelle GREMION, Canada]	Accepted - text revised and restructured to include summary
54402	85	46	85	46	Suggest adding "in the instrumental period" after "observed". [Blair Trewin, Australia]	Accepted - text revised
7078	85	48	85	49	instead of "noted with ... occurrence of regions" : With the high confidence AR5 identified the regions" [Elena Maksimovich, France]	Not applicable - section deleted

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22058	85	48	85	51	higher than ANY other 30-year period (as it is, it just suggests 1971-2000 was warmer than some other periods in the last 580 years). [Gwenaelle GREMION, Canada]	Not applicable - section deleted
54404	85	48	85	51	This seems more like a means finding than an extremes one. [Blair Trewin, Australia]	Accepted - noted in revised text.
6970	85	48		49	instead of "noted with ... occurrence of regions" : With the high confidence AR5 identified the regions" [Elena Maksimovich, France]	Not applicable - section deleted
22066	85	48		51	Please rewrite this last sentence, difficult to understand. 'The occurrence of regions' has no meaning [Gwenaelle GREMION, Canada]	Not applicable - section deleted
22068	85	53		54	Please consider the following change: 'Overall, the most complete pre-instrumental evidence of extremes are for high-duration and large spatial-scale extremes, such as...' [Gwenaelle GREMION, Canada]	Accepted - text revised
33354	85		88		Chapter 11 did not follow the new IPCC format of incorporating paleoclimate information within the text, and the authors seem to be using Box 11.2 as a way of defending this decision. Many of the critiques in this section are valid, but not more valid than they would be in any of the other chapters, and in fact could apply to other forms of data. I hope the authors will consider making more of an effort to incorporate paleoclimate data into this chapter. There is a recent PAGES publication on this topic: http://pastglobalchanges.org/products/pages-magazine/12813 [Erika Wise, United States of America]	Rejected - the format requires paleoclimate information to be included throughout and not treated within a separate chapter. For Chapter 11, paleoclimate information is assessed in a dedicated box, which permits it to be assessed holistically. As there is little extremes-relevant pre-instrumental information on many types of extremes, this is the most useful way to address this source of evidence.
22082	86	1		4	Please consider mentioning whether droughts have no precedents in terms of intensity and/or frequency [Gwenaelle GREMION, Canada]	Accepted - text revised
22088	86	1		22	I would add a mention about dating uncertainty such as: 'challenges in comparing climate extremes from different archives due to dating uncertainty. While dating error can partly be overcome for targeted paleoclimate variables because changes are interpreted over a 30yr climate window (e.g. mean temperature, cumulative precipitation), dating uncertainty has greater implications when focusing on specific punctal-in-time events.' Even for tree-ring data [Gwenaelle GREMION, Canada]	Rejected - dating uncertainty already mentioned within box 11.2
22084	86	1		55	Avoid using the term 'we' [Gwenaelle GREMION, Canada]	Accepted - text revised
7080	86	2	86	2	"pairs" instead of "precedents" [Elena Maksimovich, France]	Rejected - precedents more commonly use
7082	86	2	86	3	please write "including the" instead of "including for the" [Elena Maksimovich, France]	Not applicable - section substantially revised
6972	86	2			"pairs" instead of "precedents" [Elena Maksimovich, France]	Rejected - precedents more commonly use
46830	86	3	86	3	Ljungqvist et al. (2016) are not supporting unprecedented drying in the Sahel. In fact, Ljungqvist et al. (2016) is not even discussing this issue and the few data points may showing this on the maps in the article is not very robust. However, Ljungqvist et al. (2016) supports unprecedented drying in a twelve-century perspective in Spain and Portugal (although his conclusion may not be that robust either due to possible data noise). [Charpentier Ljungqvist Fredrik, Sweden]	Accepted - reference removed
6974	86	3			"including the " instead of "including for the" [Elena Maksimovich, France]	Not applicable - section substantially revised
44142	86	4	86	4	Add the citation "Wahl et al, 2017" after "Griffin and Anchukaitis, 2014". This work demonstrates that moisture delivery itself -- aside from the multivariate soil moisture drought measures referenced from Griffin and Anchukaitis (2014) and Cook et al. (2014b) -- was likely the lowest during 2012-2015 for any sequential 4-year period since at least 1571 in the heavily populated South Coast and agriculturally intensive southern Central Valley regions of California. This kind of specificity, both spatially and in terms of pure aridity itself, is a key component of the nature of this intense drought in one of the world's most important regional economies. [Citation: Wahl, E., Diaz, H., Vose, R., and Gross, W., 2017, "Multicentury Evaluation of Recovery from Strong Precipitation Deficits in California", Journal of Climate, 30, 6053-6063, doi: 10.1175/JCLI-D-16-0423.1.] [Eugene Wahl, United States of America]	Rejected - this section does not discuss mechanisms and the suggested citation supports the representative examples already provided.
7084	86	8	86	8	please, explain what is "PDSI" [Elena Maksimovich, France]	Not applicable - section substantially revised
22086	86	8		8	PDSi not defined before this point => Palmer Drought Severity Index (PDSI) [Gwenaelle GREMION, Canada]	Not applicable - section substantially revised
6976	86	8			please, explain what is "PDSI" [Elena Maksimovich, France]	Not applicable - section substantially revised
54406	86	14	86	14	1540 AD - where? (presumably Europe from the discussion in the next paragraph) [Blair Trewin, Australia]	Not applicable - section substantially revised
7086	86	15	86	15	"extreme year" in what ? [Elena Maksimovich, France]	Not applicable - section substantially revised
6978	86	15			"extreme year" in what ? [Elena Maksimovich, France]	Not applicable - section substantially revised
7088	86	20	86	20	please simply write "persistent" instead of "large duration". In general we say "large extent" and "long duration", but not the mix of two [Elena Maksimovich, France]	Not applicable - section substantially revised
6980	86	20			"persistent" instead of "large duration" [Elena Maksimovich, France]	Not applicable - section substantially revised

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22092	86	30		32	Consider adding 'both in terms of intensity and frequency' after 'over the last 500 years'. This referring to Barriopedro et al. (2011) and also to his Figure 2b (running decadal frequency of extreme summers). [Gwenaëlle GREMION, Canada]	Rejected - this section refers to intensity not frequency
22090	86	30		40	There is a too strong focus on specific results from specific years (here 1540, 2003, and 2010) for the too specific region in Europe. The reader is lost with details from the literature mentioned here. [Gwenaëlle GREMION, Canada]	Rejected - this section refers to intensity not frequency
7090	86	33	86	33	"2015CE" what means "CE" ? Central Europe? Common Era? [Elena Maksimovich, France]	Accepted - CE now defined in introductory paragraph
6982	86	33			"2015CE" what means "CE" ? Central Europe? Common Era? [Elena Maksimovich, France]	Accepted - CE now defined in introductory paragraph
7092	86	34	86	34	"warmth" or "warming"? [Elena Maksimovich, France]	Not applicable - section substantially revised
6984	86	34			"warmth" or "warming"? [Elena Maksimovich, France]	Not applicable - section substantially revised
22078	86	35	86	38	Study should be cited as Orth et al. 2016a. [Gwenaëlle GREMION, Canada]	Accepted - references have been corrected
22080	86	35	86	38	warmer than observed record extreme temperatures ('current records' is ambiguous as to meaning 'record extreme temperatures' or 'observations' e.g. "since records began") [Gwenaëlle GREMION, Canada]	Accepted - text revised
7094	86	38	86	38	"events " instead of "records" [Elena Maksimovich, France]	Not applicable - section revised
6986	86	38			"events " instead of "records" [Elena Maksimovich, France]	Not applicable - section revised
46832	86	40	86	43	I feel unsure if this is actually supported by what has been said before. Moreover, natural proxy archives typically lack the ability at all to capture extremes. Thus, it is hard to obtain "high confidence" for this statement based on empirical data. [Charpentier Ljungqvist Fredrik, Sweden]	Accepted - text revised
22094	86	40		42	The last sentence is not coherent with the content of the whole paragraph. One cannot use the term 'high confidence' after mentioning that in general studies agree that recent observed European summers have exceeded temperature anomalies over the last 500, except maybe (or not depending on the literature and methods used) for the year 1540 AD. => I would suggest medium confidence and more specifically mentioning FOR EUROPE in this last sentence. We cannot generalized globally a high confidence of observed vs Common Era from a few examples from Europe [Gwenaëlle GREMION, Canada]	Accepted - text revised
30096	86	44	86	45	1) What do you call "the clearest information of paleofloods"? Why "clearest"? Many paleoflood records (coming from many archives) gave "clear" information. 2) "The clearest information of palaeofloods occurs in high temporally resolved records, such as annually laminated lake deposits." Depending on the information we would like to get, there is no link between the temporal resolution of the record and the quality of the information. It's for instance very clear regarding flood magnitude. Paleoflood records with relatively low temporal resolution (due to OSL or 14C dating uncertainties) have been for instance successfully used to i) show that past floods occurred with much higher magnitude at a given place than modern events or ii) to give information to improve flood frequency analyses and, thus, flood hazard assessment and hydraulic infrastructure design. I warmly invite the authors to read the recent review written by a PAGES consortium of paleoflood researchers on the various paleoflood archives and what information they can bring: Wilhelm B., Ballesteros Canovas J.A., Macdonald N., Toonen W., Baker V., Barriendos M., Benito G., Brauer A., Corella Aznar J.P., Denniston R., Glaser R., Ionita M., Kahle M., Liu T., Luetscher M., Macklin M., Mudelsee M., Munoz S., Schulte L., St George S., Stoffel M., Wetter O. (2019) Interpreting historical, botanical, and geological evidence to aid preparations for future floods, WIRES Water, e1318 [Bruno Wilhelm, France]	Accepted - text has been revised to remove this sentence and this reference has been added.
30094	86	44	87	6	As a researcher working on floods with paleorecords, I mainly brought my attention on Box 11.2 "Extremes in paleoclimate archives" and more particularly on the section on paleofloods. In the present state, this section is poor but most importantly contains many unclear, non-sense or wrong statements that are detailed below. I strongly recommend to completely rewrite this section based on i) what was previously published in the AR5 and SREX reports and ii) what was published in the meantime. As a co-leader of the PAGES Floods Working Group (gathering more than a century of paleoflood researchers worldwide), I guarantee that we can offer our help to provide a more relevant and meaningful section that would respond to the key questions about flood variability over time. [Bruno Wilhelm, France]	Noted

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
22098	86	44		55	This paleoflood section greatly lacks literature review, underrepresenting the progress made by the palaeoflood community (E.g. PAGES Floods Working Group). To support my comment, I would like to offer this paragraph rewritten option [part1/4]: "Historical, botanical, and geological archives is providing a wealthy dataset of hundreds of historical and palaeoflood series (Wilhelm et al. 2019). Recent advances in palaeoflood hydrology from different archives such as tree rings (Ballesteros-Canovas et al. 2015), speleothems (Denniston and Luetscher 2017), and sedimentary archives (Longfield et al. 2018) are constantly increasing the world spatial coverage and quality of the reconstructions through validation using documentary evidence (Wilhelm et al. 2018). In particular the clearest information of palaeofloods occurs with high temporally resolved records, such as annually laminated lake deposits. These reconstructions provide evidence, for example, of floods exceeding probable maximum flood levels in the Upper Colorado River, USA (Greenbaum et al., 2014) and peak discharges that are double gauge levels along the middle Yellow River, China (Liu et al., 2014)." [Gwenaelle GREMION, Canada]	Noted - many of these changes have now been made
22100	86	44		55	This paleoflood section greatly lacks literature review, underrepresenting the progress made by the palaeoflood community (E.g. PAGES Floods Working Group). To support my comment, I would like to offer this paragraph rewritten option [part2/4]: "In Europe, annually resolved lake records of flooding provide evidence of pre-instrumental periods of high and low extreme rainfall and flooding in various riverine systems, which can be compared with long-term temperature (e.g. Corella et al., 2014; Wirth et al., 2013), and precipitation variability (Amann et al., 2015). AR5 reported that palaeoflood records derived from lake sediments had shown a higher flood frequency during cool and/or wet phases in the Alps, Central Europe, and the British Isles during the Common Era (Masson-Delmotte et al. 2013). Additional studies have further validated this statement since then, strengthening the temperature-flood frequency and precipitation-flood frequency relationships (e.g. Amann et al., 2015; Swierczynski et al., 2013; Wirth et al., 2013). The combination of extreme historical flood episodes determined from documentary evidence also increase the confidence in flood attribution and magnitude determination, compared to using lower resolution natural archives alone. Historical data includes, for example, peak flow recorded on infrastructure, paintings, photographs, diaries, newspapers and harvest records, which provide information on flood frequency and magnitude over many centuries (Kjeldsen et al., 2014). In regions such as Europe and China that have rich historical flood documents, there is strong evidence of high flood events over historical periods (Benito et al., 2015; Kjeldsen et al., 2014; Liu et al., 2014; Macdonald and Sangster, 2017)." [Gwenaelle GREMION, Canada]	Noted - many of these changes have now been made
22102	86	44		55	This paleoflood section greatly lacks literature review, underrepresenting the progress made by the palaeoflood community (E.g. PAGES Floods Working Group). To support my comment, I would like to offer this paragraph rewritten option [part3/4]: "While pre-instrumental records provide additional insights prior flood characteristics, pre-instrumental floods often occurred in considerably different contexts in terms of land use, irrigation and infrastructure and may not be directly insightful into modern river systems, which further prevents long term assessments of flood changes being made based on these sources. Integrating this pluridisciplinary approach and multi-archive palaeoflood reconstructions remains one of the greatest challenge (Schulte et al., 2019), but which also hold great promise (Schulte et al., 2018). In summary, we have high confidence that the magnitude of floods over the Common Era have exceeded observed records in some locations, including central Europe and eastern Asia." [Gwenaelle GREMION, Canada]	Noted - many of these changes have now been made

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
22104	86	44		55	<p>This paleoflood section greatly lacks literature review, underrepresenting the progress made by the paleoflood community (E.g. PAGES Floods Working Group). To support my comment, I would like to offer this paragraph rewritten option [part4/4]: "Associated new references to the text proposed in the previous comments:</p> <ul style="list-style-type: none"> - Amann, B., et al., 2015. A millennial-long record of warm season precipitation and flood frequency for the North-western Alps inferred from varved lake sediments: implications for the future. <i>Quaternary Science Reviews</i> 115: 89-100 - Ballesteros-Canovas, J.A., et al., 2015. A review of flood records from tree rings - Denniston, R.F., Luetscher, M. 2017. Speleothems as high-resolution paleoflood archives. <i>Quaternary Science Reviews</i> 170: 1-13 - Longfield, S.A., et al., 2018. Incorporating sedimentological data in UK flood frequency estimation. <i>Journal of Flood Risk Management</i> 12: e12449 - Masson-Delmotte, V., Schulz, M., et al., 2013: Information from Paleoclimate Archives. In: <i>Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change</i> - Schulte, L., et al., 2019. Pluridisciplinary analysis and multi-archive reconstruction of paleofloods: Societal demand, challenges and progress. <i>Global and Planetary Change</i> 177: 225-238 - Schulte, L., et al., In press 2019. Integration of multi-archive datasets for the development of a four-dimensional paleoflood model of alpine catchments. <i>Global and Planetary Change</i>. - Swierczynski, T., et al., 2013. Mid- to late Holocene flood frequency changes in the northeastern Alps as recorded in varved sediments of Lake Mondsee (Upper Austria). <i>Quaternary Science Reviews</i> 80: 78-90 - Wilhelm B., et al., 2019. Interpreting historical, botanical, and geological evidence to aid preparations for future floods, <i>WIREs Water</i> 6: e1318 - Wilhelm, B., et al., 2018. Recent advances in paleoflood hydrology: From new archives to data compilation and analysis. <i>Water Security</i> 3: 1-8 [Gwenaelle GREMION, Canada] 	Noted - many of these references have now been included
30098	86	45	86	47	<p>What "These reconstructions" refer to? The two given examples come from fluvial sediments and, thus, they are not "high temporally resolved records, such as annually laminated lake deposits". In addition, there are plenty of case studies showing such "clear" evidence worldwide and coming from various archives. [Bruno Wilhelm, France]</p>	Not applicable - section revised
22096	86	46		46	<p>Porat et al., 2014 should read Greenbaum et al., 2014 (Naomi Porat being the 6th author) [Gwenaelle GREMION, Canada]</p>	Accepted - text revised
30100	86	47	86	49	<p>1) This is partly a wrong statement since lake sediments cannot record low extreme rainfall/flooding (but only high extreme rainfall and flooding). 2) When considering "high extreme rainfall and flooding", this statement applies to all types of paleoflood archives, see the review paper above. [Bruno Wilhelm, France]</p>	Accepted - text revised
30102	86	49	86	50	<p>"We have higher confidence in extreme historical flood episodes determined from documentary evidence". Who is "we"? In any case, this "we" encompass the paleoflood community who recognizes advantages and limitations of each archive (again see e.g. the review paper above). Historical archives clearly provide relevant information about past flooding but there is no scientific argument to consider them as the best. E.g. i) they may provide incomplete records, e.g. because of the loss of sources due to destructions during wars or fires and ii) they are more limited in time than natural archives, precluding to explore the flood variability during past climate states such as those covered e.g. by the PMIP4 experiments. [Bruno Wilhelm, France]</p>	Accepted - text revised
22106	86	49		51	<p>No we do not really have higher confidence from documentary evidence compare to low resolution natural archives, the point is to strengthen paleoflood record from natural paleoflood archives using documentary evidence that can span several centuries; thus validating the flood record obtain from the natural archive (and allowing reach further back in time, then) [Gwenaelle GREMION, Canada]</p>	Accepted - text revised
7096	86	51	86	51	<p>"low resolution natural archives" can be replaced for example by "regional geomorphology"? [Elena Maksimovich, France]</p>	Accepted - text revised
6988	86	51			<p>"low resolution natural archives" can be replaced by "regional geomorphology"? [Elena Maksimovich, France]</p>	Accepted - text revised

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30104	86	55	87	4	1) "provide additional insights prior flood characteristics". This part of sentence should be clarified.. 2) According to these lines, we should reject flood series coming from catchment where human activities occurred. This means that most of instrumental records could not be used for analysis of flood frequency/magnitude trends! In addition, there are a significant number of records from catchments with no or very limited human activities such as those coming from high-latitude/altitude. Finally, this is also the interest of using natural archives that allow going further back in time than historical documents and, then, over periods with less significant human activities. [Bruno Wilhelm, France]	1) Accepted - text revised, 2) Rejected - the text does not state that we should reject these reconstructions
30106	87	4	87	5	This summary is poorer than those of the AR5 and SREX reports, while many results have been published in between. [Bruno Wilhelm, France]	Noted
40466	87	8	87	19	I think this part, related to paleo storms, is a bit poorly referenced. I would suggest the authors to read the recent summary by PAGES on this topic: http://pastglobalchanges.org/products/pages-magazine/12813 [Alessio Rovere, Germany]	Accepted - text revised with additions from noted PAGES publication
7098	87	22	87	24	please, reformulate. Message not clear! [Elena Maksimovich, France]	Noted
6990	87	22		24	please, reformulate. Message not clear! [Elena Maksimovich, France]	Noted
46834	87	25	87	25	Add Asia here. [Charpentier Ljungqvist Fredrik, Sweden]	Accepted - text revised
54408	87	28	87	28	The Tambora eruption was in 1815, not 1816 (although many of its most severe climatic impacts were in 1816). [Blair Trewin, Australia]	Accepted - text revised
7100	87	38	87	38	please replace "large magnitude" by "intense" [Elena Maksimovich, France]	Accepted - text revised
6992	87	38			please replace "large magnitude" by "intense" [Elena Maksimovich, France]	Accepted - text revised
7104	87	49	87	52	the first sentence "While ... observed extremes". It is logic : "local extremes" means "local extremes". We don't have to justify that these recent unprecedented local extremes are not representative for long-term systematic global perspective of changes. The entire paragraph can be resumed "the more data we will have one day = the more solid statements we will have then" : and what ??? Data nd knowledge is always "limited". lets focus on what we have and know - instead of writing paragraphs about "if we had this, we could have done that, but since we don't have everything we want globally, we have nothing to say about multitude of things we have already". Please, remove the entire pagargaph. you will loose the reader with these useless philosophy data-dreams. [Elena Maksimovich, France]	Noted. The paragraph has not been deleted as it is necessary to discuss the data limitations, though the state of knowledge has now been emphasised.
6996	87	49		52	the first sentence "While ... observed extremes". It is logic : "local extremes" means "local extremes". We don't have to justify that these recent unprecedented local extremes are not representative for long-term systematic global perspective of changes. The entire paragraph can be resumed "the more data we will have one day = the more solid statements we will have then" : and what ??? Data nd knowledge is always "limited". lets focus on what we have and know - instead of writing paragraphs about "if we had this, we could have done that, but since we don't have everything we want globally, we have nothing to say about multitude of things we have already". Please, remove the entire pagargaph. you will loose the reader with these useless philosophy data-dreams. [Elena Maksimovich, France]	Noted. The paragraph has not been deleted as it is necessary to discuss the data limitations, though the state of knowledge has now been emphasised.
22108	87	49		55	Paragraph difficult to follow, and too weak to conclude this Box 11.2. I suggest adding recent advances, progress and orientation for drought records, extremes, paleoflood and/or cyclones as wrap up comment to not only highlights drawbacks and challenges, but also societal demand and scientific porgress (and oriented efforts) [Gwenaelle GREMION, Canada]	Noted. The paragraph has been moved earlier as suggested.
7102	87	50	87	50	references needed after "(last 2000 years)" [Elena Maksimovich, France]	Rejected - this summarises evidence discussed throughout
6994	87	50			references needed after "(last 2000 years)" [Elena Maksimovich, France]	Rejected - this summarises evidence discussed throughout
22110	88	11	90	56	Box 11.3 seems very split between the 2015/2016 event and the 2018 event. Some more context of what we should take away from these two examples would be useful, even as simple as (line 25) ...Hereafter we focus on two recent global-scale events that featured concurrent extremes happening at several locations around the globe at the same time. The first focuses on concurrent extremes driven by variability in tropical Pacific SSTs, while the second is a case study of the impacts of global warming combined with abnormal atmospheric circulation patterns. [Gwenaelle GREMION, Canada]	Accepted.
37970	88	11			Change "2015" to "2015/2016", which is more appropriate and what is used on line 41 of this page. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Accepted.

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22112	88	21	88	21	The 0.5C increments suggests a discrete, rather than continuous change, which may be a little misleading [Gwenaelle GREMION, Canada]	Accepted. The text was corrected.
22114	88	23	88	23	Suggest to include Boers et al. 2019 (Nature) as citation for concurrent precipitation extremes [Gwenaelle GREMION, Canada]	Accepted. The following reference is referred to: Boers, N., B. Goswami, A. Rheinwalt, B. Bookhagen, B. Hoskins, and J. Kurths, 2019: Complex networks reveal global pattern of extreme-rainfall teleconnections. Nature, 566, 373–377, doi:10.1038/s41586-018-0872-x. https://doi.org/10.1038/s41586-018-0872-x.
22116	88	44	88	49	Suggest to include a brief summary of possible changes in ENSO with climate change and uncertainty surrounding this. E.g. There is some evidence of more frequent and stronger El Nino events in a warmer climate (e.g. Cai et al. 2014, Power et al. 2013, Santoso et al. 2013), although model biases and disagreement limit confidence (e.g. Kohyama et al. 2018 (GRL)). [Gwenaelle GREMION, Canada]	Noted. Here, we just refer to Chapter 2 for the observed changes in El Nino and Chapter 3 for the projection.
37972	88	51	88	55	Figure 1 of Box 11.3 is a tempting idea. However, the BAMS State of the Climate article publishes each year a global map showing notable climate anomalies and events, and there are many of these anomalies and events in years that do not have a strong El Nino. How much of what is shown in the map for the year 2015 is a consequence of the El Nino event is thus open to question. [Adrian Simmons, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Figure 1 of BOX 11.3 is reproduced.
54410	89	2	89	33	While the Ethiopian drought was clearly associated with the El Nino event, this is less true for Somalia and Kenya (which have a different rainy season and different ENSO teleconnections). The drought in southern Africa is not mentioned here and was a major impact of the 2015-16 event. [Blair Trewin, Australia]	Accepted. References on southern Africa are added.
7106	89	21	89	21	add missing reference to bibliography list : Aragão et al (2018), 21st Century drought-related fires counteract the decline of Amazon deforestation carbon emissions, Nature Communications, doi: 10.1038/s41467-017-02771-y [Elena Maksimovich, France]	Accepted.
6998	89	21			add missing reference to bibliography list : Aragão et al (2018), 21st Century drought-related fires counteract the decline of Amazon deforestation carbon emissions, Nature Communications, doi: 10.1038/s41467-017-02771-y [Elena Maksimovich, France]	Accepted.
22118	89	29	89	29	Likelihood statement included, but no confidence - implies high confidence since the likelihood statement is there. Is this intended? It is also a little odd to have only one likelihood statement out of all the statements in this paragraph [Gwenaelle GREMION, Canada]	Taken into account. Likelihood statement is deleted from this paragraph.
22120	89	45	89	45	1997 is referred to as a 'super' El Nino here, whereas earlier in the box it has been referred to as 'strong', but not 'super'. More consistency would be useful. [Gwenaelle GREMION, Canada]	Accepted.
43848	90	2	90	22	Please add Yokoyama et al. 2019 and Tsuji et al. 2019 which indicated the influence of the upper tropospheric trough which aided to moisten the troposphere, an essential condition for the large-scale heavy precipitation. (ref.) Yokoyama, C., H. Tsuji, and Y. N. Takayabu, 2019 : The effects of an upper-tropospheric trough on the Heavy Rainfall Event in July 2018 over Japan, submitted to J. Meteor. Soc. Japan. Tsuji, H, C. Yokoyama, and Y. N. Takayabu, 2019: A comparison on the roles of upper tropospheric 2 troughs in the 2017 Northern Kyushu rainfall event and 3 in the July 2018 heavy rainfall event in Japan. to be submitted [Izuru Takayabu, Japan]	Accepted.
43828	90	7	90	7	"extremes heat extremes" ==> "haet extremes" [Izuru Takayabu, Japan]	Accepted.
48660	90	8	90	8	Box 11.4 - I would suggest further collaboration with the Atlas authors [Lincoln Alves, Brazil]	Considered. The content and scope of the box is discussed among Chapter 11 and Atlas authors.
43830	90	9	90	9	Japan Ministry of Health, Labour, and Welfare reported 1469 deaths from heat strokes in Japan between May and August 2018. [Izuru Takayabu, Japan]	Noted. The source was checked, and the number updated.
43818	90	14	90	22	Here some references should be added to this phenomena happened around the edge of East Asia. For extreme precipitation, Shimpo et al. (2019) (Primary Factors behind the Heavy Rain Event of July 2018 and the Subsequent Heat Wave in Japan: DOI https://doi.org/10.2151/sola.15A-003), and Oh et al (2018) (Disentangling Impacts of Dynamic and Thermodynamic Components on Late Summer Rainfall anomalies in East Asia, doi: 10.1029/2018JD028652). For heat wave, also Imada, Y. et al. (2019) (The July 2018 high temperature event in Japan could not have happened without human-induced global warming, Scientific Online Letters on the Atmosphere, doi:10.2151/sola.15A-002). [Izuru Takayabu, Japan]	Accepted and noted. Oh et al (2018) is not specifically related to the 2018 events.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
43514	90	14	90	22	This small-scale case study can be more attractive by adding peer-reviewed studies that have conducted a quantitative assessments of the anthropogenic contribution. Also, increasing spatial scales covering other East Asian countries would be useful, showing that this extreme event is a large-scale phenomenon. [Seung-Ki Min, Republic of Korea]	Accepted. Imada et al. (2019) and other papers added.
43832	90	15	90	15	Please cite Shimpo et al. 2019. Shimpo, A. et al., 2019: Primary Factors behind the Heavy Rain Event of July 2018 and the Subsequent Heat Wave in Japan. SOLA, 15A, 13-18, https://doi.org/10.2151/sola.15A-003 . [Izuru Takayabu, Japan]	Accepted.
22122	90	21	90	21	Suggest to include: There is evidence that these extreme events occurring across different regions of the Northern Hemisphere during summer 2018 were associated with large-scale waves in the atmosphere (Kornhuber et al. 2018 (Environmental Research Letters)). [Gwenaelle GREMION, Canada]	Accepted.
43834	90	22	90	23	There are a few latest articles. Imada et al. (2019) showed that the Japan's heatwave in July 2018 could not have happened without global warming. Kawase et al. (submitted) estimated the impact of global warming since 1981 on the accumulated precipitation amount from 28 June to 8 July approximately at +6.5%. 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 . Kawase, H., Y. Imada, H. Tsuguti, T. Nakaegawa, N. Seino, A. Murata, and I. Takayabu, 2019: The heavy rain event of July 2018 in Japan enhanced by historical warming (submitted). [Izuru Takayabu, Japan]	Accepted. Imada et al and Kawase et al are added.
22128	90	36	90	39	My understanding of Vogel et al (submitted) is that 22% of the Northern hemisphere actually refers to 22% of regions in the NH that have high population or agricultural use; the text suggests 22% of the entire NH, which may be misleading) [Gwenaelle GREMION, Canada]	Accepted. The text was corrected.
22124	90	45	90	45	Suggest to include a statement on future changes in the anomalous circulation. E.g. there is currently low confidence in projected changes in the frequency or strength of the anomalous circulation patterns leading to concurrent extremes, with some studies suggesting an increase (e.g. SScreen and Simmonds 2013 (GRL), Cattiaux et al. 2016 (GRL), Mann et al. 2017 (Sci. Rep), Francis 2017 (BAMS), Wills et al (submitted)). [Gwenaelle GREMION, Canada]	Accepted. Statement was added with a reference to Cross-Chapter Box 10.1 which includes a detailed assessment on this topic (As this is a highly debated topic, 1-2 sentences with a few publications would not be enough)
22126	90	56	90	56	It would be useful to end with a short paragraph synthesizing what can be learned/understood from these two examples in the context of projected changes. Perhaps just framing each of these as storylines, and consider the additional impacts of global warming on similar events in the future? [Gwenaelle GREMION, Canada]	Accepted.
46176	91	6	92	20	BOX 11.4: Reasons for concern related to weather and climate extremes: Informing on changes in extremes supportingrelated adaptability assessments - I see better this box converted into a main paragraph [Marina Baldi, Italy]	Rejected. This is an essential handshake topic between the WG1 and WG2 reports.
53066	91	8	92	17	The 5 RfCs used traditionally could perhaps be reconsidered; in light of new knowledge and perspectives. Some of them are quite aggregated and difficult to understand and communicate. The disaggregated version used in SR1.5 (in fig SPM.2) in addition to the trad with 5 RfCs, was in my view very useful. [Jan Fuglestedt, Norway]	Accepted. A discussion of this point is included in the SOD.
7640	91	9	91	9	supportingrelated (supporting related) [Guoping LI, China]	Editorial - copyedit to be completed prior to publication
54290	91	19	91	20	"limits to adaptation" is better than "limits to adaptability" [Brian O'Neill, United States of America]	Accepted. Wording was adapted.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
54294	91	27	91	30	The aim of this box to inform the judgment of limits to adaptation in RFC2 is fine but too narrow. The judgment of very high risk, based in part on limits to adaptation, is not one made primarily on the basis of the nature of extreme events, but rather is very strongly influenced by socioeconomic conditions and adaptive capacity. Thus an assessment of the nature of extreme events will not dictate any particular outcome in terms of limits to adaptation. This box will be most useful to the WG2 task of updating and improving judgments related to RFC2 if it covers all temperature levels, without a particular aim to inform just one of the judgments that will be made within WG2. As an example, the AR5 judgment of high risk beginning at 1.5 C was made based on a limited number of projected changes in extremes. A much more comprehensive and robust characterization of differences in extremes across the full temperature range covered in the RFCs would have been extremely helpful. That said, it is important to keep in mind that, ideally, such projections of hazards are only supplementary sources of information to risk judgments. Those judgments are intended to be made, wherever the literature allows, on studies of impacts on human or ecological systems (which themselves draw on projections of extreme events). If that literature is insufficient to support a judgment (as was the case in AR5), then projections of hazards alone can be used as supplementary information. Nonetheless, it is likely to be the case in AR6 that this type of supplementary information on extremes hazards will be very useful. [Brian O'Neill, United States of America]	Accepted. Table now also includes a table indicating changes in extremes to be expected at different global warming levels, which can inform the development of the revised RFC2 in WG2 for aspects beyond limits to adaptation.
54292	91	29	91	29	"limits to adaptation" is better than "limits to adaptability" [Brian O'Neill, United States of America]	Accepted. Wording was adapted.
54296	91	31	91	43	This looks like a very useful list of aspects of changes in extreme events to cover in this box. In particular the spatial dimension is important since RFC judgments consider not only the magnitude of impacts but also how widespread they are. Metrics of compound events will also be important, and treating events occurring simultaneously and those that occur repeatedly will both be relevant to risk judgments. [Brian O'Neill, United States of America]	Accepted. We have included more material on compound events and simultaneous events in the SOD.
22130	92	33	92	34	Please clarify which region is "northwestern part of the sub-continent"? [Gwenaelle GREMION, Canada]	Accepted, region explained
44602	92	36			Cross-Chapter Box 11.1: The studies by Krishnan et al. (2019a) for increasing trend in winter-time precipitation extremes and Priya et al. (2017) for summer-time precipitation extremes over Western Himalayas are relevant citations here. (Ref: (1) Krishnan, R., Sabin, T. P., Madhura, R. K., Vellore, R. K., Mujumdar, M., Sanjay, J., et al. (2019a). Non-monsoonal precipitation response over the Western Himalayas to Climate Change, Clim. Dyn. doi:10.1007/s 1 00382-018-4357 (2) Priya, P., Krishnan, R., Mujumdar, M., and Houze, R. A. (2017). Changing monsoon and midlatitude circulation interactions over the Western Himalayas and possible links to occurrences of extreme precipitation. Clim. Dyn. 49, 2351–2364. doi:10.1007/s00382-016-3458-z. [Krishnan Raghavan, India]	Accepted, Cited the studies as both papers are relevant.
44604	92	40			Vellore et al. 2015 and Vellore et al. 2016 are relevant references for heavy precipitation and floods over the Eastern and Western Himalayas, respectively. The references are given below: (1) Vellore R.K et al. (2015) On the anomalous precipitation enhancement over the Himalayan foothills during monsoon breaks, Climate Dynamics, 43, 2009-2031. (2) Vellore, R.K., et al. (2016) Monsoon-extratropical circulation interactions in Himalayan extreme rainfall. Clim Dyn, Vol. 46: 517–3546. [Krishnan Raghavan, India]	Taken into account, combined with other comments.
44528	92	41	92	41	Ali et al., 2015 mention in text but missing referencing [Shaukat Ali, Pakistan]	Accepted, reference added.
44612	92	50			Krishnan et al. (2019b) is a recent assessment of climate change in the Hindu Kush Himalayas and a relevant citation. Ref: Krishnan R. et al. (2019b) Unravelling Climate Change in the Hindu Kush Himalaya: Rapid Warming in the Mountains and Increasing Extremes. pp 57-97 In: Wester P., Mishra A., Mukherji A., Shrestha A. (eds) The Hindu Kush Himalaya Assessment. Springer, Cham [Krishnan Raghavan, India]	Accepted, Cited the study as paper is relevant.
44610	92	53			Bhardwaj et al. 2019 is a relevant reference for rain-induced landslides in the Indian Himalayas. This reference can be included after Gupta and Uniyal (2015). Ref: Bhardwaj, A., et al. (2019): Characteristics of rain-induced landslides in the Indian Himalaya: A case study of the Mandakini catchment during the 2013 floods. Geomorphology, 330, 100-115. DOI: 10.1016/j.geomorph.2019.01.010 [Krishnan Raghavan, India]	Accepted, Cited the study as paper is relevant.
54856	92				Good cross chapter box [Gabriele Hegerl, United Kingdom (of Great Britain and Northern Ireland)]	Noted, thank you!
15616	93	3	93	12	Recently, Hunt et al. assessed the WDs in CMIP model. The author may want to refer it. (1) Hunt, Kieran MR, Andrew G. Turner, and Len C. Shaffrey. "Representation of western disturbances in CMIP5 models." Journal of Climate 32.7 (2019): 1997-2011. [Tomonori Sato, Japan]	Noted, but I can't find this paper.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
9988	93	4	93	4	Authors might find this of interest: Hasson, S., et al. Early 21st century snow cover state over the western river basins of the Indus River system, <i>Hydrol. Earth Syst. Sci.</i> , 18, 4077-4100, https://doi.org/10.5194/hess-18-4077-2014 , 2014 [Valerio Lucarini, United Kingdom (of Great Britain and Northern Ireland)]	Rejected, not much relevant.
44608	93	10			High-resolution model experiments indicate that the increasing trend of winter-time heavy precipitation events over the Western Himalayas during the recent few decades is attributable to increasing trend in the amplitude variations of western disturbances, which have linkages to the elevation dependent climate warming over the Tibetan Plateau (Krishnan et al. 2019a). Ref: (1) Krishnan, R., Sabin, T. P., Madhura, R. K., Vellore, R. K., Mujumdar, M., Sanjay, J., et al. (2019a). Non-monsoonal precipitation response over the Western Himalayas to Climate Change, <i>Clim. Dyn.</i> doi:10.1007/s 1 00382-018-4357 [Krishnan Raghavan, India]	Accepted, Cited the study as paper is relevant.
22132	93	15	93	17	Please give more context for why these two events are specifically highlighted. Do these events have a particularly large impact on people? [Gwenaelle GREMION, Canada]	Accepted, context added.
44606	93	21			Vellore et al. 2016 have documented the dynamics of the Uttarakhand June 2013 heavy precipitation and floods. This paper may be cited along with Houze et al. 2017. Ref: Vellore, R.K., et al. (2016) Monsoon-extratropical circulation interactions in Himalayan extreme rainfall. <i>Clim Dyn.</i> Vol. 46: 517–3546. [Krishnan Raghavan, India]	Accepted, Cited the study as paper is relevant.
43284	95	5	98	1	Is it possible to provide some related literature in Table 11.1 as shown in Table 11.3 [Yongjie Huang, United States of America]	Rejected. There would be too many references needed. But references to the underlying chapters have been added.
22134	95	7			Table 11.1: There are inconsistencies between this table and sections 11.3.2 and 11.3.4: 1) The table indicates that the human contribution to hot days and nights is very likely, while the section 11.3.4 states that it is virtually certain. 2) Same situation for warm spells/heatwaves. The table indicates that the human contribution to warm spells/heatwaves is very likely while in section 11.3.4 it was said to be virtually certain. 3) I don't understand the regional analysis of temperature extreme events in this table. Authors include results for some regions, while in section 11.3.2, results were presented for all continents. I think this table should be revised with the information provided in section 11.3.2. If authors employed information from section 11.9, they should be very careful because nearly no references to articles or figures are provided in the regional analysis of this chapter (section 11.9). [Gwenaelle GREMION, Canada]	Accepted: 1 and 2) The Summary of 11.3.4 (line 28) was changed: "very likely" instead of "virtually certain". 3) Inside Table 11.1, in the first line we present the uncertainty level on global scale and below, the regional signals. We are going to complete with information for each continent. Section 11.9 was changed: we are presenting references inside the tables and the texts were moved to 11.3, 11.4 and 11.6.
22136	95		95		Table 11.1 inconsistent with table 11.3, e.g. Africa: table 11.3 gives high/medium confidence everywhere except Central Africa; Table 11.1 says medium confidence for South Africa and low elsewhere. [Gwenaelle GREMION, Canada]	Rejected: The statements of 11.1 refer to the period since 1951 while for 11.3, they refer to different periods (e.g. since 1960 depending on the available literature)
22138	96		96		Regions defined as latitude bands for heavy precipitation (compared to continents for extreme T) makes it hard to reconcile with tables 11.3-11.8, which makes it hard to find the relevant citations. Suggest either retain the continental split of temperature extremes, or somehow include an overview of the relevant citations used to come to these confidence statements in the table. [Gwenaelle GREMION, Canada]	Noted. Tables 11.1 and 11.2 are not necessarily directly mapped from 11.3-11.8, they are mainly derived from global analyses.
7642	96		96		heatwaves (heat waves) [Guoping LI, China]	Taken into account - heatwave
7644	98		98		rainfall, wind, lightning /correction : heavy rainfall, wind, lightning [Guoping LI, China]	Editorial - copyedit to be completed prior to publication
48662	99	3	99	3	overlaps with Atlas 5.5 [Lincoln Alves, Brazil]	Rejected. Chapter 11 provides the assessment on extremes. If the Atlas provides similar information, this should be merged into our chapter. We did not expect the Atlas to provide actual assessments.
43286	99	3	101	1	Is it possible to provide some related literature in Table 11.2 as shown in Table 11.3 [Yongjie Huang, United States of America]	Rejected. There would be too many references needed. But references to the underlying chapters have been added.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
22140	99	4			Table 11.2: This table includes information about warm spells/heatwaves and cold spells/ cold waves, that has not been properly discussed and supported in section 11.3.5. This table should be revised according with the information provided in the section, expanding the information provided if needed. Additionally, comparing the probabilities of warm spells and cold spells provided in this table (likely at 1.5°C and at 2°C) with results provided in the AR5 and the SR15 (very likely at 2°C in comparison with 1.5°C) (page 34, line 15), the projected changes at 2° global warming are less probable in this new version of the IPCC. If that is indeed correct it should be mentioned and discussed in section 11.3.5. [Gwenaelle GREMION, Canada]	noted. Better support is provided in the revision.
7646	99		99		heatwaves (heat waves) [Guoping Li, China]	Taken into account - heatwave
43924	100	0	100	0	For the increase in precipitation associated with TCs and the increase in TC intensity, the confidence levels go with "an increase", not with a specific value of increase. So these should all be reworded as in the example for TC precip for 1.5C warming: "Medium-to-high confidence in a projected increase of TC rain rates at the global scale; the median projected rate of increase is about 11%". And similarly for the other cases. [Thomas Knutson, United States of America]	Accepted.
43926	100	0	100	0	For "Change in frequency of tropical cyclones" these should be "Low confidence for overall frequency." (as you have it), then: "Medium-to-high confidence for an increase in the proportion of TCs that reach the strongest (Category 4-5) levels. The median projected increase in this proportion is about 10% for a 1.5C global warming" (and similarly for the other scenarios). Note that it is the proportion of such storms, not the total number of such storms where we have medium-to-high confidence. [Thomas Knutson, United States of America]	Accepted.
44170	100	1	100	1	The last cell on this table for severe convective storms. This statement is too general to be meaningful. Ttrying to generalize everywhere on the Earth that experiences severe convective storms is not justified. Evidence is simply not available for everywhere. Furthermore, there will be winners and losers. Some places will experience more intense convective storms and some will experience less. It is not logical that all locations will experience more convective storms. The justification for a highconfidence is not supported by the rest of the text in this chapter. [David Schultz, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. The text was changed as "There is medium confidence that the frequency of severe convective storms increases in the spring with enhancement of CAPE, leading extension of seasons of occurrence of severe convective storms. There is high confidence of future intensification of precipitation associated with severe convective storms." as consistent with 11.7.5.
28114	100		100		The row of "Severe convective storms". Please consider clarifying "same" as what. [Gan Zhang, United States of America]	Taken into account. Changed to "Same as the left cell."
45098	102		102		Table 11.3: CORDEX MENA region also covers the Northern and Central part of the Africa region and adding the results from that region can improve the GCM/RCM matrix for the area. 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]	Noted, some relevant papers are cited.
22142	102		104		No likelihood statements in table 11.3, despite, for example, 5% confidence shown in Donat et al 2013. and 2014. [Gwenaelle GREMION, Canada]	Noted. Likelihood is not completely based on statistical significance. There are other factors such as data quality and coverage etc., that need to be considered.
22144	102		104		Additional citations: Fontaine et al. 2013 (JGR Atmos.), Ceccherini et al 2017 ((Nat. Hazards Earth Syst. Sci), Pohl et al 2017 (scientific reports), Oueslati and Pohl 2017 (J Cli.), Khomsi et al 2016 (Nat. Hazards Earth Syst. Sci) [Gwenaelle GREMION, Canada]	Noted, some relevant papers are cited.

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22146	105	4	107	1	Missing from Table 11.4. P77, L41-43 state: "Moreover, there is high confidence that anthropogenic warming has contributed to an increase in the probability of occurrence of the August 2015 heat wave in Japan." [Gwenaelle GREMION, Canada]	Accepted. References added.
22148	105	4	107	1	The level of confidence in the assessments is not stated for many cases in Table 11.4, especially with respect to droughts (last 3 columns). [Gwenaelle GREMION, Canada]	Accepted. Confidence has been added
45100	105		105		Table 11.4: Ozturk et al within the CORDEX Central Asia framework have published two papers about the Central and eastern Eurasia region. Mentioning these papers will enrich the treatments for the projections for the Central Asia region. 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]	Rejected. This table is for extremes.
35370	106	0	106	0	Re-citation of reference used in chapter Atlas (Page Atlas-46, Line 25). Rohini et al., 2016 used in Table 11.4, Page 11-106 for South Asia for warm extremes [Mehwish Ramzan, Pakistan]	Noted. It is cited in the Table
35372	106	0	106	0	Recited reference used in chapter Atlas (Page Atlas-47, Line 5). Zahid and Rasul, 2012 used in Table 11.4, Page 11-106 for South Asia for warm extremes. [Mehwish Ramzan, Pakistan]	Noted. It is cited in the Table
13254	106	1	106	55	Table 11.4: Regional assessments for Asia East Asia (EAS)-Precipitation extremes and flooding-projections Ohba and Sugimoto (2019, CD) also show the increase in extreme precipitation intensity over Japan in future climate projections. In addition, Kawase et al. (2016) and (Ohba and Sugimoto 2019, submitted) also discuss the changes in extreme snowfall in Japan 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 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. Ohba, M., and S. Sugimoto 2019: Spatially heterogeneous impacts of climate changes on heavy wet snowfall, submitted to Climate Dynamics. [Masamichi Ohba, Japan]	Accepted. References added.
44488	106				In south-eastern part of Pakistan, CDD is projected to increase while CWD is projected to decrease in 21st century which can give rise to drought conditions (Ali et al., 2019) [Shaukat Ali, Pakistan]	Accepted. Text and reference added
30220	108	5	108	5	You should add reference here to Guerreiro et al 2018 NCC paper in the section on observations and detection and attribution of heavy precipitation. For USA add ref to Barbero, R., Fowler, H.J., Lenderink, G., Blenkinsop, S. 2017. Is the intensification of precipitation extremes with global warming better detected at hourly than daily resolutions? Geophysical Research Letters, 44 (2), 974-983, DOI: 10.1002/2016GL071917. [Hayley Fowler, United Kingdom (of Great Britain and Northern Ireland)]	unclear what comment was referring to
51436	111	8	111	8	such an overview table is very useful [Bart Van den Hurk, Netherlands]	ACCEPTED
40446	112	1	112	1	In Table 11.6 in the cell concerning Temperature extreme projections over SEU please add the link: https://www.bankofgreece.gr/BogEkdoseis/ClimateChange_FullReport_bm.pdf (THE ENVIRONMENTAL, ECONOMIC AND SOCIAL IMPACTS OF CLIMATE CHANGE IN GREECE; Bank of Greece, Climate ChangeImpacts Study Committee, 2011) [Christos Zerefos, Greece]	ACCEPTED -We have assessed the report to identify new studies.
48664	114	3	114	3	overlaps with Atlas 5.5 [Lincoln Alves, Brazil]	Accepted: The references on extremes from Atlas and Chapter 12 were moved to Chapter 11.
48672	114	3	114	3	The tables are a bit confused to assess the information for South America, the information for CA and SA are very mixed, and difficult to assess the information for each region. [Lincoln Alves, Brazil]	Rejected: The first line refers to CAM. The other lines refers to AS: NWS, NSA, NES, SAM, SWS, SES and SSA

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
40398	114		117		<p>Many references are missing in Table 11-7. Here there are some suggested examples:</p> <ol style="list-style-type: none"> 1) Kharin et al (2013) presents projections on temperature and precipitation extremes, based on CMIP5 models at global scale 2) Rivera et al (2013) for observed trends in dry days for Drought category in South Eastern South America and Southern South America sub-regions 3) Penalba and Rivera (2013) for projected droughts in South Eastern South America and Southern South America sub-regions 4) As summer precipitation trends are mentioned in observed category (Vera and Díaz, 2015) for South Eastern South America sub-region; projections in summer precipitation may also be referenced (Menéndez et al., 2016) 5) Zaninelli et al (2018) for projected dryness index for Drought category in South Eastern South America and Southern South America sub-regions <p>Kharin, V. V., Zwiers, F. W., Zhang, X., & Wehner, M. (2013). Changes in temperature and precipitation extremes in the CMIP5 ensemble. <i>Climatic change</i>, 119(2), 345-357.</p> <p>Menéndez, C. G., Zaninelli, P. G., Carril, A. F., & Sánchez, E. (2016). Hydrological cycle, temperature, and land surface atmosphere interaction in the La Plata Basin during summer: Response to climate change. <i>Climate Research</i>, 68(2-3), 231-241.</p> <p>Penalba, O. C., & Rivera, J. A. (2013). Future changes in drought characteristics over Southern South America projected by a CMIP5 multi-model ensemble.</p> <p>Rivera, J. A., Penalba, O. C., & Betolli, M. L. (2013). Inter-annual and inter-decadal variability of dry days in Argentina. <i>International Journal of Climatology</i>, 33(4), 834-842.</p> <p>Zaninelli, P. G., Menéndez, C. G., Falco, M., López-Franca, N., & Carril, A. F. (2019). Future hydroclimatological changes in South America based on an ensemble of regional climate models. <i>Climate Dynamics</i>, 52(1-2), 819-830. [Vanessa Pántano, Argentina]</p>	Accepted: All references were included in Table 11.7, except Kharin et al. (2013) because it is used in AR5.
31814	115	4	117	2	Need to expand on the acronyms SP, RJ, SC (San Pablo, Rio de Janeiro??), in SES part of table. These are cities (and otherwise in tables if present) but a non-South American reader will not understand this. [Anna Sörensson, Argentina]	Accepted: All acronyms are expanded in the table
31816	115	4	117	2	With respect to this: Medium confidence: "Stratospheric ozone depletion causing increase in precipitation and decrease in maximum temperature extremes (Wu and Polvani, 2017)" and "Anthropogenic forcing explaining the precipitation changes observed in SES (Vera and Díaz, 2015)" - a more complete attribution assessment for the increase of precipitation in SESA (northern part of SES covered by these two papers) is found in Ch10:"10.4.2.2.4 The Southeastern South America summer wetting". The final statement of this section reads: "Therefore there is medium evidence but low agreement as to why SESA summer precipitation has increased since the beginning of the 20th century." Please have a look, there are many more papers cited in 10.4.2.2.4 and we have to be consistent between the two chapters. [Anna Sörensson, Argentina]	Accepted: Now at this column (Extreme precipitation D&A over SES) the text was modified: Medium confidence: Stratospheric ozone depletion causing increase in precipitation and decrease in maximum temperature extremes (Wu and Polvani, 2017). Hadley cell has shrunk and shifted towards the equator in winter over the SES which has caused an enhancement of the sinking motion over much of Argentina, Chile and Brazil, while increasing the baroclinicity (and associated precipitation) over Patagonia (Saurral et al., 2017). Anthropogenic forcing explaining the precipitation changes observed in SES (Vera and Díaz, 2015). See more details in 10.4.2.2.4 and Figure 10.19. Anthropogenic climate change has increased the risk of the April-May 2017 extreme rainfall in the Uruguay River basin (de Abreu et al., 2019).

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
31818	115	4	117	2	With respect to this: Medium confidence: "Increase in the total monsoon precipitation over southern Brazil, Uruguay, and northern Argentina under RCP8.5 (Jones and Carvalho, 2013) Wetting condition (increase in PRCPTOT and R95p) under RCP4.5 and RCP8.5 (Chou et al., 2014).", please note that Ch10 has a more complete assessment of total precipitation increase in SESA: "10.4.3.2.4 South Eastern South America (SESA) summer future precipitation changes", where the last sentence reads: "SESA precipitation will more likely than not increase based on model simulations, but the mechanisms behind this increment are still largely unexplored and constitute a knowledge gap." Please have a look, since we have to be consistent between the two chapters. I will look at Jones and Carvalho (2013) and Chou et al. (2014), which I have not cited in 10.4.3.2.4. [Anna Sörensson, Argentina]	Rejected: In this column (Future precipitation over SES) we are concerned with projections of extreme precipitation (not D&A). The text was updated. The new text is: Medium confidence: Increase in the total monsoon precipitation over southern Brazil, Uruguay, and northern Argentina under RCP8.5 (Coppola et al., 2014; Jones and Carvalho, 2013) and under A1B scenario (Menéndez et al., 2016; Reboita et al., 2014). Increase in PRCPTOT and R95p) under RCP4.5 (Chou et al., 2014a) and RCP8.5 (Chou et al., 2014a; Giorgi et al., 2014). Increase in RX5day (Kitoh et al., 2011). Rainfall increase over central Argentina, Uruguay, and southern Brazil, especially during summer, under A2 scenario (Cabré et al., 2016). Increased precipitation over the La Plata Basin and Central Argentina (Llopart et al., 2014). Drier climate in Rio de Janeiro, São Paulo and Santos (low confidence) (Lyra et al., 2018).
40394	115		115		In Table 11-7: North Western South America sub-region: the sentence seems to be unconcluded: "Decrease in the frequency and geographic extent of meteorological drought in the western Amazon, and (Duffy et al., 2015)" [Vanesa Pántano, Argentina]	Accepted: The text was corrected.
43956	116	0	116	0	SSA (Southern South America) Detection and Attribution column for changes in drought, dryness, aridity: Suggest to add entry here: Evidence for detectable anthropogenic increasing precipitation trends in southern South America (1901-2010) in analysis of Knutson and Zeng (2018)." (See their Fig. 3). Reference: 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: It was included in the column D&A precipitation extreme and flooding
40396	116		116		In Table 11-7: Chile is mentioned in South Eastern South America sub-region (in Precipitation extremes) but it seems to belong to South Western South America sub-region [Vanesa Pántano, Argentina]	Rejected: In fact Chile information it was included because in the same paper (Saurral et al., 2017) there are information about Argentina, Chile and Brazil. So we decided to keep it together in the same column.
43958	118	0	118	0	USA Detection and Attribution column for changes in drought, dryness, aridity: Suggest to add entry here: Evidence for detectable anthropogenic increasing precipitation trends in central U.S. and northern U.S. (1901-2010) in analysis of Knutson and Zeng (2018)." (See their Fig. 3). Reference: 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. This paper was missed for the SOD but will be included in the FGD.
22150	118	4	119	1	The following two event attribution studies should be added in the 5th column of Table 11.8 for Canada: Teufel, B., Diro, G.T., Whan, K. et al. (2017) Investigation of the 2013 Alberta flood from weather and climate perspectives. Clim Dyn 48: 2881. https://doi.org/10.1007/s00382-016-3239-8 Teufel, B., Sushama, L., Huziy, O. et al. (2019) Investigation of the mechanisms leading to the 2017 Montreal flood. Clim Dyn 52: 4193. https://doi.org/10.1007/s00382-018-4375-0 [Gwenaëlle GREMION, Canada]	Change accepted
14262	120	9			answer to what? Maybe replace "answer" with "difference" or "distinction"? [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. We have rephrase this sentence. It now reads: "To the question of whether changes in the mean climate are larger or smaller than changes in extremes, the answer usually depends on a number of factors such as what do we mean by mean and extremes, the variable being considered and even how the changes are calculated."

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14264	120	15			Land warms up faster than ocean also due to feedbacks altering energy transport, not just due to lower heat capacity of land compared to oceans e.g. Joshi et al. (2008) Clim. Dyn. doi:10.1007/s00382-007-0306-1 [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Noted
29286	120	30	120	31	caption should be xpanded, include the meanings of black, blue and red dots and band, etc etc. [Fabio D'Andrea, France]	Not applicable - section significantly revised
29288	120	45	120	46	"Moreover a small increase of the mean...." this sentence is true in general for most PDF. I don't understand if the sentence is placed here to refer to a specific region, spatial scale, or variable (precip, temperature?) It should be made clearer. Maybe move the sentence above in the general considerations. [Fabio D'Andrea, France]	Not applicable - section significantly revised
15622	122	1	122	30	Under the ongoing warming climate, some new types of extreme events are anticipated. Although they are argued in the other chapters/sections, it is nicer to add references here. (1) Flooding caused by the break of glacier lake. (2) Warm-Arctic and Cold mid-latitude in recent winter will be a good lesson; many people did not expect it before. (3) Terrestrial hydrological cycle in cold regions, including the frozen soil and permafrost thawing. [Tomonori Sato, Japan]	Taken into account; some of these examples have been generally considered.
9450	122	8	122	8	The sentence "The climate we have experienced is one to which both human and natural systems have adapted" might be misleading. This is because also in the past - even before industrialization started - there have been weather related natural disasters that killed people and destroyed ecosystems. In particular hum,an systems where not at all well adapted throughout the world - ther has been an adaptation deficit in many regions. It is suggested to use a more nuanced language. [Klaus Radunsky Radunsky, Austria]	Accepted.
7648	122	20	122	20	heatwaves (heat waves) [Guoping Li, China]	Taken into account - heatwave
14268	122	25			Another example could be drought followed by extreme rainfall which exacerbates the runoff as well as introducing multiple, contrasting impacts [Richard Allan, United Kingdom (of Great Britain and Northern Ireland)]	Accept. The suggested compound event was added as a second example.
29290	122		122		This FAQ should make the distinction btw "events that we know already, but more intense" and "events of a nature we have never seen". At the moment it only cite examples of the first type. [Fabio D'Andrea, France]	Accept.
9452	123	8	123	9	It is suggested to substitute "contributed" by "contribute" because this statement is valid not only in the past but also now and in the future. [Klaus Radunsky Radunsky, Austria]	Accepted - text changed
56466	124	43	124	43	Add "Allamano P., Claps P., Laio F. An analytical model of the effects of catchment elevation on the flood frequency distribution, Water Resour. Res., 45, W01402, doi:10.1029/2007WR006658, 2009a [Pierluigi Claps, Italy]	Accepted and added
56468	124	43	124	43	Add "Allamano, P., P. Claps, and F. Laio, Global warming increases flood risk in mountainous areas, Geophys. Res. Lett., 36, L24404, doi:10.1029/2009GL041395, 2009b" [Pierluigi Claps, Italy]	Accepted and added
28450	138	9	138	11	Errors in the author list. It should be "Shiogama H., Watanabe M., Imada Y., Mori M, Ishii M., Kimoto M. (2013) An Event Attribution of the 2010 Drought in the South Amazon Region using the MIROC5 Model. Atmospheric Science Letters, 14(3), 170-175, DOI: 10.1002/asl2.435" [HIDEO SHIOGAMA, Japan]	Accepted - references have been corrected in Mendeley
7650	144	10	144	10	(in revisi. /correction: (in revision). [Guoping Li, China]	corrected after paper was accepted
56470	144	28	144	28	add "A. Libertino, D. Ganora and P. Claps. Evidence for increasing rainfall extremes remains elusive at large spatial scales: the case of Italy. Geophysical Research Letters 2019,doi: 10.1029/2019GL083371 . in press. [Pierluigi Claps, Italy]	Accepted and added
22152	148	51	148	53	double check this reference, I believe it should be: Murata, A., H. Sasaki, H. Kawase, and M. Nosaka, 2017: Evaluation of precipitation over an oceanic region of Japan in convection-permitting regional climate model simulations. Climate Dyn., 48, 1779–1792. [Gwenaelle GREMION, Canada]	Accepted - references have been corrected in Mendeley
22154	152	41		42	Porat et al. 2014 should read Greenbaum et al. 2014 (Naomi Porat being the 6th author) [Gwenaelle GREMION, Canada]	Accepted - references have been corrected in Mendeley
28444	159	28	159	30	Errors in the author list. The paper "Takemi et al." should be "Takayabu I, Hibino K, Sasaki H, Shiogama H, Mori N, Shibutani Y, Takemi T (2015) Climate change effects on the worst-case storm surge: a case study of Typhoon Haiyan. Env. Res. Lett., 10, 064011, doi:10.1088/1748-9326/10/6/064011 " [HIDEO SHIOGAMA, Japan]	Accepted - references have been corrected in Mendeley

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40448	159	50	159	50	Please add the reference: THE ENVIRONMENTAL, ECONOMIC AND SOCIAL IMPACTS OF CLIMATE CHANGE IN GREECE; Bank of Greece, Climate Change Impacts Study Committee, 2011 https://www.bankofgreece.gr/BogEkdoseis/ClimateChange_FullReport_bm.pdf [Christos Zerefos, Greece]	Considered. We in general do not site publications prior to AR5. As this assessment report was released in 2011, we have not cited it.
54412	169	1	169	1	Since this map shows all of the US, not just the Midwest, I think it would be better captioned "United States trends over XXXX-XXXX, showing a trend towards cooler daily maximum temperatures in summer in the Midwest". The exact years of the trend (particularly the finishing date) should also be stated. [Blair Trewin, Australia]	Accepted. Text revised
43372	170	4	170	5	It looks to me as though the hatching cover the globe in all cases. Unless this changes for CMIP6 I suggest removing the hatching and stating in the caption that at least 2/3 of the models agree on the sign everywhere. Same comment for Fig 11.4 [James Renwick, New Zealand]	Accepted, we switched to a more stringent criterion
43288	172	1			The maps in Figure 11.5 are too small to see. [Yongjie Huang, United States of America]	Not applicable. The figure was removed.
50884	175	0	175	0	Fig11.8 is not legible (most figures aren't in this draft which makes it impossible to comment on the validity or the ease to understand of the figures) but the units do not seem correct. [Selma Guerreiro, United Kingdom (of Great Britain and Northern Ireland)]	This is a draft figure that was updated for the SOD
54068	175	1	175	1	Are there any details of significance of the trends shown in Figure 11.8? Alternatively state if no trends are significant. May be unlikely trends are significant as annual maxima is very noisy and given natural variability of rainfall a linear trend may not be an appropriate means for detection of change. [Stephen Blenkinsop, United Kingdom (of Great Britain and Northern Ireland)]	noted, this figure is replaced with one based on station data
54070	175	1	175	1	I also cannot see this Figure 11.8 mentioned in the text. [Stephen Blenkinsop, United Kingdom (of Great Britain and Northern Ireland)]	Noted.
22156	178	1	178	1	Figure 11.11 is not clear enough to see, and a higher resolution pic would be help. [Gwenaelle GREMION, Canada]	Noted. The figures were produced at publication quality for SOD.
43374	178	3	178	3	Put "USA" in here somewhere. [James Renwick, New Zealand]	This figure has been changed to a global domain.
54414	179	1	179	1	The word "trends" needs to go into the caption somewhere. [Blair Trewin, Australia]	Accepted. Captions have been modified, including the necessary terminology.
54416	182	1	182	1	"Moisture" spelt incorrectly in image header. [Blair Trewin, Australia]	Accepted
22158	184	1	184	1	consider adding figure with observed ENSO and PDO changes during this time (maybe from NOAA) [Gwenaelle GREMION, Canada]	Thanks for this suggestion. Our purview is somewhat limited in scope, and this is more of a pedagogical discussion than an assessment. Space limitations withstanding, we've chosen to not include this discussion here.
9190	184	4	184	6	There is considerable data that the frequency of Atlantic and tropical hurricanes as well as violent tornados in the United States have all have shown stable or decreasing trends over various time periods; see for example: http://www.policlimate.com/tropical/ . [Jim O'Brien, Ireland]	Noted, thank you.
22160	185	11	185	11	Wehner et., 2018 a,b,c or d? [Gwenaelle GREMION, Canada]	Taken into account. This figure was modified and we made sure that the citation was clearly specified.
30108	186	1	186	1	The caption of Box 11.1 Fig. 1. does not explain what is panel c) and the caption of b) seems to be wrong since panel b) should highlight changes in thermodynamic scaling (we thus expect that it corresponds to full scaling minus dynamic scaling). [Bruno Wilhelm, France]	Accepted. The caption of the figure in BOX 11.1 has been corrected.
51416	186	4	3	86	scaling of what with what? [Bart Van den Hurk, Netherlands]	Accepted. We have improved the quality of the figure and modified the caption to clearly describe what the figure is showing.
44136	186	4	186	8	figure caption unclear [Michaela Dolk, United States of America]	Accepted. The caption of the figure in BOX 11.1 has been corrected.
51418	186	7	4	86	Legend seems incomplete. Reference to panel c is missing. And the "note" is not wel read from the panels shown [Bart Van den Hurk, Netherlands]	Accepted. We have improved the quality of the figure and modified the caption to clearly describe what the figure is showing.
48572	186		186		In general the chapter is very nicely written however caption for Fig. Box 11.1, Figure 1 (page 186) is not clear. Authors need to mention it clearly. [Pushp Raj Tiwari, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. The caption of the figure in BOX 11.1 has been corrected.
56512	186				Caption for the Box 11.1, Figure 1 is not completely corresponding to what is shown. Please revise. [Nikolina Ban, Switzerland]	Accepted. We have improved the quality of the figure and modified the caption to clearly describe what the figure is showing.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
56514	186				The quality of the Box 11.1, Figure 1 should be improved. [Nikolina Ban, Switzerland]	Accepted. We have improved the quality of the figure and modified the caption to clearly describe what the figure is showing.
22162	187		187		No explanation is provided for the standard vs corrected normalization technique - the message would be simpler if only the corrected normalization was included. [Gwenaelle GREMION, Canada]	This is updated in the final SOD version
22164	190		190		It is quite hard to understand the graph, particularly with the overlapping shading. Could this be altered so the cumulative frequency distributions show only the mean, with the box plots giving an idea of the uncertainty? Or the uncertainty in the cumulative frequency plot shown by dashed coloured lines, rather than shading? [Gwenaelle GREMION, Canada]	The figure was updated to make it clearer. Now box plots are provided for the probability of occurrence of the area affected in 2018 under 1°C, 1.5°C and 2°C warming.
28508	192				No figure title [Kanoksri Sarinnapakorn, Thailand]	Rejected. Other Figures do also not have a title. A caption is included, which sufficiently describes the figure.
54072	195	1	195	1	I think Figure 1 for FAQ 11.3 could be made easier to interpret with the simple addition of red/orange and light/dark green dots on the changed climate curve. I did wonder if vertical and horizontal lines at the new points might be helpful but I think this would make the plot cluttered. [Stephen Blenkinsop, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. But colours in the figure are changed to be more clear as was the text.
26988	195	1	195	10	Please check text concerning panel (b): a cold extreme does not increase in magnitude if the temperature at the given return period is higher (direction "extreme heat"). As it is, the light green arrow in this panel indicates a decrease in magnitude of cold extremes. [Joachim Rock, Germany]	Accepted - text changed
29296	195	3	195	3	I have to say that I don't like this figure. If it is representing something sure, why not show a real figure from real data? Alternatively it can be an expansion of concept but in that case the caption should be edited, saying something like "An extreme hot temperature in the natural climate can increase" or "can be described as increasing...". Besides, the error bars associated with return times estimations are very big, and if real data are presented they should be included. [Fabio D'Andrea, France]	Rejected. The FAQs are meant to be conceptual.
28454	203		203		"Hideo et al. 2013" should be "Shiogama et al. 2013". [HIDEO SHIOGAMA, Japan]	Accepted - references have been corrected in Mendeley
13870	11-30	46	30	46	The temperature maximum trend projection by RCP6.0 for a City in the Mexico south show the same increasing rate as the observations (Zapata et al. 2019). This is a relevant issue in models confidence. This comment is only relate with the CMIP5 trend projections of temperature maximum. Zapata et al. 2019: Climate change projections for the Villahermosa Center-Tabasco, in press. [Mercedes Andrade, Mexico]	Noted
13868	11-35	46	35	46	The temperature maximum trend projection by RCP6.0 for a City in the Mexico south show the same increasing rate as the observations (Zapata et al. 2019). This is a relevant issue in models confidence. This comment is only relate with the CMIP5 trend projections of temperature maximum. Zapata et al. 2019: Climate change projections for the Villahermosa Center-Tabasco, in press. [Mercedes Andrade, Mexico]	Noted
8862	11-40	8	11-40	9	(Sillmann et al., 2013b) --> (Sillmann et al., 2013b; Kusunoki and Arakawa, 2015; Kusunoki, 2016; Kusunoki, 2017b) Kusunoki, S., Arakawa, O. (2015). Are CMIP5 Models Better than CMIP3 Models in Simulating Precipitation over East Asia? J. Climate 28, 5601–5621. doi:10.1175/JCLI-D-14-00585.1. Kusunoki, S. (2016). Is the global atmospheric model MRI-AGCM3.2 better than the CMIP5 atmospheric models in simulating precipitation over East Asia? Climate Dyn. doi:10.1007/s00382-016-3335-9. Kusunoki, S. (2017b). Future changes in global precipitation projected by the atmospheric model MRI-AGCM3.2H with a 60-km Size. Atmosphere 8, 93. doi:10.3390/atmos8050093. [Shoji Kusunoki, Japan]	Noted and added
8864	11-40	26	11-40	26	model at ~100km. --> model at ~100km. The 20km and 60km versions of MRI-AGCM3.2 perform better than CMIP5 AGCMs in simulating extreme precipitation (Kusunoki, 2016). Kusunoki, S. (2016). Is the global atmospheric model MRI-AGCM3.2 better than the CMIP5 atmospheric models in simulating precipitation over East Asia? Climate Dyn. doi:10.1007/s00382-016-3335-9. [Shoji Kusunoki, Japan]	Noted

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
38940	34639	10			<p>Extreme Flash Floods Hit the City of Ghat, South-west of Libya (Case of Weather Extreme Event – 2019). A summer wave of heavy rainfall and thunderstorm hit the south-western region of Libya on 28 May 2019, specifically Ghat City, which is located about 1,300 kilometers southwest of the Libyan capital, Tripoli. The rainfall commenced on 28 May, intensified on 2 June and flooding struck on 3 June after a period of heavy rain over the border region between Libya and Algeria causing the worst floods due to Ghat's geographical location in a low area between Acacus and Tassili Mountains. The catastrophic floods devastated the whole neighborhoods forcing thousands of people to flee for their lives. The strong floods affected 20,000 persons and forced about 4,250 persons to leave their homes. 1,200 persons were hosted in five collective shelters habilitated by authorities. Four people died, including three children, and about 30 others reported either injured or missing. The rising floodwaters caused huge material damage to public and private property. Several main roads were closed and the unique Ghat hospital was partially flooded. The torrential rains cut off electricity and telecommunication networks, washed away homes and crops and killed livestock. Wide areas of the city have been without drinking water for many days. Service provision was also affected due to water levels reaching up to two meters. Major risk of diseases outbreaks including acute watery diarrhea due to water contamination. Ghat City may also suffer from locusts' attacks after such flooding, taking into consideration that floods' temporary wetlands and clay pits are good environment for locusts' eggs to hatch after they have been buried for many years. Ghat declared a disaster at all levels, and several Ghat's inhabitants require humanitarian assistance, and adaptation actions. Needs priorities are shifting from household level lifesaving to community level basic service needs. According to old people's statements and climate records, such extreme event has not been reported since 66 years ago. Some photos of this severe disaster: [Abdelfatah Shibani, Libya]</p>	Noted. This is a case of extreme and very damaging event. As there is no specific comments to address, and no specific papers we can reference, no action is taken here.
8860	11-26	48	11-26	48	Define ETCCDI which is defined later part in Supplementary text Page 11-198, Line 13-14. [Shoji Kusunoki, Japan]	Accepted - text revised
13866	11-28	24	28	24	In Mexico case, Montero et al. 2018 report warming trends by ETCCDI analysis. Montero et al. 2018: Comparing climate change indices between a northern (arid) and a southern (hu-mid) basin in Mexico during the last decades. <i>Advances in Science and Research</i> , 15, 231–237, doi:10.5194/asr-15-231-2018. [Mercedes Andrade, Mexico]	Accepted - text revised
8866	11-106		11-106		<p>Tabel 11.4 Regional assessments for Asia Region = East Asia Column = Precipitation / Projections Intensification of precipitation extremes (Guo et al., 2018; ---> Intensification of precipitation extremes (Guo et al., 2018; Kusunoki, 2017a; Kusunoki and Mizuta, 2013 Kusunoki, S. (2017a). Future changes in precipitation over East Asia projected by the global atmospheric model MRI-AGCM3.2. <i>Clim. Dyn.</i> doi:10.1007/s00382-016-3499-3. Kusunoki, S., Mizuta, R. (2013). Changes in precipitation intensity over East Asia during the 20th and 21st centuries simulated by a global atmospheric model with a 60 km grid size. <i>J. Geophys. Res. Atmos.</i> 118. doi:10.1002/jgrd.50877. [Shoji Kusunoki, Japan]</p>	Accepted. References added
8868	11-106		11-106		<p>Tabel 11.4 Regional assessments for Asia Region = East Asia Column = Precipitation / Projections (Nayak et al., 2017) ---> (Nayak et al., 2017) Onset of rainy season over becomes earlier, while retreat delays over China and Korea (Kusunoki, 2018) Kusunoki, S. (2018). How will the onset and retreat of rainy season over East Asia change in future? <i>Atmospheric Science Letters</i> doi: 10.1002/asl.824. [Shoji Kusunoki, Japan]</p>	Rejected. This table is for precipitation extremes.

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
8870	11-106		11-106		Tabel 11.4 Regional assessments for Asia Region = East Asia Column = Drought / Projections (Zhou et al., 2014a) ----> (Zhou et al., 2014a) CCD is projected to increase in China and Korea (Kusunoki, 2017a) Kusunoki, S. (2017a). Future changes in precipitation over East Asia projected by the global atmospheric model MRI-AGCM3.2. Clim. Dyn. doi:10.1007/s00382-016-3499-3. [Shoji Kusunoki, Japan]	Accepted. Reference added
28412	11-114				The following paper may be useful in judging the confidence: Nakaegawa, T., Kitoh, A., Murakami, H., & Kusunoki, S. (2014). Annual maximum 5-day rainfall total and maximum number of consecutive dry days over Central America and the Caribbean in the late twenty-first century projected by an atmospheric general circulation model with three different horizontal resolutions. Theoretical and applied climatology, 116(1-2), 155-168. [Tosiyuki Nakaegawa, Japan]	Accepted: The reference was included in Table 11.7. Columns: Future extreme precipitation (RX5day) and Droughts (CDD)
8872	11-119		11-106		Tabel 11.8 Regional assessments for North America New Region = Panama Column = Precipitation / Projections Intense precipitation increases (Kusunoki et al., 2019) Kusunoki, S., Nakaegawa, T., Pinzon, R., Sanchez-Galan, J. E., Fabrega, J. R. (2019). Future precipitation changes over Panama projected with the atmospheric global model MRI-AGCM3.2. Clim. Dyn. doi: 10.1007/s00382-019-04842-w, Accepted on 1 June 2019. [Shoji Kusunoki, Japan]	Noted
8874	11-119		11-106		Tabel 11.8 Regional assessments for North America New Region = Panama Column = Drought / Projections CCD increases (Kusunoki et al., 2019) Kusunoki, S., Nakaegawa, T., Pinzon, R., Sanchez-Galan, J. E., Fabrega, J. R. (2019). Future precipitation changes over Panama projected with the atmospheric global model MRI-AGCM3.2. Clim. Dyn. doi: 10.1007/s00382-019-04842-w, Accepted on 1 June 2019. [Shoji Kusunoki, Japan]	Noted
7108	11-121	2	11-121	2	"are largely constrained by moisture availability" please replace by "are constrained by evaporation" and stop the phrase here before "leading" [Elena Maksimovich, France]	Not applicable - section significantly revised
7110	11-121	2	11-121	4	"please, remove "leading to extreme precipitation ... Clausius-Clapeyron ..7% per degree of warming)". It is too much! this long idea (2 lines!) makes the phrase heavy and multi sense. 7% of what? Of additional evaporation or additional precipitation? The delta of 1°C temperature warming starting at 0°C, 25°C reference value ? please, either add details, either remove this heavy part of the sentence. "Warmer means more evaporation". the precision about "7%" compared to "what reference value"? please remove "7%" information [Elena Maksimovich, France]	Not applicable - section significantly revised
7000	11-121	2			"are largely constrained by moisture availability" please replace by "are constrained by evaporation" and stop the phrase here. [Elena Maksimovich, France]	Not applicable - section significantly revised
7002	11-121	3			"please, remove "leading to extreme precipitation ... Clausius-Clapeyron ..7% per degree of warming)". It is too much! this long idea (2 lines!) makes the phrase heavy and multi sense. 7% of what? Of additional evaporation or additional precipitation? The delta of 1°C temperature warming starting at 0°C, 25°C reference value ? please, either add details, either remove this heavy part of the sentence. "Warmer means more evaporation". the precision about "7%" compared to "what reference value"? please remove "7%" information [Elena Maksimovich, France]	Not applicable - section significantly revised
7112	11-121	4	11-121	5	please, replace "in contrast to this local thermodynamic control" by "in addition to this local thermodynamic impact" [Elena Maksimovich, France]	Not applicable - section significantly revised
7004	11-121	4			please, replace "in contrast to this local thermodynamic control" by "in addition to this local thermodynamic impact" [Elena Maksimovich, France]	Not applicable - section significantly revised
7114	11-121	5	11-121	7	we are not talking about "mean precipitation" in this section, but extreme events. Please, clarify the idea or remove the phrase [Elena Maksimovich, France]	Not applicable - section significantly revised
7116	11-121	5	11-121	7	if the phrase is simplified, it will make more sense. For example: "changes in local precipitation extremes are also affected by regional atm-c circulation". Stop here. Please remove "moisture transport ... rates of change" : Not important info [Elena Maksimovich, France]	Not applicable - section significantly revised

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
7008	11-121	5		7	if the phrase is simplified, it will make more sense. For example: "changes in local precipitation extremes are also affected by regional atm-c circulation". Stop here. Please remove "moisture transport ... rates of change" : Not important info [Elena Maksimovich, France]	Not applicable - section significantly revised
7006	11-121	5			we are not talking about "mean precipitation", but extremes. Please, clarify the idea [Elena Maksimovich, France]	Not applicable - section significantly revised
7118	11-121	7	11-121	8	phrase "Additionally ..." please remove this phrase or make it clear [Elena Maksimovich, France]	Not applicable - section significantly revised
7010	11-121	7		8	phrase "Additionally ..." please remove this phrase or make it clear [Elena Maksimovich, France]	Not applicable - section significantly revised
7120	11-122	4	11-122	4	"... similar to past events" : we can add here "known since observations started", or "in past 100 years" [Elena Maksimovich, France]	Accepted. This point has been clarified.
7012	11-122	4			"... similar to past events" : we can add here "known since observations started", or "in past 100 years" [Elena Maksimovich, France]	Accept. This point has been clarified.
7122	11-122	5	11-122	5	remove "much" from "much more" : it is enough clear [Elena Maksimovich, France]	Rejected. The "much" here is used to emphasize that changes may be large.
7014	11-122	5			remove "much" from "much more" : it is enough clear [Elena Maksimovich, France]	Rejected. The "much" here is used to emphasize that changes may be large.
7124	11-122	8	11-122	8	instead of "natural systems" we could write simply "environment" [Elena Maksimovich, France]	Rejected. Natural systems is broader than environment.
7126	11-122	8	11-122	8	"... both human" : we can replace by "7 bln human polulation" because the population concentration and total amount is critical. Adaptation of food supply to climate change and climate anomalies is complicated because of huge population [Elena Maksimovich, France]	Rejected. A discussion of populations and food supply is not relevant to this FAQ.
7016	11-122	8			instead of "natural systems" we could write simply "environment" [Elena Maksimovich, France]	Reject. Natural systems is broader than environment.
7018	11-122	8			"... both human" : we can replace by "7 bln human polulation" because the population concentration and total amount is critical. Adaptation of food supply to climate change and climate anomalies is complicated because of huge population [Elena Maksimovich, France]	Reject. A discussion of populations and food supply is not relevant to this FAQ.
7128	11-122	17	11-122	17	"... in the past" we can specify by adding "100 years". We are talking about the time scale of 2-3 generations here, not more. [Elena Maksimovich, France]	Accepted; the text has been adjusted to be more specific.
7130	11-122	17	11-122	17	"In general, many ..." this phrase can be interpreted in two opposite manners. If this phrase is taken from the general context, then the entire report loses the credibility! Please, remove or reformulate this phrase. We can reformulate, by adding "... in the past 100 years, while likely to become more intense, more persistent or occurring over greater areas". [Elena Maksimovich, France]	Not applicable -- this paragraph has been substantially revised and this sentence removed
7020	11-122	17			"... in the past" we can specify by adding "100 years". We are talking about the time scale of 2-3 generations here, not more. [Elena Maksimovich, France]	Accepted; the text has been adjusted to be more specific.
7022	11-122	17			"In general, many ..." if this phrase can be interpreted in two opposite manners. If this phrase is taken from the general context, then the entire report loses the credibility! Please, remove or reformulate this phrase. We can reformulate, by adding "... in the past 100 years, while likely to become more intense, more persistent or occurring over greater areas". [Elena Maksimovich, France]	Not applicable -- this paragraph has been substantially revised and this sentence removed
7132	11-122	18	11-122	20	"This is because ..." the phrase is uncomprehensible and does not clarify nor the previous phrase, nor the following sentence! We could remove it. [Elena Maksimovich, France]	Not applicable -- this paragraph has been substantially revised and this sentence removed
7024	11-122	18		20	"This is because ..." the phrase is uncomprehensible and does not clarify nor the previous phrase, nor the following sentence! We could remove it. [Elena Maksimovich, France]	Not applicable -- this paragraph has been substantially revised and this sentence removed
7134	11-122	23	11-122	23	instead of "under a high level of" should write "due to" [Elena Maksimovich, France]	Taken into account, but the authors prefer the original wording.
7026	11-122	23			instead of "under a high level of" should write "due to" [Elena Maksimovich, France]	Taken into account, but the authors prefer the original wording.
7136	11-122	30	11-122	30	"The result could include types or levels of impacts not seen ..." could be reformulated "the consequences could foster the social, ecologic and financial damage not seen ..." [Elena Maksimovich, France]	Accepted. Examples of types of impacts have now been included.
7028	11-122	30			"The result could include types or levels of impacts not seen ..." could be reformulated "the consequences could foster the social, ecologic and financial damage not seen ..." [Elena Maksimovich, France]	Accepted. Examples of types of impacts have now been included.
7030	11-123	0			Another FAQ could be added here. For example. FAQ 11.4. What "likely" and "unlikely" mean for future climate change scenarios and future risk occurrence. Answer: There is evidence that readers adjust their interpretation of the likelihood language according to their professional background and experience. According to IPCC definitions (See Chapter ?? page ?? Treatment of Uncertainties) "likely" means that there is more than 66% of chance the event to happen. So far, if there is less than 33% of chance the event to happen - it is characterized to be "unlikely". [Elena Maksimovich, France]	Rejected- these terms are defined in the Guidance Note for treatment of uncertainties

Comment ID	From Page	From Line	To Page	To Line	Comment	Response
7032	11-123	0			Another FAQ could be added here. For example. FAQ 11.5. What the "compound events" means? Answer: Colocalized, combined, temporally simultaneous events. [Elena Maksimovich, France]	Rejected - compound events are explained within the chapter and defined in the glossary. In addition, the FAQ12.2 discusses combined hazards.
7138	11-123	1	11-123	32	Another FAQ could be added here. For example. FAQ 11.4. What "likely" and "unlikely" mean for future climate change scenarios and future risk occurrence. Answer: There is evidence that readers adjust their interpretation of the likelihood language according to their professional background and experience. According to IPCC definitions (See Chapter ?? page ?? Treatment of Uncertainties) "likely" means that there is more than 66% of chance the event to happen. So far, if there is less than 33% of chance the event to happen - it is characterized to be "unlikely". [Elena Maksimovich, France]	Rejected- these terms are defined in the Guidance Note for treatment of uncertainties
7140	11-123	1	11-123	32	Another FAQ could be added here. For example. FAQ 11.5. What the "compound events" means? Answer: Colocalized, combined, temporally simultaneous events. [Elena Maksimovich, France]	Rejected - compound events are explained within the chapter and defined in the glossary. In addition, the FAQ12.2 discusses combined hazards.
54838	ES				Nice summary well put together. I like the bit about heavy precipitation as well [Gabriele Hegerl, United Kingdom (of Great Britain and Northern Ireland)]	Noted with thanks
48940	VCSIXLoG				IA: When you click on multiple regions and then view regional information, it is unclear how the regional information (or if) is combined. [Laura Reynolds, United States of America]	Considered but it is not clear what this comment is about.
27434					Good chapter structure in general [Fatima Driouech, Morocco]	Thanks
27440					Table11.1: Please reconsider the sentence "Africa, except southern Africa: Low confidence because of lack of observations" taking into account results/finding issued from papers like: - Donat. et al, 2014 (Changes in extreme temperature and precipitation in the Arab region: long-term trends and variability related to ENSO and NAO. Int. J. Climatol., 34: 581–592. doi: 10.1002/joc.3707.) , - Filahi et al. (2015) Trends in indices of daily temperature and precipitations extremes in Morocco, Theor. Appl. Climatol., 124, 959–972, doi:10.1007/s00704-015-1472-4, 2016. [Fatima Driouech, Morocco]	Noted. This is reconsidered. In general, the new version of HadEX3 (an update to HadEX2) has poorer spatial coverage over African continent.
27442					Information about observed and/OR projected changes in extremes in North-Africa can also be found in (Among others) books like: IRD (2016) The Mediterranean Region under Climate Change. A Scientific Update. IRD Editions, 2016, 736p. ISBN: 978-2-7099-2219-7, OR : RICCAR assessment report and references included (https://www.unescwa.org/publications/riccar-arab-climate-change-assessment-report), OR: Climate Change and Food Security in West Asia and North Africa (ISBN 978-94-007-6750-8 ISBN 978-94-007-6751-5 (eBook) DOI 10.1007/978-94-007-6751-5). Khamsi et al (2016) can be interesting also [Fatima Driouech, Morocco]	Noted, this is now considered
27444					Tables and figures are in general among the most used parts from the reports. It would be good if Tables 11.3 to 11.16 are symmetrized like done for Tables 11.1 and 11.2. References should be put in the text. Leaving them in the Tables is not appropriate. It can even be misunderstood (choices of the references? exhaustivity?) [Fatima Driouech, Morocco]	Noted and considered. The idea of having references in regional tables is to provide an easy access to traceable account. There are both pros/cons of having references in the tables.
54852					Overall, it would be nice to link back to previous assessments. For example, since the community has focused a lot on event attribution, not as much has been said about trends but reiterating earlier results at least as a backdrop is useful, and helpful for events as well (see guidance paper and NAS report guidance). [Gabriele Hegerl, United Kingdom (of Great Britain and Northern Ireland)]	Considered. The revised version has several links to previous assessments
54858					I enjoyed reading (very quickly I am looking forward to a more thorough go) chapter 11. Its informative and has a good structure, and also does nice links to impacts. One aspect that I am not sure how it will be addressed is the event attribution results for various regions and events. In the moment, there is not much (unless I missed it) on specific findings but it would certainly be very nice to have a visual summary, maybe along the line of what the Bams supplement does? of course with a warning that such a collection is inherently biased towards events that actually have occurred. You could maybe make a map for attributed and not attributed or small contribution attributed events separately? [Gabriele Hegerl, United Kingdom (of Great Britain and Northern Ireland)]	considered. The revised version has a summary like what you suggested here.
28492					Issue: Likelihood and confidence language is used throughout the chapter. Footnote refers readers to IPCC guidance document. It would be better to make it clear what these analytic confidence ratings and words of estimative probability mean. Suggestion: Provide definition or meaning of each term to help interpretation. Or express confidence level or degree of likelihood quantitatively. Note: The terms high/medium/low confidence and likely/unlikely are quite subjective. Definitions could be provided in an appendix. [Kanoksri Sarinnapakorn, Thailand]	Considered. The whole AR6 report uses the same definition. It would be repetitive to provide detailed definition (also consider page limitation). We decided not to provide such definition in the main text.
53068					Box 11.3, Figure 4: Can you add higher temperature levels to this figure? [Jan Fuglested, Norway]	Considered. AR6 decided to include 4C warming.

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57172					Figure 11.1: units should be added next to the color bar [WGI TSU, France]	Considered. The fig and the caption are redone.
57174					Figure 11.5: the maps are too small to provide information to the reader. The layout should be different, allowing a single bigger map at the center to which the plots are referring. For more guidance, please contact the TSU graphics officer // The RCP colors should be the one presented in the IPCC visual style guide p. 8 // legend always have to be closer to where the reader starts to read the first plot (so, at the top). [WGI TSU, France]	Not applicable any more as the figure is now removed.
57176					Figure 11.6: the maps are too small to provide information to the reader. The layout should be different, allowing a single bigger map at the center to which the plots are referring. For more guidance, please contact the TSU graphics officer // The RCP colors should be the one presented in the IPCC visual style guide p. 8 // legend always have to be closer to where the reader starts to read the first plot (so, at the top). [WGI TSU, France]	Not applicable any more as the figure is now removed.
57178					Figure 11.7: the maps are too small to provide information to the reader. The layout should be different, allowing a single bigger map at the center to which the plots are referring. For more guidance, please contact the TSU graphics officer // The RCP colors should be the one presented in the IPCC visual style guide p. 8 // legend always have to be closer to where the reader starts to read the first plot (so, at the top). [WGI TSU, France]	Not applicable any more as the figure is now removed.
57180					Figure 11.8: For clarity, it would be good to add a short title on top of the map, e.g. Annual maximum 5-day precipitation (1951-2018) [WGI TSU, France]	Noted. This figure is now replaced.
57182					Figure 11.10: the maps are too small to provide information to the reader. The layout should be different, allowing a single bigger map at the center to which the plots are referring. For more guidance, please contact the TSU graphics officer // The RCP colors should be the one presented in the IPCC visual style guide p. 8 // legend always have to be closer to where the reader starts to read the first plot (so, at the top). [WGI TSU, France]	Not applicable any more as the figure is now removed.
46696					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. This chapter does not assess changes in mode of variability but use the assessment by other chapters.
55918					This Chapter is well written and clearly structured. Not much overlap exists with the other chapters. General consideration given to the extremes is targeting directly climate change issues with less focus (and only where it is necessary) to the technical, methodological and conceptual issues, which is important for IPCC report. [Olga Zolina, France]	Noted with thanks
55920					Introduction needs to better articulate in which respects the progress with respect to SREX was expected most in AR6 and how this was managed in this chapter. [Olga Zolina, France]	Considered. The introduction now makes it clear that our starting point is SREX and sub-sequent assessments, and that we following SREX in general to provide traceability and comparison.
55922					What is extreme event? Here the two major conceptual approaches should be at least mentioned very briefly - (i) the weather/climate event rarely observed with such and such thresholds and (ii) conditions resulting in hazards (crashes of infrastructure, fatalities, etc). Need to highlight the weaknesses of (ii), as (ii) is frequently used in practice. [Olga Zolina, France]	Considered. We have revised relevant text but the treatment about hazard is in Chapter 12.
55924					In sections 11.3 and 11.4 there are a lot of materials on regional changes which are then repeated in section 11.9 ("Regional information on extremes"). This should be better balanced. [Olga Zolina, France]	Considered. We have carefully reorganized the materials such that the texts in 11.9 are now integrated in 11.3 and 11.4 and there are only a summary tables in 11.9 along with a short description about the tables.

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46714					Monsoon is assessed in section 3.3.3.2; Section 4.4.1.4, 4.5.1.5; 8.2.1.3, 8.3.1.3.2, 8.3.2.2, 8.3.2.4, 8.4.2.3, 8.3.2.1.1, 8.4.2.7, 8.5.1.1.2; Section 9.5.4.7; Section 10.4.2.2.1, 10.4.2.2.2, 10.4.3.2.1, 10.4.3.2.2, 10.6.3; Section 11.1.5, 11.4.1, 11.4.4, 11.4.5, 11.7.1, 11.9.5, 11.10.2, Cross-Chapter-box-11.1.1, Section 12.4.1.3, 12.4.2.3, 12.4.2.4, 12.4.2.6, Cross-chapter box 12.1; Atlas.2.2, Atlas.2.3, Atlas.5.2.2, Atlas.5.3.1, Atlas.5.3.1, Atlas.5.3.1, Atlas.5.3.2, Atlas.5.3.3, Atlas.5.3.3, Atlas.5.5.1, Atlas.5.5.2, Atlas.5.11.1.3, in the form of ES in chapter 3,4,8,11, box in chapter 8 and above-mentioned subsections [WGI TSU, France]	Considered. Monsoon is not assessed in Chapter 11 but we make use of assessments from other chapters.
57478					Figure 11.13: the reader expects every color in the graphics to have a meaning: the light blue background representing the oceans should better be removed and replaced by white. // to simplify, "change of global temperature, + 1.5" (or something similar) could replace ΔT glob on top of each map. [WGI TSU, France]	Considered. This figure is re-done.
57480					figure 11.14: a more precise title (e.g. "Changes in consecutive dry days compared to pre-industrial conditions") would help understand the meaning of the data in % represented by colors // to simplify, "change of global temperature, + 1.5" (or something similar) could replace ΔT glob on top of each map. [WGI TSU, France]	Considered, this figure is re-done.
57482					Figure 11.15: the reader expects every color in the graphics to have a meaning: the light blue background representing the oceans should better be removed and replaced by white. // to simplify, "change of global temperature, + 1.5" (or something similar) could replace ΔT glob on top of each map. [WGI TSU, France]	Considered, this figure is re-done.
57484					Figure 11.16: the maps are too small to provide information to the reader. The layout should be different, allowing a single bigger map at the center to which the plots are referring. For more guidance, please contact the TSU graphics officer // The RCP colors should be the one presented in the IPCC visual style guide p. 8 // legend always have to be closer to where the reader starts to read the first plot (so, at the top). [WGI TSU, France]	Not applicable any more, this figure is now removed.
57486					Figure 11.17: for guidance and co-design support, contact the TSU graphics officer [WGI TSU, France]	Thanks for the offer. This figure is re-done
57488					Figure 11.18: this figure is missing information (axis titles, units), visual cues and labels which make it hard to understand. For more guidance, contact the TSU graphics officer. // TC should be spelled out in the caption [WGI TSU, France]	Noted. This figure is re-done.
57490					box 11.1 fig 1: it seems like the color bar in (a) is missing [WGI TSU, France]	Considered and corrected
57492					box 11.3 fig 2: icons need to be explained // the schematic might be a bit too busy with the current design. For some guidance, contact TSU graphics officer. [WGI TSU, France]	Considered. The figure is redone.
16278					Although I know that the editorial mistakes will be corrected, still, it must be noted that this chapter seems to have a large amount of typographic errors wherein words are combined together and need to have spaces in between as compared to Chapter 3. There are also some spelling errors that need to be corrected because it's confusing for the reviewer and they change the meaning of the statements. [Tabassam Raza, Philippines]	Noted. A lot of missing space is due to formatting. The new version is also been edited and proof-read by native English speakers.
57494					box 11.3 fig 3: for clarity, a short title on top of the first map could be added (e.g. "Global extreme climate events in July 2018 " // the second map is currently too busy and part of the information cannot be clearly understood. For some guidance, contact TSU graphics officer. [WGI TSU, France]	Noted, the figure is re-done
57496					box 11.3 fig 4: why are their 2 additional shades that are not present in the legend and what do they represent? [WGI TSU, France]	Noted, the figure is re-done
57498					box 11.5 fig 1: the burning embers should be the same design as SR15. Contact TSU graphics officer for co-design [WGI TSU, France]	Noted and corrected.
57500					FAQ 11.1 figure: this figure as it is is not suitable for a lay audience [WGI TSU, France]	Noted, the figure is simplified.
57502					FAQ 11.3 figure: the design of this figure is simpler than the previous one and would work better for a lay audience. However, annotations are needed and some elements would need to be simplified/explained (e.g. "return period") [WGI TSU, France]	Noted, the figure is being reworked.
55968					Figures 11.1 and 11.8 What does it meant the grey color here? Is it show insignificant trends or the absence of data? What is the significance level for trend estimatess shown? [Olga Zolina, France]	Noted. The figure is being reworked.
55970					Figure 11.2 Is this figure important to show? [Olga Zolina, France]	Noted. This figure is removed.
15296					Chapter looks in very good shape. Only a few fairly menial comments [Claudia Tebaldi, United States of America]	Noted with thanks
49356					General: The material is well-organized, comprehensive, and well-founded in the recent published literature. [Imke Durre, United States of America]	Noted with thanks

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13784					The chapter does not include recent developments on the role of serial dependency (i.e., day-to-day dependency) on extreme precipitation and heat waves. See the following paper: Hu, H., and Ayyub, B. M., 2018. "Extreme Precipitation Analysis and Prediction for a Changing Climate," ASCE-ASME Journal of Risk and Uncertainty in Engineering Systems, Part A: Civil Engineering, Vol. 4, Issue 3 (September 2018) https://doi.org/10.1061/AJRUA6.0000980 . See also Zhang, Y., and Ayyub, B. M., 2018. "Urban Heat Projections in a Changing Climate: Washington D.C. as a Case Study," ASCE-ASME J. Risk Uncertainty Eng. Syst., Part A: Civ. Eng., 4(4), https://doi.org/10.1061/AJRUA6.0000985 . [Bilal Ayyub, United States of America]	Noted.
52710					In its current state, the quality varies strongly from section to section. This holds for the language – in some sections, a much more concise and precise language should be achieved – as well as for the scientific quality. In some cases I had the impression that the authors were not really easy with the topic the addressed in a particular paragraph. Here cross checking with other LAs or including further CAs may help to improve the chapter. [Douglas Maraun, Austria]	Noted. This has been addressed in SOD. We have added Cas, and also have help from native English speaker to edit the English.
52712					In several cases, the selection of regions seemed to be quite arbitrary. It was then not clear whether the regions were merely illustrative examples for more general phenomena, or whether the aim was to be comprehensive but there was no literature available. This should be clarified in the corresponding sections (I will give some examples below). [Douglas Maraun, Austria]	Noted. The selection of the regions are based on the availability of literature. We make this clear in the SOD.
52714					Often the assessment was limited to comparing the messages from different papers, but ultimately also the quality of messages in a paper should be assessed. An important example is the paper by Hirabashi et al., 2013 on flood projections. They use (local) grid box GCM runoff, which often contradicts results from proper hydrological modelling (e.g. over Europe: a reduction in flood risk is projected over the Danube catchment, whereas projections based on similar models indicate an increase). Here, the LAs should be really aware of the underlying limitations of the chosen approach and assess the literature accordingly. [Douglas Maraun, Austria]	Noted. The issue about quality and creditability of messages in the published literature has been discussed at LAM3. We emphasised that we cannot take the papers in their face value.
52716					I am missing a link to the adequacy for purpose discussion in the philosophy of science. I expect a basic discussion in Chapter 1. In Chapter 10 we already refer back to such a discussion and discuss regional aspects. Chapter 11 should include a similar discussion linking to Ch 1 and 10. This discussion should convey how we can trust climate model projections of extreme events given their performance in present climate. The argument should discriminate between different extremes (e.g., for drought large-scale circulation aspects as well as local feedbacks are important, for convective extremes mainly the modelling of convection) and how these can be modelled by different types of climate models (standard GCMs, highres GCMs, RCMs, CPS RCMs). Parts of this debate are already in Chapter 11, but scattered and of varying depth and quality. Maybe our text in Chapter 10 can provide a starting point. [Douglas Maraun, Austria]	Accepted. Sections on model evaluation discuss these aspects