SROCC First Order Draft Expert Review Comments - Chapter 3							
Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
254	3	0	0			Establish approximate correspondence in the sections of Chapter 2 and visa versa. For example, a section similar to Section 2.4.2 is missing. [Bilal Ayyub, USA]	Taken into acccount. Polar Regions have their own prioritisation of issues that we reflect in our structure. We cross-reference to other chapters in the text at the level of topics
2262	3	0	0			Chapter 3 – include recent Antarctic observations from IMBIE team (“Mass balance of the Antarctic Ice Sheet from 1992 to 2017”, Nature, doi:10.1038/s41586-018-0179-y.pdf). [Kristin Campbell, USA]	Accepted - IMBIE figure added to Section 3.3.1
3640	3	46	33			(Braithwaite et al., 2015a; Braithwaite et al., 2015b; Seyboth et al.,2016)(high confidence). - please insert hyphen between brackets [Angelika Brandt, Germany]	Taken into account. An error occurred when chapter 3 references were compiled in Endnote by the TSU resulting in a displacement of some references. These displaced references have been fixed in the revised draft.
2388	3	0	0			Chapter 3 – include recent Antarctic observations from IMBIE team (“Mass balance of the Antarctic Ice Sheet from 1992 to 2017”, Nature, doi:10.1038/s41586-018-0179-y.pdf). [Durwood Zaelke, USA]	Accepted - IMBIE figure added to Section 3.3.1
15560	3	3	0	5		Exec Summary does a good job of capturing what is happening in polar regions. Is more data available because of focused scientific cooperation arrangements (e.g. Arctic Council, Antarctic Treaty? How do these arrangements improve governance? [Melinda Kimble, USA]	Taken into account. This is too detailed information for the Executive Summary, but the issue is discussed in section 3.5
18476	3	3	0			I suggest shortening the footnote to the last brackets i.e. "See Section 1.8.3 and Table 1.2 for more details." [Anette Jönsson, Sweden]	Rejected. Footnote was added by IPCC TSU
7068	3	0	0			Missing information about a response to climate change in Antarctica under the antropogenic influence: there are obviously no "citizens" but the density of the Antartic research stations is teadily increasing. Are there any estimates of the ecological impact of these stations, e.g. in the Antarctic Peninsula region? [APECS Group Review, Germany]	Taken into account. This aspect was considered, but is perceived to be minimal on a global scale, which is what SROCC seeks to address.
19176	3	3	0	5		Many of the key messages have a heavy and technical language. Consider to work on simplyfying, in order to communicate to readers the main results [Marianne Kroglund, Norway]	Accepted; we have refined the Key Messages to improve readability.
10982	3	0	0			Overall the report summary failed to capture the rapidity, complexity and seriousnes of climate change forcing in the Arctic. The physical changes and perceived human impacts are provided, but there is a little appreciation of how physical oceanography determines the species structure and microbial interactions in the Arctic. Basically this is the connection between human coastal inhabitants and the sea in different arctic regions. These connections are not well expressed while the report is extensive there is a failure to objectively use the information and state the obvious. [Connie Lovejoy, Canada]	Taken into account. we added regional summaries of changes in SST and BT in the Arctic from the ensemble means of CMIP5 (3.2.3.1. These demonstrate when major changes will be occurring in the Arctic. We also discuss how changes in climate will impact benthic pelagic coupling (3.2.3.1). We disagree that the chapter does not depict how climate change impacts ecosystem structure. The microbial interactions were not included due to space limitations.
19182	3	3	0	5		General comment: the key messages are more technical than they need to be, and include terminology that may be unfamilier to many readers. [Marianne Kroglund, Norway]	See response to 19176
12058	3	0	0			There is no statement that in paleoclimate sea level has risen in the order of meters per century on occasion. Why is this absent? Given models are imperfect statements of fact about processes we do not fully understand give boundaries. This is especially important because we are warming the planet (ocean) dozens of times faster than it has previously warmed in Earth's history. [Michael Casey, Germany]	Rejected- ice sheet projections and sea level impacts are now covered in Chapter 4. We also assess this palaeoclimate evidence in Cross Chapter Box 2.

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12886	3	0	0			Chapter 3 – include recent Antarctic observations from IMBIE team (“Mass balance of the Antarctic Ice Sheet from 1992 to 2017”, Nature, doi:10.1038/s41586-018-0179-y.pdf). [Gabrielle Dreyfus, USA]	Accepted - IMBIE figure added to Section 3.3.1
19184	3	3	0	5		Key message on extremes/abrupt change/thresholds missing -- are there sections in the chapter that can substantiate such (a) key message(s)? [Marianne Kroglund, Norway]	Taken into account; aspects of such changes are drawn out more clearly, though the natural home for many such things in SROCC is Chapter 6, which is dedicated to this subject.
13002	3	0	0			Chapter 3: include recent observations on bedrock uplift from Barletta, V. R., et al. (2018) Observed rapid bedrock uplift in Amundsen Sea Embayment promotes ice-sheet stability, SCIENCE 360:1335-1339. [Gabrielle Dreyfus, USA]	Accepted - this issue is assessed in Cross Chapter Box 2
19186	3	3	0	5		Possible to add key message on future projections for key climate change parameters more explicitly? [Marianne Kroglund, Norway]	Taken into account. Whre possible we have included impacts on important processes for global climate change by individual future scenario
17344	3	3	1	5	55	This Chapter's ES is a bit less clear and readable compared to the other chapters, perhaps due to multiple authors; so could benefit from some editorial work for the Second-Order Draft. This is an especially dense Chapter and clearly the longest of the FOD, so the ES beccomes even more important for communicating main messages. Would also suggest a reference to Chapter 4 in terms of greater expansion there of impacts from glacier and ice sheet melt from Polar regions. [Pamela Pearson, USA]	Accepted; we have refined the Exec Summary to aid readability. Citation to chapter 4 is now included in the relevant Key Message.
14374	3	0	0			References list: there are many references that are incomplete or with formatting problems. [Sérgio Henrique Faria, Spain]	accepted: reference section compiled anew in consistent style
17894	3	0	0			It would be helpful if there was some further coordination and cross referencing of information between Ch3 and Ch4, particularly in relation to the important topic of Antarctic contribution to sea level, and modeling of the Antarctic ice sheet. [Haroon Kheshgi, USA]	Accepted - New Cross Chapter Box 2 addresses this issue.
24384	3	3	1			Please ensure balance among the three sections of the ES, the first section is dominating [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account. The ES has been restructured.
16932	3	3	5	3	5	"interdisciplinary elements of the Arctic and Antarctic systems … their… impacts" sounds strange. The elements (be they physical or societal) are not disciplinary or interdisciplinary, whereas their study well may be one or the other. Reword? [Markku Rummukainen, Sweden]	Accepted. KM is revised
19072	3	0	0			Missing information on limits to adaptation and loss and damage in polar regions [Carl-Friedrich Schleussner, Germany]	taken into account. While the former concept is adressed in cross cutting chapter 6, the latter concept/policy is predominatly applied in developing countries that are particularly vulnerable to the adverse effects of climate change, and is not to our knowledge applied in polar regions.
24970	3	3	5	3	5	What does "different interdisciplinary elements" mean? The introduction rests on an understanding of those terms. [Elizabeth Speer, USA]	Accepted. KM is revised
24978	3	3	5	3	6	"interdisciplinary elements of the Arctic and Antarctic systems” sounds technical and may not be understood by the key audience of the Executive Summaries. [Hans-Otto Poertner and WGII TSU, Germany]	Accepted. KM is revised
19834	3	0	0			Please add "firn (cores)" to the glossary and refer to it at first use [Michelle A. North, South Africa]	Rejected: terms must appear in more than 1 chapter to be included in the glossary.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
1640	3	3	10	3	12	In the beginning of the Executive Summary: Please consider to include an additional paragraph on temperature change in polar regions, e.g. as described in the SWIPA report or section 3.1 on page 7 in this chapter. [Aurora Stenmark, Norway]	Accepted; we have strengthened the opening parts of the Exec Summary by including Key Messages that speak to polar temperature change directly.
12052	3	3	10	3	10	Many regions in Polar regions have warmed several degrees higher than the global warming average and are expected to continue to do so. [Michael Casey, Germany]	Accepted; we have revised the Exec Summary to highlight this important fact more clearly.
19950	3	0	0			I find the oscillating between Arctic and Antarctic paragraphs extremely confusing, because it will take at least a couple of sentences to realize that we've now moved across to the other side of the world from the previous train of thought. I understand that you are trying to present them as a single polar region with all the same issues, but there must be some way (like using subheadings) to indicate that the topic has changed location [Michelle A. North, South Africa]	Accepted: The number of subheadings that can be used is limited, but we have added explicit mention of Arctic and Antarctic at the beginning of paragraphs, to help orient the reader.
2320	3	0	0			Consider revising the title of Section 3.3.1.1.2 “Thickness and age” to focus on the fact that the ice is thinning. [Kristin Campbell, USA]	Taken into account. Headline style made consistent across chapter
2446	3	0	0			Consider revising the title of Section 3.3.1.1.2 “Thickness and age” to focus on the fact that the ice is thinning. [Durwood Zaelke, USA]	Taken into account. Headline style made consistent across chapter
21242	3	0	0			The authors may consider covering various increasing activties in the Arctic such as shipping, oil/gas production, tourism. (See e.g.; Peters et al.; Future emissions from oil, gas, and shipping activities in the Arctic. Atmos. Chem. Phys., 11: pp. 5305-5320; Fuglestvedt et al.,: Climate Penalty for Shifting Shipping to the Arctic Environ. Sci. Tech dx.doi.org/10.1021/es502379d [Jan Fuglestvedt, Norway]	Taken into account. The issue of emissions from and shipping was consciously left out as it a very specialised debate, and incomplete knowledge on the (small) net effects of different substances emitted
23098	3	0	0			An important recent development that has been overlooked in this report is the development of skillful seasonal-to-decadal predictions/forecasts of the state of the ocean. While this material was covered in AR5 (WGI, Chapt 11), the time since has seen rapid improvements these forecasts, together with their application to aid management of living marine resources – see e.g. (Payne et al., 2017; Tommasi et al., 2017) for reviews generally. The seas surrounding arctic regions (Barents Sea, Norwegian Sea and Irminger Sea) are particularly interesting in this regard as they are amongst the most predictable on the planet, where skilful forecasts out to 10 years or more can be made. These forecasts of the physical environment can be can be used to foresee changes in distributions of important species – including the examples of the distribution of NE Atlantic mackerel and Bluefin Tuna mentioned in the text (Page 3-48, line 30ff): manuscripts describing this work will be submitted before the 15 October cutoff date and sent to the TSU. More generally, these seasonal-to-decadal forecasts offer great potential as an adaptation tool for communities in high regions, and I would like to see text to this effect included - specifically in section 3.5 (potentially in 3.5.6?), but also more generally throughout the Chapter. I would also be happy to contribute such text in this regard if it is useful to the author team. Refs: Payne, M. R., Hobday, A. J., MacKenzie, B. R., Tommasi, D., Dempsey, D. P., Fässler, S. M. M., Haynie, A. C., et al. 2017. Lessons from the First Generation of Marine Ecological Forecast Products. Frontiers in Marine Science, 4. Tommasi, D., Stock, C. A., Hobday, A. J., Methot, R., Kaplan, I. C., Eveson, J. P., Holsman, K., et al. 2017. Managing living marine resources in a dynamic environment: The role of seasonal to decadal climate forecasts. Progress in Oceanography, 152: 15-49	This is a potentially fruitful line of research. However, completed applications of this approach have primarily focused on forecasts of physical variables. To our knowledge, an application of short-term forecasting for use in inferring biological responses to longer term exposure to climate change in Polar regions has not been published.

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5502	3	0	0			comments are written in collaboration with Aart Zwaan, Edward de Groot, Mario Córdova Mora, Julia Ruiz Girona all IMAU, UU [Roderik Van De Wal, Netherlands]	Noted.
10872	3	0	0			Cross chapter box 3 is referenced 3 times in this chapter but I cannot find it anywhere. [Ed Blockley, UK]	Rejected. CCBox3 is placed in Chapter 1 of SROCC
11750	3	0	0	0	0	I suggest that information is available to obtain sufficient and complete information from different countries, especially countries with hydro and marine boundaries, and to define and implement joint projects with joint facilities of the countries & IPCC or UN to complete them [Hanieh Zargarlellahi, Iran]	Rejected. No page and line reference is given and not clear what is being suggested. IPCC work is based on peer-reviewed published knowledge.
12944	3	0	0			Consider revising the title of Section 3.3.1.1.2 “Thickness and age” to focus on the fact that the ice is thinning. [Gabrielle Dreyfus, USA]	Taken into account. Headline style made consistent across chapter
13552	3	0	0			There are many highly specialist concepts covered in this report. The report is attracting huge attention at the highest international levels - and so a concerted effort needs to be made to make the most salient information highly accessible to non-specialists. Take for example "aragonite saturation" and "hypercapnia". A non-specialist has no idea what those term refer to. If this is something that is considered by the authors to be an important matter that has wider implications, then it needs to be explained plainly. Sometimes terms get explained in later sections or chapters, rather than when they first come up. There are many examples of this. All specialist concepts that are important enough to make it into section summaries, and especially the executive summary, should be explained plainly, at least in the glossary, with a reference given in the text. Also concepts that are picked up in following sections because they have further implications. In general, every attempt should be made to use plain English in favour of jargon, without compromising accuracy of course. The word 'forcing' is an important word comes up often, and needs to be defined somewhere. It is not in the AR5 glossary nor on the IPCC website glossary. It has a very specific meaning that is not necessarily known to newcomers to the field of climate change modelling. Somewhere early in the document an explanation should be given - with diagram - of terms that get used often like 'forcing', 'controls', 'positive / negative feedback', 'carry-over effect', 'response', 'driver', 'factor' that relate to how things interact (and are probably words that are used in modelling). [Debra Roberts and Durban Team, South Africa]	Taken into account. Chapter edited to reduce acronyms, explain concepts on first use and reference terms explained in glossary
14368	3	0	0			Potential conflict of interests. Some Lead Authors (LAs) have included an unusually high number of self-citations and/or citations to his/her group. I have found LAs with 10 (Derksen), 7 (Kofinas), 6 (Schuur) and 5 (Rignot) self-citations. All other LAs and CLAs cite themselves much less. Considering the broad scope of the Chapter and the amount of publications on all these subjects, such a high amount of self-citations could potentially harm the credibility of the Report. [Sérgio Henrique Faria, Spain]	Taken into acount; revisions including new references improve teh overall balance of citations. However, Lead Authors are selecetd because they are experts in their field and so their work is adequate to cite and should not be disqulified if it is genuinely germane to the section of the assessment where it is discussed; in this case the authorship is irrelevant - it is the content that matters.
23680	3	0	0			Some sections in this chapter well describe and assess where the (eco)systems currently are, but lacks some prognosis where the system will go (based on current scientific knowledge); this might be improved [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account - projections and prognoses have been added/expanded in several sections of the chapter (freshwater, terrestrial wildlife, Southern Ocean fisheries, Arctic and Antarctic marine habitat change)

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24396	3	0	0			Balance between Arctic and Antarctic could be improved (eg Arctic fisheries far greater focus then Antarctic) [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account - more detail has been added for Antarctic fisheries in line with review comments. The overall balance between the two in the revised draft reflects the difference in the number of stocks between the two regions and the greater overall treatment in the literature for Arctic fisheries as compared with Antarctic fisheries.
18526	3	0	0	0	0	Get rid of all "rainbow" colour schemes - they are misleading as they draw the eye to strong changes in colour that are not linked to the present data, and are not readable for colour-blind readers. [Angelika Renner, Norway]	Accepted. THose figures have been/are being redrawn using an IPCC colour palette
18532	3	0	0	0	0	many of the figures would be much easier to read if more of the explanatory text would be included in the figure instead of the caption. E.g. Fig. 3.8: lots of tiny numbers, quite tedious to find the corresponding text in the caption. [Angelika Renner, Norway]	Taken into account. we balanced text in revisions of figures and captions, respectively, considering priority of iformation and readability
19174	3	0	0			General comment: many sections in the chapter are rather technical, with a language that may be unfamiliar to many readers. Some section have an "intro" added (see for instance 3.3.3), which sets the stage in a more comprehensible language -- this could be a way forward also in other sections, to avoid jumping straight into the teckhnical language. Example: 3.2 Changes in Polar Ice Sheets and Glaciers -- how about starting with a general intro saying that several conditions associated with global warming are likely to have important effects on polar ice sheets and glacierimpacts, measured through mass budgets etc, and that these effects will have consequences for the Arctic environment and Arctic societies (with cross reference to impact sections)? [Marianne Kroglund, Norway]	Taken into account; we have included more general terms at the outset of sections and simplified or expalined technical terms where possble throughout the chapter.
19212	3	0	0			General comment: Throughout the report, it is referred to consequences under different RCPs. It would be nice with a compilation/overview of this information, to see different trends under different emission scenarios. Also, it would be nice to clarify if emission scenario limiting global mean temperature rise to 2 degrees C corresponds with RCP4.5 or RCP2.6. [Marianne Kroglund, Norway]	Taken into account. We have included multiple scenario prejections in figures describing trends of cryosphere elements and ocean proprties.
19898	3	0	0			Try to be consistent with where the confidence language is placed when in parentheses - sometimes it is after the citations at the end of the sentence, sometimes before. [Michelle A. North, South Africa]	accepted: placement of confidence statement and literature citations made consistent
24574	3	0	0			When addressing climate resiliences, strategies of adaptation and mitigation need to be identified. [Hans-Otto Poertner and WGII TSU, Germany]	accepted ; we made the relationship between buidling resilience and adaptation clear
19938	3	0	0			The sheer number and complexity of acronyms used in this chapter make it incomprehensible to any person not actively involved in the field of marine or polar ocean research. [Michelle A. North, South Africa]	Taken into account. Chapter edited to reduce acronyms, explain concepts on first use and reference terms explained in glossary
24614	3	0	0			While the treatment of governance nicely describes the status quo and some future tasks, it would good to assess what has been achieved by such governance and to what extent they are set up to be functional under the challenges of different climate futures, [Hans-Otto Poertner and WGII TSU, Germany]	taking into account the existing litterature and progresses in governance, especially from an internaitonal law and institutional analysis perpective, we have worked on this important aspect and we hope that they way the section on governance has been modified will adress your point, now.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
24618	3	0	0			Solution pathways are not fully developed, e.g. the potential of seaweeds to contribute to blue carbon in polare areas in accordance with expanding ranges of geographical distribution has not been assessed. [Hans-Otto Poertner and WGII TSU, Germany]	rejected; We had chosen to not go into this. Polar sequestraton rates are globally insignificant. We included an appendix 3.A.2.5 on macroalgae. The issue of carbon sequestration was not addressed in this draft as literature on the utility of this blue carbon approach is not available.
918	3	1	0			I can find no reference to the issue of escalating seabed methane emission or publications on the subject by Dr. Natalia Shakhova. As this is likely to become the most critical influence on Arctic ice and the global environment, the absences are astounding. The whole chapter, and indeed the whole report will be regarded as deficient and misleading unless these grave deficiencies are remedied. [William Clarke, Australia]	Accepted-text revised and citations included
20098	3	0	0			Please check that you use either autumn OR fall for the entire chapter [Michelle A. North, South Africa]	accepted. made consistent across chapter
20102	3	0	0			Throughout the chapter, there are numeric changes that are displayed in the 10^x scientific notation. While this may be understood by people familiar with it, most readers will see that changes are only in the range of ± 0.1 - 1 (unit), and this does not necessarily convey the degree of concern people should / would have if they saw it written as, e.g., 100,000 or 12 million (unit) change in whatever variable [Michelle A. North, South Africa]	reject. we have received guidance from IPCC that scientific notation is adequate to use in the scientific report
924	3	1	0			There is only one citation for the extensive Arctic work of Prof. Jennifer Francis of Rutgers University, see https://marine.rutgers.edu/main/jennifer-francis. Similarly only one citation for the work of Dr Jason Box and Dr Donatella Zona, though all mention the criticality of Arctic methane. [William Clarke, Australia]	Noted. We do not seek to specifically cite individual researchers; our process is to gather and assess the key literature that is new since AR5, and cite the papers that provide that new knowledge.
23668	3	0	0			Be consistent in the spelling of specific terms throughout the Chapter (e.g. polar regions vs Polar Regions, Arctic vs arctic, etc) [Hans-Otto Poertner and WGII TSU, Germany]	Accepted. IPCC spelling convention comfirmed and edited throughout
930	3	1	0			It is also surprising that I could find nowehere in the chapter discussion regarding the importance of the biological carbon pump, in particular that substantial portion of if that is caused by the diurnal, or more frequent, migration of krill and some other important phytoplankton-consuming species, between the seasurface and approximately 1,000m depth where is was established they tended to excrete their carbon-rich faecal pellets. The mass of just one species of krill, Euphausia superba, in the Southern Ocean is some 397Mt, see https://en.wikipedia.org/wiki/Krill, meaning that they would be likely to excrete a substantial portion of their bodyweight per day in faecal pellets at a depth that would tend to sequester many gigatonnes of carbon per year. References https://www.sciencedaily.com/releases/2006/02/060206230630.htm https://www.sciencedirect.com/science/article/pii/S0967064511001810?via%3Dihub and https://link.springer.com/article/10.1007/s00300-017-2118-z. [William Clarke, Australia]	Rejected - this is considered to be outside the scope of the report because the peer-reviewed reference provided (Atkinson et al. 2012) does not consider climate change impacts or responses and does not consitute a relevant update since AR5.
932	3	1	0			It is surmised that Buoyant Flake Ocean Fertilisation (BFOF) might enhance the krill carbon pump by up to a few to several times. Other vertically-migrating species, such as copepods, salps and possibly squid would also contribute. [William Clarke, Australia]	See response to comment 930

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934	3	1	0			Almost the only mentions of the word "methane" and "CH4" tended to be related to land, lakes or law. Except for that on page 63 there was virtually nothing related to methane emitting or erupting (ebullition) from the seabed. There was nothing in the body of the chapter on either methane hydrates, clathrates, methane vents or to the vanishing icy caps or plugs to massive, underlying gaseous methane deposits. [William Clarke, Australia]	Accepted-text revised and citations included
938	3	1	0			Methane emissions see https://www.climate.gov/news-features/understanding-climate/after-2000-era-plateau-global-methane-levels-hitting-new-highs, https://aslopubs.onlinelibrary.wiley.com/doi/full/10.1002/lno.10307 https://www.nature.com/articles/s41598-018-22801-z https://earthobservatory.nasa.gov/Features/MethaneMatters/ https://eos.org/project-updates/understanding-high-latitude-methane-in-a-warming-climate http://www.pnas.org/content/114/24/6215 http://www.plateclimatology.com/geologically-warmed-ocean-is-melting-arctic-sea-ice-not-climate-change/ http://rsta.royalsocietypublishing.org/content/373/2052/20140451 https://www.atmos-chem-phys.net/16/14371/2016/acp-16-14371-2016.pdf [William Clarke, Australia]	Accepted-text revised and citations included
5132	3	1	0	90		General orthographic comment: Following the arguments put forward by Kingsley (2005), the word 'Arctic' should be always capitalized [Quote from Kingsley MCS (2005) 'Arctic' or 'arctic'? Arctic 58:321: 'Arctic,' therefore, is best capitalized in all uses, both substantive and attributive, that refer to the Arctic itself. The lower-case can then be usefully reserved to distinguish the metaphorical use which means no more than 'very cold'.] Accordingly, I'd recommend to also capitalize other geographic terms, e.g., 'Antarctic' 'sub-Arctic', 'sub-Antarctic', 'high-Arctic', 'high-Antarctic', consistently throughout the entire chapter. Along the same line of arguments, it should be clarified whether the capitalization of the geographic term "Polar Regions" is correct; in most English texts (incl. Encyclopaedia Britannica), it is written "polar regions". [Dieter Piepenburg, Germany]	accepted on all accounts
14002	3	1	0	149		There seems to be a great deal of overlap in the discussion of the ice sheets and glaciers between Chapter 3 and 4 [Debra Roberts and Durban Team, South Africa]	Accepted - we have removed redundant sections and added a new Cross Chapter Box to more effectively link Chapters 3 and 4.
21074	3	1	0	92		THIS IS A FANTASTIC CHAPTER OVERALL. The graphics are terriffic, and the content overall is outstanding. Please take comments only as enhancements. Not fundamental flaws. [Thomas Wagner, USA]	Noted - thank you
358	3	1	1	149	48	I assume that this chapter is about polar regions and cryosphere processes. However, the chapter says virtually nothing about boreal forests, where permafrost is changing most dramatically. At the very least, there should e cross-references to other chapters where cryospheric changes in the boreal forest and associated wetlands and waters are discussed. [F Stuart Chapin, USA]	Noted and accepted-there was information on both the boreal biome and tundra biome; this has been revised for this draft
23670	3	0	0			Be consistent in the use of acronym vs full term; define all acronyms at first mention [Hans-Otto Poertner and WGII TSU, Germany]	Accepted. edited to define terms on first use
23672	3	0	0			cross-referencing to other sections within this chapter and other chapters should be improved [Hans-Otto Poertner and WGII TSU, Germany]	Accepted. Cross-referencing improved
23674	3	0	0			ensure the traceability of assessments [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account: Improved consistency and tracability of confidence langauge across the text and between text and ES

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23676	3	0	0			make more use of likelihood to quantify the uncertaincy of e.g. events or outcome; likelihood is used a lot in the ES but rarely in the rest of the chapter) [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account: Improved consistency and tracability of confidence langauge across the text and between text and ES
23678	3	0	0			the use of confidence language should be more balanced across the sections; in some sections confidence level is given after almost every single sentence, in other sections confidence language is hardly used [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account: Improved consistency in the use of confidence langauge across the chapter
24398	3	0	0			Highlight what is new since AR5, many sections are based on older references [Hans-Otto Poertner and WGII TSU, Germany]	taken into account: focused on priority ise of post AR5 references wherever possible. However, a range of issues covered in this chapter have not been assessed by IPCC previously, justifying the use of some older references.
24558	3	0	0			Executive summary has a very strong emphasis on physical changes with unclear policy relevance (except for 1.5 bullet points in first section. Changes in vulnerable systems are not described). For providing relevant focus under the first question it may be advisable to pair relevant changes in physical system with impacts observed in vulnerable systems. [Hans-Otto Poertner and WGII TSU, Germany]	Accpeted. Executive Summary restructured and individual KMs revised to be policy-relevant and capture changes, consequences and impacts together.
21098	3	1	1	149	1	General Comment on the whole chapter: Polar Regions are important deserts which produce at least 5% of global dust budget.This 'High Latitude Dust' is affecting local glaciers and snow. I would suggest to insert these 3 sentences in the Chapter: Ice-free areas in Polar Regions in vicinity of glaciers are active dust sources producing at least 100 Tgy-1 of dust aerosol (Bullard et al., 2016). Dust deposited on snow or glaciers reduces albedo, in case of Icelandic volcanic dust similarly as Black Carbon (Meinander et al., 2013; Peltoniemi et al., 2015). Snow-Dust Storms occur in Iceland, the largest desert in the Arctic and Europe (Dagsson-Waldhauserova et al., 2015). Bullard J.E., Matthew Baddock, Tom Bradwell, John Crusius, Eleanor Darlington, Diego Gaiero, Santiago Gassó, Gudrun Gisladottir, Richard Hodgkins, Robert McCulloch, Cheryl McKenna Neuman, Tom Mockford, Helena Stewart, Throstur Thorsteinsson. 2016. High Latitude Dust in the Earth System. Reviews of Geophysics: DOI: 10.1002/2016RG000518. Meinander, O., Kontu, A., Virkkula, A., Arola, A., Backman, L., Dagsson-Waldhauserová, P., Järvinen, O., Manninen, T., Svensson, J., de Leeuw, G., and Leppäranta, M., 2014. Brief Communication: Light-absorbing impurities can reduce the density of melting snow. The Cryosphere 8, 991-995. Peltoniemi, J. I., Gritsevich, M., Hakala, T., Dagsson-Waldhauserová, P., Arnalds, Ó., Anttila, K., Hannula, H.-R., Kivekäs, N., Lihavainen, H., Meinander, O., Svensson, J., Virkkula, A., de Leeuw, G., 2015. Soot on snow experiment: bidirectional reflectance factor measurements of contaminated snow. The Cryosphere 9, 3075-3111. Dagsson-Waldhauserova, P., Arnalds, O., Olafsson, H., Hladil, J., Skala, R., Navratil, T., Chadimova, L., Meinander, O., 2015. Snow-dust storm: A case study from Iceland, March 7th 2013. Aeolian Research 16, 69–74. [Pavla Dagsson Waldhauserova, Iceland]	Accepted: we have added some additional content related to dust into Section 3.4.1.1.3 , and added the Bullard et al. citation as suggested.
22486	3	1	2	149	20	This is a good FOD, but the section on sea ice thickness and age (3.3.1.1.2) is weak.There is a lot more literature available. [Peter Lemke, Germany]	Taken into account: section was revised and new citations added.
24560	3	0	0			Executive summary should seek to convey more specific messages with illustrative detail (e.g. like p. 4, l. 52) that capture the attention of the policymakes and have the potential to support the SPM. [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account; we have revised the Executive Summary greatly,

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
6256	3	1	4	91	62	Regardng glaciers and ice sheets there is much overlap with chapter 4 which should be resolved. While the text is muh better organized and reads well in chapter 4, lots of it goes beyond just 'sea level' and may perhaps be beter dealt with in chapter 3, since they come first and chapter 4 can refer to those sections. [Regine Hock, USA]	Accepted - we have reduced overlap by working with Chapter 4, and have written a new cross chapter box (2) dealing with the overlapping issues between our chapters.
24562	3	0	0			The first sections after introduction (more than 30 pages until p. 34) are more or less exclusively focused on physical systems without link to the impacts and adaptation section. This is a missed opportunity as such links would emphasize the policy relevance and allow cutting back or moving less important background information to the OSM. More integration is needed. [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account. THe chapter now starts with the marine section that presents many aspects of impacts
24568	3	0	0			Many of the changes to human systems and ecosystems sound vague, empirical, conceptual, have not been quantified. Observed changes are not distinguished from those projected. However, the degree of impacts needs to be identified (large or small), regardless of whether in text or tables. To prepare for a more specific ES, this should be developed into punchy, policy-relevant messaging. [Hans-Otto Poertner and WGII TSU, Germany]	taken into account. Where quantitative or statistical information related to ecosystem impact exists and we are confident about its scientific quallity we have sought to include it.
24580	3	0	0			Balance between Arctic and Antarctic tilted towards Arctic (understandably), with respect to human sector, it should be reinvestigated whether the balance is just right. [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account. Balance checked and confirmed.
920	3	1	0			Similarly absent is the seminal work by Professor Peter Wadhams, including that of his book "A Farewell to Ice" and its citations to peer-reviewed material and observations of the real world. [William Clarke, Australia]	Rejected: by necessity we assess here only works published since AR5 that have changed our assessment of the changing ocean and cryosphere. Non-peer reviewed books are not suitable for inclusion in the IPCC assessment process.
3672	3	1	36	1	36	Missing in this part of the chapter is discussion of last interglacial collapse of the West Antarctic Ice Sheet, and implications for model projections. This seems to me important to consider - how convincing is the existing evidence that WAIS has collapsed in the past, and what does such a collapse tell us about likely conditions under which it could collapse again in future? [Joanne Johnson, UK]	Rejected - this is covered in Chapter 4, which also now includes ice sheet projections
922	3	1	0			There appears to be no consideration of submissions to the UK's Environmental Assessment Audit of the Arctic, see https://www.parliament.uk/business/committees/committees-a-z/commons-select/environmental-audit-committee/inquiries/parliament-2015/inquiry7/publications/ [William Clarke, Australia]	Rejected: Submissions to government committees from individual countries are not peer-reviewed literature and are not suitable for direct inclusion in the IPCC assessment process. We are aware of the material on which those submissions are made, and cite relevant papers where appropriate.
12056	3	3	0			There is no description (or at leat I cannot find it) of the feedback where increased fresh water on the surface leading to increased sea ice fromation in antarctica insulates and reduces heat loss to the atmosphere from the ocean and thus accelerates erosion of ice shelves by seawater. This is an important process. [Michael Casey, Germany]	Taken into account: we have revised the relevant section, and included information on the potential feedback on basal melt via glacial melt impact on shelf ocean stratification and properties
926	3	1	0			Surprisingly, there are no citations for either David Wasdell, Director of the Apollo-Gaia Project or for Dr Leonid Yurganov. [William Clarke, Australia]	Rejected: by necessity we assess here only works published in the peer-reviewd literature since AR5 that have changed our assessment of the changing ocean and cryosphere. We do not select publications by specific authors.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
6212	3	1	1	2	14	Headers should be adjusted to be consistent among sections and avoid repetition. Eg. 3.3 and 3.4 repeat each time that that change reer to coean and sea ice, or the terrestrial cryosphere while 3.2 does not do that. The former is unnecessary since the main header makes clear which system each subsection will refer to. In adition for 3.4.4 the addition is misleading since terrestrial cryosphere is also glaciers but this is obviously not covered here. [Regine Hock, USA]	Accepted. Header style revised and made consistent across the chapter
6214	3	1	1	2	14	Structure: the sections on oceans, sea ice, permafrost, snow cover and freshwater all include both the physical changes AND implications, but not so 3.2. Why? It suggests there are none? Where are those implications discussed, e.g the emerging literature of changes in Greenland calving fronts on habitat and much more. [Regine Hock, USA]	Taken into account. The Ice sheet and glaciers section now also has an impacts section.
6772	3	1	1	149	48	Through this chapter and its appendix, there are 5 figures where a Rainbow colour scale is used. The rainbow colour scale has been long shown to create false boundaries, where the human eye see's a large difference between values that are actually consecutive, because of how we perceive colour. The IPCC reports should be striving for the very best in figure production to ensure the best communication of the message, allowing rainbow colour schemes to remain in the report would in my view weaken this and be a mistake. [James Pope, UK]	Accpeted. Figures have been /are being re-drawn using an IPCC colour pallete.
11982	3	1	1	70	51	north west, north-west, northwest (similar for other regions) are used interchangeably - please be consistent [Kristian Kjellerup Kjeldsen, Denmark]	Accepted. Edited throughout
12796	3	1	1	149	48	There are some useful quantitative figures in the supplementary information that would be better suited to the main text. These could replace a number of textbook-style schematic figures which do not seem so appropriate for this assessment. [Collins Matthew, UK]	Rejected. "schematic figures" are mostly syntheses of observed/projected changes, rather than textbook figures. Moving quantitative figures to the main text takes too much space.
14258	3	1	1	149	70	In Chapter 1, 'East Antarctic Ice Sheet' and 'West Antarctic Ice Sheet' are used. In Chapter 3,'East Antarctica' and 'West Antarctica' are used. Try to standardize throughout. I would suggest the former is more correct in most contexts. [Christopher Fogwill, UK]	Taken into account. However, wording is dependent on whether one is talking about the ice sheet specifically, or the regions more generally
16334	3	1	1	149	70	Throughout this chapter, the term „significant“ is often used without a true statistical meaning. I suggest to replace these the word „significant“ with „large“, „strong“ etc. if it does not refer to statistical significance [Dirk Notz, Germany]	accepted. edited throughout
6198	3	1	4	91	62	General writing styles should be homogenized between chapters and sections of this chapter. E.g. 3.2.1.1 start with detailing a number of indidvidual studies and ends with a 'In summry' statement; 3.2.1.2 also details studies but no summary statement. Other chapters start with generall assessment statements and then provide the evidence these statements are based on. Probably the latter is an easier style for readers to follow. [Regine Hock, USA]	Taken into account. Assessmnet sytle is made more consistetn across the chapter. However, the position of the summary statement in individual sections is not standardized.
18472	3	1	10	1	19	In all other Chapters the authors country is included but not here. I think it should be added. [Anette Jönsson, Sweden]	accpeted. Author country/-ies added
24382	3	1	10	1	19	please proivde coutnries for Contributing Authors [Hans-Otto Poertner and WGII TSU, Germany]	accpeted. Author country/-ies added

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2564	3	1	17	1	17	Julianne Stroeve should be Julienne Stroeve, right? [Patrik Winiger, Netherlands]	accepted. Name corrected
17554	3	1	17	1	17	Julienne misspelt [Jonathan Bamber, UK]	accepted. Name corrected
21172	3	3	10			It is recommended that this section on how and why polar regions are changing needs to address the contraction of suitable habitat for polar biodiversity in the regions and the potential for endemic or restricted biodiversity to be disrupted by invasive species. [Andrew Constable, Australia]	Accepted - this is addressed in the revised Executive Summary (KMA4) and is also treated in much greater detail in the revised version of box 3.3 (invasive species)
21174	3	3	10			I recommend that more is highlighted about biology than just productivity and commercial species. If there is no evidence yet compiled that satisfactorily enables conclusions about the effects of climate change on,say, marine mammals and birds (as one example) then it would be useful to make such a statement. There is so much literature out there on these taxa (as evidenced by the body of the chapter) that is seems appropriate to at least pass some judgement on whether conclusions can be drawn or not. It is not sufficient to only highlight if there is change. I recommend that some indications of outcomes for important topical social and management issues are needed in this special report. [Andrew Constable, Australia]	Accepted - this is addressed in the revised Executive Summary.
24884	3	3	10	3	10	Remove this line to be in coordination with the style of the other chapters' Executive Summaries. [Elizabeth Weatherhead, USA]	Reject; subheadings are permitting in IPCC Executive Summaries, and here they help structure the material
19178	3	3	11	3	11	Consider to include a key message on temperature change in polar regions, e.g. as described in the SWIPA report or section 3.1 on page 7 in this chapter. [Marianne Kroglund, Norway]	Accepted: new KM text includes mention of surface temperature changes
216	3	3	12	3	13	It would be important to differentiate ice trends already here to avoid confusion. The East Antarctic Ice Sheet (which makes up the bulk of the total Antarctic ice volume) is currently stable or growing. This needs to be mentioned here or reasons of transparency. See Goel et al., 2017; Martin-Español et al., 2017; Philippe et al., 2016; Zwally et al., 2015. [Sebastian Luening, Portugal]	The Executive Summary mentions the dominant loss signals from the ice sheets as a whole (AIS and GIS) and specifically highlights the WAIS losses, while discussion of the small EAIS change/growth is described in section 3.3. The absence of EAIS discussion in the Summary merely reflects the smaller and more ambiguous change signal here and the need to focus the Summary on the most prominent and higher-confidence changes.
1630	3	3	12	3	17	Please consider to include some quantification of the mass loss in Greenland and Antarctica. [Aurora Stenmark, Norway]	The mass losses are now described in detail in section 3.3 and appendices, but it would not be in keeping with the necessarily brief style of the Summary to describe them here.
3728	3	3	12	3	12	Losing mass has not only been in the past decade. So replace "past decade" as "last decades" in this sentence "It is virtually certain that Antarctica and Greenland have lost mass over the last decades". [Serhat Sensoy, Turkey]	Accepted, text revised
3750	3	3	12	3	12	Losing mass has not only been in the past decade. So replace "past decade" with "last decades" in this sentence "It is virtually certain that Antarctica and Greenland have lost mass over the last decades". [Serhat Sensoy, Turkey]	Accepted, text revised
4600	3	3	12	3	12	Mass loss is primarily from some parts of the Antarctic and Greenland, especially the ice sheets and adjacent glaciers; specify for clarity. [Richard B. Alley, USA]	This is now described briefly in the ES, and in more detail in 3.3
5800	3	3	12	3	12	should be "and Greenland ice sheets have lost mass.." [Sharon Smith, Canada]	Wording changed.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
6172	3	3	12	3	13	virtually uncertain for Antarctica is not justified by the literature and the enormous uncertainties that still persist for all methods)GIA estimates for GRACE, huge error in total mass loss for tiny changes in snow preicipitation and uncertai assumption for density for all geodetic methods. I would not give it more than likely. Attributes for acceleration are also exaggerated given the short time period (10 years) which is very short to establish trends and acceleration. The attributes used for the ice sheets are in stark contrast to the more moderate assessment attributes used for excample for sea ice (reductions in sea ice are far more certain than mass loss of the Antarctic ice sheet [Regine Hock, USA]	The confidence and evidence statements on the ice sheets have have revised.
7066	3	3	12	3	12	E1a: This line states that Antarctica and Greenland have "lost mass". I think this perhaps underplays the dramatic and ongoing changes of the ice sheets. Perhaps saying something like "lost considerable mass" would be a fairer reprentatation of these mass changes? [APECS Group Review, Germany]	This point is now more forcefully made, with explicit mention of the possibility of unstable losses from WAIS
7070	3	3	12	3	13	E1a: This line states that ice sheet mass loss has occurred at accelerated rates, which is true, but it is ambiguous as to what time period the stated acceleration is relative to. [APECS Group Review, Germany]	The mass losses are now described in detail in section 3.3 and appendices, but it would not be in keeping with the necessarily brief style of the Summary to describe them here.
7090	3	3	12	3	17	What about polar glacier changes? I think this information is missing in the executive summary. [APECS Group Review, Germany]	Now included
11504	3	3	12	3	17	The executive summary should include a message on how much the ice loss as accelerated in the past decade, compared to the decade before. This was one of the key messages in AR5, and an update on this data would be highly valuable. [Taehyun Park, Republic of Korea]	The mass losses are now described in detail in section 3.3 and appendices, but it would not be in keeping with the necessarily brief style of the Summary to describe them here.
12676	3	3	12	3	12	It is virtually certain that THE ICE SHEETS OF Antarctica and Greenland have lost mass over the past decade [Michiel Van Den Broeke, Netherlands]	Wording changed.
12786	3	3	12	3	17	Some quantification of the mass loss would be very useful here. [Collins Matthew, UK]	The mass losses are now described in detail in section 3.3 and appendices, but it would not be in keeping with the necessarily brief style of the Summary to describe them here.
17044	3	3	12	4	55	The confidences in the executive summary all appear on the high side. Can you confirm that the assessment of confidence been applied rigorously in all statements? [Helene Hewitt, UK]	Taken into account; assessment levels and confidence language have been checked and refined where needed.
19180	3	3	12	3	15	Consider to add to sentence: The large mass loss oin Greenland is very likely caused by enhanced surface melt, runoff and glacier flow (high conficence); and accounts for 35% of current global sea level rise. Refernce [Marianne Kroglund, Norway]	The enhanced melt in GIS is now highlighted (quantified in section 3.3, but not in the Summary)
19214	3	3	12	3	17	Is it possible to include some quantification of the mass loss in Greenland and Antarctica? [Marianne Kroglund, Norway]	The mass losses are now described in detail in section 3.3 and appendices, but it would not be in keeping with the necessarily brief style of the Summary to describe them here.
22212	3	3	12	3	13	'virtually certain' is too strong a term for Antarctica, given some disagreement in relatively recent literature [Martin Truffer, USA]	Confidence statements revised.

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7072	3	3	13	3	15	E1a: These lines state the ice sheet mass loss is "large" in Greenland and "significant" in Antarctica. I think these terms are ambiguous and somewhat misleading. The use of the word "significant" for Antarctica but not for Greenland could be misconstrued as implying that the mass loss in Greenland is somehow not significant (at least in a statistical sense). Given that rates of Greenland Ice Sheet mass loss are greater than of the Antarctic Ice Sheet, I think these lines would benefit from some rephrasing. [APECS Group Review, Germany]	Wording changed.
13030	3	3	13	3	13	Does "accelerated" also apply to the entire Antarctic or more specifically to West Antarctica? [Gerhard Krinner, France]	Wording changed.
7076	3	3	14	3	15	E1a: "enhanced" --> "increasing rates of" [APECS Group Review, Germany]	Wording changed.
7074	3	3	15	3	15	E1a: Should "very likely" be italicised? [APECS Group Review, Germany]	Yes, changed.
14222	3	3	15			very likely' should be italicized to conform with others [Christopher Fogwill, UK]	Yes, changed.
16934	3	3	15	3	15	"very likely" is not in italics here and assumedly does not refer to the standardised language of expressing likelihoods. It might be best not to use the wording of standardised language in other contexts. (Or should the "very likely" here be in italics?) [Markku Rummukainen, Sweden]	Yes, changed.
17556	3	3	15	3	15	add: "The enhanced surface melting is due to increased atmospheric temperatures in the Arctic (virtually certain)" [Jonathan Bamber, UK]	Wording changed.
1922	3	3	16	3	17	Here, it is stated that ocean-ice sheet interaction drives key ice sheet mass loss processes. I would suggest that the effect of atmosphere-ice interaction should be included as well. As noted in section 3.2.2.1 below (page 13, lines 18-19), the Southern Hemisphere extratropical circulation has experienced notable changes. These changes are expected to have contributed to the ice changes by modulating surface heat fluxes and ocean currents. Also, as noted on Page 13, lines 42-43, large-scale atmospheric circulation variability is an important driver of the accumulation changes in Greenland. [Renguang Wu, China]	Surface melting is now highlighted as the main driver of GIS change. The ocean-ice sheet interaction is now more explicitly described as sub-ice-shelf melting. The far-field drivers of change (extratropical circulation etc) are not discussed in the Summary but are included in section 3.3,
7078	3	3	16	3	17	E1a: I think this statement is somewhat ambiguous. Does the report mean to imply that ocean-ice sheet interaction is the sole driver, the primary driver or just one of several drivers of ice sheet mass loss? I suggest that the second interpretation most accurately reflects current understanding, but as the report is currently written, the first and last interpretations are more strongly implied. [APECS Group Review, Germany]	Wording changed.
12054	3	3	16	3	17	Ice formation at the contact points with the ocean require that ocean water be cooled to -2C before ice can form due to the waters salt content. The infusion of warmer waters from lower latitudes via currents and surface winds disrupts this process. As the ocean is gaining a significant magnitude of heat very rapidly relative to other periods in earth's history a continuation and acceleration of this process will occur. Some effort should be made to compare the cumulative ocean heat up takedue to increased forcing by each rcps and then compared to annual energy use. This is necessary to give people a sense of scaleand speed of the changes afoot. [Michael Casey, Germany]	Not possible for Summary. Description of mechanisms and drivers of change, and future projections, revised in chapter text.

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218	3	3	19	3	22	Authors claim that current changes may be irreversible. Palaeoclimate studies however showed, that also the polar regions have experienced oscillating climate states in the past 10,000 years. This challenges the idea that trends may be irreversible. See e.g. Valleta et al. 2015 (doi:10.1038/srep17813), Stenni et al. 2017 (doi: 10.5194/cp-13-1609-2017). [Sebastian Luening, Portugal]	Irreversibility in ice sheet response not now included in revised Summary.
1764	3	3	19	3	21	This paragraph is not entirely correct. Satellite records indicating ice-sheet wide changes are less then 50 year long, therefore no statements can be made about irreversibility on centennial time scales. The same applies to interpretation of observations in the Amundsen Sea sector. A more accurate statement is that changes are irreversible on multidecadal timescales. [Olga Sergienko, USA]	Irreversibility in ice sheet response not now included in revised Summary.
12788	3	3	19	3	22	Cross check with Chapter 6, Table 6.1 [Collins Matthew, UK]	Wording changed.
16936	3	3	19	3	20	"increasing evidence" and "medium confidence" is a bit of a strange combination. Is "increasing evidence" needed here? [Markku Rummukainen, Sweden]	Wording changed.
22488	3	3	19	3	20	Isn't this statement true for Greenland, too? [Peter Lemke, Germany]	Wording changed.
12678	3	3	20	3	20	This is especially pronounced in regions of West Antarctica -> This is VALID FOR regions of West Antarctica [Michiel Van Den Broeke, Netherlands]	Wording changed.
24886	3	3	20	3	20	“This is especially…”. What does “this” refer to? The evidence the changes? The irreversible timescales? [Elizabeth Weatherhead, USA]	Wording changed.
220	3	3	24	3	27	Authors appear to attribute glacier change of the past 100 years fully to anthopogenic reasons. This does however not take into account that glaciers have also oscillated significantly in pre-industrial times. It is a pitty that the whole chapter seems to ignore the Holocene polar climate history preceding the Little Ice Age (LIA). The polar regions have experienced several natural warm phases which need to be presented in this chapter, together with likely natural climate drivers. This is crucial context information for modern climate change. See e.g. Stenni et al. 2017 (doi: 10.5194/cp-13-1609-2017) and equivalent Arctic summaries for the past 2000 and 10,000 years. Why does this report only start in the Little Ice Age, the coldes period of the past 10,000 year, i.e. a natural cold extreme that is not representative for Holocene natural climate? [Sebastian Luening, Portugal]	Wording changed, confidence and attribution statements revised.
7086	3	3	24	3	25	In order to better contrast the two statements about glaciers on the one hand and ice sheets on the other hand, I would merge these statements into one single sentence by including 'while': 'with high confidence, while attributing changes in ice sheets…' [APECS Group Review, Germany]	Wording changed.
17558	3	3	24	3	24	better to be precise than vague here. I suggest replacing "few decades" with "four decades" (from marzeion et al) [Jonathan Bamber, UK]	Wording changed.
17724	3	3	24	3	27	This conclusion is inferred from a relatively small sample and inferred in part from modelling. Although useful in itself, it is clear that this leads to a large contribution of both statistical and modelling uncertainty that reduces the confidence of the attribution. In view of uncertainties, reviewer is of the opinion that the conclusion is formulated with too much certainty [Hessel Voortman, Netherlands]	Confidence statements reviewed and revised.
24888	3	3	24	3	27	“…is attributable to anthropogenic climate change with high confidence” doesn’t’ go well with “Attributing changes…remains challenging.” Please carefully consider and consider possibly change wording. [Elizabeth Weatherhead, USA]	Confidence statements reviewed and revised.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
6174	3	3	25	3	25	Is this based on more studies than Marzeion's. I am not aware of any other study that has quantified the anthropogenic component of glacier mass loss. If so, this should not be 'high confidence. [Regine Hock, USA]	Confidence statements reviewed and revised.
7080	3	3	25	3	25	E1a: "anthropogenic change" --> "anthropogenic forcing" [APECS Group Review, Germany]	Wording changed.
17342	3	3	25	3	27	These two sentences, both in substance and placement strike this reader as the most problematic perhaps of the entire FOD. While setting a high bar of "unambigious attribution" is a nod to scientific rigor, is it truly necessary to place this conclusion in the ES, with the resulting inevitable message to policy makers that the current mass loss of ice sheets is "naturally occuring"? Strongly suggest reconsideration of both placement, and/or message. [Pamela Pearson, USA]	Wording changed.
17786	3	3	25	3	27	Use of wording 'remains challenging' and 'presently' seems to presuppose attribution in future. There are good physical grounds for supposing that such attribution might only be a matter of time, but if this is a statement about the literature on attribution of past changes, the wording could be more straighforward. [Robert Arthern, UK]	Wording changed ('unambiguous attribution to anthropogenic influence is currently not possible')
24482	3	3	25	3	27	To phrase less technical here, e.g. consider: "Because of the strong regional variability in atmospheric and oceanic circulation in both polar regions, it is currently difficult to attribute changes in ice sheets clearly to anthropogenic influence." or even "strong variability ... makes it difficult..." [Hans-Otto Poertner and WGII TSU, Germany]	Yes, wording changed ("Because of the strong regional variability in atmospheric and oceanic circulation and a lack of long-term observations and model limitations in both polar regions, unambiguous attribution of mass loss from polar ice sheets and glaciers to anthropogenic influence is currently not possible ")
12526	3	3	26			I feel like a broken record but really polar regions should not be upper case. (throughout). This isn't a stylistic choice, it's just grammatically wrong. [Eric Wolff, UK]	Accept; we have adopted IPCC policy which is to not capitalise except in headings and subheadings.
14224	3	3	26			polar regions' doesn't need to be capitalized [Christopher Fogwill, UK]	Accept; we have adopted IPCC policy which is to not capitalise except in headings and subheadings.
21162	3	3	26			This statement on marine productivity is ambiguous as to what will happen to marine productivity, yet the justification indicates only increased productivity as a result of climate change. Are there reasons why an increase in marine productivity is not stated in the bold text. If so, they should be included in the justification. Or the bold text should be changed. [Andrew Constable, Australia]	Taken into account - see response to comment 21164 below
21164	3	3	26			The implication of this statement is that the system as a whole has become more productive i.e. energy moving up the food chains with benefits to herbivores (including krill) etc. Alternatively, the increase in phytoplankton may lead to increased carbon sequestration which would not affect the productivity of the food chains as a whole. The implied meaning of this statement is that the food web as a whole will be more productive. If the implied conclusion is not warranted then the interpretation of the statement needs to be made clear i.e. that the implications for the food web and carbon sequestration are ambigous or unknown. [Andrew Constable, Australia]	Accepted - rephrased in KMB2 of the second order draft as 'Climate-induced changes in the oceans and cryosphere are altering marine primary production, with impacts on marine foodwebs and ecosystems' (with further explicit treatment of the implications for secondary productivity etc in the subtext)
7088	3	3	27	3	27	The specific sub-section where you talk about attribution of changes in glaciers and ice sheets is 3.2.2.4; therefore I would change '{3.2.2, 3.2.4}' into '{3.2.2.4}'. [APECS Group Review, Germany]	Taken into account; section numbers updated
16938	3	3	27	3	27	what is meant by "unambiguous attribution"? That all (or some, however little) of changes are found to be due to the driver? [Markku Rummukainen, Sweden]	Accepted, text revised

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
7082	3	3	29	3	29	E1a: Should this be snow and sea ice cover/extent? [APECS Group Review, Germany]	Accepted: Text revised
7092	3	3	29	3	35	Add Section 3.3.1.1 to the end of this paragraph, to link to the sections on Arctic sea ice loss. [APECS Group Review, Germany]	Accepted: Text revised
12790	3	3	29	3	35	Can these reductions be quantified? [Collins Matthew, UK]	Rejected: editorial decision was made to not report the specific trend numbers
22314	3	3	29	3	30	While the statement that the melt of snow and ice in the Arctic system is "very high confidence" is correct, this text attributes the effects on the global climate to changes in albedo. I submit that, first, the attribution of changes in the global climate to anything in the Arctic is poorly supported by the litterature and that, second, the albedo changes is only part of the story. In fact, even inside the Arctic itself, only part of the changes are due to the albedo feedback (according to modeling). In either case, I believe that although the statemnt may be correct, the "high confidence" is not there. [Michael Tjernström, Sweden]	Accepted: KM text and confidence language revised for clarity
17422	3	3	30	3	32	The text states 'Anthropogenically-driven reductions in Arctic spring snow and summer sea ice cover have continued unabated since AR5 (very high confidence),with consequences for the global heat budget (high confidence).' There is discussion in the main text of the consequences of snow reductions for the global heat budget but not for sea ice (apart from the increase in solar radiation to the Arctic - see next comment). So, some discussion of the sea ice reduction influence on the global heat budget needs to be added to the main text. [Simon Josey, UK]	Accepted: KM text revised
15968	3	3	32	3	34	I will continue reading and comment below, however I think it is too strong a statement to say that there is high confidence that reduced snow and ice conver can influence weather and climate outside the Arctic. Interannual variabiltiy inhibits use from saying Arctic mid-latitude connections so strongly. If you don't know that physical mechanisms then you are simply saying "with high confidence is it physically possible" but we don't know if it is happening. [Patrick Taylor, USA]	Accepted: KM text revised and confidence langauge changed. There is very high confidence that changes in snow and ice affect the surface energy budget but we attach low confidence to impacts on weather and climate outside the Arctic.
22316	3	3	32	3	34	The statement that imapcts of Arctic change on midlatitude weather has "high confidence" in the summary is not reflected neither in the main text nor in litterature. This is a topic of great controversy, and it should not be described as a certain thing. [Michael Tjernström, Sweden]	Accepted. See 15968
24890	3	3	32	3	35	“There is high confidence that reduced snow.. though presently there is low confidence concerning specific mechanisms and extent..” should be reconsidered and possible wording changed. [Elizabeth Weatherhead, USA]	Accepted: text revised
10984	3	3	34	3	41	Knowledge co-production is scarce in the Arctic. There remains high distrust of scientists by Canadian Inuit. A recent focus on solving local problems is preventing discovery based research. [Connie Lovejoy, Canada]	Noted, but this section decribes options for responding, not the status quo and its implications. the section on governance treating knowledge co-production is not oriented towards future impacts in adaptive governance.this is about p5, ll34-41.
21166	3	3	34	3	36	The evidence to support the statement is different for the different regions. I suggest that the statement refer to distributions changing or expected to change. In addition, some indication needs to be given as to whether the latitudinal ranges are reducing or increasing the range or that the distributions are being displaced relative to, say, oceanic drivers. [Andrew Constable, Australia]	Taken into account - the revised Key Message (KMA4) provides a clearer assessment of the differences between regions and is framed around habitat change (expansion or contraction) rather than distribution change. Latitudinal ranges changes are described within the chapter text and Box 3.3.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
1300	3	3	37	3	38	Later onset dates of snow and ice cover iare also observed and projected and may be more important than spring period reductions in some regions e.g. Chukchi Sea (p 23 lines 29-30) [Ross Brown, Canada]	Accepted: snow and ice onset are snow explicitly stated in KM B1
1634	3	3	37	3	45	Please include more information on the thickness of the sea ice, whether it is one-year ice or multi-year ice etc. [Aurora Stenmark, Norway]	AcceptedL KM A5 revised
17726	3	3	37	3	45	The whole section is conditional with global warming established and stabilised at 2 degrees C. The actualeffects are therefore much more uncertain than is communicated here. [Hessel Voortman, Netherlands]	Accepted: KM revised
19190	3	3	37	3	45	suggestion: is it possible to add that sea ice is shifting from multiyear ice to first year ice, with refernce to 3.3.1.1.2? This shift has implications on sea ice processes, photochemical exchanges with the atmosphere, formation of melt pondsand sea ice energy balance. Mechanical sea ice properties are also being affected, with implications for shipping and ice-associated species. [Marianne Kroglund, Norway]	Accepted: KM B6 revised
24892	3	3	37	3	45	“It is virtually certain that projected warming will result in continued loss of Arctic sea ice….” This is a difficult statement given that the cause of the severity of the sea ice isn’t fully attributable to air temperatures warming. Given the uncertainty in how to attribute the past changes in Arctic sea ice, the “virtually certain” statement about the future is troubling. [Elizabeth Weatherhead, USA]	Accepted: text revised
912	3	3	38			After "temperature forcing" add "However, it may still be possible to reverse ice loss through a combination of ice thickening and typically marine-based albedo increase methods. Although ice thickening cannot prevent ice melt, it should be possible to thicken and extend sea ice in freezing weather faster than it melts at warmer times, see https://unfccc.int/documents/65014." [William Clarke, Australia]	Rejected: the geoengineering methods suggested are not proven, and it would be wrong to present them as a solution here.
914	3	3	38			Supporting and peer-reviewd documents include https://link.springer.com/article/10.1007/s10584-005-5933-0 https://asu.pure.elsevier.com/en/publications/arctic-ice-management and http://pubs.aina.ucalgary.ca/arctic/Arctic33-1-168.pdf. There are also many industry publications on ice road construction and ice thickening to make drilling platforms and other structures. [William Clarke, Australia]	See 912
1208	3	3	38	3	41	I would suggest revising this, to avoid misunderstandings. As it stands, the "occurrence of at least one sea ice-free Arctic summer every 5 years" is followed by "very likely to survive the summer under 1.5C". Why not give the probability in terms of years again, so it is correctly conved? Because otherwise it sounds very much like we would be surprised to see an ice-free Arctic under 1.5C warming, and I don't think we would be. So maybe the probability in years can be added, as was done in Sanderson et al., 2017? For 1.5C, that means once every 40 years. [Alexandra Jahn, USA]	Accepted: KM text revised
1628	3	3	38	3	41	In this chapter, it seems that RCP4.5 corresponds to the emission scenario limiting global mean temperature rise to 2 degrees C? What reference period is used here, pre-industrial or current climate? According to AR5, RCP2.6 is the emission scenario corresponding to 2 degrees global warming relative to pre-industrial temperature levels. [Aurora Stenmark, Norway]	Accepted: KM text revised
5138	3	3	38	3	39	The scenario compatible with 2 oC warming should be RCP2.6 instead of RCP4.5. [Sai Ming Lee, China]	Accepted: KM text revised

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
11508	3	3	38	3	39	Using "2°C stabilized global warming" as a shorthand for RCP4.5 is wrong and misleading and must be corrected. [Taehyun Park, Republic of Korea]	Accepted: KM text revised
3700	3	3	39	3	41	I do not share the view that the finding „ice free every 5 years at 2 °C“ is robust enough to warrant the assessment as this being „very likely“ the case. I do not share the view that at 1.5 °C global warming Arctic sea ice will very likely survive. Both claims are possibly true, but uncertainty is high as discussed by Niederdrenk and Notz, GRL, 2018. [Dirk Notz, Germany]	Accepted: KM text revised
7084	3	3	39	3	39	E1a: Should the time period for which these statements regarding the future of Arctic sea ice and snow cover are accurate be specified? Or are they implicit in the RCP scenarios? [APECS Group Review, Germany]	Accepted: KM text revised
12792	3	3	39	3	39	RCP4.5 does not stabilize at 2C warming above pre-industrial. [Collins Matthew, UK]	Accepted: KM text revised
24484	3	3	39	3	41	Please check if this is in line with SR15. [Hans-Otto Poertner and WGII TSU, Germany]	Accepted: text checked and revised to ensure consistency with SR1.5
1632	3	3	40	3	41	Please make sure this statement is consistent with the findings in SR15. [Aurora Stenmark, Norway]	Accepted: text checked and revised to ensure consistency with SR1.5
11506	3	3	40	3	40	It is very important to maintain the message on 1.5°C! [Taehyun Park, Republic of Korea]	Accepted: text checked and revised to ensure consistency with SR1.5
16940	3	3	40	3	40	What does "to survive" signify? That there is some summertime sea ice every year? How much, i.e., sufficiently to matter viz. impacts? How does this compare with the 2oC case and one out of five summers as ice-free? [Markku Rummukainen, Sweden]	Taken into account: KM revised; wording no longer appears
19216	3	3	40	3	41	Is this statement is consistent with the findings in SR15. [Marianne Kroglund, Norway]	Accepted: text checked and revised to ensure consistency with SR1.5
22490	3	3	40	3	41	"… survive albeit with greatly reduced extent." Most likely the thickness will be reduced, too. Suggestion: "… survive albeit with greatly reduced extent and thickness." [Peter Lemke, Germany]	Taken into account: KM revised; wording no longer appears
12532	3	3	42			"Antarctic sea ice trends have shown a weak response to greenhouse gas-driven warming". This is a bit misleading. Surely the point is that many parts of Antarctica have not seen a greenhouse-gas driven warming yet (page 8, line 41) and hence there has not been a sea ice response? [Eric Wolff, UK]	Taken into account: KM revised; wording no longer appears
13032	3	3	42	3	45	Nevertheless, delayed Antarctic warming has been one of the characteristicsalready of the very first coupled projections. Maybe the situation is not that bad. [Gerhard Krinner, France]	Taken into account: KM revised; some wording no longer appears but we retian low confidence in the Antarctic sea ice projections
6758	3	3	43	3	43	I don't agree with the statement that Antarctic sea ice has shown a weak response to GHGs, I think this is misleading, given the observed trends in Antarctic sea ice are not well explains and forcings such as Ozone can not be discounted. Saying a weak response implies there is a response in the sea ice, when it is not possible to argue if there is any response at all. [James Pope, UK]	Taken into account: KM revised; wording no longer appears
6760	3	3	43	3	44	"though with strong observed reductions since 2015" - it is in my opinion far to early to be making statements about Antarctic sea ice trends based on the recent 2 low years. I think this statement needs to be carefully worded to ensure that it acknowledges we are currently unsure if these recent lows are a new regime in Antarctic sea ice or if they are a just anomalous years. [James Pope, UK]	Accepted:text revised to capture the negative Antarctic sea ice anomalies in 2016 - 2018
7094	3	3	43	3	44	Here it says 'strong observed reductions' have occurred since 2015, whereas it says since 2016 on page 21 line 33. [APECS Group Review, Germany]	Accepted: text revised

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
12680	3	3	43	3	44	though with WEAK INCREASE BEFORE AND strong observed reductions since 2015 [Michiel Van Den Broeke, Netherlands]	Accepted: text revised
1636	3	4	2	4	6	Perhaps this paragraph is somewhat too technical, and therefore difficult to understand for many readers. Please consider to rewrite and avoid terms like "baseflow in northerly-flowing Arctic rivers", "concomitant" and "thermokarst". [Aurora Stenmark, Norway]	Taken into account: KM no longer appears in this form
6176	3	4	2	4	4	Is there really 'high confidence'. There is huge controversy in the literature regarding the causes of the Arctic rive flow increase with little consensus. McClelland et al, (2004) evaluated direct potential effects of permafrost thaw, and and found that this could not explain the increase. There is some evidence that changes in pathways occur due to permafrost thaw but possibly due to changes in evaporation rather than groundwater discharge. Despite extensive research this topic seems still not resolved. [Regine Hock, USA]	Accepted: KM no longer appears in this form; in-chapter text also revised
10698	3	4	2	4	4	Second Assessment Report of Roshydromet on Climate Change in Russian Federation (2014) documets also raise of precipatation last decades, which results in up to 10-20% runoff raising. Please add. [Oxana Lipka, Russian Federation]	Taken into account: KM no longer appears in this form
19192	3	4	2	4	6	Very technical -- possible to simplify? [Marianne Kroglund, Norway]	Noted-this term is now defined in glossary
7096	3	4	5	4	5	E1a For non specialists: please either define 'thermokarst', or just add '(thaw)' after this word. Giving: "... due to intensified thermokarst (THAW) activity..." [APECS Group Review, Germany]	Noted-this term is now defined in glossary
24894	3	4	11	4	13	"...cause the mobilisation of this organic carbon" with "high confidence" is concerning because there is an ongoing challenge of identifying the expected increase in methane concentrations due to the melting permafrost. Are the authors sure? [Elizabeth Weatherhead, USA]	Text has been reworded to clarify statements and confidence language
1638	3	4	12	4	15	Please make it clear that the carbon emissions from permafrost will increase from current levels in both RCP4.5 and RCP8.5. As it reads now, it might be interpreted that emissions from permafrost will be reduced from current levels in RCP4.5. [Aurora Stenmark, Norway]	Accepted-text revised
13034	3	4	13	4	15	This only talks about the permafrost carbon. The ecosystem as a whole can have a different response due to the vegetation C uptake. Should this be mentioned? [Gerhard Krinner, France]	Accepted-vegetation carbon and soil carbon dynamics detailed separately
5140	3	4	14	4	14	The scenario compatible with 2 oC warming should be RCP2.6 instead of RCP4.5. [Sai Ming Lee, China]	Accepted-text revised
11510	3	4	14	4	15	Using RCP4.5 as a shorthand for 2°C scenarios is misleading and must be corrected. [Taehyun Park, Republic of Korea]	Accepted-text revised
16942	3	4	14	4	14	Constrained warming may reduce emissions compared to higher warming cases, but not in absolute sense as emissions still increase compared to present-day (or preindustrial) baseline. Perhaps wording like "will lead to smaller increases in emissions". [Markku Rummukainen, Sweden]	Accepted-text revised
23684	3	4	15	4	15	Please use °C instead of writing degrees [Hans-Otto Poertner and WGII TSU, Germany]	Accepted; change made
12794	3	4	17	4	24	Are these changes forced or just natural internal variability? [Collins Matthew, UK]	Accepted: attribution of the changes is now included in the text.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
916	3	4	18			I understand that in more recent times the Southern Ocean carbon drawdown has actually weakened and the sea ice has begun to retreat, with the likely result of less formation of cold bottom water. Continued loss of sea ice and shelf ice is likely to reduce buttressing and increase ice cliff disintegration, see https://nsidc.org/arcticseaicenews/charctic-interactive-sea-ice-graph/. [William Clarke, Australia]	Taken into account: the relevant literature on these aspects is assessed fully in Sections 2 and 3.
222	3	4	26	4	27	This statement is misleading. Later in the text you are explaining and illustrating (e.g. p. 22, Fig. 3.7) that the Antarctic polar ocea has been cooling in the past decades. Why not mention this important fact here? Fast readers should know that Antarctic climate is more compex than elsewhere in the world. It should also be stated that Antarctic temperatures as a whole have probably not warmed during the past 100 years (e.g. Luscher et al. 2016, doi: 10.1007/s00382-015-2582-5). In Figure 3.7b of the FOD one can also see that Antarctic sea ice in many coastal areas around Antarctica has been growing. Needs to be mentioned in the summary, even though it may appear inconvenient. [Sebastian Luening, Portugal]	Taken into account. Heat content in the Southern Ocean has increased in recent decades with very high confidence, and whilst there is inevitably regional variability superposed, this does not negate the rate of change. Phrasing has been adjusted where relevant, and attribution included.
24896	3	4	26	4	27	There are two ideas in this sentence. Do they both get a “high confidence?“ [Elizabeth Weatherhead, USA]	Taken into account. Confidence statement applies to the whole headline, which has been revised
17788	3	4	30	4	30	What distinguishes 'formal' and 'informal' actors? Is there a more descriptive term? [Robert Arthern, UK]	Formal actors are “official actors” such as states, institutions within formal international organizations (i.e. the EU or the WTO) that have a direct formal power attributed by treaty law and have a weight in the decision-making law formation processes and in the adoption of legal acts. For example, in case of EU law, formal actors or officials are: “the EU Commission, or the Council” or “States”. Informal actors are “non-official actors” which are actors other than those described above but that can have an informal role and can “influence” the decision-making law process (and conduct lobby activities externally) without having the right to vote in the decision-making fora or without having a formal legal authority establish by treaty to do so. Example of “informal actors” are: Indigenous People at the Arctic Council (because they do not have the right to vote but are still influencing and have a weight in the decision-making processes or the “”WWT or Birdlife association” in the EU law formation process of legal acts or again the role of WWF at the Arctic Council.
24486	3	4	34	4	39	Suggest to combine this paragraph with the first paragraph on page 5. [Hans-Otto Poertner and WGII TSU, Germany]	Accepted: key messages revised
16944	3	4	37	4	39	This could be combined with the text on page 5, lines 1-7. [Markku Rummukainen, Sweden]	See response to 24486
11010	3	4	38	4	55	To the impacts which you list (food security, movement), I would suggest that you add loss of habitability due to sea ice loss/coastal erosion linked also to sea level rise . [Ben Orlove, USA]	Rejected. While an intersting concept, we have not developed material on habitabilty in our chapter, so we cannot support mentioning in eth Executive Summary. We have however conributed Arctic coastal erosion material to Cross Cutting Chapter 6 where this is discussed.
20966	3	4	38	4	38	"including to Antarctic krill": omit "to" [Claudio Richter, Germany]	Accepted: text revised

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20968	3	4	38	4	38	"cornerstone species" sensu Bracken & Low (Ecology letters 15.5 (2012): 461-467) refers to a rare species with disproportionally large effects on the community. This is not the case for krill, which is very abundant. Replace with "foundations species" sensu Dayton (In: Proceedings of the colloquium on conservation problems in Antarctica. Lawrence, KS: Allen Press, 1972. pp. 81-96) [Claudio Richter, Germany]	Accepted - replaced with 'keystone' (see also comment #23682)
23682	3	4	38	4	38	I suggest using "keystone" instead of "cornerstone" [Hans-Otto Poertner and WGII TSU, Germany]	Accepted
21170	3	4	41			This section on why polar regions matter only consider the material components of the Polar Region. There is a widespread literature on the importance of polar regions to regional and distant societies for spiritual reasons, psychological well-being and also that polar regions are sentinels for prospects for the Earth systems. There is an increasing fear that the contraction of polar systems spells the imminent loss of the integrity of these systems. It is recommended that attention be given to this component of their signfiicance, which also has societal and economic consequences for peoples and nations in these regions or related to these regions in some way. [Andrew Constable, Australia]	Taken into account. This is a good point that in order to appear in the Executive Summary has to be substantiated in the chapter. We have worked to strengthen aspects of the theme, for example by concluding on impacts of species "of global conservation value". However, we have not been able (yet) to identify "widespread literature" that would comply with IPCC rules.
10838	3	4	43	4	44	I don't like "Observed changes in ice sheets and glaciers raise sea level worldwide" which is a bit of a nothing statement and doesn't make sense. One can either say that the observed reduction in ice sheet mass has raised global sea level, or that generally, reductions in ice sheet/glacier mass contribute to SLR. This sentence is a mixture of the two but is unclear and imprecise. This is also one of few bold 1st lines in this introductory section that doesn't make a strong scientific statement with quantified uncertainty (i.e, like "high confidence"). It may also be better to make it clear that we're talking about observed reductions. I would recommend changing this to something more like: "Observed reductions in the mass of ice sheets and glaciers have raised sea level worldwide (confidence statement)". [Ed Blockley, UK]	Accepted: key message revised
24898	3	4	43	4	46	"..virtually certain that melting ice sheets and glaciers dominate observed sea level rise...". I believe that warming of the oceans has a notable impact on sea level rise, thus I suggest changing the word "dominate" to something less strong. When I read "dominate," I think that this is 90% of the cause of SLR. Do the authors want to communicate that? Furthermore, chapter four write on page 4-17, "Thermal expansion is a major contribution to the rate of global mean sea level rise.." Consistency? [Elizabeth Weatherhead, USA]	Accepted: key message revised
3674	3	4	44	4	44	Language not clear: Change to: "the contribution from melting ice sheets and glaciers dominates observed sea level rise" [Joanne Johnson, UK]	Accepted: key message revised
11792	3	4	44	4	44	"dominate *contributions to* observed" [King Matt, Australia]	Accepted: key message revised
17898	3	4	44	4	44	the evidence for this statement seems to be primarily in Table 4.1 and not in chapter 3. Suggest refering to that table. [Haroon Kheshgi, USA]	Accepted: key message revised

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
20668	3	4	45	4	45	I think we have to be very careful about the use of the word 'accelerating' for past ice loss. A rate that has increased is not the same thing, and the difference between the two statements depends a lot on the time periods chosen. (I think 'accelerated rates' as in L13 is more acceptable, though still not ideal.) This needs further justification and quantitative detail to be justified. [Tamsin Edwards, UK]	Accepted: key message revised
12682	3	4	48	4	55	Multiple vague wordings here: have consequences (what consequences?); food insecurity is increasing -> food security is decreasing, environmental changes (what changes?), changes to travel condistions (what changes?). It should be possible to quantify the increase in Arctic shipping. [Michiel Van Den Broeke, Netherlands]	Taken into account: KM completely revised
24386	3	4	48	4	55	This merges several important risks to humans and human systems in one single bullet, suggest splitting and expanding [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account: KM completely revised
7098	3	4	50	4	51	E1a Not only hunting, by also fishing activities. Suggestion: "... to access hunting AND FISHING grounds..." [APECS Group Review, Germany]	Accepted: text revised
5802	3	4	51	4	52	Statement implies complete loss of permafrost in these regions by 2050 which is not the case. A more correct statement is that "permafrost is projected to significantly thaw" in these areas. [Sharon Smith, Canada]	Accepted: text revised
24900	3	4	53	4	55	These lines are very similarly to the lines on page 3-5, Lines 13-15. Consolidate? [Elizabeth Weatherhead, USA]	Taken into account: KM's completely revised
23686	3	4	55	4	55	The cross reference to 3.4.3.2 is not sufficient (this section does not cover Ship traffic and arctic infrastructure). Do you mean 3.4.3.3? [Hans-Otto Poertner and WGII TSU, Germany]	Accepted: text revised
3618	3	5	1			change to: Future climatic change has the potential to impact productivity of many, including several commercialimportant species in the polar oceans (high confidence). [Angelika Brandt, Germany]	Accepted: key message revised
21168	3	5	1			This statement is not clear. It is already covered in earlier statements. Fisheries management does not determine whethere climate change impacts on the productivity of fish stocks. However, it may exacerbate impacts i.e. make them worse if spatial management measures are not in place to ensure that fisheries do not cause a disproportionate increase in the effects of climate change. [Andrew Constable, Australia]	Taken into account - in the revised version of the Execuitve Summary, productivity and impacts on fisheries are treated in sepearate Key Messages. However, our chapter still supports that the risk of impacts on fisheries is affected by fisheries management (not only limited to spatial management)
12684	3	5	2	5	7	Again multiple vague wordings here: has the potential, several, potentially, depend on, complex. This section comes across as non-scientific and negatively impacts the readability of the chapter. [Michiel Van Den Broeke, Netherlands]	taken into account. We have revised the statement to be more concrete. We don't believe the reviewer's critique in the 2nd part of the statement is justified though
23688	3	5	2	5	2	I wouldn't narrow it down to Arctic fish stocks, as there might also be an impact on other economically important Arctic species (e.g. large Arctic crabs) [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account
3676	3	5	9	5	9	Not clear what is meant by "sectors" - before reading the rest of the paragraph, I thought it meant sectors of the Arctic and Antarctic ice sheets. Replace "sectors operating" with "commercial and industrial operations". [Joanne Johnson, UK]	Accept; we have removed usage of the word in this way.
11794	3	5	9	5	9	"sectors" is jargon. There are sectors of ice sheets as well. [King Matt, Australia]	See response to 3676

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12686	3	5	9	5	15	Ibid: Most sectors (specify), climate change (which variables), significant ways (what ways), some (which)…it is somewhat ridiculous to let this vague statement be followed by 'high confidence'. The following sentences suffer from the same problems. [Michiel Van Den Broeke, Netherlands]	Taken into account; the Key Message has been revised.
14226	3	5	17			What are the options…' [Christopher Fogwill, UK]	Accept; sentence fixed.
21176	3	5	17			I did not understand these points or their justification. In my experience in the Southern Ocean, there has been no improvement related to governance measures associated with climate change other than to discuss climate change. For the Southern Ocean, there is also no relationship of the Antarctic Treaty System with global bodies responsible for climate change. In this case, the ATS could play a role in mitigation and adaptation by having each management body reporting to the UNFCCC on the impacts of climate change on their mandates. [Andrew Constable, Australia]	Taking into account that at the general level, even not UNCLOS or OSPAR for example, are contemplating climate change's impacts given that the drafters of these conventions at that time did not know a lot about this phenomenon and that there are no provisions providing for adaptation because the interactions between climate change, the (law) of the sea under the new era of Anthropocene is simply new, we do not see your point so relevant. Futhermore, responses from a regulatory point of view are not totally ready yet or are still a work in progress everywhere. So it would be naïf to think that "there has been no improvement" (admitting that your point would be someway correct). Moreover, in the case of Antarctica, Antarctic governance relates to climate change as its place for science to understand its mechanisms and its real/potential effects both in the ATS and on the earth system as a whole (Antarctic Treaty Consultative Meeting XXXII, Washington Ministerial Declaration, 2009). From this perspective, the question is whether the current governance system relating to Antarctica, including the role of SCAR in it, is conducive to promote such climate science in the Antarctica. We do not see the question as "regulatory issues in mitigation/adaptation.
19218	3	5	18	5	18	Suggestion: Include key message "The fate of the Arctic and its impact on the remainder of the globe remains troublesome even if much of the world's temperature were to stabilize in response to an aggressive mitigation of greenhouse gas emissions (GHG). The potential magnitude of physical and biological changes in the Arctic, their possible instability, and the role of the Arctic in the global climate system context are not settled topics. Nevertheless, model results suggest that early and substantial mitigation efforts could slow further Arctic changes". Ref: SWIPA 2017 + Overland et al 2018 submitted to Nature Climate Change [Marianne Kroglund, Norway]	Taken into account; we have revised the Executive Summary and introduced new Key Messages that bring forward many of the points made.
4056	3	5	19	5	21	Perhaps this text is too complicated and difficult to understand. Please consider to rewrite. [Aurora Stenmark, Norway]	Taken into account; the text has been revised to aid readability.
12688	3	5	19	5	41	These three sections suffer from the same problems: they are not specific and therefore not scientific. This is only aggravated by the 'confidence' statements that follow them, these come across as completely meaningless. [Michiel Van Den Broeke, Netherlands]	Taken into account. Note that from a WG I perspective it may appear this way, but this section is about human responses and confidence statements do reflect the available literature according to IPCC rules. However, we have clarified text where possible.
10700	3	5	20	5	20	Mitigate' is very cinfusing in this sentence. Please change the term to not mix with CO2 emission reduction. [Oxana Lipka, Russian Federation]	taken into account; the statement has been revised

SROCC First Order Draft Expert Review Comments - Chapter 3							
Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
16946	3	5	22	5	23	Does this mean that also sustainable development (or the interaction of effects of climate change and sust dev) constrains human choice, increases risk and limits the ability to adjust behaviour? This sounds one-sidedly negative. There are also positive consequences, I suppose. [Markku Rummukainen, Sweden]	taken into account for revision.
1326	3	5	26			good point re fragmentation with respect to Antarctica and with SCAR being a key link here with the Antarctic Treaty Consultative Meeting, with parties since 2010 looking at ways to improve interaction [Marcus Haward, Australia]	Internaitonal cooperation is relevant in the Antarctic with regards to the role of reserach stations
14228	3	5	26			International cooperation in responding...' [Christopher Fogwill, UK]	International cooperation in the Antarctic is rather relevant with regards to the role of research stations
24488	3	5	26	5	32	Can be indicated if this development has improved or worsened the situation in polar regions? [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account in revisions, significance and limitation of the trends made explicit
6070	3	5	36			'indigenous peoples' must be capitalized. This comment applies to all instances of 'Indigenous Peoples' throughout the text. [Joanna Petrasek Macdonald, Canada]	Accept; this change has been made.
22586	3	5	36	5	41	Please capitalize "Indigenous Peoples" - I've found that the spelling is not consistent throughout the report (see also Chapter 1). It would be good if you could generally capitalize "Indigenous" (also in front of "knowledge"), which is usually done to recognize Indigenous the same way we would nationalities (which are also always capitalized in English). Finally, I agree that a co-production of knowledge approach would generate more holistic knowledge, but I'm not clear what you mean by "greater perceived legitimacy". Do you really mean to say it has only greater legitimacy in peoples' perception, and if so, why? Doesn't have a holistic approach greater legitimacy as a matter of fact? I would argue the latter. [Eva Kruemmel, Canada]	accepted; Indigenous capitalised throughout.taken into account, in revisions
17790	3	5	38	5	46	This section made me wonder whether about the degree to which this is a scientific chapter. Is it intended that all conclusions of this chapter, and the statements in the executive summary are drawn exclusively from peer-reviewed scientific literature that could be reproduced? If so, this would be worth emphasising. [Robert Arthern, UK]	Taken into account; the assessment is scientific, but broader than just physical science - elements of social science are drawn in where appropriate, and are key to the integrated approach. The text flags this directly, including in the Introduction.
13036	3	5	39	5	43	multiple ways of knowing: We are on a very slippery slope here. Sound evidence-based reasoning is the only way forward for science. Facilitating a better understanding of challenges people face, and acceptance, is a worthy undertaking BUT the science itself must remain sound. [Gerhard Krinner, France]	Taken into account. There is no suggestion or implication made in the text that science should not be sound. Knoweldge co-production is presented in the text. This statement and the underpinning science and concepts are also clarified in the Cross Chapter Box on Indigenous Knowledge and Local Knowledge
14230	3	5	39			Chapter 1 consistently used a comma after 'e.g.' Make sure this is standardized through report. [Christopher Fogwill, UK]	Editorial; copyedit to be completed prior to publication

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
6072	3	5	40			It is crucial that local knowledge and Indigenous Knowledge systems are not lumped together or mixed up. They are very different and distinct from one another. Indigenous knowledge is based on a specific culture and knowledge system, has its validation process and is passed forward from generation to generation, often thousands of years old. Local knowledge is aquired due to experiences and observations made by living in a specific place, but is not necessarily based on a knowledge system or a specific culture. These terms cannot be used interchangeably and lumping them here together would encourage readers to make the assumption that they are one in the same or at least very similar. This comment has been made extensively in Ch. 1. Please refer to Indigenous knowledge and local knowledge separately. The Inuit Circumpolar Council has a specific definition for Indigenous knowledge that we would be happy to provide. This comment applies to all instances where the words 'local and Indigenous Knowledge' or 'Indigenous and local knowledge' are used in this chapter. Also note that Indigenous Knowledge should be capitalized. [Joanna Petrasek Macdonald, Canada]	Accepted; the terms are now used in their separate contexts throughout SROCC.
16948	3	5	45	5	45	"multidisciplinary elements of the Arctic and Antarctic" sounds strange. Issues, topics and aspects may be disciplinary or multidisciplinary, as well as their study. But not physical or social systems as such. [Markku Rummukainen, Sweden]	Accepted; statement now changed.
24902	3	5	45	5	55	Nicely written. [Elizabeth Weatherhead, USA]	Noted - and thanks
19800	3	5	48	5	49	Be consistent with capitalization (or not) of "Polar Regions" - I would suggest not capitalizing it when in body text [Michelle A. North, South Africa]	See response to 12526.
6074	3	5	50	5	51	Unclear what 'disproportionately valued' means? Is this implying that Indigenous knowledge (IK) is more valued in the Arctic context? And who is determining HOW MUCH IK should be valued? Please clarify. [Joanna Petrasek Macdonald, Canada]	Taken into account. The phrase used is "disproportionately valuable". The clarifications asked for by the reviewer are elaborated upon in the chapter text; we refer to section 3.5 and Cross-Chapter Box 3 for details.
12690	3	5	50	5	51	The wording of the synthesis is vague: e.g. what are 'conventional scientific data'? [Michiel Van Den Broeke, Netherlands]	Taken into account; we have revised the sentence.
14232	3	5	50			…centres and the challenges of operating…' [Christopher Fogwill, UK]	Accept; sentence amended as indicated.
22588	3	5	50	5	51	Please again capitalize "Indigenous" and clearly separate from local knowledge. Also, I read the sentence as saying that Indigenous knowledge and local knowledge are only "disproporationally valuable" when considered together with scientific data. However, I would argue that Indigenous knowledge" is just as valuable when considered on its own. [Eva Kruemmel, Canada]	See response to 6072.
13038	3	5	56	5	57	What is CCAMLR? [Gerhard Krinner, France]	Accepted. Comment refers actually to page 6 not 5, but term is now spelled out in full.
23690	3	6	1			This is a really nice and well prepared introduction to the chapter, with Fig 3.1 providing a good overview on key features and interaction while at the same time including references to the respective sections [Hans-Otto Poertner and WGII TSU, Germany]	Noted - and thanks
2558	3	6	3	6	51	There are a lot of well written and nice sentences. However, these paragraphs contain a lot of redundancies and could be substantially shortened. For example: adapatation and response are each mentioned three times. It would be nice if these sentences could be condensed to one each. Likewise with sentences mentioning the complexity and importance of the cryosphere and oceans. etc. [Patrik Winiger, Netherlands]	Taken into account; some condensing of material has been conducted, though explicit statements are retained where helpful also.

SROCC First Order Draft Expert Review Comments - Chapter 3							
Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
19802	3	6	3	6	55	Be consistent with capitalization (or not) of "Polar Regions" - I would suggest not capitalizing it when in body text, it interrupts the flow of reading [Michelle A. North, South Africa]	accepted; polar regions not capitalised throughout
2550	3	6	4	6	4	imports -> importance [Patrik Winiger, Netherlands]	Accepted; change made
7100	3	6	4	6	5	"of the imports" should be "of the importance" and the wording "right across the globe" is odd [APECS Group Review, Germany]	Acepted; changes made. See response to 15970
15970	3	6	5	6	5	Not sure why the word "right" is here. I recommend removing for clarity. [Patrick Taylor, USA]	Accepted. Word removed.
16950	3	6	7	6	7	suggest "... a further growing body..." or suchlike. The knowledge at the time of AR5 has been further compounded. Just "growing" may sound like there was very little earlier. [Markku Rummukainen, Sweden]	Reject; the term just denotes expansion of the literature and available information, which is true
19804	3	6	8	6	11	This sentence could be shortened to improve readability [Michelle A. North, South Africa]	Accepted; sentence shortened
5804	3	6	13	6	21	The section seems to be ignoring other extensive syntheses especially for the Arctic that focus on the cryosphere including consequences (including ecological, socio-economic) of its changes. A key assessment is the AMAP SWIPA2017 report as well as the more detailed regional synthesis that draw from the scientific basis in SWIPA that were part of the Adaptation Actions for a Changing Arctic (AACA) project led by AMAP. The 3 regions covered were Baffin Bay Davis Strait; Barents; Beaufort Chuckhii. It would seem that the IPCC report should acknowledge and build on these extensive syntheses. [Sharon Smith, Canada]	Taken into account. Assessments such as SWIPA (and others) are fully in scope, and information from them are used extensively within Chapter 3. The sentence referred to specifically sets the remit of the Chapter, which takes the information in AR5 as its starting point.
7102	3	6	15	6	16	"this, this" is unclear. Try "To achieve the goal, this chapter..." [APECS Group Review, Germany]	Accepted; change made.
360	3	6	17	6	20	This sentence is too long and may be very difficult for the reader to understand. Consider cutting into shorter senstences. [George Burba, USA]	Accepted; sentences shortened to aid readability
2552	3	6	17	6	21	This is a very long and convoluted sentence with redundant information. I suggest to remove it, or at least shorten the entire paragraph, so that information is not repeated. [Patrik Winiger, Netherlands]	Accepted; see response to 360
5328	3	6	17	6	18	The term "reports" is used both to describe previous IPCC reports and the contributions of the different working groups to these reports, this makes this sentence unnecessarily confusing. [Roderik Van De Wal, Netherlands]	Accepted; sentence rephrased
5330	3	6	17	6	21	The message that the report integrates information which would previously have appeared in different reports, may be brought more efficiently (using less words) [Roderik Van De Wal, Netherlands]	Accepted; sentence shortened
7104	3	6	17	6	17	"ensemble" is a jargon term for climate science that takes away from the meaning here [APECS Group Review, Germany]	Accepted; word changed
2554	3	6	18	6	18	The content between the brakets seems unnecessary to me. [Patrik Winiger, Netherlands]	Reject; creating this opportunity is a key reason for the SROCC report as a whole, and highlighting it here is appropriate.
19806	3	6	18	6	18	Condense to the following: "...would have been assessed separately...", instead of: "assessed in separate reports..." [Michelle A. North, South Africa]	Accepted; sentence changed.
892	3	6	19	6	20	ocean, atmosphere and cryosphere [Herve Nifenecker, France]	Reject; SROCC focusses on the ocean and cryosphere predominantly, and these are the relevant elements to highlight here.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
362	3	6	23	6	23	The part of sentence before ; is probably not needed. It does not add anything to report and may be confusing to a reader. Perhaps just start "The polar regions are two integrated parts of the Earth systems, and interacts with the rest..." [George Burba, USA]	Accepted, first half of sentence removed
6180	3	6	23	6	23	mentioning 'delineation' makes the reader immediately wonder: how is this done in this chapter. Either let the reader know the definition or don't mention delineation. [Regine Hock, USA]	Taken into account; "delineation" removed here. delineation is outlined later on the same page.
6178	3	6	24	6	25	unclear: what are the 2 integrated parts? This is not mentioned anywhere? [Regine Hock, USA]	Reject; the sentence says what these are.
364	3	6	28	6	28	Consider replacing "perspectives of" with "perspectives for" [George Burba, USA]	Taken into account; "perspectives of" seems appropriate though
6184	3	6	28	6	36	a lot of wordsfor little (and unclear) substance [Regine Hock, USA]	Reject: the context provided here is important for elucidating the aims and intentions of the chapter.
1328	3	6	30			could environmental security be added here? [Marcus Haward, Australia]	Reject. The sentence lists multiple "perspectives" (meanings) of the Polar Regions. "Environmental Security" is a topic of concern and doesn't fit the list.
366	3	6	32	6	32	Consider removing "aslo" [George Burba, USA]	Accepted; word removed
1702	3	6	32	6	32	I think the word 'also' is not needed, or could be replaced by 'as well' [Mark England, UK]	Accepted; word removed
6182	3	6	32	6	32	what is the soutern polar region, without a definition/delineation this hangs in the ai [Regine Hock, USA]	Accepted; replaced with Antarctic
7106	3	6	32	6	33	this sentence is very confusing to follow [APECS Group Review, Germany]	Taken into account; rephrased to add clarity
368	3	6	34	6	34	Consider replacing "knowledge on" with "knowledge of" [George Burba, USA]	Taken into account; replaced with "knowledge relating to"
370	3	6	35	6	35	There is an inconsistency here with "such different perspectives". The same paragraph above in line 32 states "many of these perespectives are equally relevant" [George Burba, USA]	Accepted; sentence rephrased
7108	3	6	35	6	35	Is Chapter Box 1 the same as Box 3.1? This inconsistancy was confusing throughout the chapter [APECS Group Review, Germany]	Reject. The reference clearly is to "Cross Chapter Box", not to to "Box"
372	3	6	36	6	36	The part ", yet oftem overlap in space" may not hold exactly true here and also does not add much. Consider removing it. [George Burba, USA]	Accepted, phrase removed and sentence edited for clarity
19808	3	6	36	6	36	Delete: ", yet often they overlap in space." [Michelle A. North, South Africa]	Accepted, phrase removed and sentence edited for clarity
5332	3	6	37	6	37	It would be useful to say something about the consequences of this overlap. [Roderik Van De Wal, Netherlands]	Accepted, phrase removed and sentence edited for clarity
6186	3	6	38	6	46	this is true for all chapters and such general statements should rather go into chapter 1 and not be repeated in each chapter [Regine Hock, USA]	Reject. This is a very important perspective re the Arctic and we cannot presume that all readers of our chapter will have read chapter 1 first.
19810	3	6	38	6	38	Replace: "the totality of" with "all", so that it reads: "Consideration of all peer-reviewed scientific knowledge..." [Michelle A. North, South Africa]	Accept; change made.
374	3	6	39	6	39	Consider removing "considdering in parrallel". It does not read well and unclear. [George Burba, USA]	Reject; the parallel nature of the process is a key element that needs to be stressed. Cross Chapter Box 1 elaborates in detail.

SROCC First Order Draft Expert Review Comments - Chapter 3							
Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
22590	3	6	39	6	46	Please capitalize "Indigenous Peoples" and also "Indigenous" (also in front of "knowledge"), and separate "Indigenous knowledge" (which I would put first, since it has the older heritage) from "local knowledge". Ultimately, it is somewhat difficult to use "published" Indigenous knowledge - first of all because very little is published, second, because it can easily be taken out of context and be misinterpreted, since it is very complex. The context/analysis should ideally always be confirmed by the knowledge holders. [Eva Kruemmel, Canada]	Accepted; changes made. Reference is also made to Cross Chapter Box 3, where the detailed issues the reviewer points to are eluded to.
12118	3	6	41			while integrating local / indigenous knowledge is certainly important, "evidence" has particular meaning. Suggest "not only increases awareness but..." [Andrew Lowther, Norway]	Accepted; replaced with "knowledge"
12120	3	6	43			differentiate between published (peer reviewed) and other unreviewed / nonscientific literature pieces. [Andrew Lowther, Norway]	Reject; all references used in this report adhere to IPCC standard
1766	3	6	48	6	50	Suggest adding a refefernce Fyke J.G., O.V. Sergienko, J.T.M. Lenaerts, M. Löfverström, and S. Price. (2018), An overview of interactions and feedbacks between ice sheets and the Earth system, Rev. Geophys., 56. https://doi.org/10.1029/2018RG000600 [Olga Sergienko, USA]	Reject; we are keeping the Introduction purposefully reference-free, excepting the delineation/definitions of the polar regions we adopt where they cannot be avoided
19812	3	6	50	6	51	Modify to read: "...to help with navigation, Figure 3.1 provides a schematic of the chapter sections." [Michelle A. North, South Africa]	Accepted; sentence changed to "These are outlined in detail throughout the course of this chapter; to help navigation, Figure 3.1 includes pointers to the relevant chapter sections."
5334	3	6	54	6	57	It would be nice to show a map of the two areas [Roderik Van De Wal, Netherlands]	Accepted; we have included inset maps in Figure 3.1 showing the two areas.
7112	3	6	54	6	57	Could it be useful to have a figure diagramming the boundaries of the Polar Regions? Most policy makers won't be familiar with the location of the subantarctic front, the CCAMLR area, etc. [APECS Group Review, Germany]	Accepted; we have included inset maps in Figure 3.1 showing the two areas.
23692	3	6	55	6	55	introduce ACC as acronym for Antarctic Circumpolar Current here [Hans-Otto Poertner and WGII TSU, Germany]	Rejected; we have removed all but one acronyme from the introduction to improve readibility
2556	3	6	56	6	56	Please explain the abbreviation CCAMLR [Patrik Winiger, Netherlands]	Taken into account; we have removed all but one acronyme from the introduction to improve readibility
7110	3	6	56	6	56	CCAMLR acronymn isn't written out and hasn't yet been mentioned. This will be confusing to many. [APECS Group Review, Germany]	Taken into account; we have removed all but one acronyme from the introduction to improve readibility
23694	3	6	56	6	56	I suggest providing full name for CCAMLR at first mention for readers not familiar with Southern Ocean management and conservation [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account; we have removed all but one acronyme from the introduction to improve readibility
10840	3	6	57			The Arctic is defined here as comprising the areas of the Arctic Large Marine Ecosystems (PAME, 2013). However this PAME definition does not include the Sea Of Okhotsk. It seems odd to include the Faroe Islands – which are perennially ice free – but exclude Okhotsk which at least partially covered by ice for over half the year. [Ed Blockley, UK]	Taken in account. Any definition will throw up ambiguities; we stress that our approach is a broad one and applied flexibly so that the major system elements (such as sea ice) can be assessed in full. To make this even clearer, we have included the Sea of O and ice affected Baltic in a map of the Artci region we presnt in the Introduction
5806	3	7	1	7	7	A map would be helpful to show what region is being considered as many readers may be less familiar witt areal extent of the zones mentioned here such as permafrost zones, and the various biomes mentioned. [Sharon Smith, Canada]	Accepted; we have included inset maps in Figure 3.1 to show the areas considered

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
10702	3	7	1	7	7	This diffenition is unclear, not geographical. Actually you describe not just Polar Regions, but Polar Regions and seasonally snow-covered with permafrost territories. Please change the chapters' name or use other definition for the Polar Regions. Please provide a map. [Oxana Lipka, Russian Federation]	See response to 10840. Re inclusion of a map, we have included inset maps in Figure 3.1
14234	3	7	2			characterized [Christopher Fogwill, UK]	reject; IPCC uses UK English
1302	3	7	3	7	3	"persistent seasonal' is an oxymoron… [Ross Brown, Canada]	Accepted; changed to "persistent winter season"
6188	3	7	3	7	3	perhaps it should be made clear which parts of the domain that satisfies theses conditions is NOT included in this chapter and refer to Chapter 2 (e.g. the mountainous regions in northern Russia, all Iceland and Alaska, which are covered in chapter 2 instead) [Regine Hock, USA]	Accepted; we have included the information as a footnote
22492	3	7	3	7	7	Is it possible/sensible to insert a geographical map showing the footprint of the Polar Regions? [Peter Lemke, Germany]	Accepted; inset maps are now included in Figure 3.1 showing this.
8176	3	7	4	7	4	"of the" duplicated after "20%". Remove one. [Benoit Montpetit, Canada]	Accepted; fixed.
16836	3	7	4	7	4	twice "of the" in the sentence : "they emcompass surface areas equalling 20 % of the of the global…" [Anthony Mémin, France]	Accepted; fixed.
12092	3	7	7	7	11	Unclear why there are two halves to this figure; why can't there be one multiple, with all elements, and legible numbers? [Sarah Cooley, USA]	Taken into account; the figure denotes Arctic and Antarctic elements in different panels. This is now made explicit in the figure.
5336	3	7	8	7	11	I really like figure 3.1, however, to make it even easier to read I would recommend to indicate clearly that the left part is the Arctic and the right part the Antarctic. [Roderik Van De Wal, Netherlands]	Accepted; this is now made explicit in the figure
5338	3	7	8	7	10	The numbers in the figure are too small to read [Roderik Van De Wal, Netherlands]	Accepted; enlarged
14236	3	7	8	7	11	Numbers on Figure 1 too small to read well [Christopher Fogwill, UK]	Accepted; enlarged
376	3	7	9	7	10	Please add clearly disttinguishable labels "Arctic" and "Antarctic" to the two pictures. [George Burba, USA]	Accepted; this is now made explicit in the figure
378	3	7	9	7	10	Numbers in small black circlear are difficult to read. Consider making them larger. [George Burba, USA]	Accepted; enlarged
3504	3	7	9	7	28	Numbers inside Figure 3.1 are rather small, hence difficult to read. [Deborah Verfaillie, Spain]	Accepted; enlarged
3506	3	7	9	7	28	Maybe it should be shown or stated somewhere that the left picture in Fig. 3.1 represents the Arctic, while the right picture is Antarctica. [Deborah Verfaillie, Spain]	Accepted; this is now made explicit in the figure
7116	3	7	9	7	9	This figure needs some additional labeling such as "Northern Polar Region" or "Arctic" otherwise to a non scientist it won't be immediately clear that the left side is Arctic and right side is Antarctic. They just look sort of similar. [APECS Group Review, Germany]	Accepted; this is now made explicit in the figure
17428	3	7	9	7	10	Figure 3.1: Label the left panel Arctic and the right Antarctic, to make it clear to the reader why there are two panels. [Sonya Legg, USA]	Accepted; this is now made explicit in the figure
20670	3	7	9	7	11	Needs North and South labels next to diagrams [Tamsin Edwards, UK]	Accepted; this is now made explicit in the figure
22396	3	7	9	7	28	I would add some subtitles in the subfigures too (« Arctic » and « Antarctic »). [Matthieu Chevallier, France]	Accepted; this is now made explicit in the figure
2560	3	7	10	7	10	The schematics in this chapter are fantastic! [Patrik Winiger, Netherlands]	Noted - and thanks
19814	3	7	10	7	12	Try to increase the font size of the section numbers within the figure, and label the leftmost figure as "Arctic" and the rightmost figure as "Antarctic", or North and South Polar Region, respectively [Michelle A. North, South Africa]	Accepted; both points actioned
3678	3	7	12	7	12	Fig. 3.1: The numbers on this figure are too small to be seen. [Joanne Johnson, UK]	Accepted; enlarged

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
5340	3	7	12	7	28	The presentation of the caption belonging to this figure might improve if put in a table, coupled to the figure. [Roderik Van De Wal, Netherlands]	Taken into account; the statements we make to explain the numbered processes don't lend themselves to a table presentation, but we have used a list format.
4104	3	7	23	7	24	“effected” should be “affected”, and “effects” should be “affects” [Kaitlin Naughten, UK]	Accepted; changes made
2562	3	7	26	7	26	Could you maybe be a little bit more specific regarding "northern popoulations". I assume you mean humans, or does it include animal populations? [Patrik Winiger, Netherlands]	Taken into account; it includes both, but the figure caption is not the place to expand. Link to relevant section of the main text is given.
7114	3	7	27	7	28	Subglacial discharge can also be important in the Arctic so should be included in the Arctic schematic too. It is referred to in the Arctic context within the report (3.2.2.3 pg 14 line 28-30, 3.3.1.2.4 pg 29 line 3-5) [APECS Group Review, Germany]	Accepted; figure adapted accordingly
14086	3	7	27	7	27	meltwater discharge impacts ocean stratification and circulation as well as sea level (Fogwill et al., 2015 Sensitivity of the Southern Ocean to enhanced regional Antarctic ice sheet meltwater input(Earths Future); van Wijk and Rintoul, 2014. Freshening drives, Freshening drives contraction of Antarctic Bottom Water in the Australian Antarctic Basin (2014) [Christopher Fogwill, UK]	Accepted; caption amended
12122	3	7	33			consistency in capitalisation please [Andrew Lowther, Norway]	accepted; section copy-edited edited to IPCC style
24904	3	7	35	7	44	This section reads incomplete. Add changes in circulation, changes in methane release, changes in use of the Arctic (shipping, drilling)? [Elizabeth Weatherhead, USA]	Taken in account. Circulation is covered in following section. Methane is currently a small effect
1704	3	7	36	7	36	Suggest to rewrite as "For the last two decades changes in Arctic air temperature are double the global average" [Mark England, UK]	Accepted
4106	3	7	36	7	37	“a clear indicator climate change” should be “a clear indicator of climate change” [Kaitlin Naughten, UK]	Accepted
7118	3	7	36	7	37	this sentence is confusing and the comma is used incorrectly [APECS Group Review, Germany]	Accepted, sentence edited
8178	3	7	36	7	37	The first sentence of this paragraph needs to be rewritten. Suggestion: "For the last two decades, Arctic air temperature change is double that of global change and is a clear indicator of climate change (references)." [Benoit Montpetit, Canada]	Accepted, sentence edited
12648	3	7	36	7	36	"change" should be "changes" [Gillian Young, UK]	rejected, referring to total Arctic average here
12692	3	7	36	7	36	changeS [Michiel Van Den Broeke, Netherlands]	rejected, referring to total Arctic average here
16298	3	7	36	7	36	indicator of climate' [Lynne Talley, USA]	rejected, referring climate change here
18370	3	7	36	7	36	'change’ --> ‘changes’ (plural) [Nicholas Golledge, New Zealand]	rejected, referring to total Arctic average here
19816	3	7	36	7	36	"…Arctic air temperature change is double that of…", not "are" [Michelle A. North, South Africa]	accepted
20970	3	7	36	7	36	replace "change" with: "changes" [Claudio Richter, Germany]	rejected, referring climate change here
22398	3	7	36	7	37	a clear indicator OF climate change [Matthieu Chevallier, France]	accepted
22876	3	7	36	7	44	This whole paragraph is not well worded, unclear and too long sentences [Lena Rubensdotter, Norway]	taken into account: paragraph edited
2566	3	7	37	7	37	The mentioned references do not primarily deal with Arctic air temperature change. A more fitting reference would be 'Pithan and Mauritsen 2014' (or references therein). [Patrik Winiger, Netherlands]	noted

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
2570	3	7	37	7	38	This reference is on CMIP3 and CMIP5 (at least judging from the title, the original is in Russian) and not the "last two generations of global climate assessments", since CMIP6 is already available. I suggest you remove this sentence altogether. [Patrik Winiger, Netherlands]	rejected; CMIP6 is not out, Important point for credibility
3588	3	7	37	7	38	Haine & Martin (2017, Scientific Reports | 7: 4618 | DOI:10.1038/s41598-017-04573-0 1) objectively quantify Arctic amplification and show that it is projected to decline through the 21st century. They associate the corresponding peak in Arctic amplification, which occurs in the 2010s, with maximum rate of loss of Arctic sea ice. [Thomas Haine, USA]	Taken into account; Focus is on near term rather than later in century
7120	3	7	37	7	37	"robust" is one of the IPCC confidence words but isn't highlighted or used consistently here [APECS Group Review, Germany]	accepted
7124	3	7	37	7	37	The citation by Richter Menge should include the website: Richter-Menge, J., J. E. Overland, J. T. Mathis and E. O. (Eds.), 2017: Arctic Report Card 2017. Http://www.arctic.noaa.gov/Report-Card [APECS Group Review, Germany]	accepted
7126	3	7	37	7	37	Notz and Storeve 2016b is the same as 2016a. This citation does not show the 2x Arctic temperature warming. It establishes a relationship between CO2 and sea ice loss [APECS Group Review, Germany]	accepted
12650	3	7	37	7	37	Space required between full stop and "This ratio..." [Gillian Young, UK]	accepted
13454	3	7	37	7	37	Add 'of' before 'climate change' [Debra Roberts and Durban Team, South Africa]	Accepted
18372	3	7	37	7	37	insert ‘of’ before ‘climate change’ [Nicholas Golledge, New Zealand]	accepted
19194	3	7	37	7	37	While recognising that we need to refer to background papers here, it would also make sense to point the reader towards other scientific assessments such as SWIPA. Consider therefore to add reference: Overland, J; Walch, J, Kattsov. V 2017. Trends and Feedbacks. In: Snow, Water, Ice and Permafrost in the Arctic (SWIPA) 2017. pp. 9-23. Arctic Monitoring and Assessment Programme (AMAP), Oslo, Norway. [Marianne Kroglund, Norway]	accepted
2568	3	7	38	7	38	Kattsov and Pavlova, 2015' This reference appears to be actually two separate publications, both in Russian. Could you please indicate this fact (and correct the the typo 'cebtury' in Line 34 page 113) or give a reference available in English. Further, I would like to point you to 'Annex 2 of the Principles Governing IPCC Work, the Guidance Note on the Use of Literature in IPCC Reports' where it says: "For any source written in a language other than English, an executive summary or abstract in English is required." [Patrik Winiger, Netherlands]	reject. The paper is citable under IPCC citation rules. It has an English abstract and the main elements of the sentence it is supporting (2:1 ratio, model generations) are accessable in the abstract and main figures .

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
19188	3	7	38	7	38	One could consider to here that "Stabilizing global temperatures near 2° C could slow, but not halt further changes in the Arctic; anticipated mid-century annual Arctic temperatures increases are +4° C, and greater in winter (AMAP 2017; Overland et al 2018 (submitted)). References: 1) AMAP 2017. Snow, Water, Ice and Permafrost in the Arctic (SWIPA) Assessment (Arctic Monitoring and Assessment Programme, 2017). 2) James Overland, Edward Dunlea, Thomas Armstrong, Jason E. Box, Robert Corell, Martin Forsius, Vladimir Kattsov, Morten Skovgård Olsen, Janet Pawlak, Lars-Otto Reiersen, John Walsh, and Muyin Wang, 2018. Submitted to Nature Climate Change-Perspectives. [Marianne Kroglund, Norway]	Acepted
2574	3	7	39	7	44	It is currently not at all clear what exactly causes Arctic amplification. Altough the phenomenon of faster warming poles has been known as early as the first simplified model calculations by Arrhenius himself (1896, On the influence of carbonic acid in the air upon the temperature of the ground; DOI: 10.1080/14786449608620846). Maybe it is obvious, but the increase in CO2 deserves a mention in this list of mechanisms for Arctic Amplification. [Patrik Winiger, Netherlands]	taken into account: CO2 is external forcing while amplification is Arctic centric
2576	3	7	39	7	44	It is not clear to me why some of the listed reasons for Arctic amplification get a reference and some don't. Either give a reference for every item or list some references at the end of the sentence. I suggest you give reference to 'Pithan and Mauritsen 2014' (That paper consists of a good compilation of previous work, including Arrhenius) and 'Serreze and Barrie 2011' at the end of the sentence. [Patrik Winiger, Netherlands]	accepted
3702	3	7	39	7	44	I suggest these possible causes of Arctic Amplification to be ordered by their importance (e.g. as described by Pithan and Mauritsen, 2014) [Dirk Notz, Germany]	Taken into accounts in edits, but not clear what order is quantitative
6380	3	7	39	7	44	The sentence "Mechanisms for Arctic Amplification include [...] the lower rate of heat loss to space in the Arctic relative to the sub-tropics due to lower mean temperatures" is somewhat bizarrely phrased. The point that I think the authors want to make is that a greater increase in surface temperature is needed in Polar Regions to balance a given radiative imbalance, since the baseline temperature is colder. Please rephrase. [François Massonnet, Belgium]	Taken into account, but current wording is more direct for the space available
6382	3	7	39	7	44	The recent paper by Goosse and co-authors (2018, doi:10.1038/s41467-018-04173-0) makes a comprehensive overview of polar climate feedbacks and their role in polar amplification. [François Massonnet, Belgium]	accepted
7122	3	7	39	7	39	Arctic Amplification is a jargon term. The first sentence defines it, but you don't actually say that's the amplification before using the term in this line. The summary in 3.a.1.2 (pg.142) is very good. Perhaps reference that? [APECS Group Review, Germany]	accepted
7128	3	7	39	7	44	Most of this text is identical to text on P6 of the Arctic Report Card (Richter-Menge et al., 2017). This should be attributed appropriately [APECS Group Review, Germany]	Taken into account; reference to Richter Menge included
13040	3	7	39	7	44	True but as this is an assessment, it might be worth stating that there is probably no definite agreement yet on which factors/processes are dominant. [Gerhard Krinner, France]	accpeted
14238	3	7	39			amplification' doesn't need to be capitalized [Christopher Fogwill, UK]	accepted
14240	3	7	39	7	44	use semicolons not commas to separate list [Christopher Fogwill, UK]	accepted

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
19818	3	7	39	7	39	"Amplification" doesn't need to be capitalized [Michelle A. North, South Africa]	accepted
22318	3	7	39	7	44	The whole discussion on causes for amplified warming needs to be written much more tentative and the list of references needs expanding substantially. The albedo feedback is pretty robust and accounts for part of the amplification, and likely an enhanced transport of water vapor, potentially affecting both clouds and the greenhouse effect. But already here we're on shaky ground; the Pithan and Mauritsen reference deals with what feedbacks are in the models. For the real world, we just don't know for sure. The Makshtas reference needs to be comp+lemented; I do not believe we know what the trends in clouds are, certainly no in winter when we have to rely on passive sensors that are essentially usless without sunlight or stay south of 82N. This whole segment implies a certainty that is just not there. [Michael Tjernström, Sweden]	Taken into account; references amended, Makshtas reference dropped, uncertainty stated
5342	3	7	40	7	41	These mechanisms seem to be not specific to the Arctic in the direct way, but can be present in many locations and only interact with the feedbacks that are also mentioned; shouldn't the reasons be mentioned that are specific to the Arctic? [Roderik Van De Wal, Netherlands]	rejected, most are Arctic specific
15972	3	7	40	7	40	Although the water vapor feedback is positive in the Arctic, I would argue that increased water vapor in the Arctic atmospehre is not contributing to Arctic Amplification because the feedback strength is larger in the Tropics. Arctic Amplification is with respect to the rest of the globe and the water vapor feedback is stronger elsewhere. Pithan and Mauristen (2014) show this in Fig. 2. [Patrick Taylor, USA]	Taken into account. Others imply moisture is important. We are simply listing potential influences
15976	3	7	40	7	43	I think it is important to mention that role of atmospheric heat transport chnages as a mechanisms for Arctic Amplification. No remote forcing mechanisms is mentioned here. [Patrick Taylor, USA]	accepted
2572	3	7	41	7	41	Also this reference is in Russian and (judging from the title) appears to be dealing with 'Climate of the Hydrometeorological Observatory Tiksi region' and not 'Mechanisms for Arctic Amplification' or 'a potential decrease of total cloudiness in summer and increase in winter'. To me, it is not clear what this last sentencens 'a potential decerase of...' means. I suggest to remove it or rewrite it and give an additional reference in English language, or replace/remove the non-English reference. I would like to point you to 'Annex 2 of the Principles Governing IPCC Work, the Guidance Note on the Use of Literature in IPCC Reports' where it says: "For any source written in a language other than English, an executive summary or abstract in English is required." [Patrik Winiger, Netherlands]	accepted, Makshtas reference dropped,
12652	3	7	41	7	41	The authors mention the "potential" decrease of cloudiness in summer and increase in winter, but they have not mention the transition seasons which are likely of importance for sea ice melt and refreeze. For example, springtime cloudiness has been correlated with low summer sea ice fraction in 2013 (Kapsch et al., 2013, Nature Climate Change). [Gillian Young, UK]	Taken into account; listing only broad concepts not details here

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
380	3	7	42	7	44	Agrument after ", and the lower" seems weak or perhaps invalid. Consider stopping the sentence at "... and Barry, 2011)." removing everything after this. [George Burba, USA]	rejected; this term seem to contribute
16952	3	7	42	7	43	It is not readily clear why this (lower rate of heat loss...) would contribute to the Arctic Amplification. [Markku Rummukainen, Sweden]	rejected; this term seem to contribute
15974	3	7	43	7	43	A recent publication by Hegyi and Taylor (2018) illustrate the lower rate of heat loss to space over the last ~15 years in observations. Ref: Hegyi, B. M., & Taylor, P. C. (2018). The unprecedented 2016–2017 Arctic sea ice growth season: The crucial role of atmospheric rivers and longwave fluxes. Geophysical Research Letters, 45, 5204–5212. https://doi.org/10.1029/2017GL076717 [Patrick Taylor, USA]	Taken into account: added heat transport
894	3	7	44	7	44	melting necessitates increase transfer of heat from the attmosphere to the cryosphere, leading to a slowing down of the atmospheric temperature increase rate (Berger A. et al., 2017) André Berger,Qiuzhen Yin ,Hervé Nifenecker ,and Jean Poitou. Earth's Future, 5, 811–822, doi:10.1002/2017EF000554. [Herve Nifenecker, France]	noted
7142	3	8	1	8	3	The reference given for the setence beginning 'First, both winter 2016 and 2018' refers only to 2016. Perhaps remove '2018' and add a sentence after to say that similar behaviour has been observed in 2018. Is there a reference for this? [APECS Group Review, Germany]	Taken into account in edits (2018 is new data, not published knowledge yet)
8180	3	8	1	8	3	Here the authors mention the temperature anomaly of 2018 but only cite a study of 2016. I recommend citing the source of this +6 degree anomaly (my guess is NCEP/NCAR reanalysis dataset. [Benoit Montpetit, Canada]	Taken into account in edits
12654	3	8	1	8	1	"singular impacts" - this phrase is unclear, what are the authors referring to? [Gillian Young, UK]	accepted
15978	3	8	1	8	11	To amplify the point being made here, one can also refer to the record number of hours that Cape Morris Jessop in Northern Greenland was above freezing in Feb. 2018 (61 hours). [Patrick Taylor, USA]	noted, but focus is on pan-Arctic
16954	3	8	1	8	1	What is the source of the information of the winter 2018 conditions? [Markku Rummukainen, Sweden]	taken into account; included reference to new data from ESRL/PSD
22326	3	8	1	8	11	Although these are three large anomalies discussed here, it really means nothing out of context. It may signifiy a trend change - or not. We don't know until it has happened again and again. It would be better to spend this space discussing what we need to learn in order to understand the rapid changes in the Arctic instead of hiding behind large anomolous but still single years. [Michael Tjernström, Sweden]	taken into account. added sentence on last five years so not jut a one off event
23198	3	8	1	8	4	What is the period of record here? That would help to put the extreme anomaly into context. [Anthony Lupo, USA]	taken into account in edits
2580	3	8	2	8	3	You can't use the 'Overland and Wang 2016' reference for a 2018 event. Also, the later 'Overland and Wang 2018' was written in 2017. Please pick an appropriate reference. [Patrik Winiger, Netherlands]	accepted. Added refeence to data fromESRL/PSD
5808	3	8	2	8	2	What is meant by "central Arctic" - central North American Arctic? -- need to be careful when using relative terms in report that is considering entire circumpolar region. [Sharon Smith, Canada]	noted; in a polar regions/ pan-Arctic chater in a global report central Arctic is unambiguous

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
6384	3	8	2	8	2	Please specify with respect to what the +6°C anomaly is calculated. [François Massonnet, Belgium]	accepted
7144	3	8	2	8	2	Perhaps clarify that regional temperature anomalies were greater than 6C and /or the area-averaged 2-m air temperature anomaly north of 66N was estimated as 4-6C based on reanalysis products (Overland & Wang, 2016) [APECS Group Review, Germany]	taken into account - these detail are in the reference
382	3	8	3	8	3	"...a split of the tropospheric..." [George Burba, USA]	accepted
12656	3	8	5	8	5	Has "subarctic" been defined? [Gillian Young, UK]	noted, but there is no space for such details here
2578	3	8	6	8	6	change 'are' to 'were' [Patrik Winiger, Netherlands]	accepted
5344	3	8	6	8	8	AR5 states "partly", while here "dominantly" is stated. [Roderik Van De Wal, Netherlands]	noted, sentence on Greenland is now removed
384	3	8	7	8	7	Consider replacing the part of the sentence with "...since 2007, but now low sea ice extents are observed in sequential winters, ..." [George Burba, USA]	Taken into account; expanded to include winter
7134	3	8	7	8	8	Citation for sequential low sea ice extents in summer would be good. NSIDC might be a good source: https://nsidc.org/news/newsroom/arctic-sea-ice-maximum-record-low-third-straight-year [APECS Group Review, Germany]	accepted
7146	3	8	8	8	8	2015 was also a low winter sea ice extent. Could reword to say that the four lowest winter sea ice extents occurred in the last four years. [APECS Group Review, Germany]	Accepted
12694	3	8	8	8	9	The statement is arbitrary: years can also be identified in which mass loss of the Greenland ice sheet was reduced (e.g. 2013). [Michiel Van Den Broeke, Netherlands]	accepted
14242	3	8	8			Greenland Ice Sheet [Christopher Fogwill, UK]	noted, material on Greenland now removed
16956	3	8	8	8	8	What is the source of the information of the winter 2018 conditions? [Markku Rummukainen, Sweden]	accepted
17074	3	8	8	19	22	Citations: there are likely 20+ further studies that could be cited. Maybe add e.g. in the beginning [Frank Paul, Switzerland]	accounted
21546	3	8	8	8	9	Article by Kintish is a science-journalism commentary. 2017 was a low melt year for the Greenland Ice Sheet see for example Arctic Report Card 2017. [Fiamma Straneo, USA]	accepted
386	3	8	9	8	11	The last sentence of the paragraphis unclear and will be difficult for the reader to understand. Consider simplifying. [George Burba, USA]	rejected; seems clear on outside of previous experience
2582	3	8	9	8	9	The 'Kintsch 2017' reference is a 'News' article in Science, and not original research. Please consult 'Annex 2 of the Principles Governing IPCC Work, the Guidance Note on the Use of Literature in IPCC Reports'. I think, according to that you have to replace this reference: "In general, newspapers and magazines are not valid sources of scientific information.". Perhaps you can reference the Polar Portal of the Danish research institutions? http://polarportal.dk/en/greenland/ [Patrik Winiger, Netherlands]	accepted
7130	3	8	9	8	11	The "high agreement" and "medium evidence" language is not italicized properly. It is also unclear how these designations were determined [APECS Group Review, Germany]	accepted; standardsed, clarified
7132	3	8	9	8	11	Clarify at the very beginning of this paragraph what years you will consider (e.g. after 2014) with regards to post AR5. Otherwise shuouldn't you include the large Greenland surface melt event from 2012? (https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2012GL053611) [APECS Group Review, Germany]	taken into account; multiple years mentioned

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
7148	3	8	9	8	9	A better reference than Kintisch, 2017 (which is a news article) would be M. Tedesco, J. E. Box, J. Cappelen, R. S. Fausto, X. Fettweis, K. Hansen, T. Mote, I. Sasgen, C. J. P. P. Smeets, D. van As, R. S. W. van de Wal, and I. Velicogna, 2017: Greenland Ice Sheet [in Arctic Report Card 2017], http://www.arctic.noaa.gov/Report-Card. [APECS Group Review, Germany]	accepted
7150	3	8	9	8	9	Note that although 2016 and 2017 had earlier than average melt, total 2017 melt was actually below average (Arctic Report Card, reference above). [APECS Group Review, Germany]	accepted
13042	3	8	9	8	11	The sea-ice thickness also probably is way out of past bounds, too; arguably it's the most striking change. [Gerhard Krinner, France]	accepted
12658	3	8	10	8	10	Comma between "AR5" and "provide" not required [Gillian Young, UK]	accepted
14244	3	8	10			no comma needed after AR5 [Christopher Fogwill, UK]	accepted
23696	3	8	10	8	10	confidence language should be in italics [Hans-Otto Poertner and WGII TSU, Germany]	accepted
19196	3	8	11	8	11	This statement is supported also by the SWIPA 2017 assessment and Overland et al 2018 Refernces: 1) AMAP 2017. Snow, Water, Ice and Permafrost in the Arctic (SWIPA) Assessment (Arctic Monitoring and Assessment Programme, 2017). 2) James Overland, Edward Dunlea, Thomas Armstrong, Jason E. Box, Robert Corell, Martin Forsius, Vladimir Kattsov, Morten Skovgård Olsen, Janet Pawlak, Lars-Otto Reiersen, John Walsh, and Muyin Wang, 2018. Submitted to Nature Climate Change-Perspectives. [Marianne Kroglund, Norway]	accepted
6386	3	8	13	8	31	This section on polar-lower latitude linkages is surprisingly short given the large body of scientific literature that has been published on the topic recently. There are in addition a few elements missing in the discussion: (1) the fact that the response of the atmospheric circulation to one big anomaly of sea ice is not the same problem as the mean atmospheric changes to new background sea ice conditions ; to my knowledge there are some consistent responses in the first case while in the second case the literature is less consensual. (2) The fact that the physical mechanisms and causality links can only be investigated with numerical models, and that these models are also one reason why there is no consensus on the response. (3) Nothing is said on the potential tropical-Arctic linkages (i.e., forcing from the tropics). If such forcings are believed not to exist, it should be written. This will better mirror with the next section on Antarctic changes. [François Massonnet, Belgium]	noted; the issue is space and that an extensiv e review here is not required, just an update since AR5. Much is covered in the references
11126	3	8	13	8	36	Extreme low temperature related to polar vortex, which should be caused by Arctic warming, was significantly occurred in the mid-latitude during a past decade. In this report, this important connection process between arctic and mid-latitude was just described in Box.3.1 [Potential for Arctic and Mid-latitude weather linkages]. I think that this sector will be should more detail descriptions about mechanism, impacts to ocean temperature and ecosystem [Inseong Han, Republic of Korea]	noted; the issue is space and that an extensiv e review here is not required, just an update since AR5. Much is covered in the references
7140	3	8	14	8	14	the italics here are confusing with the confidence statement language [APECS Group Review, Germany]	acepted; edited (this is about p9 l14)

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
22320	3	8	14	8	15	I think there is something wrong with this sentence: "Since AR5 understabding of … has become … important topic … impacting 10s of millions…". How can the increased understanding become an important topic impact that much people? Isn't it the Arctic effects on the mid-latitude weather - if any - that impact that many people? This is a highly debated and uncertain field of science and that fact should not be hidden behind fancy language. [Michael Tjernström, Sweden]	accepted
1708	3	8	15	8	15	Should 10s be 'tens' instead? [Mark England, UK]	accepted
7136	3	8	15	8	15	write out 10's to "tens" [APECS Group Review, Germany]	accepted
13044	3	8	15	8	16	Not only the complexity of the processes, but also the short record and high variability. [Gerhard Krinner, France]	accepted
14088	3	8	15	8	15	10s should be' tens' [Christopher Fogwill, UK]	accepted
2586	3	8	16	8	16	I don't think 'controversial' is the right word here, as it contains negative connotations. I suggest 'actively discussed' or 'part of ongoing research'. [Patrik Winiger, Netherlands]	rejected; contoversy is correct state of science
19200	3	8	16	8	16	"..but the science is difficult given the complexity on intervening meteorological processes" -- consider to add reference here, for instance AMAP 2017, chapter 2.3 Potential Arctic- and mid-latitude waether linkages, or Overland et al 2018 -- submitted to Nature Climate Change - Perspectives. [Marianne Kroglund, Norway]	rejected; other sources cover the background
24906	3	8	16	8	17	“Assessments continue to be controversial.” This sentence could be misused out of context. It needs to be clarified. Also, references to NRC in an international document to should be clarified to refer to the US National Research Council.” This section should name more references than NRC, and include AMAP, ACIA and earlier IPCC documents. [Elizabeth Weatherhead, USA]	rejected; references give history of controversy
2584	3	8	17	8	20	Reformulate: Arctic forcing from sea ice and snow loss and rising greenhouse gas concentrations is clearly increasing, but the link to mid-latitude impacts is mediated by jet stream dynamics; connectivity is reduced by the influence of chaotic internal natural variability and other tropical and oceanic forcings. [Patrik Winiger, Netherlands]	accepted
8182	3	8	18	8	18	"increased temperatures is clearly increasing" seems redundant. Suggest removing "increased" or remplacing by "higher". [Benoit Montpetit, Canada]	rejected; final increasing refers to forcing
388	3	8	19	8	19	Term "chaotic" is not correct. Consider replacing it with "currently unpredictable". [George Burba, USA]	rejected; refers to nonlinear atmsopheric processes
19198	3	8	21	8	22	Formulation "intra- and inter-annual intermittency in the likage pathway" may be unfamiliar to many readers [Marianne Kroglund, Norway]	Taken into account - revised text
22322	3	8	21	8	22	While it is true that a major problem in this context is due to natural variability and chaos, this sentence - without references - implies that there is only one pathway and that we can know what it is if we can beat down the moise. I submit the problem is much more complicated than that. [Michael Tjernström, Sweden]	taken into accont; we say that PART of the contoversy is noted
22408	3	8	21	8	22	There are many other aspects in the scientific controversy : signal to noise ratio, lack of robustness of model sensitivity experiments, spread of atmospheric reanalyses in the polar regions… [Matthieu Chevallier, France]	taken into accont; we say that PART of the contoversy is noted

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
1706	3	8	24	8	24	Suggest that 'winter' be specified: e.g. Petoukhov, V., and V. A. Semenov (2010), A link between reduced Barents-Kara sea ice and cold winter extremes over northern continents, J. Geophys. Res., 115, D21111, doi:10.1029/2009JD013568 [Mark England, UK]	accpted
2590	3	8	24	11	22	I have not reviewed the references. [Patrik Winiger, Netherlands]	noted
22324	3	8	29	8	31	Again, avoid single episode examples as support for something that may just be a freakl insidence. Instead build robust statistics or admit that all we have (except for the Barents Sea to East Siberia link) are just hypotheses. I'm surprised that the tendensies from model experiments (where the sample can be made larger) that ice loss in some regions can amplify a nagative AO provided that the AO is negative to begin with is not discussed at all. [Michael Tjernström, Sweden]	Taken into account. See References Ayarzaguena and Screen, 2016; Trenary et al., 2016. Added sentence
12696	3	8	30	8	30	Please throughout the report avoid the use of 'warm/cold temperatures', use 'high/low temperatures' instead. [Michiel Van Den Broeke, Netherlands]	noted, but but warm/ cold is now generally acceptable
390	3	8	31	8	31	Replace "feed" with "fed" [George Burba, USA]	accepted
7154	3	8	31	8	31	Explain "geopotential height" and why it is relevant [APECS Group Review, Germany]	accepted
12660	3	8	33	8	36	Please consider changing the colourmap chosen for Figure 3.1 as colourblind readers may have difficulty viewing the current ones. The colourmaps used in Figures 3.7(a) and (b) are much better for colourblind readers. [Gillian Young, UK]	accepted
2588	3	8	34	8	34	Whenerver possible, please try to avoid the rainbow color scale, it can distort perceptions of data and alter meaning by creating false boundaries between values. Instead, use continuous color scales (e.g, bright to dark) or help from tools such as Color Brewer or HCL Wizard [Patrik Winiger, Netherlands]	accepted
392	3	8	35	8	35	Not sure if this is a typo or an accepted standard. Why we have 950 mb on the left figure and 500 mb on the right one. [George Burba, USA]	Noted
16958	3	8	40	9	31	This is rather difficult to follow. Could be streamlined and reorganised. Line 15 (The region…) can be deleted, as well as lines 28-31 (Time will tell…) that are uninformative/speculative at best. [Markku Rummukainen, Sweden]	Taken into account. Paragraphs revised
20972	3	8	40	8	40	"uniform" ? You mean: "pronounced" ? [Claudio Richter, Germany]	rejected. The changes are less uniform compared to the Arctic which has seen warming in all regions
12528	3	8	41			"Western" surely you mean "West", it just seems confusing to add a new non-recognized terminology. [Eric Wolff, UK]	Accepted
3590	3	8	43	8	43	Fix "literuatr" [Thomas Haine, USA]	Accepted
6388	3	8	43	8	43	literuatre --> literature [François Massonnet, Belgium]	Accepted
7138	3	8	43	8	43	misspelled literature [APECS Group Review, Germany]	Accepted
12530	3	8	43			literature (spelling) [Eric Wolff, UK]	Accepted
12698	3	8	43	8	43	typo 'literature' [Michiel Van Den Broeke, Netherlands]	Accepted
15980	3	8	43	8	43	"literature" is spelled incorrectly [Patrick Taylor, USA]	Accepted
19820	3	8	43	8	43	Literature is misspelt [Michelle A. North, South Africa]	Accepted
20672	3	8	43	8	43	Typo 'literature' [Tamsin Edwards, UK]	Accepted
22400	3	8	43	8	43	Literuatre → literature [Matthieu Chevallier, France]	Accepted

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
20504	3	8	44	8	44	Add reference: (Evtushevsky et al., 2015; Turner .....) [Gennadi Milinevsky, Ukraine]	Taken into account. This reference could not be found. However we have added Evtushevsky et al 2018 which examines the impact of the tropical Pacific on the SH extratropical circulation
7152	3	8	45	8	45	The second reference to Smith and Polvani (2017) should be removed, as they do not show tropical Pacific links to Antarctic ice shelves and glaciers (they only mention a link in the introduction) [APECS Group Review, Germany]	accepted
13456	3	8	45			What does 'as well as' refer to - does the Pacific influence the Antarctic ice shelf (plus the rest of the list)? or does the Antarctic ice shelf (plus rest of list) influence 'these temperature changes'? [Debra Roberts and Durban Team, South Africa]	Taken into account. rephrased
14090	3	8	45	8	45	Refernces to Tropical Pacific Infulence should include Turney, C. S. M. et al. Tropical forcing of increased Southern Ocean climate variability revealed by a 140-year subantarctic temperature reconstruction. Clim. Past 13, 231-248, doi:10.5194/cp-13-231-2017 (2017). It provides a 140year annual record extending beyond the instrumental period demonstarting a Pacif influence and highlighting the drivers of interannula variability [Christopher Fogwill, UK]	accepted; reference added
15562	3	9	0	12		In discussion of changes in Ice Sheets, Sea Ice, etc. since AR is it reasonable to conclude that these shifts in both the Northern and Southern Hemisphere cannot be reversed on a Centennial time scale? It mentions WAIS in the summary, but the text seems to suggest long term impacts at both poles. [Melinda Kimble, USA]	rejected. It is unclear exactly what this comment is referring to (AR?) however irreversibility is not addressed in this box
19822	3	9	1	9	1	Please write out Southern Hemisphere in full [Michelle A. North, South Africa]	accepted
5346	3	9	5	8	6	I think that a very short explanation of what the SAM, PSA and zonal-wave 3 are would be more convenient than the reference to the supplementary material. [Roderik Van De Wal, Netherlands]	taken into account; We have expanded the acronymns but due to very limited space we point to the appendix for more explanation
5348	3	9	5	9	9	It would be useful to have a brief explanation of how this mechanims works, as it is not a basic/intuitive one [Roderik Van De Wal, Netherlands]	taken into account; Due to space constraints we point to the appendix for further explanation
7198	3	9	5	9	5	Explain the acroynm "SAM" and "PSA". The SAM is explained later in the paragraph, but these terms should be explained from the outset. [APECS Group Review, Germany]	accepted; the acronyms have been expanded
13458	3	9	5	9	9	The acronyms should be defined. [Debra Roberts and Durban Team, South Africa]	accepted; the acronyms have been expanded
19824	3	9	5	9	5	Although you do refer to the supplementary material, please still introduce the full terms before using acronyms (SAM, PSA, SSTs, etc) [Michelle A. North, South Africa]	accepted; the acronyms have been expanded
22402	3	9	5	9	9	Meaning of acronyms such as SAM, PSA (SST?)s hould be explicited earlier. [Matthieu Chevallier, France]	accepted; the acronyms have been expanded
23698	3	9	5	9	5	"supplementary material": I suggest specifying, i.e. see Annex 3.A.1.3 [Hans-Otto Poertner and WGII TSU, Germany]	accepted
18374	3	9	6	9	6	what is meant by 'Antarctic continental...changes'? Surface mass balance? [Nicholas Golledge, New Zealand]	taken into account; Changed to "Antarctic surface climate"
7180	3	9	8	9	8	To be consistent with the discussion on P143, replace 'since the 1970s' with 'from the late 1970s to late 1990s.' [APECS Group Review, Germany]	taken into account; rephrased as suggested
20510	3	9	8	9	8	Add reference: (.....Schneider et al., 2015a; Grytsai et al., 2017) [Gennadi Milinevsky, Ukraine]	Taken into account; This reference could not be found. However we have added Evtushevsky et al 2018 which examines the impact of the tropical Pacific on the SH extratropical circulation

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
13460	3	9	9			Of tropical SSTs? [Debra Roberts and Durban Team, South Africa]	accepted;rephrased as suggested
1710	3	9	11	9	13	A recent paper which is available for early online access would be a perfect addition to these references. England et al (2018) Contrasting the Antarctic and Arctic atmospheric responses to projected sea ice loss in the late 21st Century, Journal of Climate (in press), doi:10.1175/JCLI-D-17-0666.1. Results suggest that the response to future Antarctic sea ice loss is consequential and may in fact be less seasonal than the response to Arctic sea ice loss. [Mark England, UK]	accepted; reference added
394	3	9	13	9	13	Replace "since" with "due to observations that" [George Burba, USA]	accepted; rephrased as suggested
2592	3	9	13	9	13	has shown a small but significant increase in extent over the satellite era'... Well. At least in the last couple of years the sea ice area and extent are declining. Please clarify this. [Patrik Winiger, Netherlands]	Taken into account; paragraph is now removed
18376	3	9	13	9	14	change 'since' to 'because' and remove comma after 'sea-ice' [Nicholas Golledge, New Zealand]	accepted; Corrected
23700	3	9	13	9	15	revise punctuation in this sentence; any reason why "increase" is in italics? [Hans-Otto Poertner and WGII TSU, Germany]	Accepted. The italics were to highlight the difference to the Arctic but have been removed
24908	3	9	13	9	13	Consider changing "since" to "because" as "since" refers to a temporal relationship. [Elizabeth Weatherhead, USA]	taken into account;rephrased.
1824	3	9	14	9	15	No confidence level estimate provided for the Antarctic sea ice increase. [Aku Riihelä, Finland]	accepted; confidence level added
6392	3	9	14	9	14	sea-ice --> sea ice [François Massonnet, Belgium]	accepted
14246	3	9	14			no hyphen needed in 'sea ice', no comma after 'sea ice' [Christopher Fogwill, UK]	accepted
16300	3	9	14	9	14	Antarctic sea ice has declined precipitously over the last 2 years, so this statement is no longer accurate, although it was certainly accurate up to that time. IN fact the text now has a paragraph tacked on in lines 25-31. Please combine these paragraphs so the next reader doesn't fall in the trap of wanting to correct the misstatement about continuing increase of sea ice. [Lynne Talley, USA]	Taken into accout; we now discuss additional literature on the declines since spring 2016
396	3	9	15	9	15	Add "... sparcely populated, and difficult and expensive to explore". [George Burba, USA]	taken into account; This sentence has been removed.
7200	3	9	15	9	15	"The region is sparsely populated" is not clear to the non-expert that you are not referring to human population [APECS Group Review, Germany]	taken into account; This sentence has been removed.
2594	3	9	17	9	17	I assume you will update this section with respet to the newly published findings by the IMBIE team (Shepherd et al. Nature 2018) ? [Patrik Winiger, Netherlands]	Noted; This paragraph has been removed
6762	3	9	18	9	21	The two step response is process dependant on ozone depletion. Is a medium confidence level appropriate for a model dependant result which didn't include changes in other anthropogenic forcings such as GHGs? [James Pope, UK]	Noted; This paragraph has been removed
7182	3	9	19	9	19	Another reference on the two-timescale response: Kostov, Y., Marshall, J., Hausmann, U. et al. Clim Dyn (2017) Fast and slow responses of Southern Ocean sea surface temperature to SAM in coupled climate models 48: 1595. https://doi.org/10.1007/s00382-016-3162-z [APECS Group Review, Germany]	Noted; This paragraph has been removed
12124	3	9	19			move citation to end of sentence to improve readability [Andrew Lowther, Norway]	Noted; This paragraph has been removed
16302	3	9	19	9	19	The two timescale response was under fire at the recent POLAR2018 meeting. [Lynne Talley, USA]	Noted; This paragraph has been removed

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
398	3	9	20	9	23	This sentence is quite difficult to understand. Consider simplifying and cutting in shorter sentences. [George Burba, USA]	Noted; This paragraph has been removed
3592	3	9	21	9	21	It says "eventually melts the sea ice", which probably should be corrected from "melts" to "removes". I.e. the sea ice loss isn't assoicated with enhanced melting, but with diminished formation. [Thomas Haine, USA]	Noted; This paragraph has been removed
7184	3	9	21	9	23	Swart & Fyfe (2013) show that freshwater effect on sea ice trends over the historical period is small. I think a better representation of the literature would be: "Freshwater increases due to increased glacial melt and/or rainfall have been hypothesized as leading to increased sea ice (Bintaja et al., 2013), but modelling studies disagree on the sea ice response to enhanced freshwater input (eg. Swart & Fyfe, 2013; Pauling et al., 2016, 2017; Bintaja et al., 2017; Haid et al., 2017)." Additional references: Pauling, A.G., C.M. Bitz, I.J. Smith, and P.J. Langhorne, 2016: The Response of the Southern Ocean and Antarctic Sea Ice to Freshwater from Ice Shelves in an Earth System Model. J. Climate, 29, 1655–1672, https://doi.org/10.1175/JCLI-D-15-0501.1 ; Haid, V., Iovino, D., and Masina, S.: Impacts of freshwater changes on Antarctic sea ice in an eddy-permitting sea-ice–ocean model, The Cryosphere, 11, 1387-1402, https://doi.org/10.5194/tc-11-1387-2017, 2017. [APECS Group Review, Germany]	Noted; This paragraph has been removed

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
22540	3	9	21	9	23	"Freshwater increases due to increased glacial melt and/or rainfall changes have also been hypothesized as leading to increased sea ice (Swart and Fyfe, 2013)." I note that a fuller explanation is given on p.22, lines 32-36. However, I repeat my comments that pertained to Chapter 1 on this issue. Below is a quote from Pauling et al. (2017) that better captures the literature on this: "Satellite observations of Antarctic sea ice extent have shown an overall slight increase over time in recent decades (Parkinson & Cavalieri, 2012), in stark contrast to the rapid decline seen in the Arctic (Cavalieri & Parkinson, 2012). This increase has not been reproduced by models in the Coupled Model Intercomparison Project phase 5 (CMIP5) (Zunz et al., 2013). Proposed reasons for the discrepancy between models and observations include meridional wind (Holland & Kwok, 2012), stratospheric ozone depletion (Turner et al., 2009) (although the studies of Bitz and Polvani (2012) and Sigmond and Fyfe (2010) found that this caused sea ice loss), internal variability (Polvani & Smith, 2013; Turner et al., 2016; Zunz et al., 2013), and freshwater input from ice shelf melt (Bintanja et al., 2013, 2015) (although the studies of Swart and Fyfe (2013) and Pauling et al. (2016) found that this had no significant effect on the rate of change of sea ice area with respect to time). A consensus on the cause of sea ice expansion in recent decades is therefore lacking." [Inga Smith, New Zealand]	Taken into account: This paragraph has been removed

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
22542	3	9	21	9	23	References for above comment (part 1): Bintanja, R., van Oldenborgh, G. J., Drijfhout, S. S., Wouters, B., & Katsman, C. A. (2013). Important role for ocean warming and increased ice-shelf melt in Antarctic sea ice expansion. Nature Geoscience, 6(5), 376–379. https://doi.org/10.1038/ngeo1767 Bintanja, R., van Oldenbrough, G. J., & Katsman, C. A. (2015). The effect of increased fresh water from Antarctic ice shelves on future trends in Antarctic sea ice. Annals of Glaciology, 56(69), 120–126. https://doi.org/10.3189/2015AoG69A001 Bitz, C. M., & Polvani, L. M. (2012). Antarctic climate model response to stratospheric ozone depletion in a fine resolution ocean climate model. Geophysical Research Letters, 39, L20705. https://doi.org/10.1029/2012GL053393 Cavalieri, D. J., & Parkinson, C. L. (2012). Arctic sea ice variability and trends, 1979–2010. The Cryosphere, 6(4), 881–889. https://doi.org/10.5194/tc-6-881-2012 Holland, P. R., & Kwok, R. (2012). Wind-driven trends in Antarctic sea ice drift. Nature Geoscience, 5(12), 872–875. https://doi.org/10.1038/NGEO1627 Parkinson, C. L., & Cavalieri, D. J. (2012). Antarctic sea ice variability and trends, 1979–2010. The Cryosphere, 6(4), 871–880. https://doi.org/10.5194/tc-6-871-2012 [Inga Smith, New Zealand]	Noted; This paragraph has been removed

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
22544	3	9	21	9	23	References for above comment (part 2): Pauling, A. G., Bitz, C. M., Smith, I. J., & Langhorne, P. J. (2016). The response of the Southern Ocean and Antarctic sea ice to fresh water from ice shelves in an Earth System Model. Journal of Climate, 29(5), 1655–1672. https://doi.org/10.1175/JCLI-D-15-0501.1 Pauling, A.G., Smith, I.J., Langhorne, P.J., Bitz, C.M. (2017). Time-Dependent Freshwater Input From Ice Shelves: Impacts on Antarctic Sea Ice and the Southern Ocean in an Earth System Model. Geophysical Research Letters, 44(20):10454–10461, doi: 10.1002/2017GL075017. Polvani, L. M., & Smith, K. L. (2013). Can natural variability explain observed Antarctic sea ice trends? New modeling evidence from CMIP5. Geophysical Research Letters, 40, 3195–3199. https://doi.org/10.1002/grl.50578 Sigmond, J. C., & amd Fyfe, M. (2010). Has the ozone hole contributed to increased Antarctic sea ice extent? Geophysical Research Letters, 37, L18502. https://doi.org/10.1029/2010GL0440301 Swart, N. C., & Fyfe, J. C. (2013). The influence of recent Antarctic ice sheet retreat on simulated sea ice area trends. Geophysical Research Letters, 40, 4328–4332. https://doi.org/10.1002/grl.50820 Turner, J., Comiso, J. C., Marshall, G. J., Lachlan-Cope, T. A., Bracegirdle, T., Maksym, T.,…Orr, A. (2009). Non-annular atmospheric circulation change induced by stratospheric ozone depletion and its role in the recent increase of Antarctic sea ice extent. Geophysical Research Letters, 36, L08502. https://doi.org/10.1029/2009GL037524 Zunz, V., Goosse, H., & Massonet, F. (2013). How does internal variability influence the ability of CMIP5 models to reproduce the recent trend in Southern Ocean sea ice extent. The Cryosphere, 7, 451–468. https://doi.org/10.5194/tc-7-451-2013. [Inga Smith, New Zealand]	Noted; This paragraph has been removed
2230	3	9	22	9	22	Freshwater increases due to increased glacial melt changes have not only been "hypothesized", they are indicated by some simulations although the sensitivity strongly depends on the experimental design. See review in section "The Effects of Ice-shelf Meltwater on the Climate System" of Asay-Davis et al. (2017). Asay-Davis, X. S., Jourdain, N. C., and Nakayama, Y. (2017). Developments in simulating and parameterizing interactions between the Southern Ocean and the Antarctic Ice sheet. Current Climate Change Reports, 3(4), 316-329. [Nicolas Jourdain, France]	Noted; This paragraph has been removed
4108	3	9	22	9	23	The wording implies that Swart and Fyfe (2013) were arguing that increased freshwater was causing expansion of sea ice, when in fact they were arguing the opposite. [Kaitlin Naughten, UK]	Noted; This paragraph has been removed
10986	3	9	26	9	31	From the literature cited, this seems more like high confidenence [Connie Lovejoy, Canada]	Noted; This paragraph has been removed

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
13046	3	9	26	9	27	Recent paper by Massonnet et al., Nature Climate Change 2018 very relevant here: linked to sea-ice thickness [Gerhard Krinner, France]	Noted; This paragraph has been removed
12700	3	9	28	9	28	Time will tell…' Please use a more scientific formulation here [Michiel Van Den Broeke, Netherlands]	Noted; This paragraph has been removed
24910	3	9	28	9	28	Ozone recovery may not occur due to lack of compliance with the Montreal Protocol. There have been a couple of recent papers indicating that some countries are illegally producing ozone depleting substances. Consider changing “ozone recovery” to “ozone changes.” [Elizabeth Weatherhead, USA]	Noted; This paragraph has been removed
14248	3	9	30			no comma needed after parenthesis [Christopher Fogwill, UK]	Noted; This paragraph has been removed
16304	3	9	30	9	30	remove extra comma after parenthesis [Lynne Talley, USA]	Noted; This paragraph has been removed
21178	3	9	34			It would be useful to include in the introduction a section on 'Why differences in physical changes would be expected to be different between poles". It is included later in the text but a short summary of the difference in physical responses between a land-locked ocean and an ocean-isolated land will help the reader understand how the Arctic sea ice and circulatory system is bounded by land and 'contained' whereas the same system in the Southern Ocean is 'unbounded'.... etc. Will the Arctic become more like the Southern Ocean once the multi-year ice is all gone and the summer ice cover is much more like the Antarctic. [Andrew Constable, Australia]	Taken into account; sentence added to Introduction
5810	3	9	36			Section 3.2 - This section does not consider ecosystem and social system impact as is the case for other cryosphere component (i.e. doesn't take the same approach as other sections). There is no real discussion about some of the local effects of polar glaciers for example - impacts on freshwater systems etc. [Sharon Smith, Canada]	Taken into account - impacts are in new section 3.4
6200	3	9	36	18	45	Overall the the ice sheet part is not well presented with lots of individual studies presented one after another rather than assessing the literature and coming up with general statements including confidence language for those assessment statements rather than for individual studies. It is hard to read and follow and lacks coherent writing. [Regine Hock, USA]	Taken into account - text revised substantially throughout
7166	3	9	36			Section 3.2: No reference is made to Chapter 6 of the SWIPA 2017 report about changes to Arctic land ice, while this section would greatly benefit from inputs from this exhaustive report, especially for the Greenland Ice Sheet and Arctic glaciers. I have some specific comments below where this reference could be added. Reference: Box, J. E. and M. Sharp, 2017. Changes to Arctic land ice. In: Snow, Water, Ice and Permafrost in the Arctic (SWIPA) 2017. pp. 137-168 . Arctic Monitoring and Assessment Programme (AMAP), Oslo, Norway. [APECS Group Review, Germany]	taken into account. We have expanded our references. In general, we cite high-level assessment such as SWIPA 2017 for their key findings and refer to the primary literature to substantiate our own assessment.
7178	3	9	36			Section 3.2: I think that this section is nice in terms of what is happening for Antarctica and Greenland. However, there is not much information on polar glaciers, while they do contribute to sea-level rise and there exists littérature (see SWIPA 2017 report, Chapter 6). Further details about polar glaciers could be provided in Sections 3.2.1.4, 3.2.2 and 3.2.4.3. [APECS Group Review, Germany]	Accepted - section 3.3.2 included on polar glaciers

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
18768	3	9	36	18	6	The value of the long term observations from the photographic archive for understanding rates of GrIS glacier retreat is neglected in the review. The output from workers such as Bjork et al (Nat. Geosc. 2012, DOI: 10.1038/NGEO1481) and Kjeldsen et al (Nature, 2015, doi:10.1038/nature16183) should however be incorporated somewhere within this review. [Peter Nienow, UK]	Accepted - reference to these long-term Greenland studies has been added.
23706	3	9	36			please check and include this new publication on Antarctic ice sheet mass balance: The IMBIE Team (2018) Mass balance of the Antarctic Ice Sheet from 1992 to 2017. Nature 558: 2019-222. DOI: 10.1038/s41586-018-0179-y. [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - IMBIE now widely cited.
7186	3	9	38			Overall, to would be nice to see the Antarctic sections consistently organized (i.e. 1) general mass balance trends, 2) accumulation rate trends and 3) dynamical mass loss). Currently, the subsections start and proceed in different orders [APECS Group Review, Germany]	Accepted - structure modified to cover observed mass changes, SMB and dynamic mechanisms, and ocean and atmsophee drivers.
2232	3	9	40	10	23	Sections 3.2.1.1 and 3.2.1.2 will need to include the recent estimates from IMBIE (Shepherd et al. Nature 2018). [Nicolas Jourdain, France]	Accepted - IMBIE now widely cited.
3986	3	9	40	9	41	Box 3.1 starts with Northern hemisphere while the text here starts with the Southern hemisphere. It might be more coherent for the reader to discuss the hemispheres in the same order each time as far as possible. [Helene Hewitt, UK]	taken into account; the whoel section on ice sheets and glaciers is revised and positioned elsewhre in the chapter
5350	3	9	40	9	41	I would probably have made the title a bit more compact (e.g. East Antarctic Ice Sheet Mass Budget Estimates") [Roderik Van De Wal, Netherlands]	Accepted - subtitles now modified throughout.
6190	3	9	40	9	40	awkward title. I suggest just "East Antarctic Ice Sheet Mass Budget Estimates. Where they come from does not need te be in the title undless there was another section that has different methods. Also 3.2.1.3 also does not have this addition [Regine Hock, USA]	Taken in to account - subtitles changed throughout.
7168	3	9	40	9	41	Rephrase the title of this sub-section as the later part is not necessary: '3.2.1.1 East Antarctic Ice Sheet'. [APECS Group Review, Germany]	Taken in to account - subtitles changed throughout.
7188	3	9	40	10	4	the paragraphs discussing East Antarctic accumulation trends is somewhat disorganized and bounces between timescales. Consider reorganizing by time frames [APECS Group Review, Germany]	Taken in to account - section restructured.
22878	3	9	40	9	40	This whole sub-chapter; 3.2.1.1. is a bit tho "shortly" written, needs some clarifying words; like adding "Global" in "sea level drop in line 46, Antarctican <Ice sheets> in line 52 etc. Also make sure ALL place names are illustrated on figure/map since Antarctican geography is not well known outside science. [Lena Rubensdotter, Norway]	Taken in to account - 'global' added and substantial rewording for other locations.
1822	3	9	43	15	35	One of the important global consequences from changes in the ocean-cryosphere system is the contribution to sea level rise (SLR) from melting snow and ice. Currently, the text does contain statements on current best estimates for SLR from various components of the cryosphere, but the statements are scattered throughout the text, with no summaries provided. I recommend an addition of a table summarizing the current (and projected?) cryosphere-based SLR contributions. [Aku Riihelä, Finland]	Taken into accout - chapter 4 now covers sea level rise.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
1836	3	9	43	12	41	The text here is filled with mass balance change numbers, but with little summarizing discussion on e.g. the relative magnitude of changes. Please consider adding a summary sub-section where such commentary is provided, possibly with a table describing the SMB changes and identifying the ones with most magnitude, with confidence information if possible. [Aku Riihelä, Finland]	Taken into account - discussion of mass balance observations reworded.
7156	3	9	43	9	49	E1a: This paragraph is about the recent surface mass balance of Dronning Maud Land. However, the first sentence gives the reader the impression that the paragraph will focus instead on changes in all of (East) Antarctica between 200 - 1000 years before present. Perhaps it would be clearer to begin with an overview, stating the overall SMB trend (last 50 years?) in East Antarctica and that this varies between regions and temporally. Then go on to state what these variations are. [APECS Group Review, Germany]	Accepted - section reworded.
7170	3	9	43	9	44	I have the feeling this first sentence is more related to the second paragraph of this sub-section as it is about centennial timescales and not decadal timescales. You can keep it there if you also state that advances have been made in collecting data on decadal timescales. [APECS Group Review, Germany]	Taken into account - Anatrctic SMB drivers of change now moced to section 3.3.1.3 Mechanisms of Antarctic mass change and reworded.
22494	3	9	43	11	22	It would be good to insert the geographical names (Donning Maud Land, Wilkes Land, ASE, etc in the map of Fig. 3.2 [Peter Lemke, Germany]	Rejected: this figure does not exist in SOD
7158	3	9	44	9	46	E1a: Reference period for anomalies should be stated. [APECS Group Review, Germany]	Taken into account - this section now reworded with further description of observation periods. Now in section 3.3.1.3 Mechanisms of Antarctic mass change
7172	3	9	44	9	47	I think it is important to mention the technique that was used to find this result. [APECS Group Review, Germany]	Accepted - now made clear that thisinformation comes from firn and ice cores.
7190	3	9	44	9	47	This sentence is poorly phrased and seems somewhat out of context with the introductory sentence and the following sentence. [APECS Group Review, Germany]	Taken into account - this section has been rewritten.
19830	3	9	44	10	41	Please remove all these acronyms (SMB, MBM, GIA, ASE, SOSE, etc.), they are seldom used in the chapter and make it extremely difficult for non-subject-experts to understand what is going on, without having to constantly refer back to the previous mention when it was written out [Michelle A. North, South Africa]	Taken into account - variety of acronyms reduced, remaining ones are commonyl used, are defined and used primarily for ice sheet names (WAIS, GIS, EAIS, AP) and for SMB.
7160	3	9	47	9	49	C1: Is one study sufficient to assign such high likelihood and confidence to the inferred trend in accumulation? [APECS Group Review, Germany]	Accepted - this section has been revised (now 3.3.1.3) and all confidence statements revised.
24912	3	9	47	9	49	I am not used to seeing the “very likely” and “medium confidence” associated with results from a single paper. Should these terms be used as a consensus statement from the authors on a general issue? [Elizabeth Weatherhead, USA]	Accepted - this section has been revised (now 3.3.1.3) and all confidence statements revised.
400	3	9	48	9	48	The construction "very likely, with medium confidence" here and everywhere in the report should be carefully avoided. This verbal constructions makes the report to appear unreliable. By now, most readers have forgotten the content of footnotes 1 and 2 from page 3-3. Without these footnotes, such phrases may be counter productive. [George Burba, USA]	Rejected - we are constrained to use the agreed IPCC formualtion of terms on confidence and evidence.
6192	3	9	48	9	48	improper use of confidence language? My understanding is that it should be used for statement originating from a number of different studies and not be applied to the results of ONE single study. More examples througout the text. [Regine Hock, USA]	Accepted - this section has been revised (now 3.3.1.3) and all confidence statements revised.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
14250	3	9	48			...found it very likely…' [Christopher Fogwill, UK]	Accepted - this section has been revised (now 3.3.1.3) and all confidence statements revised.
16960	3	9	48	9	48	The combination of "very likely" and "medium confidence" is a bit complicated to follow. Is it timely to quantify likelihood for a lowish confidence level? (May be all right within the guidelines for expressing uncertainty.) What does it actually mean? [Markku Rummukainen, Sweden]	Accepted - this section has been revised (now 3.3.1.3) and all confidence statements revised.
17688	3	9	48			Is this correct use of IPCC uncertainty language? Mixture of quantitative (likelyhood) and qualitative (confidence) terms? Check throughout the chapter. There are other similar mixtures. [Andreas Kääb, Norway]	Accepted - this section has been revised (now 3.3.1.3) and all confidence statements revised.
23702	3	9	48	9	48	Delete "(East Antarctica)", this is already said above [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - text is now revised (and now in section 3.3.1.3)
23704	3	9	48	9	48	Please do not combine likelihood and confidence for one statement; use either the one or the other [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account - now (largely) use statements combining level of agreement and level of evidence and, separately, levels of likelihood.
7162	3	9	51	9	51	E1a: "century" --> "centennial" [APECS Group Review, Germany]	Accepted - wording has been revised throughout this section.
7164	3	9	51	9	56	E2/C1: I think it should be reiterated that the statements in this paragraph refer to SMB - the use of the word "growth" on line 53 could imply net mass increase. Also, Thomas et al. (2017) reported smaller uncertainties than quoted here. On line 54 the report states that East Antarctica contributed 10 %of the inferred growth (in SMB), This figure actually applies to the East Antarctic Plateau (only areas above 2000 m). [APECS Group Review, Germany]	Accepted - now reads 'a snowfall-driven growth'
7174	3	9	51	9	51	Typo: 'Thomas et al. (2017)…' [APECS Group Review, Germany]	Accepted
7192	3	9	51	9	51	The type of records should be clearly indicated. [APECS Group Review, Germany]	Accepted - clarified that they are ice and firn core records.
16838	3	9	51	9	51	Change "On century time scales, Thomas and others (Thomas et al. 2017)" to "On century time scales, Thomas et al. (2017)" [Anthony Mémin, France]	Accepted - wording has been revised throughout this section.
17792	3	9	51	9	56	Check this. Is this really a study about growth of Antarctica? I don't think the Thomas et al. study includes ice dynamics. [Robert Arthern, UK]	Accepted - now reads 'a snowfall-driven growth'
19826	3	9	51	9	51	Correct the citation to read: "On century timescales, Thomas et al. (2017) used 49 records…" [Michelle A. North, South Africa]	Accepted - wording has been revised throughout this section.
1826	3	9	52	9	52	"likely" should be in italics following the text protocol? [Aku Riihelä, Finland]	Accepted
7194	3	9	52	9	52	Likely is used without italics. Either From reading the sentence, it should be italicized. If not, another word should be chosen. [APECS Group Review, Germany]	Accepted
4998	3	9	53	9	53	Specify that "growth" is in surface accumulation only; even though this follows a section on surface mass balance, the section as a whole is not limited to the surface terms, and it is not clear as written here [Richard B. Alley, USA]	Accepted - now reads 'a snowfall-driven growth'
7176	3	9	53	9	53	I would be more specific: 'an ice growth of …' [APECS Group Review, Germany]	Accepted - wording has been revised throughout this section.
11796	3	9	53	9	53	growth here refers only to growth in accumulation not as an ice sheet overall which is unknown over this time period [King Matt, Australia]	Accepted - wording has been revised throughout this section.
17794	3	9	53	9	53	Check units. Are these trends in annual SMB (Gt/yr/decade)? [Robert Arthern, UK]	No, per decade.
7196	3	9	55	9	56	This sentence references the Antarctic Peninsula as do sentences in the West Antarctic subsection. It should either be in the West Antarctic subsection or in a subsection or section by itself. [APECS Group Review, Germany]	This is now in a section titled 3.3.1.3 Mechanisms of Antarctic mass change
13048	3	9	55	9	56	Accelerated growth since 1990 in the Peninsula, but then accelerated loss in West Antarctica recently… this might confuse the reader. Could you say some more words? [Gerhard Krinner, France]	Accepted - wording has been revised throughout this section.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
14252	3	9	55			Weddell Sea (capital s needed) [Christopher Fogwill, UK]	Accepted
13462	3	10	0			Fig 3.2 The coastal areas that are coloured dark grey in the maps on the right, are coloured dark red in the coloured map. Those areas should maybe also be grey or else it looks as if those areas uniformly correspond to -150cm on the mass balance legend? [Debra Roberts and Durban Team, South Africa]	Taken into account - different figures are now used.
3680	3	10	1	10	1	Ice cores or firn cores? Need to clarify. [Joanne Johnson, UK]	Accepted - now reads 'ice cores'
5000	3	10	1	10	4	Not clear why cores that suggest a decrease are in line with cores that suggest no change. Clarify. [Richard B. Alley, USA]	Accepted - wording changed.
7202	3	10	1	10	4	E2: Is there a citation missing on line one regarding the possible 1000 year accumulation decrease? Or is this paraphrased from Frezzotti et al. (2013)? Is there a citaton missing for the final statement of this paragraph? [APECS Group Review, Germany]	Accepted - see section 3.3.1.3 Mechanisms of Antarctic mass change
7248	3	10	1	10	4	These two sentences should have a confidence and likelihood assigned to them. [APECS Group Review, Germany]	Accepted - see section 3.3.1.3 Mechanisms of Antarctic mass change
19828	3	10	1	10	1	What is meant by an "accumulation decrease"? Consider using less ambiguous language [Michelle A. North, South Africa]	Taken into account - section is substantially re-worded for clarity. 'Accumulation decrease' still used.
1828	3	10	6	10	18	The Antarctic mass balance estimates from various sources appear to diverge substantially, but the text provides little commentary or discussion as to the possible causes for this. I recommend adding an additional paragraph to provide commentary to the reader. [Aku Riihelä, Finland]	Accepted - wording has been revised throughout this section (now section 3.3.1.2 East Antarctic Ice Sheet)
3820	3	10	6	10	18	Include reference Shepherd, A., et al. "Mass balance of the Antarctic Ice Sheet from 1992 to 2017." Nature 556 (2018): pages219-222. [Ola Kalen, Sweden]	Accepted
5002	3	10	6	10	18	This section is headed "East Antarctic" but includes some discussion of West Antarctic and Peninsula (e.g., p. 9, line 52). As such, each result that is restricted to East Antarctica should be labeled as such. Line 6 introduces the paragraph as Antarctic mass balance, but the Velicogna et al number on line 10 is East Antarctic, not Antarctic. There should be a general rewrite to clarify. It would be better to start with a quick overview of all of Antarctic, and then subdivide. [Richard B. Alley, USA]	Accepted - wording has been revised throughout this section (now sections 3.3.1.1 West Antarctic Ice Sheet and Antarctic Peninsula and 3.3.1.2 East Antarctic Ice Sheet)
6196	3	10	6	11	9	It is hard to follow all those mass change numbers; perhaps better in a table? [Regine Hock, USA]	Taken into account - some numbers moved to tables, where date ranges allow.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
7214	3	10	6	10	18	E1b?: I think this paragraph lacks clarity and reads more like a list rather than a synthesis. Perhaps it would be best to state initially that, relative to the mass fluxes, estimated net Antarctic mass change is small, regardless of the method used, but that there are differences between methods and possibly time periods. The report could then outline the estimates from the various methods, perhaps starting with those that indicate smaller mass changes, ending with those that indicate larger mass changes. In doing this, it would be clearest if the time periods were consistent throughout - as it is, it is difficult to judge how much of the quoted differences in mass change are due to methodological differences and how much are due to temporal changes in mass fluxes. The final sentence of the paragrapgh seems a bit bolted on and it is not clear where it is reported independently (i.e. in the report or in the cited papers). [APECS Group Review, Germany]	Accepted - this section has been substantially revised.
7220	3	10	6	10	18	I think this paragraph should be the first of Section 3.2.1.1 as it provides information on the total mass balance of East Antarctica, which is the most important information of this sub-section. You would then talk about accumulation records (the current first and second paragraphs of the sub-section). [APECS Group Review, Germany]	Taken into account - see new section 3.3.1.2
7250	3	10	6	10	18	The partitioning of the mass balance would benefit from be described more systematically. There are only a couple mentions of the mass balance components. [APECS Group Review, Germany]	Accepted - see new sections 3.3.1.1 and 3.3.1.2
11978	3	10	6	10	7	change "mass budget method (MBM) to "Input-Output (I-O)" - in my mind this is much more in line with literature. Note that MBM is used throughout the document [Kristian Kjellerup Kjeldsen, Denmark]	Accepted - now called input-output bugeting
13050	3	10	6	10	18	Might want to take into account the very recent IMBIE assessment here [Gerhard Krinner, France]	Accepted
14092	3	10	6	11	22	Should up date in light of The IMBIE Team. Mass balance of the Antarctic ice sheet from 1992 to 2017. Nature 558, https://doi.org/10.1038/s41586-018-0179-y (2018). [Christopher Fogwill, UK]	Accepted
17596	3	10	6	10	18	It is notable that you do not mention Zwally et al 2015 anywhere and this could be seen as biased reporting of published results. Better to discuss this result in the context of other published evidence by Dietrich et al, Scambos and Shuman and Martin-Espanol et al, 2017, GRL that indicates flaws in the approach used and results obtained, especially the calibration of the radar and laser altimetry. [Jonathan Bamber, UK]	Accepted - now include this in section 3.3.1.2
17796	3	10	6	10	18	Include results from The IMBIE Team (Nature, 2018). [Robert Arthern, UK]	Accepted
6194	3	10	7	10	7	Acronyms should be avoided: MBM is not necessary, also ASE. It just makes this unreadable for non-experts [Regine Hock, USA]	Taken into account - some acronyms removed
7204	3	10	7	10	8	E1a: I suggest "Estimates of East Antarctic mass balance from the MBM range from..." [APECS Group Review, Germany]	Accepted - wording has been revised throughout this section.
17560	3	10	7	10	7	There is no convention but Input-Output Method (IOM) is generally the more commonly adopted term for the MBM now and has been used in multiple studies by different authors. [Jonathan Bamber, UK]	Accepted - now called input-output bugeting

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
7252	3	10	8	10	9	The statement '...dynamic losses concentrated in the Wilkes Land sector.' should be referenced, especially since Rignot et al. (2011) do not mention Wilkes Land specifically and is not included in the references. [APECS Group Review, Germany]	Accepted - now reference Flament, 2012 and Serreze, 2016
7254	3	10	8	10	9	The right panels in Figure 3.2 have dates from mid1980-mid 2017, not 1979-2016 [APECS Group Review, Germany]	Taken into account - figures have changed.
2600	3	10	9	10	9	Please explain the abbreviation GRACE [Patrik Winiger, Netherlands]	Taken into account - GRACE acronym removed, now refer to satellite gravimetry.
7206	3	10	9	10	9	E1a: Remove space after 2011) [APECS Group Review, Germany]	Accepted
7208	3	10	9	10	10	E1a: I suggest: "From GRACE, te mass balance during 2002-2016 was...". This sentence should also clarify whether the statements refer to East Antarctica (as in the previous sentence) or all of Antarctica (following the first sentence of the paragraph). [APECS Group Review, Germany]	Taken into account - this section has been rewritten.
7222	3	10	9	10	18	As Wilkes Land is cited several times in this paragraph, I would show it on the map (Fig. 3.2). [APECS Group Review, Germany]	Taken into account - awaiting final decision on figures
7268	3	10	9	10	9	"Wilkes Land" should be labelled on the Figure 3.2 [APECS Group Review, Germany]	Taken into account - awaiting final decision on figures
12702	3	10	9	10	9	"with dynamic losses concentrated in the Wilkes Land sector" This important statement appears to derive from an unpublished source, see also line 21. Requires close scrutiny; not sure whether the evidence supports 'likely' and 'high confidence'. [Michiel Van Den Broeke, Netherlands]	Accepted - now reference Flament, 2012 and Serreze, 2016
11798	3	10	10	10	10	at some stage it should be summarised the progress in measurement techniques since AR5. We have CryoSat-2, landsat velocities back to 1970s (e.g., Gardner TC), but we have had modest advances in GIA modelling and hence GRACE (some inverse solutions but otherwise still using IJ05R2 and W12). The Barletta et al 2018 Science paper shows GIA signal not modelled in current GIA models of the full Antarctic - much of West Antarctica may be underlain by low viscosity mantle and requires knowledge of centennial scale glacier thinning (see also for Ant Peninsula Nield et al EPSL 2014) and this is not replicated by current continent-wide GIA models applied to GRACE [King Matt, Australia]	Taken into account - have added results from Gardner et al., 2018. Have rewritten the description of mass balance measurement techniques. Have included mention of GIA shortcomings.
16840	3	10	10	10	10	Using Velicogna & al. (2014) paper is not the best reference, prefering Shepherd & al. (2018 - Mass balance of the Antarctic Ice Sheet from 1992 to 2017 - Nature, vol. 558, 219-222, known as IMBIE experiment) which compare results from several techniques and gives more realistic uncertainties and for several time interval between 1992 and 2017 [Anthony Mémin, France]	Accepted
16842	3	10	10	10	11	Not sure what is the importance of the Cryosat-2 results from McMillan et al. (2014) here, if the IMBIE paper is cited (which it should be), then this reference is useless [Anthony Mémin, France]	Checking - not clear from the IMBIE paper that McMillan 2014 data are included or are independent.
7210	3	10	11	10	11	E1a: "for" --> "during" [APECS Group Review, Germany]	Accepted
7212	3	10	11	10	14	E1a: "approach" after "modelling" on line 11. This sentence also seems unnecessarily complex to me - is there a need to provide additional details on the inputs to the Bayesian hierarchical modelling approach but not, for example, the GRACE and cryosat-2 approaches mentioned in the previous sentence? [APECS Group Review, Germany]	Accepted, section rewritten.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
16844	3	10	11	10	15	Why not citing Mémin & al. (2014 - Snow- and ice-height change in Antarctica from satellite gravimetry and altimetry data, Earth and Planetary Science Letters, 404, 344-353) who independently show typically the same results using GRACE & Envisat combined estimate of surface-mass change with a rate of 51 +- 22 Gt/yr between 01/2003-10/2010 for the East Antarctic Ice Sheet with a comparison to the regional climate model RACMO and for two GIA models ? [Anthony Mémin, France]	Accepted - wording changed. Have referenced Mémin & al. (2014).
16846	3	10	11	10	15	"A Bayesian hierarchical modelling" do we really need this level of precision here ? I think (see comment above) that a better description of changes for different time intervals with explanation of the SMB anomalies as a dominating source would be more appropriate. For example, Mémin & al. (2015 - Interannual variation of the Antarctic Ice Sheet from a combined analysis of satellite gravimetry and altimetry data, Earth and Planetary Science Letters, 422, 150-156) shows that interannual changes with a periodicity of 4,7 years could account for up to 30 % of the annual rate of accumulation in Enderby Land. This signal might be related to ocean/atmosphere/ice-sheet interactions (ENSO, antarctic circumpolar wave...) [Anthony Mémin, France]	Accepted - wording changed. Have referenced Mémin & al. (2015).
17562	3	10	11	10	11	"Bayesian hierarchical modelling" => "Bayesian hierarchical modelling approach" [Jonathan Bamber, UK]	Taken into account - wording changed.
17564	3	10	12	10	12	glacio => glacial [Jonathan Bamber, UK]	Accepted
7224	3	10	15	10	17	What is the technique used to retrieve this result? It is not clear. [APECS Group Review, Germany]	Accepted - wording changed. Now in section 3.3.1.2 East Antarctic Ice Sheet
7256	3	10	15	10	16	The pattern of mass loss should be described more clearly than simply stating that different regions contribute differently. Perhaps relate regional differences warm water intrusion or other contributing factors (with a confidence rating). [APECS Group Review, Germany]	Accepted - section has been rewritten. Now have sections describing causes of change.(section 3.3.1.6)
15532	3	10	16	10	18	Provide recommendations for the observational gaps and needs. Is better resolution needed? Higher accuracy? More coverage? The observation community needs qualitative and quantitative recommendations! [Daniel Feldman, USA]	Taken into account - observational gaps were not the topic of this section. Revised text has more detailed discussion of evidence strengths and weaknesses.
15982	3	10	20	10	20	Just as a note the phrase "not likley different from zero" is difficult to understand and follow. If possible consider another way to convey this message. [Patrick Taylor, USA]	Accepted - changed.
16962	3	10	20	10	21	Rather complicated expressions (not likely different from). Combinations of likelihood and confidence are also a bit difficult to decipher. (AR5 Guidance notes also specify, I believe, that it is not necessary to explicity quote the confidence level of a likelihood, when the confidence level is very high/high.) [Markku Rummukainen, Sweden]	Taken into account - confidence statements substantially revised.
17798	3	10	20	10	20	Check wording. Not likely different from zero? This seems to be trying to convey not significantly different from zero, a different concept. The true value is 'virtually certain' to be different from zero, since a precise balance of inputs and outputs to the nearest snowflake is astonishingly unlikely. [Robert Arthern, UK]	Accepted - now 'close to zero'. Snowflakes not counted.
19832	3	10	20	10	20	What is meant by: "is not likely different from zero"? Please rephrase this for clarity [Michelle A. North, South Africa]	Accepted - wording changed.
23708	3	10	20	10	21	Please do not combine likelihood and confidence for one statement; use either the one or the other [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account - confidence, likelihood, evidence and agreement statements substantially revised.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
7258	3	10	21	10	21	If Wilkes Land is going to be specifically mentioned, this phrase should mention mass loss driven by changing glacier dynamics instead of stating that 'important glacier changes are…' [APECS Group Review, Germany]	Accepted. See section 3.3.1.3 "Ice loss driven by glacier acceleration has likely continued over recent years for some East Antarctic drainage basins in Wilkes Land {{Flament, 2012 #610; Serreze, 2016 #62}}…"
1830	3	10	23	10	25	The loss/gain circles and the corresponding numbers in Figure 3.2 (right) are currently imperceptibly small. Please consider increasing their size and possibly refocusing the right side to match the temporal coverage of the mass balance figure on the left, making them of equal size and promoting readability. [Aku Riihelä, Finland]	Taken into account -figures have been changed.
7226	3	10	23	12	24	Figures 3.2 and 3.3: I would separate the left figure (mass balance from GRACE) and the four right panels (mass balance from the mass budget method) into two different figures as they show different things, use different techniques and are computed over different averaging periods. [APECS Group Review, Germany]	Taken into account -figures have been changed.
7228	3	10	23	12	24	Figures 3.2 and 3.3: I would enhance the size of the four right panels as we hardly see the numbers and the size of the circles. These four panels would be more readable if they were separated from the left map. [APECS Group Review, Germany]	Taken into account -figures have been changed.
7230	3	10	23	12	24	Figures 3.2 and 3.3 (four right panels): it is not clear which part of the circle is dedicated to SMB and which part is for ice dynamics. It should be clearly indicated in the figure. [APECS Group Review, Germany]	Taken into account -figures have been changed.
7232	3	10	23	12	24	Figures 3.2 and 3.3 (left figure): I would change the color of ice shelves into gray (as in the four right panels) not to confuse with the mass balance and temperature color bars. [APECS Group Review, Germany]	Taken into account -figures have been changed.
7246	3	10	23	12	24	Figures 3.2 and 3.3: I would add titles to the colorbars of the left figure, i.e. 'termperature' and 'mass balance'. [APECS Group Review, Germany]	Taken into account -figures have been changed.
7260	3	10	23	10	23	Figure 3.2 is difficult to interpret. In the left panel, the mass balance changes are overwhelmed by the ocean temperature scale. Consider a different, more muted color scale for the ocean temperatures. In addition, the regions discussed in the text should be clearly labeled. The color bars are difficult to read. The ice shelves should be a different color - it is unclear if they are part of mass balance color scale. [APECS Group Review, Germany]	Taken into account -figures have been changed.
7262	3	10	23	10	23	Figure 3.2 (right). These figures cannot be read in print or at a reasonable scale. [APECS Group Review, Germany]	Taken into account -figures have been changed.
12662	3	10	23	10	26	Please consider changing the colourmap chosen for Figure 3.2 as colourblind readers may have difficulty viewing the Jet colourmap used. Suggest Python's Viridis/Matlab's Parula instead. [Gillian Young, UK]	Taken into account -figures have been changed.
13288	3	10	23	10	24	The text within the 4-panel figure (3.2) on the right-hand side is too small to be meaninfgul. Further, the pie-charts are too small in most places to reasonably expect the reader to extract any useful information from them. (A similar problem persists in Figure 3.3.) [Katherine Bishop-Williams, Canada]	Taken into account -figures have been changed.
20674	3	10	23	10	25	Assume you will get rid of rainbow palette and make this more accessible? [Tamsin Edwards, UK]	Taken into account -figures have been changed.
20676	3	10	23	10	25	What does pale red mean? [Tamsin Edwards, UK]	Taken into account -figures have been changed.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
2596	3	10	24	10	24	Whenerver possible, please try to avoid the rainbow color scale, it can distort perceptions of data and alter meaning by creating false boundaries between values. Instead, use continuous color scales (e.g, bright to dark) or help from tools such as Color Brewer or HCL Wizard. Suggestion: Use a grey-scale for temperature and keep the blue-to-red scale for cm water equivalent. [Patrik Winiger, Netherlands]	Taken into account -figures have been changed.
11998	3	10	24	10	25	Please update the color scheme representing the GRACE estimate in Fig 3.2 Left - it is impossible to decipher and also choose a different color for the ocean temp, e.g. two colors centred around white (keep in mind red-green color blindness). I would also urge the editors to improve the readability of Fig 3.2 Right [Kristian Kjellerup Kjeldsen, Denmark]	Taken into account -figures have been changed.
17550	3	10	24	10	30	Kobashi et al. (2017) has shown that Greenland (Summit and southwest) has been cooling over the past decade. This cooling is a cascading effect of the stronger solar activity of the late 20th century likely by slowing down of ocean currents (Kobashi et al., 2015). The effect of solar activity on Greenland delays about 20-30 years by the ocean responses. Therefore, the effect of current weaker solar activity since ~2000 will likely appear in Greenland about 10 years later from today. Greenland probably will start warming quite rapidly inducing melting of the ice-sheet in a decade or so, inducing melting of ice-sheet and sea-level rise. In our recent paper (Kobashi et al., 2017), we found that the effect of changing solar activity on Greenland temperature persisted through the past 11,500 years. Interestingly, abrupt climate changes in the early Holocene may also be related to the variable solar activity (see supplementary figure 9 of the paper). In the past, when Greenland temperature delayed from hemispheric-wide climate changes, often the Greenland temperature rapidly adjusts to the hemispheric trend likely related to a rapid start-up of ocean currents. Now, hemispheric temperature has been rising, but Greenland temperature has stayed relatively low. The next adjustment (6-8 C) of the Greenland temperature to catch up with the hemispheric trend might be also quite rapid say in a few years. We know it when Greenland temperature experiences rapid warmings, hemispheric wide climate changes also occur (Kobashi et al., 2007, 2008). The future abrupt climate change may disturb human activities (e.g., agriculture) in wide-spread areas. Kobashi, T., JP Severinghaus, EJ Brook, JM Barnola, AM Grachev, Precise timing and characterization of abrupt climate change 8200 years ago from air trapped in polar ice, Quaternary Science Reviews 26 (9-10), 1212-1222, (2007). Kobashi, T., JP Severinghaus, JM Barnola, 4±1.5 C abrupt warming 11,270 yr ago identified from trapped air in Greenland ice, Earth and Planetary Science Letters 268 (3-4), 397-407, (2008). Kobashi, T., DT Shindell, K Kodera, JE Box, T Nakaegawa, K Kawamura, On the origin of multidecadal to centennial Greenland temperature anomalies over the past 800 yr, Climate of the Past 9, 583-596 (2013). Kobashi, T., JE Box, BM Vinther, K Goto-Azuma, T Blunier, JWC White, Modern solar maximum forced late twentieth century Greenland cooling, Geophysical Research Letters 42 (14), 5992-5999, (2015). [Takuro Kobashi, Japan]	Noted - very interesting various findings but difficult to draw clear relevance to this assessment. Temperature record focussed on Greenland summit (i.e. at extreme GIS low temperature) at mean annual temperatures approx -30 degrees therefore relevance to ablation zone not clear. Relevance of volcanic forcing to recent timeframe not clear and unpredictability of volcanic forcing makes application to MB predictions on relevant timescales unfeasible.
3682	3	10	26	10	26	Numbers in panels A-D are too small to read. [Joanne Johnson, UK]	Taken into account -figures have been changed.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
7234	3	10	29	10	29	Change 'Time series' into 'Mean' as it is not really a time series but rather an average over four different time periods. [APECS Group Review, Germany]	Taken into account -figures have been changed.
7264	3	10	29	10	32	Rignot et al., 2011 is not included in the reference section and none of Rignot et al. (2011) journal articles have a figure similar to the panels on the left. [APECS Group Review, Germany]	Taken into account -figures have been changed.
16848	3	10	29	10	29	"Time series of mass" not sure this is appropriate because there is no time series shown [Anthony Mémin, France]	Taken into account -figures have been changed.
7236	3	10	30	10	30	I think it is rather 1980 and not 1979 (as stated in the upper left panel). [APECS Group Review, Germany]	Taken into account -figures have been changed.
23710	3	10	30	10	31	Rignot et al. 2011 is not in reference list [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account -figures have been changed.
20678	3	10	31	10	31	Typo: 'partioning' [Tamsin Edwards, UK]	Accepted
5352	3	10	35	10	36	I would probably have made the title a bit more compact (e.g. West Antarctic Ice Sheet Mass Budget Estimates") [Roderik Van De Wal, Netherlands]	Accepted - sub-section titles have changed.
7238	3	10	35	10	36	Rephrase the title of this sub-section as the later part is not necessary and add Antarctic Peninsula: '3.2.1.2 West Antarctic Ice Sheet and Antarctic Peninsula'. [APECS Group Review, Germany]	Accepted - sub-section titles have changed.
7244	3	10	35			Section 3.2.1.2: I think you should mention Figure 3.2 at least once in this sub-section, as it is an important figure that illustrates the key results of this sub-section. [APECS Group Review, Germany]	Accepted.
3822	3	10	38	11	9	Include reference Shepherd, A., et al. "Mass balance of the Antarctic Ice Sheet from 1992 to 2017." Nature 556 (2018): pages219-222. [Ola Kalen, Sweden]	Accepted.
7266	3	10	38	10	42	See previous comments on Rignot et al. (2011). I believe the reference should be fixed. [APECS Group Review, Germany]	Accepted.
7216	3	10	39	10	40	E1a: I suggst this sentence is reworded to something like: "West Antarctic mass loss increased from 34+-9 Gt/yr to 112+-21 Gt/yr between 1979-2003 and 2003-2016", or even "West Antarctic mass loss was ~300 % greater during 2003-2016 than during 1979-2003". It may then make sense to include the estimates of mass loss for all of West Antarctica based on GRACE, Bayesian methods and altimetry before going onto to describe how this varies regionally due to glacier dynamics. [APECS Group Review, Germany]	Accepted - section has been substantially rewritten.
7240	3	10	39	10	42	I think it is important to mention the technique that was used to find this result. [APECS Group Review, Germany]	Accepted - section has been substantially rewritten.
11800	3	10	39	10	39	the GIA correction being smaller is not the issue. The uncertainty is smaller mainly because the area of integration of GIA eerrors is smaller as WAIS is smaller than EAIS [King Matt, Australia]	Accepted - section has been substantially rewritten.
12704	3	10	39	10	39	lower -> smaller [Michiel Van Den Broeke, Netherlands]	Accepted - section has been substantially rewritten.
7218	3	10	41	10	41	E1a: It is not clear what is meant by "regroups" nor why stating the total potential sea level contribution from this region is necessary, given that the paragraph is about observed mass changes. [APECS Group Review, Germany]	Accepted - section has been substantially rewritten.
11802	3	10	41	10	41	regroups is not a correct word here [King Matt, Australia]	Accepted - section has been substantially rewritten.
3684	3	10	42	10	42	Last 2 words should be "western" rather than "west of". [Joanne Johnson, UK]	Accepted - section has been substantially rewritten.
7242	3	10	42	11	1	It would be great to locate Getz, George VI and Strange ice shelves in Fig. 3.2. [APECS Group Review, Germany]	Taken into account - awaits final decision on chapter figures.
7296	3	11	1	11	1	Grammar: 'indicates'. [APECS Group Review, Germany]	Accepted

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16850	3	11	1	11	3	rates citation from Velicogna & al. (2014) might not be the most appropriate ones, please refer to comment 3, the IMBIE experiment is more appropriate for such a report. [Anthony Mémin, France]	Accepted
1834	3	11	2	11	9	The reporting of mass balance changes in the text is somewhat inconsistent. Here, the text mentions a "mass loss of 133 +/- 18 Gt/yr". Elsewhere, the negative mass balance changes are reported as -X Gt/yr. Please choose a standard way to describe the change. [Aku Riihelä, Finland]	Accepted, now refer to losses as negative numbers and gains as positive numbers.
7270	3	11	2	11	2	E1a: "West Antarctic" should be "West Antarctica". [APECS Group Review, Germany]	Accepted (and abbreviated to WAIS)
12706	3	11	2	11	2	West AnatrcticA [Michiel Van Den Broeke, Netherlands]	Accepted (and abbreviated to WAIS)
8184	3	11	4	11	4	correct "Peninsula" at the end of the line [Benoit Montpetit, Canada]	Accepted (and abbreviated to AP)
7298	3	11	5	11	5	Replace 'is' by 'of'. [APECS Group Review, Germany]	Accepted
16852	3	11	5	11	6	same remark as in comment 4 [Anthony Mémin, France]	Unclear
18378	3	11	6	11	6	Clarify what is meant by ‘rapid’, seems a bit vague otherwise [Nicholas Golledge, New Zealand]	Taken into account - rapid loss now only used ina summary statement, following presentation of the loss rates.
3686	3	11	7	11	7	Loss of mass over what timescale? - need to specify. [Joanne Johnson, UK]	Taken into account - wording changed. Note that mass changes and their time periods are defined.
16964	3	11	7	11	8	Could consider whether both a likelihood and confidence statement are really needed. [Markku Rummukainen, Sweden]	Taken into account - confidence and likelihood staements revised.
23712	3	11	7	11	8	Please do not combine likelyhood and confidence for one statement; use either the one or the other [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account - confidence and likelihood staements revised.
7272	3	11	11	11	22	E1b/C3: These paragraphs attempt to illustrate the relative importance of dynamic mass loss and surface mass balance, which is a very important point to make. However, I think it could be done more effectively. Lines 11-13 outline the long term trends in surface accumulation for different regions of West Antarctica - I think this would benefit from some context and figures. For example, stating the overall trend and magnitude of surface accumulation for West Antarctica would give the reader some perspective on the relative importance of SMB and dynamics. Lines 15-16 state that SMB anomalies have exerted little effect on West Antartctic mass balance, which I agree with, but I think this point should be supported by direct comparison of rates of mass loss by these suites of processes - Figure 3.2 contains this information but it is not referred to in the paragraph. [APECS Group Review, Germany]	Accepted - the mechanisms of change (dynamics vs SMB) are now treated explicitly.
7312	3	11	11	11	13	In the previous subsection on East Antarctica, discussion of accumulation came before discussion of mass balance. In this subsection, they come after. [APECS Group Review, Germany]	Taken into account - wording revised.
7274	3	11	15	11	15	E1a: Should "very likely" be italicised? [APECS Group Review, Germany]	Accepted
7300	3	11	15	11	22	I would re-organize the 4 sentences of this paragraph because ASE belongs to West Antarctica and Bellingshausen Sea to Antarctic Peninsula. So I would first have West Antarctica, then ASE, then Antarctic Peninsula, and finally Bellingshausen Sea. [APECS Group Review, Germany]	Taken into account - section rewritten.
7314	3	11	15	11	15	If very likely is meant statistically, it should be italicized. If not, the language should be changed to avoid confusion. [APECS Group Review, Germany]	Accepted

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
11806	3	11	15	11	22	the long-term thinning of Ant Pen glaciers follow ice sheet retreat should be mentioned here or elsewhere. Rott et al TC 2018 show the Larsen A, B thinning continues to change patterns but also continues out of balance since 1995 or 2002 breakups of Larsen A,B. Zhao et al EPSL 2017 show that Fleming Glacier has lost 60m of thickness at the front, and the current thinning rate is 4x the long-term average since 1966, 52 years ago [King Matt, Australia]	Accepted - Rott et al 2018 and Zhao et al., 2017 findings cited.
17800	3	11	15	11	22	Include quantitative description of negligible (e.g. < X%), with X stated. [Robert Arthern, UK]	Accepted - wording changed.
7302	3	11	16	11	18	I would reverse the two parts of this sentence (glacier dynamics first and then SMB) to make it more logical. Suggestion: 'In the Peninsula, the long term changes caused by glacier dynamics in Graham Land and Georges VI are larger than SMB changes.' [APECS Group Review, Germany]	Taken into account - SMB and dynamics now treated explicitly.
7278	3	11	18	11	19	E1a: The reference period in Mouginot et al. (2014) should be indicated here. [APECS Group Review, Germany]	Accepted - wording changed.
7316	3	11	18	11	22	The role of grounding line retreat in mass loss should be discussed more thoroughly, particularly in regard to West Antarctica [APECS Group Review, Germany]	Taken into account - section on GL retreat now in 3.3.1.3
7276	3	11	20	11	20	E1a: There should be a space before units are given - i.e. after 1 and before km. Same for "%" (e.g. line 18) [APECS Group Review, Germany]	Accepted.
19836	3	11	20	11	20	Add "grounding line" to the glossary and insert (see Glossary) [Michelle A. North, South Africa]	Pending
7280	3	11	21	11	21	E1a: Changes in tense. "is" --> "was" [APECS Group Review, Germany]	Accepted
17566	3	11	21	11	21	Rapid GL retreat. Not really rapid. If you consider the rates to be then need to define what is rapid but consider this to be misleading [Jonathan Bamber, UK]	Taken into account - GL discussion rewritten (section 3.3.1.3)
11804	3	11	23	11	23	I expected to have a summary of the Antarctic numbers somewhere. I just see East, West by themselves [King Matt, Australia]	Taken into account - AIS, WAIS, EAIS and AP mass balances presented in new Figure 3.3.1
1898	3	11	24	11	56	It would seem appropriate to acknowledge Kjeldsen et al., 2015, Nature (Spatial and Temporal distribution of mass loss of teh Greenland ice sheet) -- This study, new since AR5, now fills the gap of 20th Century sea level rise contribution, and also highlights that ice sheet mass loss was only 1/3 of post-2010 rates during the 1900-1983 period [William Colgan, Denmark]	Accepted
6258	3	11	24	12	6	It would be easier to read if first the general changes were presented first, then the regional ones and mass partitioning and specific processes likel firn aquifers. Also, the paper by Machguth et al, 2016 revealing new aspects regarding runoff from firn should be cited for firn runoff. [Regine Hock, USA]	Taken into account - section substantially reworded. Discussion of firn aquifer added.
2598	3	11	26	11	28	This sentences contains a lot of information and is hard to follow. Please break it up in smaller chunks, to increase readability. Also, what is meant with "upper part" and "lower part" ? [Patrik Winiger, Netherlands]	Taken into account - section rewritten.
7282	3	11	26	11	34	E1a/b/C1: I suggest that this paragraph would be clearer if the opening sentence stated the inferred trends in snowfall accumulation and the level of confidence in this inference. The evidence for this could follow. In addition, the ice cores and radar data are extremely sparse at high elevation areas, where accumulation may be greatest. Are the inferences from these lines of evidence supported by e.g. reanalysis data, which may help to fill the gaps at high elevations. If not, I suggest that the authors consider reducing the level of certainty given here. [APECS Group Review, Germany]	Accepted - reworded.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
7318	3	11	26	11	27	This sentence should be rephrased. [APECS Group Review, Germany]	Accepted
7320	3	11	26	11	34	This paragraph focus on Lewis et al (2017) and indicates that Overly et al. (2016), Karlsson et al. (2016) and Andersen et al. (2006) demonstrate similar results. Specificity and discussion of different time frames (as is done in the EAIS and WAIS sections) would enhance the strength of the certainty statements. [APECS Group Review, Germany]	Taken into account. Sections on observed changes, mechanisms and drivers reformatted (new sections 3.3.1.4, 3.3.1.5 and 3.3.1.6)
15984	3	11	26	11	34	This sentence doesn't make sense because it seems impossible to analyze data from 2013-2014 on 25 IceBridge flights and analyze data over the past 100-300 years. This many be editorial but this doesn't make sense. Reading on, it isn't clear how analyzing IceBridge data provides information on accumulation trends from 1712. Maybe I am just ignorant. [Patrick Taylor, USA]	Taken into account - section substantially reworded.
21558	3	11	26	12	20	For clarity I suggest the following changes of this section: 1) Start with estimates of Mass Balance - i.e. how much mass the Greenland Ice Sheet has lost in recent years and temporal context. 2) Partitioning of the change - right now the SMB portion is very long and the ice dynamics is reduced to nothing. The relative weight should be rebalanced. While it is true that MB changes due to SMB changes have been increasing the glacier retreat and thinning as a result of dynamic processes is still a sizable component of ice loss 30-40% even in recent years. The text briefly mentions this but the description is largely about SMB changes. [Fiamma Straneo, USA]	Accepted. Sections on observed changes, mechanisms and drivers reformatted (new sections 3.3.1.4, 3.3.1.5 and 3.3.1.6)
7322	3	11	28	11	29	What 'good agreement' means in this context should be explained [APECS Group Review, Germany]	Taken into account - section rewritten.
7324	3	11	29	11	31	The sentence 'Significant ...' should be rephrased and moved to above the previous sentence both for proper attribution and clarity. [APECS Group Review, Germany]	Taken into account - section rewritten.
17568	3	11	31	11	34	This may true in a mean sense but is, IMO, misleading as recent satellite observations from both GRACE and alteimtry indicate a +ve accumulation trend in central-northern Greenland. See eg Khan et al, 2015, ERL and Hurkmans et al 2014, TC and Zwally 2011 J Glac for the trends. These are evident for the most recent decades, which have roughly coincided with a +2 deg warming over Greenland. [Jonathan Bamber, UK]	Taken into account - section rewritten. See new sections 3.3.1.5 Mechanisms of Greenland mass change.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
11768	3	11	34	11	34	I suggest to add this: Finally, all the reconstructions over the 2 last centuries show that the recent melt increase and mass loss rate since the end of the 1990s are unprecedented in the recent Greenland history (Box, 2013 ; Kjeldsen et al., 2015; Fettweis et al., 2017). Ref: Box, J. E.: Greenland ice sheet mass balance reconstruction, Part II: Surface mass balance (1840–2010), J. Climate, 26, 6974–6989, doi:10.1175/JCLI-D-12-00518.1, 2013. Kjeldsen, K. K., Korsgaard, N. J., Bjørk, A. A., Khan, S. A., Box, J. E., Funder, S., Larsen, N. K., Bamber, J. L., Colgan, W., van den Broeke, M., Siggad-Andersen, M. L., Nuth, C., Schomacker, A., Andresen, C. S., Willerslev, W., and Kjær, K. H.: Spatial and temporal distribution of mass loss from the Greenland Ice Sheet since AD 1900, Nature, 528, 396–400, doi:10.1038/nature16183, 2015. [Xavier Fettweis, Belgium]	Taken into account - similar statements now made in new section 3.3.1.4 Greenland Ice Sheet
7326	3	11	36	11	37	In previous paragraphs, this type of confidence statement occurs at the end of the paragraph, not the beginning. [APECS Group Review, Germany]	Taken into account - confidence statements substantially revised.
7328	3	11	36			This statement is true and the first line of the paragraph is true, but to a non-glaciologist, these statements are contradictory. Some effort should be made to explain that uncertainty in runoff would only increase the contribution of runoff to mass loss. [APECS Group Review, Germany]	Taken into account - section rewritten.
7330	3	11	36			Melt and runoff are used somewhat interchangeably, but the distinction is important, particularly in reference to the next paragraph on firn aquifers. [APECS Group Review, Germany]	Taken into account - melt and runoff now distinct in section 3.3.1.5 Mechanisms of Greenland mass change and 3.3.1.6.2 Atmospheric forcing
16966	3	11	36	11	49	It is not clear what the text implies. It first seems to state that there are good observations, and this leads to well-constrained RCMs. Then it is mentioned that RCMs might be clear underestimates. Please clarify. [Markku Rummukainen, Sweden]	Taken into account - section substantially rewritten.
18746	3	11	36	11	49	It seemed odd not to refer to at least one on Fettweis's papers in this section given the performance of MAR in recent years [Peter Nienow, UK]	Accepted - Fettweis now referenced in sections 3.3.1.4 Greenland Ice Sheet and 3.3.1.6.2 Atmospheric forcing
19232	3	11	36	11	49	heavy language. Needed to explain ablation zones, albedo, GrIS, IGY, etc? [Marianne Kroglund, Norway]	Taken into account - section substantially rewritten.
19838	3	11	36	11	49	GrIS is not a necessary acronym for Greenland Ice Sheet, nor is it explained. Please remove this acronym throughout. [Michelle A. North, South Africa]	Taken into account. Changed to GIS - word limits, you see.
7284	3	11	37	11	37	E1a: I think "lower ablation zone" should be defined here or elsewhere. Also I think it should be "surface melt" as there will be basal melting here. [APECS Group Review, Germany]	Taken into account - section substantially rewritten.
7332	3	11	37	11	38	While statements on peak melt rates are useful, they are out of context with the paragraph. [APECS Group Review, Germany]	Taken into account - section substantially rewritten.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
7286	3	11	38	11	38	E2/E1a: It is not clear what is meant by ~0.3/9 metres of ice (which I believe should be metres of ice equivalent). It looks like these values have been taken from Table 1 in Fausto et al. (2016), which reports total ablation, not melt rates. [APECS Group Review, Germany]	Taken into account - section substantially rewritten.
7288	3	11	40	11	40	E1a: By "full melt calculations" do you mean "full energy balance calculations"? [APECS Group Review, Germany]	Taken into account - section substantially rewritten.
14254	3	11	41			need to define first use of GrIS [Christopher Fogwill, UK]	Accepted. Now use GIS.
7290	3	11	42	11	49	E1a: I think this point would be clearer if the typical width of outlet glaciers is included somewhere here. As it is currently written, it is not clear that the relatively course resolution models do not simulate melting of outlet glaciers at all. Instead, it reads as if the main difference in the statistically downscaled RACMO2.3 is that the albedo of the outlet glaciers is captured, whereas the key difference is in fact the area of ice at low elevations. Also, as currently written, it suggests that the statistically downscaling itself caused the increase in surface melting, which is obviously not true. [APECS Group Review, Germany]	Taken into account - new wording is "Runoff totals remain uncertain, however, because although gridded SMB fields from RCMs agree reasonably well with observations {{Lucas-Picher, 2012 #630; Fettweis et al., 2013;Noël, 2015 #631}}, they do not currently resolve the narrow coastal outlet glaciers where melt is greatest, leading to an underestimate of surface melt in typical RCMs {{Noel et al., 2016 #634}}."
7304	3	11	42	11	43	I think you should add this key reference to strengthen your statement: Fettweis, X., Box, J. E., Agosta, C., Amory, C., Kittel, C., Lang, C., van As, D., Machguth, H., and Gallée, H.: Reconstructions of the 1900–2015 Greenland ice sheet surface mass balance using the regional climate MAR model, The Cryosphere, 11, 1015-1033, https://doi.org/10.5194/tc-11-1015-2017, 2017. Fettweis et al. (2017) use MAR with 8 different reanalyses over the period 1900-2015 to reconstruct the Greenland Ice Sheet SMB. They find that ERA-Interim and NCEP-NCARv1 are the most accurate reanalyses to force MAR compared to observations in terms of surface melt extent. [APECS Group Review, Germany]	Accepted - reference added.
7340	3	11	42	11	42	Explain the acroynm "IGY". [APECS Group Review, Germany]	Acronym removed.
11760	3	11	42	11	42	Replace "since the IGY" by "since the 1940s" according to Fettweis et al. (2013) who showed that forcing reanalyses are diverging before 1940, which impacts results of the MAR RCM. Fettweis, X., Box, J. E., Agosta, C., Amory, C., Kittel, C., Lang, C., van As, D., Machguth, H., and Gallée, H.: Reconstructions of the 1900–2015 Greenland ice sheet surface mass balance using the regional climate MAR model, The Cryosphere, 11, 1015-1033, https://doi.org/10.5194/tc-11-1015-2017, 2017. [Xavier Fettweis, Belgium]	Acronym removed, section rewritten, reference added.
11766	3	11	43	11	43	A reference to the Polar RCM MAR is missing here. e.g. Fettweis et al. (2017) [Xavier Fettweis, Belgium]	Accepted - reference added.
7306	3	11	44	11	46	Rephrase based on Table 1 from van den Broeke et al. (2016): 'Based on RACMO2.3 model outputs integrated over the GrIS, surface melt, rainfall, refreezing of liquid water and meltwater runoff have increased from 433 Gt yr-1, 23 Gt yr-1, 200 Gt yr-1 and 256 Gt yr-1 in 1961-1990 to 581 Gt yr-1, 28 Gt yr-1, 245 Gt yr-1 and 363 Gt yr-1 over 1991-2015, respectively (van den Broeke et al., 2016).' [APECS Group Review, Germany]	Taken into account - section substantially rewritten, see 3.3.1.5 Mechanisms of Greenland mass change.
8186	3	11	44	11	45	This sentence requires a verb somewhere to indicate that the RAMCO output gives the results after the ":". [Benoit Montpetit, Canada]	Taken into account - section rewritten.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
13052	3	11	44	11	46	Why only RACMO assessed here? [Gerhard Krinner, France]	Taken into account - section rewritten. Reference to specific models removed, discussion broadened.
17570	3	11	44	11	49	Long winded explanation of something that has been demonstrated numerous times before going back at least 20 years: that ablation is sensitive to topography. Did not feel all of this was necessary or useful here. [Jonathan Bamber, UK]	Taken into account - section substantially rewritten, see 3.3.1.5 Mechanisms of Greenland mass change.
5354	3	11	45	11	46	An "is approximately equal to" sign result probably would benefit by giving estimates of uncertainty (if available). [Roderik Van De Wal, Netherlands]	Taken into account - section substantially rewritten, see 3.3.1.5 Mechanisms of Greenland mass change.
7342	3	11	47	11	48	"runoff increased by 30%". Is this closer to the measured value? [APECS Group Review, Germany]	Section substantially rewritten, see 3.3.1.5 Mechanisms of Greenland mass change.
11774	3	11	48	11	49	Replace "which implies that Greenland SMB cannot be accurately determined at typical RCM resolutions of 5–15 km" by "because the low-lying marginal glaciated areas and neighbour ice caps are better resolved". Most of the ice sheet can be resolved at resolution of ~ 10 km. [Xavier Fettweis, Belgium]	Taken into account - section substantially rewritten, see 3.3.1.5 Mechanisms of Greenland mass change.
1832	3	11	51	11	51	The meaning of the reference (Humphrey et al) is not clear from its placement in the sentence. Restructure sentence for clarity. [Aku Riihelä, Finland]	Taken into account - reworded to "It has recently become apparent (medium evidence) that in west GIS {{Humphrey, 2012 #635}} and especially in south-east and north-west GIS, (areas with high accumulation and high summer surface melt rates) {{Kuipers Munneke, 2014a #636}}, perennial firn aquifers store liquid water year-round {{Forster, 2013 #637}} before it drains in crevasses downslope, buffering the runoff response {{Poinar, 2017 #638}}.
7292	3	11	51	11	51	E1a: Consider listing SE and NW Greenland first. [APECS Group Review, Germany]	Noted
7308	3	11	51	11	53	I would reverse the order (southeast and northwest before west) since this is especially true for southeast and northwest Greenland. [APECS Group Review, Germany]	Noted
7334	3	11	51	11	54	This sentence should be edited for clarity and readability. [APECS Group Review, Germany]	Noted
7336	3	11	51			There should be some statement about the certainty that the firn aquifer has or doesn't have a significant impact on either the timing of runoff or ice dynamics. [APECS Group Review, Germany]	Taken into account - discussion of significance of firn aquifer storage and growth extended (section 3.3.1.5 Mechanisms of Greenland mass change)
7344	3	11	51	11	51	"In west Greenland (Humphrey et al., 2012)". Why is there a citation here. It read as though Humprey et al. discovered Greenland. [APECS Group Review, Germany]	Taken into account, sentence reworded.
11974	3	11	51	11	52	northwest Greenland is not characterized by high acc and high melt rates in particular relative to SW and SE - I think the reference to K-M2014a is wrong [Kristian Kjellerup Kjeldsen, Denmark]	Accepted - wording changed, reference updated.
19840	3	11	51	11	51	How is it possible to have "west Greenland (), but especially southeast and northwest Greenland…"? Southeast is not west Greenland at all. Please rewrite this to improve clarity [Michelle A. North, South Africa]	Taken into account - wording changed
22214	3	11	51	11	56	this paragraph is not put into any context. Why do firn acquifers need to be discussed here? [Martin Truffer, USA]	Taken into account - discussion of significance of firn aquifer storage and growth extended (section 3.3.1.5 Mechanisms of Greenland mass change)

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7294	3	11	53	11	56	E1a/b: As it is currently written, this section could be misconstrued as implying that all the water temporarily stored in the acquifer drains into crevasses, or it at least doesn't give the reader much indication as to how much water drains into these crevasses, which hinders evaluation of the importance of these acquifers. Is this a question that warrents further discussion here? [APECS Group Review, Germany]	Taken into account - discussion of significance of firn aquifer storage and growth extended (section 3.3.1.5 Mechanisms of Greenland mass change). Wording on drainage changed.
7310	3	11	55	11	55	Replace 'an' by 'a'. [APECS Group Review, Germany]	Accepted.
7338	3	11	55	11	56	While the current volume of the firn aquifer is correct. The statement implies that this the volume that drains each year, which is not true. This sentence should include reference to calculations of firn aquifer volume change and drainage rates (Miege et al., 2016; Miller et al., 2017a,b). [APECS Group Review, Germany]	Taken into account - discussion of significance of firn aquifer storage and growth extended (section 3.3.1.5 Mechanisms of Greenland mass change)
8188	3	11	55	11	55	change "an" to "a" [Benoit Montpetit, Canada]	Accepted
17572	3	11	55	11	56	140 Gt is not similar to present-day annual runoff. It's about half or less. See previous paragraph! [Jonathan Bamber, UK]	Accepted - now provide the runoff figures for comparison.
19842	3	11	55	11	55	Please write out "metres above sea level (m a.s.l.)" at first use. Also, ensure the unit is consistent with Chapter 2 (m a.s.l.) and not as has been used here (m asl). [Michelle A. North, South Africa]	Taken into account, abreviation removed.
13464	3	12	0			Fg 3.3 What do the pies in the pie charts represent? The legends are not clear. Need spaces in the titles. Beware of tiny and unequal font sizes. [Debra Roberts and Durban Team, South Africa]	Taken into account - figures changed.
2306	3	12	1	12	6	Arctic amplification promotes atmospheric conditions that lead to enhanced melting, which observations have corroborated. With rising temperatures, there is also increased surface runoff and mass loss from the decreasing ability of the firn to effectively retain meltwater in the high elevations. (Tedesco M., et al. (2016) Arctic cut-off high drives the poleward shift of a new Greenland melting record, NATURE COMMUNICATIONS 7(11723):1–6; Tedesco M., et al. (2016) Arctic cut-off high drives the poleward shift of a new Greenland melting record, NATURE COMMUNICATIONS 7(11723):1–6; Noël B., et al. (2017) A tipping point in refreezing accelerates mass loss of Greenland's glaciers and ice caps, NATURE COMMUNICATIONS 8(14730):1–8; Machguth H., et al. (2016) Greenland meltwater storage in firn limited by near-surface ice formation, NATURE CLIMATE CHANGE 6:390–393.) [Kristin Campbell, USA]	Taken into account - discussion of significance of firn aquifer storage and growth extended (section 3.3.1.5 Mechanisms of Greenland mass change)

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
2432	3	12	1	12	6	Arctic amplification promotes atmospheric conditions that lead to enhanced melting, which observations have corroborated. With rising temperatures, there is also increased surface runoff and mass loss from the decreasing ability of the firn to effectively retain meltwater in the high elevations. (Tedesco M., et al. (2016) Arctic cut-off high drives the poleward shift of a new Greenland melting record, NATURE COMMUNICATIONS 7(11723):1–6; Tedesco M., et al. (2016) Arctic cut-off high drives the poleward shift of a new Greenland melting record, NATURE COMMUNICATIONS 7(11723):1–6; Noël B., et al. (2017) A tipping point in refreezing accelerates mass loss of Greenland's glaciers and ice caps, NATURE COMMUNICATIONS 8(14730):1–8; Machguth H., et al. (2016) Greenland meltwater storage in firn limited by near-surface ice formation, NATURE CLIMATE CHANGE 6:390–393.) [Durwood Zaelke, USA]	Taken into account - discussion of significance of firn aquifer storage and growth extended (section 3.3.1.5 Mechanisms of Greenland mass change)
7388	3	12	1	12	20	I think that you could re-organize these two paragraphs into three paragraphs to make it simpler to understand. My suggestion is to focus on the total mass balance in a first paragraph by taking the information in P12 L8-14, then talk about the increase in the runoff contribution in a second paragraph by taking the information in P12 L1-6, and finally end with the contributions from the different Greenland regions by taking information in P12 L14-20. These could form three distinct paragraphs. Following one of my previous comments, I think these paragraphs should go in the beginning of Section 3.2.1.3 as they form the most interesting part of this sub-section. [APECS Group Review, Germany]	Taken into account - now have separate sections 3.3.1.4 Greenland Ice Sheet, 3.3.1.5 Mechanisms of Greenland mass change and 3.3.1.6 The causes of ice sheet change (with sub-sections 3.3.1.6.1 Ocean heat forcing and 3.3.1.6.2 Atmospheric forcing)
10988	3	12	1	12	30	This is an example of the disconnect between physical forcing and biololgical consquences is lacking. [Connie Lovejoy, Canada]	Rejected in this section - biological consequences are described later in the chapter.
11808	3	12	1	12	1	the start to this sentence makes one think 1990 is the start of mass loss, but Danish work with photogrammetry has shown the 20th thinning is substantial. [King Matt, Australia]	Taken into account - Danish work (Kjeldsen et al 2015) now referenced.
12930	3	12	1	12	6	Arctic amplification promotes atmospheric conditions that lead to enhanced melting, which observations have corroborated. With rising temperatures, there is also increased surface runoff and mass loss from the decreasing ability of the firn to effectively retain meltwater in the high elevations. (Tedesco M., et al. (2016) Arctic cut-off high drives the poleward shift of a new Greenland melting record, NATURE COMMUNICATIONS 7(11723):1–6; Tedesco M., et al. (2016) Arctic cut-off high drives the poleward shift of a new Greenland melting record, NATURE COMMUNICATIONS 7(11723):1–6; Noël B., et al. (2017) A tipping point in refreezing accelerates mass loss of Greenland's glaciers and ice caps, NATURE COMMUNICATIONS 8(14730):1–8; Machguth H., et al. (2016) Greenland meltwater storage in firn limited by near-surface ice formation, NATURE CLIMATE CHANGE 6:390–393.) [Gabrielle Dreyfus, USA]	Taken into account - discussion of significance of firn aquifer storage and growth extended (section 3.3.1.5 Mechanisms of Greenland mass change)
17728	3	12	1	12	20	The timescales used change constantly throughout this section, leaving the actual message unclear to the reader [Hessel Voortman, Netherlands]	Taken into account - 5-year periods consistent with those for Antarctica are now provided (from Bamber et al., 2018). Note though that the various periods studied by multiple different authors are the periods they chose, and this is an assessment of the available research.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
7346	3	12	3	12	3	E1a: consider removing "even" [APECS Group Review, Germany]	Accepted
7372	3	12	3	12	3	Remove 'even'. [APECS Group Review, Germany]	Accepted
7374	3	12	3	12	4	Grammar: 'have not appreciably changed'. [APECS Group Review, Germany]	Taken into account - grammar ok.
1902	3	12	4	12	6	It is important to note that these partition ratios, or fractions of mass loss due to runoff versus iceberg, rely on assumptions of the "reference" runoff and iceberg fluxes associated with an ice sheet at equilibrium. Emerging evidence suggests that our understanding of "reference" fluxes is shifting, so that better understanding of ice-sheet behaviour during the pre-satellite era directly influences our partition assessment during the satellite era (Colgan et al., 2015, Annals of Glaciology, "Greenladn high-elevation mass balance: inference and implication of reference period imbalance") [William Colgan, Denmark]	Accepted - this correction added
18744	3	12	4	12	4	"for most of THE recent…." - text addition [Peter Nienow, UK]	Accepted - section rewritten.
18748	3	12	4	12	6	Is it worth also noting here that three of the last four years (since the 2012 year referred to in Enderlin et al) have not seen such high negative SMB so the % value will likely have dropped (i.e. to highlight the varaibility and the fact that this is not a monotonic trend) [Peter Nienow, UK]	Noted - reference available?
7348	3	12	5	12	6	E1a: There should be a space before each % symbol. [APECS Group Review, Germany]	Accepted.
7376	3	12	5	12	6	It is preferable to put the references at the end of the sentence. [APECS Group Review, Germany]	Accepted
896	3	12	6	12	6	2012 and cools down the atmosphere [Herve Nifenecker, France]	Unclear
1904	3	12	8	12	20	I know that assessment reports require brevity, but here IPCC is again mixing GRACE assessments, which sample all of Greenland including the peripheral glaciers, with MDM/Altimetry assessments, which only sample the ice sheet proper. I feel that SROCC needs to acknowledge that peripheral glaciers are responsible for approximately 15% of Greenland mass loss rather than continue the AR5 tradition of treating all satellite derived numbers as the same. It is now clear that the peripheral glaciers are responding disproportionately fast to climate change. (See for example Colgan et al., 2015, Remote Sensing of the Environment, "Hybrid Glacier Inventory, Gravimetry and Altimetery mass balance product for Greenland and the Canadian Arctic"). [William Colgan, Denmark]	Taken into account - section 3.3.2 Polar glaciers describes the changes in ice-sheet-marginal independent glaciers.
7350	3	12	8	12	8	E1a: Consider rewording., e.g.: "Greenland ice sheet mass loss during 2011-2016, estimated from Cryosat-2, averaged…". It is not "the" mass loss. As written, it states that cryosat-2 lost mass in Greenland… [APECS Group Review, Germany]	Taken into account - section rewritten.
7352	3	12	8	12	20	E1a: I think it would be clearer to state at the outset that mass balance estimates using all methods indicate mass loss of the Greenland ice Sheet since 1990. I also think that the final statement could be bolder - why not also state that the rate of mass loss increased considerably after 2000? [APECS Group Review, Germany]	Accepted - see new section 3.3.1.4 Greenland ice sheet
7378	3	12	8	12	20	I think this paragraph should be the first of Section 3.2.1.3 as it provides information on the total mass balance of the Greenland Ice Sheet, which is the most important information of this sub-section. You would then talk about the specific components of SMB afterwards. [APECS Group Review, Germany]	Taken into account - see new section 3.3.1.4 Greenland ice sheet
7380	3	12	8	12	8	Remove 'over a short period' since you explicitly mention the period in the same sentence (2011-2016). [APECS Group Review, Germany]	Taken into account - see new section 3.3.1.4 Greenland ice sheet

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
7382	3	12	8	12	8	Grammar: 'averages'. [APECS Group Review, Germany]	Taken into account - see new section 3.3.1.4 Greenland ice sheet
7386	3	12	8	12	20	I think you should also make reference to Helm et al. (2014) who find a GrIS mass loss of 375 Gt yr-1 over 2011-2014 based on Cryosat-2 in order to complement Rignot et al. (2011) and McMillan et al. (2016) that you already cite. Reference: Helm, V., Humbert, A., and Miller, H.: Elevation and elevation change of Greenland and Antarctica derived from CryoSat-2, The Cryosphere, 8, 1539-1559, https://doi.org/10.5194/tc-8-1539-2014, 2014. [APECS Group Review, Germany]	Rejected - the Helm study is included in the larger IMBIE study that is now included inthis section.
11976	3	12	8	12	8	remove short (working with high res data 5 year period is not short) [Kristian Kjellerup Kjeldsen, Denmark]	Taken into account - see new section 3.3.1.4 Greenland ice sheet
7396	3	12	9	12	10	The reference should be Enderlin et al. (2014), not 2013. [APECS Group Review, Germany]	Accepted
7398	3	12	9	12	10	The statement '... with a growing ...' needs to be supported by references to different studies which demonstrate this trend. [APECS Group Review, Germany]	Taken into account - see new section 3.3.1.4 Greenland ice sheet
898	3	12	10	12	10	melt, warming the atmosphere [Herve Nifenecker, France]	Unclear
7354	3	12	10	12	10	E2/C3: The statement regarding the fraction of mass loss due to surface melting requires a reference. Also, I think the reference to Enderlin et al. (2013) should actually be Enderlin et al. (2014). [APECS Group Review, Germany]	Taken into account - see new section 3.3.1.5 Mechanisms of Greenland mass change
7356	3	12	10	12	11	E1a/E2: This statement is confusing because it cites a paper that was published before the end of the time period under consideration. The same applies to the following sentence (though I believe earlier in the report, it is stated that the Rignot et al. (2011) dataset has been extended...). [APECS Group Review, Germany]	Accepted - see new section 3.3.1.5 Mechanisms of Greenland mass change
18750	3	12	10	12	10	Same point as above as growing fraction of SMB controlled by melt may have considerable variability [Peter Nienow, UK]	Noted - though not sure how to summarise here. Temperature trends are given over and between multi-year periods (e.g. "The post-1990s period experienced the warmest Greenland near-surface summer air temperatures of the 1840 to 2010 period"). Not clear that interannual variability discussion is called for here.
3298	3	12	11	12	11	May be yr -1 but not yr -2. [Castor Muñoz Sobrino, Spain]	Rejected - units refer to the acceleration, in Gt per year per year.
7408	3	12	11	12	11	"with an acceleration of 10.6 ± 1 Gt yr-2". What is this an acceleration in comparison to? [APECS Group Review, Germany]	Taken into account - section revised, acceleration statement removed.
11980	3	12	12	12	20	Firstly, the Rignot et al, 2011 does not appear in the reference list. Secondly, Rignot et al, 2008 (not referenced) provide estimates from 1958 to 2007. In fig 3.3 caption is is stated that estimates from 1972 to 2017 is based on an updated version of Rignot et al 2011. Please revise main text accordingly. Thirdly, with regards to longer-term estimates, Kjeldsen et al, 2015 (doi:10.1038/nature16183) provide observation-based- and empirically modeled-estimates from the end of the Little Ice Age (1900 AD) to 2010, which provides a context for modern observations. [Kristian Kjellerup Kjeldsen, Denmark]	Taken into account - section substantially rewritten, Kjeldsen et al., 2015 reference added.
12708	3	12	12	12	12	How can Rignot et al (2011) report on 2010-2017 mass losses? [Michiel Van Den Broeke, Netherlands]	Taken into account - section rewritten.
7384	3	12	14	12	17	This sentence is not clear. Furthermore, I think the high accumulation, high discharge regions are only southeast and northwest Greenland in the first part of the sentence, since you mention northeast later on. Please rephrase. [APECS Group Review, Germany]	Taken into account - see new sections 3.3.1.4 Greenland Ice Sheet, and 3.3.1.5 Mechanisms of Greenland mass change

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7400	3	12	14	12	18	This sentence is lacking in detail. The regions should be named or more clearly described. Further, it is unclear is high discharge and high accumulation rates are spatially coherent or distinct. There is certainly variability in accumulation rates across the regions with the highest dynamics driven mass loss. Further, this statement is somewhat implying that much of the mass loss is dynamical. Overall, this sentence should be more clearly described and referenced. [APECS Group Review, Germany]	Taken into account - see new sections 3.3.1.4 Greenland Ice Sheet, and 3.3.1.5 Mechanisms of Greenland mass change
7358	3	12	15	12	15	E1a: "Figures" --> which Figure? [APECS Group Review, Germany]	Taken into account - see new sections 3.3.1.4 Greenland Ice Sheet, and 3.3.1.5 Mechanisms of Greenland mass change
7360	3	12	15	12	17	E1a/C4: This sentence first states that the north east sector contributed 3 mm SLR since 1972, then that it contributed 2 mm since 1972. Which is it? This sentence also needs a reference. Alos, there should be spaces between the figure and the units. Also "northeast" should be "north east". [APECS Group Review, Germany]	Taken into account - see new sections 3.3.1.4 Greenland Ice Sheet, and 3.3.1.5 Mechanisms of Greenland mass change
19844	3	12	15	12	15	Modify to read: "high discharge regions in northeast, southeast, and northwest Greenland" [Michelle A. North, South Africa]	Taken into account - see new sections 3.3.1.4 Greenland Ice Sheet, and 3.3.1.5 Mechanisms of Greenland mass change
19846	3	12	15	12	15	Which figures are being referenced here? [Michelle A. North, South Africa]	Taken into account - figures have been changed.
23714	3	12	15	12	15	Specify "Figure" (Figure 3.3 A-E) [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account - figures have been changed (and referenced).
7362	3	12	17	12	18	E1a/C2/C3: This sentence should have a reference. Has mass loss really spread to the entire ice sheet? Surely high elevation areas are still gaining mass annually? "the mass loss" --> "mass loss". [APECS Group Review, Germany]	Taken into account - see new sections 3.3.1.4 Greenland Ice Sheet, and 3.3.1.5 Mechanisms of Greenland mass change
13054	3	12	17	12	18	It's a bit of a pity that the figure does not show very clearly the accelearion of the loss, while the acceleration is a key result that has also been mentioned in the executive summary. You might consider adding a time series figure to show this more clearly [Gerhard Krinner, France]	Taken into account - figures have been changed (and referenced).
7364	3	12	18	12	19	E1a: This sentence is about glacier mass loss (presumably outlet glacier?), whereas the rest of the paragraph seems to be about Greenland ice sheet mass loss. This is somewhat confusing and it is common sense that outlet glacier mass loss is dominated by outlet glacier dynamics. "Evolution of marine-terminating outlet glaciers" is quite vague and, given that these glaciers contribute ~40-60 % of Greenland Ice Sheet mass loss, I think they deserve rather more attention here. [APECS Group Review, Germany]	Taken into account - dynamic and SMB mechanisms of loss now clearly distinguished. See new sections 3.3.1.4 Greenland Ice Sheet, and 3.3.1.5 Mechanisms of Greenland mass change. See also 3.3.2 Polar glaciers for discussion of independent, peripheral glaciers.
7402	3	12	18	12	19	this statement should directly reference the best estimates of SMB and dynamical mass loss. [APECS Group Review, Germany]	Taken into account - see new sections 3.3.1.4 Greenland Ice Sheet, and 3.3.1.5 Mechanisms of Greenland mass change
18752	3	12	18	12	19	Perhaps this would be where it is worth pointing out more clearly how the contributions of SMB and MTG dynamics to overall loss continue to vary [Peter Nienow, UK]	Taken into account - see new sections 3.3.1.4 Greenland Ice Sheet, and 3.3.1.5 Mechanisms of Greenland mass change
7366	3	12	22	12	30	I don't think Figure 3.3. right is readable - the font is very small and the resolution too coarse to read when zooming in. Please try and either make this larger or considerably increase the resolution. The same applies to Figure 3.2. [APECS Group Review, Germany]	Taken into account - figures have been changed (and referenced).
7404	3	12	22	12	23	Figure 3.3 is difficult to interpret. In the left panel, the ocean temperature color scale overwhelms the mass balance color scale. The right panels are not readable in print or when zoomed in. [APECS Group Review, Germany]	Taken into account - figures have been changed (and referenced).

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
8190	3	12	22	12	23	I strongly suggest increasing the figure size. Especially the one on the left since it it very difficult to view some pie charts and the text in them. [Benoit Montpetit, Canada]	Taken into account - figures have been changed (and referenced).
12664	3	12	22	12	25	Again, please consider changing the colourmap chosen for Figure 3.3 as colourblind readers may have difficulty viewing the Jet colourmap used. Suggest Python's Viridis/Matlab's Parula instead. [Gillian Young, UK]	Taken into account - figures have been changed (and referenced).
2602	3	12	23	12	23	Whenerver possible, please try to avoid the rainbow color scale, it can distort perceptions of data and alter meaning by creating false boundaries between values. Instead, use continuous color scales (e.g, bright to dark) or help from tools such as Color Brewer or HCL Wizard. Suggestion: Use a grey-scale for temperature and keep the blue-to-red scale for cm water equivalent. [Patrik Winiger, Netherlands]	Taken into account - figures have been changed (and referenced).
11984	3	12	23	12	23	Please update the color scheme representing the GRACE estimate in Fig 3.3 Left - it is impossible to decipher and also choose a different color for the ocean temp, e.g. two colors centred around white (keep in mind red-green color blindness). I would also urge the editors to improve the readability of Fig 3.3 Right [Kristian Kjellerup Kjeldsen, Denmark]	Taken into account - figures have been changed (and referenced).
19848	3	12	23	12	25	Figure 3.3 could be enlarged to fit the page width, allowing one to read the text, particularly for the small figures [Michelle A. North, South Africa]	Taken into account - figures have been changed (and referenced).
3688	3	12	25	12	25	Fig. 3.3: Numbers in panels A-E are too small to read. [Joanne Johnson, UK]	Taken into account - figures have been changed (and referenced).
7370	3	12	25	12	40	E1b: This paragraph about polar glaciers did not give me a clear impression of how polar glaciers are changing nor what the level of scientific understanding of these changes are. Rather than simply stating that estimates of mass balance have improved, I suggest that the paragraph would benefit from including some figures to give an overview of the mass balance of these glaciers and perhaps their contribution to sea level rise (which would facilitate comparison with e.g. Greenland and Antarctica). The listed causes for the recently 'improved results' are a bit vague and don't give the reader a sense of how good the results actually are. Providing a level of confidence and likelihood here would be informative. [APECS Group Review, Germany]	Accepted- We have written a new section on polar glaciers (3.3.3) which includes asesment of observed changes, mechanisms, drivers and projections using calibrated uncertainty language. It also includes a new figure showing an overview of mass changes for different polar regions.
16968	3	12	25	12	30	Caption - the smaller panels bear letters A…E - should be explained. [Markku Rummukainen, Sweden]	Accepted - this figure has been removed
20680	3	12	25	12	30	Again, w\hat does pale red mean? [Tamsin Edwards, UK]	Accepted - this figure has been removed
7368	3	12	26	12	30	E1b: The structure of this subsection is rather odd: 1. trends in accumulation. 2. Runoff. 3. Acquifers. 4. Greenland mass loss increased since 1990. 5. Greenland mass loss since 2000. I think it would be much clearer if the subsection opened with an overview of Greenland ice sheet mass loss prior to and since 2000. Then go on to discuss how this is split between runoff and dynamics. Then discuss each of those two components. [APECS Group Review, Germany]	Accepted - see our revised structure
7390	3	12	28	12	28	Change 'Time series' into 'Mean' as it is not really a time series but rather an average over five different time periods. [APECS Group Review, Germany]	Accepted - this figure has been removed
23716	3	12	29	12	29	clarify that the different time periods are shown in A-E [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - this figure has been removed
7406	3	12	30	12	30	Check reference. [APECS Group Review, Germany]	Accepted - this figure has been removed

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
7394	3	12	33			Section 3.2.1.4: This sub-section is very weak compared to previous sub-sections. I think a little bit more could be said about recent changes in glacier mass balance. Chapter 6 of the SWIPA 2017 report could be a good source of inspiration: Box, J. E. and M. Sharp, 2017. Changes to Arctic land ice. In: Snow, Water, Ice and Permafrost in the Arctic (SWIPA) 2017. pp. 137-168 . Arctic Monitoring and Assessment Programme (AMAP), Oslo, Norway. [APECS Group Review, Germany]	Accepted- We have written a new section on polar glaciers (3.3.3) which includes asesment of observed changes, mechanisms, drivers and projections using calibrated uncertainty language. It also includes a new figure showing an overview of mass changes for different polar regions. We cite the Box and Sharp SWIPA assesment.
12574	3	12	33	12	40	this is a very short and rudimentary paragraph compared to the ice sheet sections, given that the eustatic sea level rise is dominated by mass loss from glaciers (e.g. Dieng, H. B., Cazenave, A., Meyssignac, B., and Ablain, M.: New estimate of the current rate of sea level rise from a sea level budget approach, Geophys. Res. Lett., 44, 3744–3751, https://doi.org/10.1002/2017GL073308, 2017). there is a considerable amount of glacier ice in the polar regions outside the ice sheets, and these ice masses experience important changes. [Thomas Vikhamar Schuler, Norway]	Accepted- We have written a new section on polar glaciers (3.3.3) which includes asesment of observed changes, mechanisms, drivers and projections using calibrated uncertainty language. It also includes a new figure showing an overview of mass changes for different polar regions.
17690	3	12	33	12	40	The section on polar glaciers is by far too short. Polar glaciers contribute currently significantly to SLR, and their changes have a number of implications for humans and ecosystems. Six lines for this topic, without concrete numbers of changes, is too little information for a special report on cryosphere. There is also a notable imbalance regarding the amount of information given for polar glaciers (ch3) and non-polar glaciers (ch2), which is hardly based on differences in importance. I suggest to significantly extend section 3.2.1.4 , and aspects relating to polar glaciers in other sections of Ch3. [Andreas Kääb, Norway]	Accepted- We have written a new section on polar glaciers (3.3.3) which includes asesment of observed changes, mechanisms, drivers and projections using calibrated uncertainty language. It also includes a new figure showing an overview of mass changes for different polar regions.
1318	3	12	35	12	40	I found the treatment of polar glaciers (outside of ice sheet) minimalist. These glaciers cover large areas and they account for a large fraction of the glacier contribution to sea level rise. As they are not dealt with in the High Mountain chapter, a closer attention needs to be drawn on these glaciers in the Polar chapter. At this stage I did not provide a list of references (I do not think this is the point of the review) but I am happy to contribute with references if needed. [Etienne Berthier, France]	Accepted- We have written a new section on polar glaciers (3.3.3) which includes asesment of observed changes, mechanisms, drivers and projections using calibrated uncertainty language. It also includes a new figure showing an overview of mass changes for different polar regions.
5812	3	12	35	12	40	Aren't in situ methods also utilized for determining mass balance and reported in WGMS? Aren't these results also reported annually in BAMS State of Climate Report which will provide up to date information for 2017 in the report to be released in the next month or two. [Sharon Smith, Canada]	Accepted- Our new section on polar glaciers (3.3.3) cites a new compilation of geodetic and in situ observations, including a new figure illustrating these in situ results alongside GRACE estimates of glacier mass change
14256	3	12	35			The mass balance of glaciers, including those in the polar regions, has been addressed...' [Christopher Fogwill, UK]	Taken into account - section has been rewritten
15986	3	12	35	12	40	Consider Harig and Simons (2016): Harig, C., and F. J. Simons, 2016: Ice mass loss in Greenland, the Gulf of Alaska, and the Canadian Archipelago: Seasonal cycles and decadal trends. Geophysical Research Letters, 43, 3150–3159, doi:10.1002/2016GL067759. [Patrick Taylor, USA]	Accepted - reference added
1320	3	12	36	12	36	I think Jacobs et al. 2011 should be replaced with Jacob et al. 2012 [Etienne Berthier, France]	Rejected - reference removed

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
16970	3	12	37	12	38	How have the results improved? What new knowledge does it imply? [Markku Rummukainen, Sweden]	Accepted- We have written a new section on polar glaciers (3.3.3) which includes asesment of observed changes, mechanisms, drivers and projections using calibrated uncertainty language. It also includes a new figure showing an overview of mass changes for different polar regions.
1322	3	12	38	12	38	Alaska glaciers seem to be included in both Chapter 2 and chapter 3. Lead authors should coordinate on this. [Etienne Berthier, France]	Accepted - Alaskan glaciers now only included in Ch2
7392	3	12	38	12	38	I would a reference to the Randolph Glacier Inventory: Pfeffer et al. (2014). The Randolph Glacier Inventory: a globally complete inventory of glaciers, Journal of Glaciology, 60(221): 537-552, doi: 10.3189/2014JoG13J176. [APECS Group Review, Germany]	Accepted - Pfeffer et al. 2014 cited and Randolph regions used in new glaciers figure
11606	3	12	38	13	2	This section 3.2.1.4 does not include mass balance change of each region except for Alaska and Canada. Matsuo and Heki (2013) showed mass balance by GRACE, which will be a good refence about Iceland, Svalbard and Russian Arctic. Matsuo, Koji, and Kosuke Heki. "Current ice loss in small glacier systems of the Arctic Islands (Iceland, Svalbard, and the Russian High Arctic) from satellite gravimetry." Terrestrial, Atmospheric and Oceanic Sciences 24.4-1 (2013): 657-670. [Keiko Konya, Japan]	Accepted - Section 3.3.3. now includes mass changes for each of the polar regions that we agreed (with Chapter 2) to cover.
13056	3	12	38	12	40	Nothing to say about the European or Asian Arctic, or the Antarctic glaciers? SMB-dominated? [Gerhard Krinner, France]	Accepted - Section 3.3.3 now covers high Arctic, Asian and Antarctic glaciers. Chapter 2 covers European glaciers and Asian glaciers outside of the polar regions.
5356	3	12	40	12	41	The relation with the paper about Greenland Blocking Index is not clear to me from this sentence, since I think it barely touches precipitation and accumulation in Greenland; moreover I read it as correlating an seasonal anomaly with an yearly anomal y (let's call it "partial self-correlation"), which should correlate well for precipitation except if the season is always very dry compared to other seasons. [Roderik Van De Wal, Netherlands]	Accepted - this text has been removed
19854	3	13	0	13		Please consider whether all these acronyms are really necessary (e.g., SAM, NAO, AMO…) [Michelle A. North, South Africa]	Rejected - these acronyms refer to well known modes of climate variabiliy, which we describe in our supplement, and now refer to in this part of the chapter.
3508	3	13	1	13	2	Some references to studies of glacier SMB in the subantarctic region should be added here, for example for the Kerguelen Islands: Verfaillie et al., 2015. Recent glacier decline in the Kerguelen Islands (49ºS, 69ºE) derived from modeling, field observations, and satellite data, J. Geophys. Res. Earth Surf., 120, 637–654, doi:10.1002/2014JF003329. And Favier et al., 2016. Atmospheric drying as the main driver of dramatic glacier wastage in the southern Indian Ocean, Scientific Reports, 6, 32396, doi: https://doi.org/10.1038/srep32396. There are probably similar studies for South Georgia and other subantactic Islands. [Deborah Verfaillie, Spain]	Accepted - Section 3.3.3. now contains a section on subAntarctic glaciers and cites these two references.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
3960	3	13	4	16	1	A paper has just come out in Nature Communications describing a volcanic heat source under PIG - Evidence of an active volcanic heat source beneath the Pine Island Glacier" by Brice Loose, Alberto Naveira Garabato, Peter Schlosser, William Jenkins, David Vaughan, and Karen Heywood. Published 22nd June 2018. It seems that this is a driver of change that should be mentioned, although there is low confidence regarding the magnitude of the impact. [Ben Webber, UK]	Accepted - text revised and reference to this paper included in Section 3.3.1.3
7428	3	13	4			Section 3.2.2: The content of this sub-section mostly focuses on ice sheets, while changes are also happening for glaciers. My suggestion is to include a bit more information about the drivers of change for glaciers. [APECS Group Review, Germany]	Accepted- Section 3.3.3. includes a section on the drivers of glaciers
18770	3	13	4	18	6	Potential links between recent increases in surface melt generation across Greenland and associated changes in subglacial hydrology and ice-motion (via subglacial water pressure) are surprisingly neglected given the plethora of papers that have investigated this topic. Thus the issue of the extent to which more meltwater may or may not make the ice-sheet flow faster due to hydrodynamic coupling is entirely neglected (apart from stating on page 18, line 1 that sub-glacial hydrology needs to be incorporated in to ice sheet models to improve projections of the future of the GrIS). Several papers including (e.g. Stevens et al, GRL 2016; doi.org/10.1002/2016GL070414, 'Greenland ice sheet flow response to runoff variability'; Tedstone et al, Nature 2015, doi: 10.1038/nature15722, 'Decadal slowdown of a land-terminating sector of the Greenland Ice Sheet despite warming'; Tedstone et al, PNAS 2013, doi/10.1073/pnas.1315843110, 'Greenland ice sheet motion insensitive to exceptional melt water forcing'; Sole et al, GRL 2013, doi.org/10.1002/grl.50764, 'Winter motion mediates dynamic response of the Greenland ice sheet to warmer summers') are highly relevant here to the likely impact of increased melt on the dynamics of land-terminating glaciers. [Peter Nienow, UK]	Accepted - see section 3.3.1.5
7410	3	13	8	13	16	E1b/C3: In the first sentence of this paragraph it is stated that understanding of the relationship between atmospheric temperature and ice sheet accumulation has improved. I think the reader would be in a stronger position to evaluate the rest of the paragraph if this relationship was spelled out in the second sentence of the paragraph. As it is, the paragraph simply lists observed/derived changes in atmospheric temperature and then states that atmospheric warming is not a driver of accumulation change. Is the final statement of this paragraph based on process-understanding or merely based on comparison of trends? I also think this paragraph would benefit from some figures outlining the magnitude of warming over various time periods. As it is, it is difficult to see how the judement of low confidence has been decided. [APECS Group Review, Germany]	Rejected - this text has been removed
402	3	13	11	13	12	Line 11 says "record warmth", but line 12 says "similar wormth". This is difficult for reader to reconcile. [George Burba, USA]	Accepted - text revised to clarify this
5358	3	13	11	13	12	It is probably convenient to note that similar warmth likely occured over the last 2000 years based on isotope reconstructions. As it is formulated now, it is not clear what is meant exactly with "similar warmth" that occured earlier. [Roderik Van De Wal, Netherlands]	Accepted - text revised to clarify previous reconstructions came from ice cores

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404	3	13	12	13	12	Replace "earlier" with "prior to 200 years ago". [George Burba, USA]	Accepted - text revised
7412	3	13	12	13	12	E1a: "similar warmth occurred earlier" is quite vague and not particularly relevant to the point of the paragraph, which is to assess whether recent trends in air temperature affect ice sheet accumulation. [APECS Group Review, Germany]	Accepted - text revised
14260	3	13	12			How much earlier did this warmth occur? Decades? Centuries? Millennia? [Christopher Fogwill, UK]	Accepted - text modified to indicate that such conditions occured 1% of the time in the last 2000 years
16972	3	13	13	13	16	Trend within natural variability does not need to imply no forcing (depends on the history of possible forcing terms…). Also, not readily clear why the ice sheet accumulation could be associated with atmospheric warming? (Increased snowfall? Moisture convergence?) Is the finding of importance here that the ice sheet accumulation was probably due to other factors? [Markku Rummukainen, Sweden]	Rejected - this text has been removed
7434	3	13	14	13	16	This sentence should parse WAIS and EAIS in order to more clearly reference the previous sentences and set up the following paragraph. [APECS Group Review, Germany]	Accepted - text revised to include a new introductory sentence
14094	3	13	15	13	15	increased should be increased [Christopher Fogwill, UK]	Accepted - text revised
7414	3	13	18	12	31	E1a: As with the previous paragraph, it would be informative to include a description of the processes underlying the links between the intensity of the southern hemisphere extratropical circulation, SAM and ice sheet accumulation. [APECS Group Review, Germany]	Rejected - beyond the mandate of the report
7416	3	13	21	13	24	E1a: The timescale over which the SAM has been in it's most positive state is not clear until the end of this sentence - I suggest moving 1979-2013 to nearer the beginning of the sentence. [APECS Group Review, Germany]	Accepted - text revised
7430	3	13	21	13	21	Replace 'is' by 'has been'. [APECS Group Review, Germany]	Accepted - text revised
7436	3	13	21	13	22	If discussing SAM and its links to the ASL and accumulation, the role of ENSO should also be discussed, particularly in reference to the Antarctic Peninsula (e.g., Paolo et al., 2017, Nat. Geosci; Hosking et al., 2013, J. Climate) [APECS Group Review, Germany]	Accepted - text has been revised to include reference to ENSO (Section 3.3.1.6)
16854	3	13	26	13	26	correct "geographaphically" to "geographically" [Anthony Mémin, France]	Accepted - text revised
11986	3	13	33	13	43	Bjørn et al, 2017 (doi: 10.1038/s41558-017-0029-1) found that precipitation influenced an asymmetric behavior of glaciers and ice caps in east and west Greenland linked to the NAO [Kristian Kjellerup Kjeldsen, Denmark]	Rejected- this section has been removed
17574	3	13	33	13	36	See comment 8. Here, you are talking about since 1990s and then use the phrase long-term increase. Mixed messaging. Since 1990s, observational data implies interior ice sheet increase even if the models don't indicate this. Why do you believe the models more than the obs here? This seems like biased reporting, which should be avoided. [Jonathan Bamber, UK]	Accepted - this text has been revised with the commented part removed
7418	3	13	34	13	39	E1a: This sentence is rather long and difficult to follow. Consider splitting it into two. [APECS Group Review, Germany]	Accepted - this text has been removed
19850	3	13	34	13	34	This sentence doesn't make sense: "but accumulation shows no long-term increase" is unrelated to the first half of the sentence. Please rewrite for clarity [Michelle A. North, South Africa]	Accepted - this text has been removed

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
1906	3	13	35	13	39	I think the NAO variability is better described as East-West across the entire Greenland, rather than a phenomenon restricted to Northern/Western Greenland. Specifically, Bjork et al. (2018, Nature Climate Change - Changes in Greenland's pheriperhal glaciers linked to the NAO) highlight this dipole, not just for glaciers but also on the ice sheet proper, and suggest that projected trends to positive NAO conditions will help preserve eastern ice while diminishing westren ice. [William Colgan, Denmark]	Accepted - this reference has been added to the Polar Glaciers section (3.3.2)
7420	3	13	40	13	41	E2/C4: I don't follow the meaning of this sentence. Greenland blocking index is "the mean 500 hPa geopotential height for the 60–80°N, 20–80°W region" (Hanna et al., 2016), not the correlation between north Greenland accumulation and enhanced summertime accumulation, as stated in the report. Also, what is meant by "enhanced summertime accumulation"? Enhanced relative to what? And over what time period is this statement accurate? This statement is also somewhat at odds with the assertion earlier in the report that accumulation has not changed much on the GrIS. [APECS Group Review, Germany]	Accepted - text removed
7438	3	13	40	13	41	This statement is unclear and an effort should be made to improve the description of the relationship between the wintertime GBI and accumulation. [APECS Group Review, Germany]	Accepted - text removed
7422	3	13	41	13	43	E1b: But the report states that there has been no change in accumulation? What are the trneds in these atmospheric indices? I think this statement is correct (large scale circulation is an important driver of Greenland accumulation and SMB), but it is important to be consistent and clear. [APECS Group Review, Germany]	Accepted - text removed
7440	3	13	41	13	43	This statement is unclear. An effort should be made to clarify that the 'changes' referenced here are really variability in accumulation and not secular accumulation changes to avoid confusion with previous statements. [APECS Group Review, Germany]	Accepted - text removed
7432	3	13	47	13	47	Add 'surface' before 'melt events'. [APECS Group Review, Germany]	Accepted - this text has been removed but other instances have been clarified
406	3	13	49	13	49	Replace "favoured" with "promoted". [George Burba, USA]	Rejected - this text has been removed
2234	3	13	50	13	50	Another reference in addition to Nicolas et al. (2017) is: Deb, P., Orr, A., Bromwich, D. H., Nicolas, J. P., Turner, J., and Scott Hosking, J. (2018). Summer drivers of atmospheric variability affecting ice shelf thinning in the Amundsen Sea Embayment, West Antarctica. Geophysical Research Letters. [Nicolas Jourdain, France]	Rejected - text has been removed
7442	3	13	53	13	53	Recent' should be clarified to an appropriate time (i.e. 1940's). [APECS Group Review, Germany]	Accepted - recent changed to 'observed'
1908	3	13	55	14	5	It seems more relevant to talk about the extreme Greenland melt events documented by Fausto et al. 2016 here than where they are currently mentioned in section 3.2.1.3. In some ways, the extreme fohn winds of Antarctica and the atmospheric rivers in Greenland are similar, in that they both highlight that a significant portion of annual mass loss can be traced to individual synoptic events. [William Colgan, Denmark]	Accepted - synoptic scale events now mentioned in new Section 3.3.1.6.2

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
7424	3	13	55	14	5	E1a: The main point of this paragrapgh is not very clear. From the first sentence, I expected the paragraph to put recent melting of Antarctic into a longer term perspective. But it then goes on to describe very recent fohn events and the impact of the NAO on Greenland summer temperatures. Can the first sentence be rephrased to better introduce the reader to the differing drivers of melting on Greenland and Antarctica. [APECS Group Review, Germany]	Accepted - text revised to move first sentence on WAIS accumulation to previous paragraph. Added a new paragraph below this to discuss synoptic-scale events (fohn and atmospheric rivers).
19236	3	13	55	14	5	heavy language. What are the implications of the described melt? [Marianne Kroglund, Norway]	Accepted - text revised to indicate surface melt is still a minor part of Antarctic Ice Sheet mass balance
7426	3	13	57	14	2	E1a: increased melting over and relative to what time periods? The example given in the next sentence illustrates only that fohn events in winter are important for the annual melt budget, not that they have increased in response to a more positive SAM. [APECS Group Review, Germany]	Accepted - text revised to make time scale and significance clear
19234	3	13	57	13	57	has SAM been spelled out earlier? If not, spell out here. [Marianne Kroglund, Norway]	Accepted - use of SAM checked
19852	3	13	57	13	57	Please include "föhn wind" in the glossary and reference it here [Michelle A. North, South Africa]	Rejected - glossary is limited in scope
5360	3	14	3	14	5	The negative NAO: since it is not persistently negative over such a long time scale, a trend is meant? [Roderik Van De Wal, Netherlands]	Accepted - text revised to make mention of an increase in NAO phases
7444	3	14	3	14	5	E1a/C3: Is it just the fact the NAO is negative? Or is it the strength of the negative NAO that matters? Or the shift from a positive to a negative phase? I think these are important differences that should be made clear. Does there need to be two brackets before Fettweis et al..? There should be a space before the % symbol on line 4. "explains" should be "can explain". [APECS Group Review, Germany]	Accepted - text revised to make mention of an increase in NAO phases
7480	3	14	3	14	3	Add this sentence before 'For Greenland': 'In coastal East Antarctica, increased melting has been partly caused by katabatic winds (Lenaerts et al., 2017).' Or something in that spirit to cite this important study. Reference: Lenaerts et al. (2017). Meltwater produced by wind–albedo interaction stored in an East Antarctic ice shelf, Nature Climate Change, 7, 58-62, doi:10.1038/nclimate3180. [APECS Group Review, Germany]	Accepted - added to new section 3.3.1.6.2
11762	3	14	4	14	5	Add … (NAO) index, favouring more anticyclonic conditions (I.e. sunnier and drier conditions) as well as advection of warm air masses along the western coast, explains … [Xavier Fettweis, Belgium]	Rejected - text removed
19856	3	14	4	14	4	North Atlantic Oscillation has already been written out on the previous page - decide whether you want / need to use the acronym and either only use NAO, or write it out in full [Michelle A. North, South Africa]	Accepted - text revised
1838	3	14	7	14	7	Albedo may be described as percentage 0-100% or a fraction of 0-1. Therefore, please identify here if the change reported is in relative or absolute units. [Aku Riihelä, Finland]	Accepted - text revised
5004	3	14	7	14	7	a -1.2% reduction is an increase. Either it is a -1.2% change, or it is a reduction of 1.2%. Earlier parts of the chapter used signs of change appropriately, but wise to revisit to be sure, and probably should add a comment on usage for greatest clarity. [Richard B. Alley, USA]	Accepted - text revised
7446	3	14	7	14	8	E1a: This could be interpreted as a reduction in biological agents. The figures quoted for the change in albedo are a double negative - i.e. the report gives a negative percentage reduction in albedo, which means an increase in albedo, which is not true. [APECS Group Review, Germany]	Accepted - text revised

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7450	3	14	7	14	7	E2/C5?: Where is the 1.2+-0.9 % reduction in summer albedo obtained from? I can't find reference to it in the above papers and it is not clear in the report which of the cited papers the figure is taken from. Given that the time period given (2000-2017) extends past the publication of the latter two cited papers, I think this sentence could be rearranged and made clearer. [APECS Group Review, Germany]	Accepted - detail removed from sentence
16974	3	14	7	14	8	A "reduction" should not be given a minus-sign. (.e., -1.2% change or 1.2% reduction) [Markku Rummukainen, Sweden]	Accepted - text revised
16976	3	14	7	14	15	Difficult to read - please rewrite. What is the assessment result? [Markku Rummukainen, Sweden]	Accepted - text revised
19858	3	14	7	14	7	Fix the plus-minus symbol [Michelle A. North, South Africa]	Accepted - text revised
23718	3	14	7	14	7	please explain "biological agents" [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - changed to 'organic matter'
23720	3	14	7	14	15	all references cited here are not in the reference list [Hans-Otto Poertner and WGII TSU, Germany]	Editorial- copyedit to be completed prior to publication
7448	3	14	8	14	8	C5: Box et al. (2015), Tedesco et al. (2015) and Stibal et al. (2017) are missing from the reference list. Should the reference to Tedesco be 2016? (The cryosphere, 10, 10.5194/tc-10-477-2016). [APECS Group Review, Germany]	Accepted, text revised
5142	3	14	9	14	12	The sentence "Clouds increase snow melt by increasing the surface radiation balance..." seems conflicting with the ensuing sentence "Clear skies drove the recent melt increase in the western ablation zone..." in physical reasoning. [Sai Ming Lee, China]	Rejected - text removed
7452	3	14	9	14	11	E1a: What is meant by "increasing the surface radiation balance"?. Is this sentence meant to imply that increased water vapour transport has increased cloud cover, which has "increased the surface radiation balance"? This is not immediately clear in the report. [APECS Group Review, Germany]	Rejected - text removed
7482	3	14	9	14	9	I think clouds increase meltwater runoff and not snow melt according to Van Tricht et al. (2016). Furthermore, this reference is cited in the text but is not part of the reference section. Please add it: Van Tricht et al. (2016). Clouds enhance Greenland ice sheet meltwater runoff, Nature Communications, 7, 10266, doi: 10.1038/ncomms10266. [APECS Group Review, Germany]	Rejected - text removed
7504	3	14	9	14	12	Hofer e al. (2017) directly contradict the conclusions of Van Tricht et al. (2016) (Hofer et al., 2017; page 5 lines 2-10) without clear distinction of the ablation zone. Therefore, these two papers should be more carefully rectified and the confidence statements should, perhaps, be reconsidered. [APECS Group Review, Germany]	Rejected - text removed
12666	3	14	9	14	9	"increasing the surface radiation balance" - perhaps rephrase, "by trapping more upwelling longwave"? [Gillian Young, UK]	Rejected - text removed
15988	3	14	9	14	10	I question the ability to say with high confidence that clouds increase snow melt across Greenland. The Van Tricht et al. (2016) results show a small effect relying on the diurnal melt cycle not a massive direct increase in the net surface energy balance. Further, Bennartz et al. (2013), while intriguing highlights a rare, unique condition that took place over Summit for just a few days where the clouds were just right. This results is not representative of the entire Greenland Ice Sheet. I argue that one cannot say unequivocally what what role of cloud are on surface melt and certainly not with high confidence. [Patrick Taylor, USA]	Rejected - text removed

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17576	3	14	9	14	10	This statement needs modification. It may be correct in a time-mean sense but as stated later, clouds can do the opposite depending on the seasonality and altitude of the changes. [Jonathan Bamber, UK]	Rejected - text removed
18754	3	14	9	14	13	The area in which more clouds increase ablation needs to be added, to contrast with areas where less clouds increase ablation (west) in order to make these two sentences and observations clearer and less contradictory. [Peter Nienow, UK]	Rejected - text removed
7484	3	14	11	14	11	Replace 'than' by 'compared to'. [APECS Group Review, Germany]	Rejected - text removed
900	3	14	12	14	12	comment: Clear sky should increase cooling at night and, thus,decrease melting [Herve Nifenecker, France]	Rejected - text removed
12668	3	14	12	14	12	Is the "cloud radiative effect" defined? [Gillian Young, UK]	Rejected - text removed
7454	3	14	13	14	13	E1a: In text citations should be e.g. Liu et al. (2016). [APECS Group Review, Germany]	Editorial - copyedit to be copleted prior to publication
7486	3	14	13	14	14	Check the way references are cited in this sentence. [APECS Group Review, Germany]	Editorial - copyedit to be copleted prior to publication
8192	3	14	13	14	13	Lui et al. 2016 does not need to be in parenthesis to keep citing consistency over the chapter [Benoit Montpetit, Canada]	Editorial - copyedit to be copleted prior to publication
16856	3	14	13	14	13	correct "(Liu et al. 2016)" to "Liu et al. (2016) [Anthony Mémin, France]	Editorial - copyedit to be copleted prior to publication
19860	3	14	13	14	15	Fix the references to author (year). [Michelle A. North, South Africa]	Editorial - copyedit to be copleted prior to publication
7456	3	14	14	14	14	E1a/b: Correlations in which direction? Given the explanation in the first part of the sentence, I would expect a negative correlation between greenland melt and sea ice coverage. [APECS Group Review, Germany]	Rejected - text removed
8194	3	14	14	14	14	same with Stroeve et al. 2017 [Benoit Montpetit, Canada]	Editorial - copyedit to be copleted prior to publication
16858	3	14	14	14	14	correct "(Stroeve et al. 2017)" to "Stroeve et al. (2017)" [Anthony Mémin, France]	Editorial - copyedit to be copleted prior to publication
11810	3	14	16	14	16	I didn't see any discussion of surface hydrology and ice dynamics. [King Matt, Australia]	Accepted - Now discussed in Sections 3.3.1.3 and 3.3.1.5
902	3	14	17	14	17	comment: What about ice-atmosphere interactions? [Herve Nifenecker, France]	Accepted - we now have a section 3.3.1.6.2 Atmospheric forcing
7488	3	14	17			Section 3.2.2.3: As this is quite important, I would add one or two introductory lines in the very beginning of this sub-section about the main ice-ocean interaction processes, i.e. submarine melt and calving in GrIS and AIS. [APECS Group Review, Germany]	Accepted - we have added an introductory sentence in Section 3.3.2.3
14264	3	14	17	15	27	Needs a paragraph here on palaeo reconstructions/studies of oce-ocean interactions. These are an important source of knowledge that is currently missing here. [Christopher Fogwill, UK]	Rejected - This section is focussed on modern observed processes resulting in mass change. However, we now reference palaeo studies of ice ocean interaction (e.g. Hillanbrand et al. 2017 Nature) in the Cross Chapter Box on uncertainties in sea level changes caused by marine ice sheets.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
1608	3	14	19	14	30	I suggest to add following sentence into 3.2.2.3. ocean-cryosphere interactions: The presence of a floating ice tongue at the major Helheim Glacier in SE Greenland, since at least 300 AD lasting until 1900 AD, was followed by elevated 20th century glacier calving due to the loss of the tongue. This regime shift was attributed to 20th century unprecedented low sea-ice occurrence in the East Greenland Current and suggest that properties of this current are important for the stability of the present ice tongues in NE Greenland (Andresen et al. 2007). Reference: Andresen, C. S., Kokfelt, U., Sicre, M.-A., Knudsen, M. F., Dyke, L. M., Klein, V., Kaczmar, F., Miles M. W., and Wangner, D. J. (2017) Exceptional 20th century glaciological regime of a major SE Greenland outlet glacier. Scientific Reports 7(13626): 1–8. DOI: 10.1038/s41598-017-13246-x. Web link. [Camilla Snowman Andresen, Denmark]	Rejected - beyong the mandate of the report. We do not have space in our chapter for such detailed and site specific information, despite its relevance.
7474	3	14	19	14	40	E1b: I think that this section would benefit from a sentence evaluating the confidence in our process understanding of how submarine melting may affect calving. This related to the stability of glaciers (O'leary and christoffersen, 2013) and underpins the inability of ice sheet scale or glacier scale models to simulate the response of tidewater glaciers to ocean forcing. [APECS Group Review, Germany]	Accepted - text revised and this link between melting and calving is also now assessed in the Polar Glaciers section (3.3.3)
14096	3	14	19	15	11	This section is very poorly structured and lacks focus. I appreciate the complexity of the issues but this need structure to clarify the messge (and an update in the references throughout). The focus here is crucial, at present it does not do the work undertaken on either the Norh Atlantic, or Southern Ocean justice. In terms of Antarctic impcats, the authors have not refered at all to the freshening and contraction of AABW that may be having a crucial impact on circulation and SO stratification, which could also play a significnt role in enhancing CDW onlap onto the shelf. Figure 3.4 in particular is simplistic and only captures a few of the feedback mechanisms refered too. [Christopher Fogwill, UK]	Rejected - this comment is vague, not supported by references, and offers little in the way of concrete suggestions.
7490	3	14	21	14	21	I would add a reference after 'upper ocean heat content since the 1950s': Cheng et al. (2017). Improved estimates of ocean heat content from 1960 to 2015, Science Advances, 3(3), e1601545, doi: 10.1126/sciadv.1601545. [APECS Group Review, Germany]	Accepted - Cheng 2017 reference added
7458	3	14	22	14	22	E1a: "deep knowledge" is quite ambiguous and I don't think entirely correct here. By deep knowledge, did the authors mean sufficient process understanding to predict with confidence water transport between the shelf and fjord heads? The processes and drivers are reasonably well known (e.g. Cowton et al. (2016), JoG, 10.1017/jog.2016.117), but the efficiency and relative importance of these processes are not as well constrained. [APECS Group Review, Germany]	Accepted - text revised to refer to 'complete' rather than deep knowledge.
12710	3	14	22	14	22	Remove 'deep knowledge of the', and change 'remains' into 'remain' [Michiel Van Den Broeke, Netherlands]	Accepted - text revised to refer to 'complete' rather than deep knowledge, and remains changed to 'remain'.
14262	3	14	22	14	23	This sentence doesn't quite make sense. Suggest either, '...processes by which warmer ocean waters are driven toward the Greenland ice sheet remains elusive.' or '...processes by which warmer ocean waters drive the Greenland ice sheet retreat remains elusive' depending on what you;re trying to say! [Christopher Fogwill, UK]	Accepted - text revised to make it clear that we are referring to both processes.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
18756	3	14	22	14	23	Sentence doesn't make grammatical sense [Peter Nienow, UK]	Accepted - text revised.
7460	3	14	23	14	23	E1a: remove "retreat". [APECS Group Review, Germany]	Accepted - text revised.
7472	3	14	23	14	24	E1b: I think an important step has been missed here. Although "deep knowledge" of the processes responsible for driving warm water from the ocean towards glaciers is lacking, I would suggest that there is high confidence that transmission of warm water along fjords has nonetheless occurred. [APECS Group Review, Germany]	Accepted - text revised to include sentence about transmission of warm water
7492	3	14	23	14	23	Remove 'retreat'. [APECS Group Review, Germany]	Accepted - text revised
20682	3	14	23	14	23	Remove 'retreat' [Tamsin Edwards, UK]	Accepted - text revised
7462	3	14	24	14	25	E1b/C1/C3: The cited paper (O'Leary and Christoffersen, 2013) used a flow line model to investigate the effect of undercutting on calving. This is not necessarily in support of the statement in the report that warmer temperatures affect the stability of these glaciers. More complex, 3D simulations indicate the vertical distribution of melting, water depth and buttressing by ice melange are also important (see Benn et al. 2017, JoG, 10.1017/jog.2017.41; Todd et al. 2018, JGR, 10.1002/2017JF004349). Water temperatures undoubtedly affect the vertical distribution of submarine melting, and therefore undercutting, which appears to influence glacier stability, but there are important subtleties that I think should be accounted for here. I think that the degree of confidence assigned to this statement is perhaps a bit optimistic (particularly given that only medium confidence is given to the contributions to the warming subpolar N Atlantic). [APECS Group Review, Germany]	Accepted - text revised, confidence changed from medium to low
7506	3	14	24	14	24	Studies should not be plural, unless there are additional references beyond O'Leary and Christoffersen (2013). [APECS Group Review, Germany]	Accepted - text revised to add e.g. before reference
20684	3	14	24	14	26	Says 'Modelling studies' (plural), but only one study is cited. Also seems to contradict final statement of paragraph. [Tamsin Edwards, UK]	Accepted - text revised
22216	3	14	24	14	25	'high confidence' is an overstatement. It is clear that water temperatures near ice fronts can influence stability, but it is far from clear that they must do so. [Martin Truffer, USA]	Accepted - text revised, confidence changed from medium to low
17802	3	14	25	14	25	Stability in what sense? Structural stability? Stability as a dynamical system? [Robert Arthern, UK]	Accepted - text revised to refer to 'structural' stability
7464	3	14	26	14	27	E1a: It would be more accurate to state that the dominant trigger for outlet glacier retreat has not been identified. I don't think anyone believes that there is only a single trigger. [APECS Group Review, Germany]	Accepted - text revised to refer to dominant drigger rather than single.
2604	3	14	27	14	30	Suggestion. Rewrite to: Bed characteristics (Enderlin et al., 2013; Morlighem et al., 2016), and subglacial hydrology (Gladish et al., 2015) also play important roles in linking Greenland outlet glacier behaviour to ocean forcing on seasonal and interannual time scales (Straneo et al., 2016) (low confidence). [Patrik Winiger, Netherlands]	Accepted - text revised.
7508	3	14	27	14	29	Bed geometry could also include reference to Felikson et al. (2017; Nat. Geosci). In addition, there are a number of other mechanisms controlling ice-ocean interactions, including mélange characteristics (indicated in Figure 3.4) and fjord geometry, that should probably be listed. [APECS Group Review, Germany]	Accepted - text revised to incorporate these additional processes and references
7466	3	14	28	14	28	E2: Consider citing Slater et al (2015), GRL, 10.1002/2014GL062494 for subglacial hydrology. [APECS Group Review, Germany]	Accepted - reference added

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
7510	3	14	28	14	28	Subglacial hydrology' would be better phrased as 'subglacial discharge' because Gladish et al. (2015) don't discuss the state of the subglacial hydrologic system, its evolution, etc., but instead focus on how subglacial discharge may alter fjord temperature. [APECS Group Review, Germany]	Accepted - text revised, 'hydology' changed to 'discharge'.
7512	3	14	30	14	30	Reference Figure 3.4. [APECS Group Review, Germany]	Accepted - text revised to change year 2013 to 2012
7468	3	14	32	14	33	E2: None of the cited papers used continental-scale ice sheet models. Their simulations were each of a single outlet glacier. [APECS Group Review, Germany]	Accepted - text revised to 'regional scale'.
10990	3	14	32	14	40	Care et al 2013, needs updating, see abstracts from recent POLAR2018 conference in Davos [Connie Lovejoy, Canada]	Rejected - we can't cite conference abstracts
7470	3	14	34	14	35	E2/C2: I don't think any of these cited papers prescribed changes in the terminus position in their models. Instead, terminus position was found to be a key control of Jakobshavn Isbrae, but this is not necessarily generalisable to other glaciers. [APECS Group Review, Germany]	Accepted - text modified, 'prescribed' removed
18758	3	14	34	14	34	"… models ARE driven.." [Peter Nienow, UK]	Accepted - text revised
19862	3	14	34	14	34	"Patterns of acceleration and dynamic thinning in these models are triggered…" [Michelle A. North, South Africa]	Accepted - text revised
17578	3	14	40	14	40	A better reference here would be Moon et al, 2012 Science [Jonathan Bamber, UK]	Accepted - reference added
18760	3	14	40	14	40	Note that a paper in press (PNAS - Cowton et al - Linear response of east Greenland's tidewater glaciers to ocean/atmosphere warming) does generate results that are statistically significant and could be used to force modelling studies [Peter Nienow, UK]	Accepted - reference added
19864	3	14	40	14	40	"unwarranted" isn't the right word, replace with "unwise", or "inaccurate" or similar [Michelle A. North, South Africa]	Accepted - unwarrented changed to unwise
2312	3	14	42	14	48	Additional citation to add for ice-shelf buttressing: Pollard D., et al. (2015) Potential Antarctic Ice Sheet retreat driven by hydrofracturing and ice cliff failure, EARTH & PLANETARY SCIENCE LETTERS 412:112–121. [Kristin Campbell, USA]	Accepted - reference added
2438	3	14	42	14	48	Additional citation to add for ice-shelf buttressing: Pollard D., et al. (2015) Potential Antarctic Ice Sheet retreat driven by hydrofracturing and ice cliff failure, EARTH & PLANETARY SCIENCE LETTERS 412:112–121. [Durwood Zaelke, USA]	Accepted - reference added
7478	3	14	42	14	48	E1b: Perhaps this paragraph would benefit from first outlining what the changes in the ice shelves have been? And that these changes appear to be driven by basal melting? [APECS Group Review, Germany]	Rejected - the references describe the observed changes and these need not be repeated here due to lack of space
7494	3	14	42	14	42	At the end of the sentence, I would precise: 'either through lateral embayments or pinning points'. [APECS Group Review, Germany]	Accepted - text revised, suggested words incorporated
7496	3	14	42	14	43	Related to the first sentence of this paragraph about buttressing, I would add a key reference: Fürst et al. (2016). The safety band of Antarctic ice shelves, Nature Climate Change, 6,479-482, doi: 10.1038/nclimate2912. [APECS Group Review, Germany]	Accepted - reference added
7500	3	14	42	14	48	Although you mainly focus on observations here, I would add a sentence stating that buttressing is currently challenging to model. References: Pattyn et al. (2017, already in the reference section) + Matsuoka et al. (2015). Antarctic ice rises and rumples: Their properties and significance for ice-sheet dynamics and evolution, Earth-Science Reviews, 150, 724-745, doi: 10.1016/j.earscirev.2015.09.004. [APECS Group Review, Germany]	Accepted - text revised and reference added. We also reference our new cross chapter box on uncertainties in future sea level here

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
12936	3	14	42	14	48	Additional citation to add for ice-shelf buttressing: Pollard D., et al. (2015) Potential Antarctic Ice Sheet retreat driven by hydrofracturing and ice cliff failure, EARTH & PLANETARY SCIENCE LETTERS 412:112–121. [Gabrielle Dreyfus, USA]	Accepted - reference added
22218	3	14	42	14	45	Reese et al., 2018, Nat. Clim. Change is relevant here, as well as Fuerst et al., 2016, Nat. Clim. Change [Martin Truffer, USA]	Accepted - reference added
3948	3	14	45	14	46	ice sheet instability is also an important factor in driving inland thinning - suggest inserting "... and ice sheet instability (e.g., Joughin et al., 2014)" after "ice shelf melting" [Ben Webber, UK]	Accepted - text revised and new sentence added
7476	3	14	45	14	46	E1a: "resulting from ice shelf melting" should be "resulting primarily from ice shelf thinning". Ice shelf retreat will also affect buttressing, and retreat may be unrelated to thinning. Also, "most of" on line 46 is a bit vague. [APECS Group Review, Germany]	Accepted - text revised following suggestion
11812	3	14	46	14	46	This limitation to Amundsen Sea is incorrect. Antarctic Penisnula is the best example of this with Larsen A, B and Wordie Ice Shelf (the latter most recently in Zhao et al EPSL 2017 and another paper on its velocity in The Cryosphere in 2017 or so) [King Matt, Australia]	Accepted - text revised to include examples/citations from outside of Amundsen Sea sector
1394	3	14	47	14	47	More recently, Adusumilli et al., 2018 (in GRL) shows this, for ice shelves in the Peninsula [Susheel Adusumilli, USA]	Accepted - reference added
17804	3	14	47	14	47	There is some evidence from elsewhere, e.g. Minchew et al. 2018 (https://doi.org/10.1017/jog.2018.24). [Robert Arthern, UK]	Accepted - reference added
7498	3	14	50	14	50	Add 'Antarctic' before 'coast' to make it clearer. [APECS Group Review, Germany]	Accepted - text revised
7514	3	14	50	15	11	Somewhere in here, there should be a more extensive discussion about the role of ENSO in ice shelf thinning (e.g. Paolo et al., 2018, Nat. Geosci.; Deb et al., 2018, GRL) [APECS Group Review, Germany]	Accepted - text revised to be more generalised and references added
7502	3	14	53	14	53	Replace 'that' by 'which'. [APECS Group Review, Germany]	Accepted
19866	3	14	53	14	53	Add "polynyas" to the glossary and reference it here, or at least cite Box 3.2 [Michelle A. North, South Africa]	Accepted - reference to Box 3.2 added
23722	3	14	53	14	53	consider referring to Chapter 3, Box 3.2 here [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - reference to Box 3.2 added
4110	3	14	56	15	1	If it is possible to cite another paper at this stage in the review process, the recently published simulations of Naughten et al. 2018 (doi:10.1175/JCLI-D-17-0854.1) offer further support to a link between reduced sea ice formation and warming on the Antarctic continental shelf. [Kaitlin Naughten, UK]	Accepted - reference added
4112	3	14	56	15	2	I do not agree that there is “high agreement” in the community that a weakening of easterly winds would necessarily cause warming on the continental shelf. For example, Donat-Magnin et al. 2017 (doi:10.1002/2017JC013059) showed that the sensitivity of continental shelf tempratures to zonal wind stress is considerably reduced when ice shelf thermodynamics are considered. A negative feedback in ice shelf cavities counteracted the isopyncal changes produced by changes in the winds, and the continental shelf actually cooled as a result. [Kaitlin Naughten, UK]	Accepted - text revised; confidence statement downgraded and reference added
13466	3	15	0			Fig 3.4 Is there really a ridge at the grounding line everywhere? This diagram suggests so. [Debra Roberts and Durban Team, South Africa]	Accepted - figure caption revised to make clear this is a schematic
3950	3	15	4	15	5	Dutrieux et al. (2014) is the most complete reference, but consider including Jacobs et al. (2011); Christianson et al. (2016); Webber et al. (2017) [Ben Webber, UK]	Accepted - references added

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
7518	3	15	4	15	4	Add 'in Antarctica (Jourdain et al., 2017)' after 'elsewhere'. Reference: Jourdain et al. (2017). Ocean circulation and sea-ice thinning induced by melting ice shelves in the Amundsen Sea, Journal of Geophysical Research, doi: 10.1002/2016JC012509. [APECS Group Review, Germany]	Accepted - text revised and reference added.
22220	3	15	4	15	4	This statement needs a reference [Martin Truffer, USA]	Accepted - reference added
5362	3	15	5	15	8	This sentence may profit if a bit more explanation is given on how exactly the wind forces thickness changes in CDW .. [Roderik Van De Wal, Netherlands]	Accepted - text revised to make reference to Walker et al (2013), which identifies the undercurrent that transports the CDW onshore. Variability in that flow may be the key.
1712	3	15	6	15	6	comma needed after 'indirectly' [Mark England, UK]	Accepted
3742	3	15	8	15	9	Winds and storms over the Amundsen Sea are highly variable owing to complex interactions between SAM, ENSO and the Amundsen Sea Low (Uotila et al. 2013; Turner et al., 2016). Uotila, P., Vihma, T., & Tsukernik, M. (2013). Close interactions between the Antarctic cyclone budget and large-scale atmospheric circulation. Geophysical Research Letters, 40(12), 3237–3241, doi:10.1002/grl.50560. [Petteri Uotila, Finland]	Accepted - reference added
3952	3	15	8	15	9	Orographic flows such as katabatic winds also impact the coastal regions, with potentially large imapcts on ice shelf melting. Also note that sea ice modifies the transfer of wind stress (and associated curl) to the ocean. [Ben Webber, UK]	Accepted - text modified to briefly mention atmospheric forcing of ocean currents.
12714	3	15	9	15	9	Fyke et al. typo [Michiel Van Den Broeke, Netherlands]	Rejected - not in this section
19868	3	15	9	15	9	"ENSO" has not yet been explained in full. Please note previous comments about all the acronyms [Michelle A. North, South Africa]	Rejected - ENSO defined previously, and in Supplementary material.
408	3	15	13	15	14	In the Figure 3.4, all red arrows look the same. Consider adding dashed lines in addition to colors. [George Burba, USA]	This figure has been removed as it was 'text book' style and didn't illustrate assesment.
18528	3	15	14	15	14	the colour scheme is unhelpful, does not work for colour blind readers. Also, the dark green arrow is not included in the legend [Angelika Renner, Norway]	This figure has been removed as it was 'text book' style and didn't illustrate assesment.
2308	3	15	16	15	27	TYPO: Joughin et al 2013 should be Joughin et al 2012 [Kristin Campbell, USA]	Accepted - reference corrected
2434	3	15	16	15	27	TYPO: Joughin et al 2013 should be Joughin et al 2012 [Durwood Zaelke, USA]	Accepted - reference corrected
7520	3	15	16	15	16	Add 'in both Antarctic and Greenland Ice Sheets' after 'glaciers'. [APECS Group Review, Germany]	Accepted - text revised
12932	3	15	16	15	27	TYPO: Joughin et al 2013 should be Joughin et al 2012 [Gabrielle Dreyfus, USA]	Accepted - reference corrected
19870	3	15	16	15	27	This figure caption contains an obcene number of acronyms, which are a) not helpful in interpreting the figure (rather include the acronyms NAC, ACC and CDW with their full form in the figure legend with the colour arrows, is much easier to see), and b) many of them are not used again, nor even in the figure itself (e.g., IW and AW). Why include these latter acronyms at all? [Michelle A. North, South Africa]	Rejected - Irminger Water (IW) and Atlantic Water (AW) are used both in the figure and the caption text. Note though that this figure is being revised more generally
21548	3	15	16	5	17	Figure is from Joughin et al. 2012, Science not 2013. Also in references. [Fiamma Straneo, USA]	Accepted - reference corrected
20686	3	15	26	15	26	Produces 'a' positive feedback [Tamsin Edwards, UK]	Accepted - text added
13058	3	15	30	15	30	Maybe specify "polar glacier" instead of only "glacier" [Gerhard Krinner, France]	Accepted - this text has been removed as the D/A work on glaciers is not significant at the regional (polar) scale.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
14266	3	15	30	16	14	Again, needs a palaeo section. Our understanding or ice sheet/glacier dynamics in different cliamte conditions has improved markedly in recent years through palaeo studies,helping us to attrubiute and distinguish /natural vs 'anthropogenic' modern changes but there is no discussion of this. [Christopher Fogwill, UK]	Rejected - comment is not specific enough and does not give examples from peer-reviewed literature. Moreover, detection/attribution work is defined more specifically in IPCC reports. We've used palaeo evidence elsewhere where it extends the period of modern observations, provides insight into a process or helps understand magnitude and timescale of natural variability
1422	3	15	32	15	37	Quite some overlap with sections from chapter 2 (2.2.3.3) and chapter 4 (4.2.2.6.1): make sure this is consistent and consider ommiting one of these and refer to similar section in other chapters [Harry Zekollari, Switzerland]	Accepted - This section on polar glacier attribution has been removed partly to avoid overlap
7522	3	15	32	15	35	Something is not clear in this sentence, especially around 'glacier observations'. I do not get it. [APECS Group Review, Germany]	Accepted - This section on polar glacier attribution has been removed.
14268	3	15	32			anthropogenic not anthrogenic [Christopher Fogwill, UK]	Accepted - This section on polar glacier attribution has been removed.
16480	3	15	32	15	32	This section on attribution is an essential and well-developed part of the chapter. The first sentence, however, is slightly inaccurate. Edit it to say something like "…in attributing the fractions of glacier changes caused by natural and by anthropogenic factors." [Patrick Gonzalez, USA]	Accepted - This section on polar glacier attribution has been removed.
16482	3	15	32	15	32	Edit this sentence to something more accurate, like "It is challenging to attribute the fractions of observed changes in ice sheets caused by natural and by anthropogenic factors." [Patrick Gonzalez, USA]	Accepted - This section on polar glacier attribution has been removed.
16860	3	15	32	15	32	correct "antrhogenic" to "antrhopogenic" [Anthony Mémin, France]	Accepted - This section on polar glacier attribution has been removed.
7516	3	15	35	15	37	E1a: As written, it is not clear how this study supports the statement of the previous paragraph because the link to anthropogenic forcing is not made. There should be a space before "(high confidence)". [APECS Group Review, Germany]	Accepted - This section on polar glacier attribution has been removed.
1420	3	15	36	15	36	Here the study by Roe and colleagues (for which the publication date is 2017 by the way, and not 2016) is described as a modelling study, which is somewhat misleading, as this may let the reader think that it is also a glacier modelling study (like the study by Marzeion et al., 2014). Consider reformulating this sentence and describing the study as a 'signal-to-noise analysis based on observed glacier changes' or something alike [Harry Zekollari, Switzerland]	Accepted - This section on polar glacier attribution has been removed.
16978	3	15	36	15	37	Not readily clear what the sentence attempts to convey. If the meaning is that glacier retreat is attributed to climate change, please reword. E.g. "Also regional-scale glacier retreat is attributed to… ", or whatever applies. [Markku Rummukainen, Sweden]	Accepted - This section on polar glacier attribution has been removed.
13060	3	15	39	15	45	Maybe the involved timescales, rather long for ice sheets, complicate he picture. We do not know for sure how much the ice sheets still respond to past changes (LIA etc.) [Gerhard Krinner, France]	Accepted - text revised to mention timescales
14098	3	15	39	15	39	Yes regional climate does play a factor but it is the long response times of ice sheets and glaciers that makes atribution particularley challenging (suggested referance Golledge, N. R. et al. The multi-millennial Antarctic commitment to future sea-level rise. Nature 526, 421-425, doi:10.1038/nature15706 or Bracegirdle, T. J. et al. A MULTI-DISCIPLINARY PERSPECTIVE ON CLIMATE MODEL EVALUATION FOR ANTARCTICA. Bulletin of the American Meteorological Society, doi:10.1175/bams-d-15-00108.1 (2015). [Christopher Fogwill, UK]	Accepted - text revised to mention timescales

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16980	3	15	39	16	14	It does not come across whether attribution has been possible, or not. Suggest making a clearer statement - what is the assessment result? [Markku Rummukainen, Sweden]	Accepted - text revised to make it clear that full attribution has not been possible. For partial attribution, confidence language has been added.
23724	3	15	41	15	41	here, in section 3.2.2.4, you are referring to section 3.2.2.4; guess you mean 3.2.2.2? [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - text revised
19872	3	15	42	15	42	This AMO acronym is not used again in this section. Please remove [Michelle A. North, South Africa]	Editorial - copyedit to be completed prior to publication
20688	3	15	42	15	43	Remove comma in Line 43 or add another in Line 42 [Tamsin Edwards, UK]	Editorial - copyedit to be completed prior to publication
1840	3	15	43	15	45	Is there medium confidence in that anthropogenic drivers are behind GrIS mass loss acceleration? I find the text a bit paradoxical - medium confidence in a difficult-to-explain phenomenon? [Aku Riihelä, Finland]	Accepted - text revised in attribution section and new section (3.3.1.6.2) added to discuss atmospheric forcing.
12712	3	15	44	15	45	Not clear wht the 'medium confidence' statement refers to (see also p. 16, l. 3) [Michiel Van Den Broeke, Netherlands]	Accepted - text revised in attribution section and new section (3.3.1.6.2) added to discuss atmospheric forcing.
1714	3	16	2	16	3	England et al., 2016 reference may be more pertinent after stratospheric ozone depletion with the Waugh et al., 2015 reference [Mark England, UK]	Accepted - reference added.
7538	3	16	3	16	3	What about the observational period not being long enough to clearly make attribution? Isn't it a supplementary factor that makes the attribution challenging? [APECS Group Review, Germany]	Accepted. Text revised to include sentence 'We also require a longer observational baseline of ice sheet responses to climate change'.
7532	3	16	4	16	4	E1a: Remove "The" before "basal melting". [APECS Group Review, Germany]	Rejected - text no longer included
7534	3	16	5	16	5	E1a: Add "The" before Antarctic Ice Sheet". [APECS Group Review, Germany]	Rejected - text no longer included
7536	3	16	8	16	8	E1a: "amount" --> "amounts" [APECS Group Review, Germany]	Rejected - text no longer included
410	3	16	9	16	9	Remove duplicate "Fyke et al" [George Burba, USA]	Accepted - text revised
3988	3	16	9	16	9	repeated Fyke et al. [Helene Hewitt, UK]	Accepted - text revised
7524	3	16	9	16	9	E1a: Repetition of Fyke et al. [APECS Group Review, Germany]	Accepted - text revised
7544	3	16	9	16	9	Typo: 'Fyke et al. (2014b)'. [APECS Group Review, Germany]	Accepted - text revised
8196	3	16	9	16	9	Fyke et al. Duplicated [Benoit Montpetit, Canada]	Accepted - text revised
11988	3	16	9	16	9	Fyke et al appears twice [Kristian Kjellerup Kjeldsen, Denmark]	Accepted - text revised
14370	3	16	9	16	9	Repetition: "Fyke et al. Fyke et al." [Sérgio Henrique Faria, Spain]	Accepted - text revised
16862	3	16	9	16	9	remove one "Fyke et al." in "In this way, Fyke et al. Fyke et al. (2014b)..." [Anthony Mémin, France]	Accepted - text revised
17430	3	16	9	16	9	Delete extra "Fyke et al" listing. [Sonya Legg, USA]	Accepted - text revised
18762	3	16	9	16	9	Grammar re Fyke reference [Peter Nienow, UK]	Accepted - text revised
19874	3	16	9	16	9	Fix citation Fyke et al [Michelle A. North, South Africa]	Accepted - text revised
23726	3	16	9	16	9	"Fyke et al. Fyke et al. (2014b)" is this supposed to be one or two references? Please revise [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - text revised
7526	3	16	10	16	10	E1a: I think this should be "Greenland surface melting [in marginal areas?]" [APECS Group Review, Germany]	Accepted - text revised
18764	3	16	10	16	10	Earlier the report suggested that there were no interior snowfall trends (page 11 L31-34) [Peter Nienow, UK]	Accepted - this earlier text has been removed.
19876	3	16	12	16	12	Replace "but also in" with "and" [Michelle A. North, South Africa]	Rejected - text no longer included

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
1912	3	16	16	16	16	I note that this section 3.2.3 (Rapid and/or Irreversible Changes) makes no mention of cryo-hydrologic warming. Which AR5 section 4.4.4.2.2 identified as an emerging and relevant process of low scientific understanding. Presumably we now much more about cryo-hydrologic warming since then. For example, see either van der veen et al. 2011 (J. Glaciol. Controls on the recent speed-up of Jakobshaven Isbrae) or Lampkin et al., 2013 (J. Geophys. Res - Drainage from water-filled crevasses along the margins of Jakobshavn Isbra), both of which postulate that ice warming/softening is a key process enhancing the recent collapse and retreat of Jakobshavn Isbrae. [William Colgan, Denmark]	Noted. The whole material is now moved to a new cross-chapter box, where we have a very limited space and very limited number of allowed references, so we cannot discuss in details all the processes.
7540	3	16	16			Section 3.2.3: Don't you need to talk about rapid changes at the surface (e.g. for Greenland Ice Sheet)? This is not mentioned in this sub-section. [APECS Group Review, Germany]	Rejected. The comment is not clear
7546	3	16	16			Overall, section 3.2.3 lacks reference to rapid/irreversible changes to Greenland and glaciers. They should be included because Antarctica is not the only region undergoing such changes. [APECS Group Review, Germany]	Partly Accepted. Greenland is added, while discussion of the polar glaciers will be given in the corresponding section, and non-polar glaciers are in Chapter 2.
14100	3	16	16	15	55	The sections on ice shelf collapse and Marine instability need work. MISI was covered in AR5, and studies such as Golledge, N. R. et al. The multi-millennial Antarctic commitment to future sea-level rise. Nature 526, 421-425, doi:10.1038/nature15706 have demonstarted that high-order processes such as MICI are NOT required to invoke highly dynamic repsoses from the Antarctic Ice Sheets in high-resolution models, in contrasts to those including MICI and surface melt parametrisation (eg Deconto and Pollard, 2016). Such physics, that is challeged from observations is not required in model studies. Overall this section should be dived up into sections in relation to Grellend / Antarctica for clarity for the reader. [Christopher Fogwill, UK]	Partly Accepted. In the new version we note that MISI/MICI solutions may not be unique to explain the dynamic response from the AIS. Note however that future projections will be covered in Chapter 4, not Chapter 3. Note text MISI and MICI will be discussed in a new cross-chapter box.
23728	3	16	16	17	30	in section 3.2.3 its all about Antarctica. Are there no rapid/irreversible changes in the Arctic/Greenland? [Hans-Otto Poertner and WGII TSU, Germany]	Accepted. New version will mention Greenland. See the corresponding text in a new cross-chapter box.
18766	3	16	17	16	17	Gourmelen et al 2017, GRL, 10.1002/2017GL074929, 'Channelized melting drives thinning under a rapidly melting Antarctic ice shelf' is a very relevant reference to this process. [Peter Nienow, UK]	Noted. This material was moved to a cross-chapter box, where we have a strict limit of references, so we are not able to include this reference
2236	3	16	18	16	36	The large calving event of Larsen C in 2017 is mentionned in the "ice shelf collapse" section, but I don't think there is any robust evidence that this is the precursor of an ice shelf collapse. It may seem so considering the history of previous Larsen collapses, but Fürst et al. (2016) suggest that this calving event does not affect butressing. Fürst, J. J., Durand, G., Gillet-Chaulet, F., Tavard, L., Rankl, M., Braun, M., & Gagliardini, O. (2016). The safety band of Antarctic ice shelves. Nature Climate Change, 6(5), 479. [Nicolas Jourdain, France]	Accepted, text revised. Note that text was moved to a new cross-chapter box
7542	3	16	18	16	18	I am wondering whether the title of this sub-section is appropriate as you do not really talk about sudden ice shelf collapse but rather about progressive ice shelf disintegration. Please consider rephrasing. Furthermore, in this sub-section, I would mention the potential 0.5 m sea-level rise contribution from Zacharie Isstrom, which entered a phase of accelerated retreat in Fall 2012. Reference: Mouginot et al. (2015). Fast retreat of Zachariæ Isstrøm, northeast Greenland, Science, doi: 10.1126/science.aac7111. [APECS Group Review, Germany]	Accepted, this title does not exist anymore. Note that text was moved to a new cross-chapter box

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
1396	3	16	20	16	35	We cannot have an entire section on "Ice Shelf Collapse" without talking about the collapse of Larsen B Ice Shelf and the subsequent glacier speed up! I would say we have at least "medium confidence" about that. We are also more confident about the processes that influenced this event than those that triggered the recent iceberg from Larsen C. [Susheel Adusumilli, USA]	Rejected. Larsen B event was described in AR5, we are focusing on literature after AR5.
2314	3	16	20	16	28	Additional citations to add for ice-shelf buttressing and thinning ice shelves: Pollard D., et al. (2015) Potential Antarctic Ice Sheet retreat driven by hydrofracturing and ice cliff failure, EARTH & PLANETARY SCIENCE LETTERS 412:112–121; Konrad H., et al. (2018) Net retreat of Antarctic glacier grounding lines, NATURE GEOSCIENCE 11:258–262. [Kristin Campbell, USA]	Accepted, text revised. Note that text was moved to a new cross-chapter box
2440	3	16	20	16	28	Additional citations to add for ice-shelf buttressing and thinning ice shelves: Pollard D., et al. (2015) Potential Antarctic Ice Sheet retreat driven by hydrofracturing and ice cliff failure, EARTH & PLANETARY SCIENCE LETTERS 412:112–121; Konrad H., et al. (2018) Net retreat of Antarctic glacier grounding lines, NATURE GEOSCIENCE 11:258–262. [Durwood Zaelke, USA]	Accepted, text revised. Note that text was moved to a new cross-chapter box
3954	3	16	20	16	35	This section deals with all antarctic ice shelves at once. For clarity, insert some discussion about the different processes controlling ice shelf stability in regions such as the Antarctic Peninsula, warm ocean (Weast Antarctic) ice shelves and cold ocean (East Antarctic, Ross & Filchner-Ronne) ice shelves. [Ben Webber, UK]	Rejected. We do not have space to discuss everything in details, but we do discuss the processes that control ice shelf stability and we do specify the regions where these processes are going on
6208	3	16	20	18	44	perhaps better to hav all ice shelf collapse/instability discussion together with sections on Antarctica projections to avoid repetition and have a more logical/better flow [Regine Hock, USA]	Rejected. We have moved all the projections discussions to Chapter 4
12938	3	16	20	16	28	Additional citations to add for ice-shelf buttressing and thinning ice shelves: Pollard D., et al. (2015) Potential Antarctic Ice Sheet retreat driven by hydrofracturing and ice cliff failure, EARTH & PLANETARY SCIENCE LETTERS 412:112–121; Konrad H., et al. (2018) Net retreat of Antarctic glacier grounding lines, NATURE GEOSCIENCE 11:258–262. [Gabrielle Dreyfus, USA]	Accepted, text revised. Note that text was moved to a new cross-chapter box
19878	3	16	20	16	21	Modify to read: "Mass loss from the Antarctic Ice Sheet occurs primarily via basal melting of its ice shelves and iceberg calving." or similar [Michelle A. North, South Africa]	Accepted, but in new version this text does not exist. Note that text was moved to a new cross-chapter box
19884	3	16	20	16	20	Replace "between 18,000 years ago and the present" with: "during the past 18,000 years" [Michelle A. North, South Africa]	Accepted, text revised. Note that text was moved to a new cross-chapter box
1716	3	16	21	16	21	possible comma needed after 'AR5' [Mark England, UK]	Accepted, text revised. Note that text was moved to a new cross-chapter box
7528	3	16	21	16	21	E1a: "Since AR5 ice shelves" --> "Since AR5, ice shelves" (comma after AR5) [APECS Group Review, Germany]	Accepted, text revised. Note that text was moved to a new cross-chapter box
19880	3	16	21	16	22	Modify to read: " Since AR5, ice shelves continued to retreat, including the detachment of a large iceberg from the Larsen C ice shelf in 2017 ()" [Michelle A. North, South Africa]	Accepted, but this text does not exist anymore. Note that text was moved to a new cross-chapter box
19886	3	16	21	16	21	Change the citation Weber et al to: "Author (year) showed…" [Michelle A. North, South Africa]	Accepted, text revised. Note that text was moved to a new cross-chapter box
19882	3	16	23	16	23	Replace "have shown" with "show" [Michelle A. North, South Africa]	Accepted, text revised. Note that text was moved to a new cross-chapter box

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
7530	3	16	24	16	24	E1a: There should be a comma after iceberg calving [APECS Group Review, Germany]	Accepted, text revised. Note that text was moved to a new cross-chapter box
5006	3	16	31	16	31	Reword for clarity. This seems to imply that transition from no-surface-melt to surface-melt would stabilize an ice shelf, which is surely wrong. "that surface melt may be a stabilizing factor" [Richard B. Alley, USA]	Accepted, text revised. Note that text was moved to a new cross-chapter box
12716	3	16	31	16	31	Surface melt will never be a stabilizing factor, rather the rapid evacuation of surface meltwater (reformulate to reflect this) [Michiel Van Den Broeke, Netherlands]	Accepted, text revised. Note that text was moved to a new cross-chapter box
22222	3	16	31	16	32	seems misleading. It is not the melt that is stabilizing, it is (maybe) the fact that the melt is evacuated. It would always be even more stable without melt. [Martin Truffer, USA]	Accepted, text revised. Note that text was moved to a new cross-chapter box
19888	3	16	36	16	36	Surely it should be "inter-model comparison exercises"? [Michelle A. North, South Africa]	Rejected. The comment does not belong to this section
5498	3	16	37	16	57	contentwise this section is not fully consistent with chapter 4 where MISI is included in their projections based on partly different papers [Roderik Van De Wal, Netherlands]	Accepted. The two pieces of similar text from Chapters 3 and 4 is now merged in a new the Cross-chapter Box
16864	3	16	37	16	56	A very recent paper by Barletta et al. (2018 - Observed rapid bedrock uplif in Amundsen Sea Embayment promotes ice-sheet stability, Science, 360, 1335-1339) might be worth to include in this paragraph , It shows that new estimate of Earth's mantle viscosity might increase stability of the West Antarctic Ice Sheet thanks to increased rate of the bedrock uplifting [Anthony Mémin, France]	Accepted, text revised. Note that text was moved to a new cross-chapter box
2238	3	16	38	16	48	The ability of ICE SHEET models to simulate processes controlling the MISI has indeed improved, but melt rates are still very poorly parameterized in these models (except, to some extent, Seroussi et al. 2017 who use a coupled ocean model). Oceanic melt rates are important for triggering a MISI and determining the rate of grounding line retreat. [Nicolas Jourdain, France]	Partly accepted. The model projections will be discussed in Chapter 4
1768	3	16	39	19	41	This paragraph is not accurate. Konrad et al. (2018) report observed grounding line retreat, but their observations do not provide information about causes of the retreat. Marine Ice Sheet Instability Hypothesis is valid for steady-state configurations of unconfined marine ice sheets. Pine Island Glacier is confined, and it is unclear whether this hypothesis is true for confined configurations. Modeling and theoretical studies suggest that the Marine Ice Sheet Instability Hypothesis is not true for laterally confined marine ice sheets (e.g. Gudmundsson et al. 2012, Gudmundsson 2013, Schoof et al. 2017, Haseloff and Sergienko 2018, Reese et al., 2018). References: Gudmundsson, G. H., Krug, J., Durand, G., Favier, L., and Gagliardini, O.: The stability of grounding lines on retrograde slopes, The Cryosphere, 6, 1497-1505, https://doi.org/10.5194/tc-6-1497-2012, 2012.; Gudmundsson, G. H.: Ice-shelf buttressing and the stability of marine ice sheets, The Cryosphere, 7, 647-655, https://doi.org/10.5194/tc-7-647-2013, 2013.; Schoof, C., Davis, A. D., and Popa, T. V.: Boundary layer models for calving marine outlet glaciers, The Cryosphere, 11, 2283-2303, https://doi.org/10.5194/tc-11-2283-2017, 2017.Haseloff, M., & Sergienko, O. (2018). The effect of buttressing on grounding line dynamics. Journal of Glaciology, 1-15. doi:10.1017/jog.2018.30; Reese, R., Winkelmann, R., and Gudmundsson, G. H.: Grounding-line flux formula applied as a flux condition in numerical simulations fails for buttressed Antarctic ice streams, The Cryosphere Discuss., https://doi.org/10.5194/tc-2017-289, in review, 2018. [Olga Sergienko, USA]	Partly accepted. We have ample evidence that Pine Island and Thwaites are undergoing MISI, and so are the Larsen A and B glaciers. Jakobshavn is also undergoing MISI. In the case of a confined ice shelf, it is true that the MISI will be subdued and slowed down, but from there to say that "the MISI is not true for laterally confined marine ice sheets" is a stretch. However, you are right that Konrad (2018) is mentioned in a wrong context, so we reworded it. Also we added this phrase: "The onset and persistence of MISI is dependent on several factors in addition to overall bed slope, including the details of the bed geometry and conditions, ice-shelf pinning points, lateral shear from the walls, self-gravitation effects on local sea level and isostatic adjustment. Hence, long-term retreat on every retrograde-sloped bed is not necessarily unstoppable". Note that the whole text was moved to a cross-chapter box, where we have a strict limit on the number of papers that we can site, so we cannot add all the references you suggested.

SROCC First Order Draft Expert Review Comments - Chapter 3							
Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
1770	3	16	39	16	47	This paragraph is not accurate. Konrad et al. (2018) report observed grounding line retreat, but their observations do not provide information about causes of the retreat. Marine Ice Sheet Instability Hypothesis is valid for steady-state configurations of unconfined marine ice sheets. Pine Island Glacier is confined, and it is unclear whether this hypothesis is true for confined configurations. Modeling and theoretical studies suggest that the Marine Ice Sheet Instability Hypothesis is not true for laterally confined marine ice sheets (e.g. Gudmundsson et al. 2012, Gudmundsson 2013, Schoof et al. 2017, Haseloff and Sergienko 2018, Reese et al., 2018). References: Gudmundsson, G. H., Krug, J., Durand, G., Favier, L., and Gagliardini, O.: The stability of grounding lines on retrograde slopes, The Cryosphere, 6, 1497-1505, https://doi.org/10.5194/tc-6-1497-2012, 2012.; Gudmundsson, G. H.: Ice-shelf buttressing and the stability of marine ice sheets, The Cryosphere, 7, 647-655, https://doi.org/10.5194/tc-7-647-2013, 2013.; Schoof, C., Davis, A. D., and Popa, T. V.: Boundary layer models for calving marine outlet glaciers, The Cryosphere, 11, 2283-2303, https://doi.org/10.5194/tc-11-2283-2017, 2017.Haseloff, M., & Sergienko, O. (2018). The effect of buttressing on grounding line dynamics. Journal of Glaciology, 1-15. doi:10.1017/jog.2018.30; Reese, R., Winkelmann, R., and Gudmundsson, G. H.: Grounding-line flux formula applied as a flux condition in numerical simulations fails for buttressed Antarctic ice streams, The Cryosphere Discuss., https://doi.org/10.5194/tc-2017-289, in review, 2018. [Olga Sergienko, USA]	Partly accepted. We have ample evidence that Pine Island and Thwaites are undergoing MISI, and so are the Larsen A and B glaciers. Jakobshavn is also undergoing MISI. In the case of a confined ice shelf, it is true that the MISI will be subdued and slowed down, but from there to say that "the MISI is not true for laterally confined marine ice sheets" is a stretch. However, you are right that Konrad (2018) is mentioned in a wrong context, so we reworded it. Also we added this phrase: "The onset and persistence of MISI is dependent on several factors in addition to overall bed slope, including the details of the bed geometry and conditions, ice-shelf pinning points, lateral shear from the walls, self-gravitation effects on local sea level and isostatic adjustment. Hence, long-term retreat on every retrograde-sloped bed is not necessarily unstoppable". Note that the whole text was moved to a cross-chapter box, where we have a strict limit on the number of papers that we can site, so we cannot add all the references you suggested.
1910	3	16	39	17	4	Here too it seems appropriate to acknowledge Kjeldsen et al., 2015 (Nature, Spatial and Temporal Distribution of Mass Loss of the Greenland Ice Sheet) -- Which constrains 1900-1983 mass balance rates to highlight that post-2010 mass loss is 3x higher than the 20th century background rate. This is important empirically-derived contextualization of recent mass loss as anomalous. [William Colgan, Denmark]	Rejected. The comment does not belong to this section
7548	3	16	39	16	39	This statement is overly broad and should be discussed in more detail (e.g. Furst et al, 2016, Nat Clim Change) [APECS Group Review, Germany]	Partly accepted. We do not have space to discuss everything in details, but we added reference to Furst et al., 2016, elsewhere
20690	3	16	39	16	39	Need mechanistic references for this sentence. Currently implies the ref of grounding line retreat observations explains the link with ice shelf thinning/collapse, which it doesn't, [Tamsin Edwards, UK]	Accepted, text revised. Note that text was moved to a new cross-chapter box

SROCC First Order Draft Expert Review Comments - Chapter 3							
Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
18826	3	16	42	16	44	The use if MISI needs a clear definition, as multiple meanings are currently attached to the related words ‘stability’ and ‘instability’, especially with an iconoclastic term as MISI or MICI. Observed changes in glaciers are very commonly associated with use of the word ‘instability’ (as is the case within the references cited), whereas in its original (Weertman, 1974) and subsequent usage (Schoof, 2007a) it refers to a self-generated growth of a small perturbation (e.g., grounding line retreat or advance). This is also the way it is used amongst modellers when investigating grounding line behaviour. According to the definition of MISI, the observations in Thwaites glacier pertain to accelerated grounding line retreat potentially leading to MISI. Whether we are at the onset of MISI is totally unknown. The observed accelerated grounding line retreat could well be due to increased forcing, which is a linear and not a nonlinear response. [Frank Pattyn, Belgium]	Accepted, text revised. Note that text was moved to a new cross-chapter box
6202	3	16	44	16	47	this should be moved to the section about projection and models. Is out of place here [Regine Hock, USA]	Accepted, text revised. Note that text was moved to a new cross-chapter box
19890	3	16	44	16	54	SMB and GCM should be written out in full at the beginning of this section [Michelle A. North, South Africa]	Rejected. The comment does not belong to this section
15990	3	16	45	16	47	This sentence beginning with "These discrepancies…" doesn't read well. [Patrick Taylor, USA]	Accepted, text revised. Note that text was moved to a new cross-chapter box
20692	3	16	46	16	47	Large spread' is undefined/subjective. Several of these projections overlap or are cloes, so give numbers to justify this statement, [Tamsin Edwards, UK]	Taken into account. The model projections discussion was moved to Chapter 4.
17806	3	16	47	16	47	Arthern and Williams (2017;doi.org/10.1002/2017GL072514) explain some of the reasons for this spread, including sensitivities to melt rates in new ocean cavities, timing of ice rise floatation, and choice of melt rate parameterisation near the grounding line. [Robert Arthern, UK]	Taken into account. The model projections discussion was moved to Chapter 4.
5500	3	16	49	16	55	ice cliff instability is parted in much more detail in chapter 4 it requires cross referencing prevent discussing MICI without the context of hydrofracturing MICI on its own doesn't do anything it is the combination ice cliff instability and hydrofracturing [Roderik Van De Wal, Netherlands]	Accepted. The two pieces of similar text from Chapters 3 and 4 is now merged in the Cross-chapter Box
6204	3	16	49	16	54	Acronym MICI should be avoided. [Regine Hock, USA]	Rejected. We use MICI for the sake of saving space, and the difinition of MICI is explained the first time it is used.
7550	3	16	49	16	55	This paragraph discusses the role of MICI in the context of modeling efforts, but there should also be discussion of the role that MICI plays in current ice sheet behavior, particularly in Greenland. [APECS Group Review, Germany]	Partly accepted. MICI is more a hypothetic process rather than really observed one, but we do discuss in the new version of text several MICI-type processes in Antarctica and Greenland. Note that the whole text was moved to a new cross-chapter box
20694	3	16	49	16	49	This should say 'proposed' or 'hypothesised' mechanism. [Tamsin Edwards, UK]	Accepted, text revised. Note that text was moved to a new cross-chapter box
20696	3	16	49	6	51	Bassis and Walker results are only about cliff failure height, not "runaway" failure or "ice sheet disintegration". Need to make this clear, [Tamsin Edwards, UK]	Accepted, text revised. Note that text was moved to a new cross-chapter box

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
17808	3	16	51	16	51	There are numerous reasons to regard the Marine Ice Cliff Instability (MICI) as extremely poorly understood and current parameterisations as highly speculative. The appropriate values for failure stress are highly uncertain, the equations used by Bassis and Walker (2012) do not satisfy hydrostatic equilibrium, and bending stresses are not included in their analysis. All these factors make it difficult to prescribe theoretical upper bounds on cliff height, although observations by Wise et al. (2017) may be relevant to providing an empirical constraint. Retreat rates are constrained even less by theory. DeConto and Pollard (2016) do employ a model that satisfies hydrostatic equilibrium, but this is far from being a process-level model of fracture, failure stresses are uncertain and they do not include bending stresses either. They explore sensitivity to prescribed (not modelled) maximum retreat rates and compare with paleo-records, but this is not a very stringent test of a physical theory since boundary conditions and climate forcing are very uncertain for the paleo era. The available studies do little more than raise the possibility of MICI and provide some speculation and very loose bounds upon how it may operate. Improved physical theories and more direct evaluations of their success at reproducing the behaviour of actual ice cliffs will be needed to accurately predict mass losses from this process. In general, I would favour presenting the most important results in this report, such as sea level curves, with and without MICI contributions, wherever any attempt is made to estimate the latter. We know so little about the potential magnitude of sea level rise from this process. By keeping separate MICI and non-MICI results available the report would still be useful in the event that the single available MICI parameterisation (DeConto and Pollard, 2016) proved inaccurate. [Robert Arthern, UK]	Taken into account. We modified the text to make it clear that MICI is a hypothetic process. The projections of sea level belongs to Chapter 4, not Chapter 3.
18380	3	16	51	16	51	Change this to clarify that this is only in ONE ice sheet model, not ‘models’ (plural). Both citations use the same model. [Nicholas Golledge, New Zealand]	Accepted, text revised. Note that text was moved to a new cross-chapter box
20698	3	16	51	16	51	"an ice sheet model" i.e. singular - both references refer to the same model/parameterisation. [Tamsin Edwards, UK]	Accepted, text revised. Note that text was moved to a new cross-chapter box
5008	3	16	52	16	52	Note that the collapse from MICI depends on forcing--it is a projection, which is not made clear here. Also note, as explained by Alley et al. 2015, that the rate of retreat used by Pollard et al and DeConto and Pollard is lower than probably would occur, leading to slower ice-sheet loss, because of specification of an upper limit on retreat rate. Alley, R.B., S. Anandakrishnan, K. Christianson, H.J. Horgan, A. Muto, B.R. Parizek, D. Pollard and R.T. Walker. 2015. Oceanic forcing of ice-sheet retreat: West Antarctica and more. Annual Reviews of Earth and Planetary Sciences 43, 207–231. [Richard B. Alley, USA]	Taken into account. The discussion of model projections is moved to Chapter 4.
3510	3	16	53	16	55	Reference to Section 3.2.3.4 should be indicated instead of 3.2.3.5. [Deborah Verfaillie, Spain]	Accepted, but this section does not exist any more in SOD
3824	3	16	53	16	53	change to "Section 3.2.3.4" [Ola Kalen, Sweden]	Accepted, but this section does not exist any more in SOD
11990	3	16	53	16	55	I would suggest adding the period defining " recent geological past" [Kristian Kjellerup Kjeldsen, Denmark]	Accepted, text revised. Note that text was moved to a new cross-chapter box

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
13062	3	16	53	16	53	Better say: "In one model", so that the reader can easily understand why the confidence is low? [Gerhard Krinner, France]	Accepted, text revised. Note that text was moved to a new cross-chapter box
14270	3	16	53			3.2.3.4 not 3.2.3.5 [Christopher Fogwill, UK]	Accepted, but this section does not exist any more in SOD
18382	3	16	53	16	55	Retreat due to MICI assigned 'low confidence' here, which appears to conflict with p17 L28-30 where it is described as 'likely' [Nicholas Golledge, New Zealand]	Taken into account. In section 3.2.3.2 we are talking about present situation and future projections, while in 3.2.3.4 - about paleo evidence of MICI occurred in the past. However, the text was modified to avoid this misunderstanding. Note that the wole text was moved to a new cross-chapter box
20700	3	16	53	17	53	Section 3.2.3.5 should say 3.2.4 [Tamsin Edwards, UK]	Accepted, but this section does not exist any more in SOD
20702	3	16	53	16	55	This section does not provide evidence for MICI, only for increased AIS ice loss and cliff failure above ~100 m. [Tamsin Edwards, UK]	Accepted, text revised. Note that text was moved to a new cross-chapter box
1772	3	17	1	17	1	Subsubsection 3.2.3.3 Subglacial water discharges does not belong to Subsection 3.2.3 Rapid and/or Irreversible changes. Suggest removing it entirely. [Olga Sergienko, USA]	Accepted. The section was modified and moved to section 3.3.1
13064	3	17	1	17	30	Not clear why this should be relevant for climate change. It's interesting but maybe not relevant. [Gerhard Krinner, France]	Accepted. The section was modified and moved to section 3.3.1
15564	3	17	1		30	New evidence since AR5 of subglacial melt in Antarctica merits close attention. Paleo studies suggesting instability in Antarctic lakes suggests the subglacial flows could develop more problems in the future. [Melinda Kimble, USA]	Noted
7564	3	17	3	17	4	It would be useful to preface this discussion with statements referencing that in AR5, the subglacial system in Greenland and its limited importance in recent accelerations of outlet glaciers. [APECS Group Review, Germany]	Rejected. In our report we discuss the subglacial processes in different context compared to that in AR5
7566	3	17	3	17	15	This paragraph lacks any assessment of the importance of subglacial hydrology and discharge in controlling ice dynamics or rapid /irreversible changes. The only confidence assessment is related to Lake Vostok, with is only one of many lakes. [APECS Group Review, Germany]	Accepted. In SOD we attempt to make such an assessment. In fact, there is very low evidence on how subglacial system will react on the climate change, and what will be the feedback on ice dynamics
14274	3	17	7			...by a system'" [Christopher Fogwill, UK]	Accepted, text revised. Note that text was moved to section 3.3.1.3
16866	3	17	8	17	9	Missing important contribution from Flament & al. (2014 - Cascading water underneath Wilkes Land, East Antarctic ice sheet, observed using altimetry and digital elevation models, The Cryosphere, 8, 673-687) showing the subglacial lake drainage in Wilkes Land in East Antarctica. [Anthony Mémin, France]	Accepted, text revised. Note that text was moved to section 3.3.1.3
7568	3	17	12	17	13	Only one reference is listed, but the sentence references 'A few studies...' [APECS Group Review, Germany]	Accepted, text revised. Note that text was moved to section 3.3.1.3
20704	3	17	12	17	12	"A few studies" but only one cited [Tamsin Edwards, UK]	Accepted, text revised. Note that text was moved to section 3.3.1.3
412	3	17	13	17	13	Remove "However" and start with "Calculations..." [George Burba, USA]	Accepted, text revised. Note that text was moved to section 3.3.1.3
1718	3	17	14	17	14	should be 'that Lake Vostok' rather than 'that the Lake Vostok' [Mark England, UK]	Accepted, text revised. Note that text was moved to section 3.3.1.3

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
224	3	17	17	17	30	This palaeoclimate paragraph is much to short. The pre-industrial Holocene climate is important context for the understanding of recent climate change in the polar regions. Need to describe the succession of warm and cold phases which alternate in millennia-rhythm. Possible climatic drivers of this? Refer to the Antarctic temperature reconstructions for the past 2000 years by PAGES2k 2013, Stenni et al. 2017 and classical ice core studies from both Greenland and Antarctica. Who took the decision to leave out the pre-industrial Holocene climate history in this report? This gap now weakens both the pre-industrial reference context as well as any attribution discussion for modern polar climate change. [Sebastian Luening, Portugal]	Rejected. In this section we only discuss paleo-evidence of rapid ice mass changes in the regions of Antarctica sensitive to the ice sheet instability processes. The mentioned references are cited in other sections of the report, where appropriate.
7570	3	17	17	17	17	The discussion of the paleo record would be enhanced by including references to paleo-subglacial hydrology and its behavior and effect on ice dynamics (e.g. Simkins et al., 2017; Nat. Geosci). [APECS Group Review, Germany]	Noted. The discussion of paleo evidence of the subglacial hydrology is not relevant in the context of this section.
13066	3	17	17	17	30	Can you specify (define exactly) what "rapid" means here? [Gerhard Krinner, France]	Accepted. Rapid in this case is centennial time-scale. Note however that this section title does not exist anymore in SOD
3694	3	17	19	17	30	Missing here is a description of when in the past the modern ice sheet surface was reached. Johnson et al (2014) showed that PIG had thinned to its modern configuration by mid-Holocene. We cannot rule out later retreat and readvance, but evidence for this - if it occurred - must lie beneath the present ice sheet surface, and can only be accessed by subglacial drilling. [Joanne Johnson, UK]	Noted. We cannot really discuss something for which we do not have any evidence
11814	3	17	19	17	30	the new report of Kingslake et al 2018 in Science is worth of mention here given the indication of behind-present retreat and then readvance. This also has implications for GIA (and also is suggested the readvance was caused by GIA). The potential for late Holocene dynamics to be contuining through to today should be discussed [King Matt, Australia]	Accepted, text revised. The Kingslake's paper was published in Nature. Note that text was moved to a new cross-chapter box.
14272	3	17	20			utlizing [Christopher Fogwill, UK]	Accepted, text revised. Note that text was moved to a new cross-chapter box
8198	3	17	21	17	21	Weber et al., 2014 does not need to be in parenthesis [Benoit Montpetit, Canada]	Accepted, text revised. Note that text was moved to a new cross-chapter box
5230	3	17	22			After the sentence on the work by Weber et al. (2014). It could make sense to add this sentence. [Laurie Menviel, Australia]	Accepted, text revised. Note that text was moved to a new cross-chapter box
5232	3	17	22			"Simulations of the Antarctic ice-sheet deglaciatio further suggested a ~2 m sle contribution from WAIS due to [Laurie Menviel, Australia]	Accepted, text revised. Note that text was moved to a new cross-chapter box
5234	3	17	22			sub-surface warming of the Antarctic continental shelves at the time of MWP-1A (Golledge et al, 2014, Nature communications). [Laurie Menviel, Australia]	Accepted, text revised. Note that text was moved to a new cross-chapter box
14102	3	17	22	17	22	The Weber reference is directly supported by the direct reconstruction in Fogwill, C. et al. Antarctic ice sheet discharge driven by atmosphere-ocean feedbacks at the Last Glacial Termination. Scientific reports 7 (2017). This provides a detial ice sheet surface reconstruction for the Weddell Sea Embayment [Christopher Fogwill, UK]	Noted, but we cannot add this reference: this material was moved to a new cross-chapter box, where we have a very struct limit of the references.
3690	3	17	25	17	25	Change to: "has been identified from rock surfaces adjacent to glaciers...." [Joanne Johnson, UK]	Accepted, text removed. Note that text was moved to a new cross-chapter box
3692	3	17	25	17	25	After "Ross and Weddell Sea embayments", add "by dating exposed rock surfaces". [Joanne Johnson, UK]	Accepted, text removed. Note that text was moved to a new cross-chapter box

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
12534	3	17	26	17	27	"It is very likely that rapid Antarctic ice sheet changes happened in the past (high confidence)". I cannot see where this high confidence comes from - you present one example with medium confidence and one with high confidence and then synthesise this sparse evidence as giving you high confidence for the general statement. In addition, without a definition of what "rapid" means in those examples, this statement is not very meaningful. [Eric Wolff, UK]	Accepted, text revised. Note that text was moved to a new cross-chapter box
14104	3	17	26	17	26	The refeferences for this section should include Fogwill, C. J. et al. Drivers of abrupt Holocene shifts in West Antarctic ice stream direction determined from combined ice sheet modelling and geologic signatures. Antarct. Sci. 26, 674-686, doi:doi:10.1017/S0954102014000613 (2014). It provides the only unambigous reconstruction of Holoccene draw down using short lived cosmogenic radio-isotope 14C in combination with 10Be, 26Al (as used in the studies currently highlighted) [Christopher Fogwill, UK]	Rejected. We cannot cite every existing paper, and this particular reference is not relevant in the context of this section.
17580	3	17	26	17	30	It is essential here to define what is meant by rapid and to be clear that the paleo evidence equates to that definition. Rapid could mean centennial or millennial or....? A 3 m contribution from the WAIS over, say, 3000 years is 1 mm/yr and not so far from the present-day contribution of the GrIS. Is that what you mean by rapid or....? [Jonathan Bamber, UK]	Accepted, text revised. Note that text was moved to a new cross-chapter box
18384	3	17	28	17	30	Retreat due to MICI described as ‘likely’ here but assigned ‘low confidence’ on p16 L53-55 [Nicholas Golledge, New Zealand]	Taken into account. In section 3.2.3.2 we are talking about present situation and future projections, while in 3.2.3.4 - about paleo evidence of MICI occurred in the past. However, the text was modified to avoid this misunderstanding. Note that the whole text was moved to a new cross-chapter box
7576	3	17	29	17	29	Perhaps could include "Adkins (2013), The role of deep ocean circulation in setting glacial climates, PALEOCEANOGRAPHY, VOL. 28, 1–23, doi:10.1002/palo.20046" with Hillenbrand et al. 2017 reference. [APECS Group Review, Germany]	Rejected. This paper is not relevant in the context of this section.
20706	3	17	30	17	30	Wise et al. provides evidence for cliff failure, but not for MICI (i.e. whether and how a cliff failure could lead to a widespread, sustained positive feedback) [Tamsin Edwards, UK]	Accepted. We have re-worded this sentence. Note that the whole text has moved to a new cross-chapter box
7554	3	17	32	17	32	I would rename the title of this sub-section as 'Model projections'. [APECS Group Review, Germany]	Section 3.2.4 (FOD numbering) Projections and Models has been removed. This is to avoid overlap with Chapter 4. Note that we have created a new cross chapter box between Chapters 3 and 4 to make this link more explicit. And in section 3.3.4.1, we point readers to Chapter 4
7572	3	17	32			It may be beyond the scope of this section, but it would be beneficial to see a chart describing the various projections made since AR5. [APECS Group Review, Germany]	See above - comment 7554
17346	3	17	32	19	5	Greatly missing here is an extended discussion of what paleo studies can tell us about projections. While this is included in Ch. 4, suggest either inclusion here as well, or a reference to the relevant sections in Ch. 4. [Pamela Pearson, USA]	See above - comment 7554
23730	3	17	32	19	5	I suggest changing the heading of subsections 3.2.4.1 and 3.2.4.2 to «Greenland Ice Sheet» and "Antarctic Ice Sheet" to avoid confusion with 3.2.4.3 Polar Glaciers [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - text revised

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
226	3	17	34	18	45	This report stays unfortunately silent on a critical issue. Current climate models have so far failed to reproduce Antarctic climate development of the past 100 years, as well as of the dynamic of the past few millennia. Why is this being concealed here? See Abram et al., 2016; Goosse, 2017; Jones et al., 2016 (doi:10.1038/nclimate3103); Stenni et al., 2017. [Sebastian Luening, Portugal]	See above - comment 7554
6206	3	17	34	18	6	There is much about methods and limitation but I miss results. What do these models say that will happen to the ice sheet by 2100 and beyond? [Regine Hock, USA]	See above - comment 7554
7556	3	17	36	17	36	Capitals: 'Greenland Ice Sheet'. [APECS Group Review, Germany]	See above - comment 7554
17582	3	17	36	17	40	This statement is not quite correct. SOME studies have focused on inter comparison. [Jonathan Bamber, UK]	See above - comment 7554
7558	3	17	38	17	38	I think you refer to Goelzer et al. (2017a) about initMIP-Greenland, and not Goelzer et al. (2017b). [APECS Group Review, Germany]	See above - comment 7554
20708	3	17	38	17	38	Goelzer et al. 2017b should be 2017a [Tamsin Edwards, UK]	See above - comment 7554
23238	3	17	39	17	39	Remove Holschuh et al. 2014 citation (should be in Antarctic section) [Tamsin Edwards, UK]	See above - comment 7554
1900	3	17	44	17	54	It would seem appropriate to acknowledge Colgan al., 2015, Earth Future (Considering therm-viscous collapse of the Greenland Ice Sheet) -- Which models thermo-mechanical feedbacks being alluded to in this text. Specifically, this study suggests that weakening and softening of the ice sheet could decrease ice sheet volume by 5+/-2% (or 33+/-18cm SLE) within five centuries. This mechanism of cryohydrologic warming is not included in the conventional models being described here. [William Colgan, Denmark]	See above - comment 7554
7562	3	17	44	17	45	It would be good to provide numbers in terms of ice loss or sea-level rise arising from these studies to be able to compare to AR5. [APECS Group Review, Germany]	See above - comment 7554
11994	3	17	44	17	47	Although numbers may be at the low end, Aðalgeirsdóttir et al, 2014, explicitely syate that they regard their results as lower bounds of future mass loss as a number of listed feedback mechanisms are accounted for, and additionally, they discuss how the spin-up and the initial state of the ice sheet also influences the results. Moreover, the range provided by each study may also reflect how ice dynamics is treated, how a constrant ice sheet configuration impacts the SMB forcing, etc. Also, perhaps worth mentioning that improvements in the bedrock dataset (Morlighem et al, 2017) will surely influence projections as it is becoming clearer how much of the ice sheet can become/will remain exposed to oceanic forcing/warming, however, certain areas, particular the southeast still remains an open question due to the limited number of bed returns in the OIB radar data. [Kristian Kjellerup Kjeldsen, Denmark]	See above - comment 7554
7560	3	17	48	17	51	If I understand correctly, you seem to suggest that the Greenland ice sheet model studies after AR5 are worse than the ones used for AR5 (which used the Nick flowline modeling). This needs to be further explained. [APECS Group Review, Germany]	See above - comment 7554
7574	3	17	48	17	48	There is justification that PDD melt calculations are overly sensitive and it would be beneficial to cite it (e.g. Bauer & Ganopolski, 2017, Clim. Past, etc.) [APECS Group Review, Germany]	See above - comment 7554
13068	3	17	48	17	48	Could you justify why you think that this parameterization could be too sensitive? Do the authors say that or is that your assessment? [Gerhard Krinner, France]	See above - comment 7554

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
7552	3	17	52	17	53	E1a: This sentence doesn't make sense to me. How can dynamic mass loss be dominated by changes in SMB? Surely, by definition, SMB is ignored? [APECS Group Review, Germany]	See above - comment 7554
17584	3	17	52	17	53	Confusing sentence. Replace "future dynamic losses" by "future losses" [Jonathan Bamber, UK]	See above - comment 7554
7578	3	17	53	17	54	"Spatial patterns show the greatest decrease in ice thickness in southwest Greenland." Could a figure or reference be included to support this statement? [APECS Group Review, Germany]	See above - comment 7554
5364	3	17	56	17	56	"limitations and gaps that limit": maybe the formulation can be improved? [Roderik Van De Wal, Netherlands]	See above - comment 7554
1424	3	17	57	18	3	Goelzer er al. (2017a, TCD) --> Goelzer et al. (2018, TC, doi: □10.5194/tc-12-1433-2018) [Harry Zekollari, Switzerland]	See above - comment 7554
20710	3	17	57	17	57	Goelzer et al. 2017a should be 2017b [Tamsin Edwards, UK]	See above - comment 7554
20712	3	17	57	17	57	climate "and ice sheet" models [Tamsin Edwards, UK]	See above - comment 7554
5240	3	18	1	36	1	This is quite a pity that no paleoclimate evidence is brought into these sections. [Laurie Menviel, Australia]	See above - comment 7554
5242	3	18	1	36	1	There is evidence for past changes in Southern Ocean dynamics with impacts on climate and the global carbon cycle. [Laurie Menviel, Australia]	See above - comment 7554
5244	3	18	1	36	1	These can help to improve our understaning of future changes. [Laurie Menviel, Australia]	See above - comment 7554
7582	3	18	1	18	1	Add 'van den' before 'Broeke'. [APECS Group Review, Germany]	See above - comment 7554
12718	3	18	1	18	1	VAN DEN Broeke [Michiel Van Den Broeke, Netherlands]	See above - comment 7554
20714	3	18	1	18	1	Broeke et al. 2017 citation missing and mis-cited: should be van den Broeke, M. et al. (2017), Greenland Ice Sheet Surface Mass Loss: Recent Developments in Observation and Modeling, Curr Clim Change Rep. [Tamsin Edwards, UK]	See above - comment 7554
11764	3	18	3	18	3	Add … (Goelzer et al., 2017a), and large uncertainties in potential general circulation changes in summer over North-Atlantic, not projected by current GCM but mainly responsible of the current melt acceleration over GrIS (Hanna et al., 2018; Delhasse et al., 2018). None GCM from CMIP5 projects circulation changes as currently observed over Greenland while the increase of summer anticyclonic blocking events is mainly responsible of the recent melt acceleration (Hanna et al., 2018) and could enhance the future melt increase by a factor 2 if such circulation changes (NAO<0) will continue in future (Delhasse et al.,2018). Delhasse, A., Fettweis, X., Kittel, C., Amory, C., and Agosta, C.: Brief communication: Impact of the recent atmospheric circulation change in summer on the future surface mass balance of the Greenland ice sheet, The Cryosphere Discuss., https://doi.org/10.5194/tc-2018-65, in review, 2018. Hanna, E., Fettweis, X., and Hall, R. J.: Recent changes in summer Greenland blocking captured by none of the CMIP5 models, The Cryosphere Discuss., https://doi.org/10.5194/tc-2018-91, in review, 2018. [Xavier Fettweis, Belgium]	See above - comment 7554

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
20716	3	18	4	18	4	they "also" include. The previous list of limitations is common to ice sheet and climate/coupled models. [Tamsin Edwards, UK]	See above - comment 7554
24388	3	18	8	18	9	Confused by this title as there are many many pages before ecological and social system impacts are mentioned [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - Chapter structure changed to improve flow to impacts
13004	3	18	10	18	45	While there is uncertainty as to the threshold response of West Antarctic collapse, the rate of melting and, importantly, amount of committed sea-level rise may depend on rate of atmospheric and ocean warming. (International Cryosphere Climate Initiative (2015), Thresholds and Closing Windows: Risks of Irreversible Cryosphere Climate Change, WWW.ICCINET.ORG/THRESHOLDS, 6-7.) [Gabrielle Dreyfus, USA]	See above - comment 7554
13070	3	18	10	18	14	Recent paper by Massom et al., Nature 2018 relevant here [Gerhard Krinner, France]	See above - comment 7554
14276	3	18	11			colon instead of semicolon [Christopher Fogwill, UK]	See above - comment 7554
17586	3	18	11	18	11	The term "collapse" is emotive. It conjurs a sudden and massive event. Would help to define what is meant. E.g. loss of majority of the ice sheet or... [Jonathan Bamber, UK]	See above - comment 7554
20718	3	18	11	18	12	MISI is still a hypothesis, albeit with preliminary evidence to support it. So 'modelling suggests MISI (Section 3.2.3.2) "is underway" in the Amundsen Sea Embayment, driven by ocean-forced basal melting' [Tamsin Edwards, UK]	See above - comment 7554
17810	3	18	12	18	12	To say that MISI is driven by ocean-forced basal melting is perhaps an oversimplification and it might be better to tease out the causal chain of events further than is done here. Melt does not feature at leading order in Schoof's flowline analysis of MISI (Schoof 2007; doi.org/10.1029/2006JF000664, 'Model B'). Gudmundsson (2013; doi.org/10.5194/tc-7-647-2013) has shown that buttressing by ice shelves provides a negative feedback that can stabilise ice sheet equilibria in 3-dimensional calculations, but this effect is also not included in Schoof's flowline analysis of MISI, so it can be considered an extra negative feedback that acts in opposition to the positive feedback behind MISI (see also Goldberg, 2009; doi.org/10.1029/2008JF001227, for discussion of this effect). Arthern and Williams (2017) examine the causal relationship between basal melt rates and accelerating retreat. In those simulations, melt in new ocean cavities that open up during the retreat can reduce the negative feedback from buttressing by ice shelves that would otherwise suppress MISI. In that study, this effect is termed the submarine melting feedback. If the melt is sufficiently intense, the retreat accelerates. This occurs when a combination of two positive feedbacks (MISI and the submarine melting feedback) together outweigh a single negative feedback (buttressing). The three feedbacks do not operate independently, rather the submarine melt feedback modulates the buttressing feedback and the buttressing feedback modulates the MISI feedback. [Robert Arthern, UK]	See above - comment 7554
7590	3	18	16	18	33	As this paragraph is rather long and involves several ideas, I suggest to cut it into two paragraphs. [APECS Group Review, Germany]	See above - comment 7554
7584	3	18	17	18	17	Add 'compared to other Antarctic regions' after 'thinning'. [APECS Group Review, Germany]	See above - comment 7554
14278	3	18	19			needs references!e.g. Fogwill et al 2014, JQS [Christopher Fogwill, UK]	See above - comment 7554

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
7586	3	18	20	18	21	Please add references to support this statement. For example: Joughin et al. (2014). Marine Ice Sheet Collapse Potentially Under Way for the Thwaites Glacier Basin, West Antarctica, Science, 344(6185), 735-738, doi: 10.1126/science.1249055. [APECS Group Review, Germany]	See above - comment 7554
8200	3	18	20	18	21	should it be "will be vulnerable" instead of "are vulnerable"? [Benoit Montpetit, Canada]	See above - comment 7554
15534	3	18	20	18	21	Need clear references about this disagreement. [Daniel Feldman, USA]	See above - comment 7554
23732	3	18	20	18	21	which studies exactly do disagree? Please provide references [Hans-Otto Poertner and WGII TSU, Germany]	See above - comment 7554
7580	3	18	21	18	22	E1a: consider rewording this sentence. Perhaps "The degree to which"... [APECS Group Review, Germany]	See above - comment 7554
12720	3	18	21	18	21	Basal melting can refer to ice shelves and ice sheets, please clarify this with each use. [Michiel Van Den Broeke, Netherlands]	See above - comment 7554
17812	3	18	21	18	23	The text states 'the degree with which MISI or MICI may be self-sustaining if basal melting decreases is unknown' then cites six different studies that all have interesting things to say about this important question, beyond the simple fact that it is unknown. It would be better to summarise the the key conclusions on this topic drawn from these studies: for example Favier et al. (2014) state 'Pine Island Glacier's grounding line is probably engaged in an unstable 40 km retreat'; Joughin et al 2014 state 'Except possibly for the lowest-melt scenario, the simulations indicate that early-stage collapse has begun'; Seroussi et al. (2014) state ' Pine Island Glacier will continue to change rapidly over the coming decades and remain a major contributor to sea level rise, even if ocean-induced melting is reduced'; Arthern and Williams (2017) state 'Even without additional forcing from changes in climate, ice shelf collapse, or ice cliff collapse, the model predicts slow, sustained retreat of West Antarctica, driven by the marine ice sheet instability and current levels of ocean-driven melting.'; Feldmann and Levermann (2015) state 'Our results show that if the Amundsen Sea sector is destabilized, then the entire marine ice sheet will discharge into the ocean, causing a global sea-level rise of about 3 m.'. [Robert Arthern, UK]	See above - comment 7554
20720	3	18	21	18	22	Delete "if basal melting increases" as this applies to MISI but not necessarily MICI [Tamsin Edwards, UK]	See above - comment 7554
17814	3	18	23	18	23	The study by Seroussi et al. (2017) is also relevant. [Robert Arthern, UK]	See above - comment 7554
20722	3	18	27	18	27	Citation of Pattyn et al. (2017) [review] should be Pattyn (2017) [modelling]. [Tamsin Edwards, UK]	See above - comment 7554
7588	3	18	29	18	30	This sentence is not clear. Please rephrase. [APECS Group Review, Germany]	See above - comment 7554
23200	3	18	29	18	29	Use Munneke et al. (2014b) - elimiate first names - here and elsewhere. [Anthony Lupo, USA]	See above - comment 7554

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
2240	3	18	31	18	31	The problem is not only that confidence in model projections of ocean circulation is low, it is also that none of the CMIP5 ocean models represents ice-shelf cavities and ice-shelf melt. Donat-Magnin et al. (2017) have shown that the absence of melt-induced circulation can strongly affect projections of coastal temperatures in the Amundsen Sea. Donat-Magnin, M., Jourdain, N. C., Spence, P., Le Sommer, J., Gallée, H., & Durand, G. (2017). Ice-Shelf Melt Response to Changing Winds and Glacier Dynamics in the Amundsen Sea Sector, Antarctica. Journal of Geophysical Research: Oceans. [Nicolas Jourdain, France]	See above - comment 7554
2242	3	18	31	18	33	"Coupled models" would be clearer as "Ocean/ice-sheet coupled models". And an additional reference suporting that melt parameterizations overestimate melt rates is Jordan et al. (2018) : Jordan, J. R., Holland, P. R., Goldberg, D., Snow, K., Arthern, R., Campin, J. M., ... & Jenkins, A. (2018). Ocean-Forced Ice-Shelf Thinning in a Synchronously Coupled Ice-Ocean Model. Journal of Geophysical Research: Oceans, 123(2), 864-882. [Nicolas Jourdain, France]	See above - comment 7554
3956	3	18	31	18	31	It should be noted here that most global coupled climate models have either no ice shelves or very crude representation of ice shelves and their cavities. [Ben Webber, UK]	See above - comment 7554
7592	3	18	35	18	41	I would add a sentence stating what would happen more precisely if the threshold is passed in terms of West Antarctic collapse (e.g. sea-level rise contribution). [APECS Group Review, Germany]	See above - comment 7554
16982	3	18	38	18	38	What is the baseline year for the "future cumulative carbon emissions" - when does the "future" start? [Markku Rummukainen, Sweden]	See above - comment 7554
16984	3	18	39	18	39	What is the baseline period/warming for the "under 1oC warming"? [Markku Rummukainen, Sweden]	See above - comment 7554
20724	3	18	39	18	39	Missing reference in list: Levermann, A. et al., 2013. The multimillennial sea-level commitment of global warming. Proceedings of the National Academy of Sciences, 110(34), pp.13745–13750. [Tamsin Edwards, UK]	See above - comment 7554
3826	3	18	43	18	45	Add lack of knowledge of sub-ice shelf conditions and topography, e.g. Turner, John, et al. "Atmosphere-ocean-ice interactions in the Amundsen Sea Embayment, West Antarctica." Reviews of Geophysics 55.1 (2017): 235-276. [Ola Kalen, Sweden]	See above - comment 7554
5010	3	18	43	18	43	The realization that stability likely depends on the flow-law exponent of the bed (viscous/plastic) comes first from Parizek et al., 2013, which should be cited here. Parizek, B.R., K. Christianson, S. Anandakrishnan, R.B. Alley, R.T. Walker, R.A. Edwards, D.S. Wolfe, G.T. Bertini, S.K. Rinehart, R.A. Bindschadler, and S.M.J. Nowicki. 2013. Dynamic (In)stability of Thwaites Glacier, West Antarctica. Journal of Geophysical Research-Earth Surface 118, 1-18, doi:10.1002/jgrf.20044 [Richard B. Alley, USA]	See above - comment 7554

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
7594	3	18	43	18	45	When I read this very small paragraph, I have the feeling that the sources of uncertainty in Antarctic model projections are less important than for Greenland (compare to P17 L56 - P18 L6). However, there is at least as much uncertainty in Antarctic model projections compared to Greenland, if not more, due to the larger size of Antarctica and the lack of observations. In the sources of uncertainty for Antarctic model projections, you probably forgot to mention: lack of understanding of MISI and MICI, inaccurate representation of sub-glacial hydrology, missing processes of ocean circulation and calving, poor representation of basal friction, lack of observations (especially of basal topography and bathymetry), uncertainty in the atmospheric and oceanic forcings, etc. [APECS Group Review, Germany]	See above - comment 7554
7596	3	18	43	18	45	As in the previous section on Greenland, it would be beneficial to list and perhaps discuss the missing or poorly parameterized processes. [APECS Group Review, Germany]	See above - comment 7554
15536	3	18	43	18	45	Need recommendations for the specific types of work needed to systematically address these sources of uncertainty. [Daniel Feldman, USA]	See above - comment 7554
17588	3	18	43	18	45	Thought this statement was too vague to be informative. Would benefit from more detail. [Jonathan Bamber, UK]	See above - comment 7554
20726	3	18	43	18	45	Add to list 'sub-glacial hydrology (Bueler and van Pelt, 2015)' and 'negative feedbacks from solid Earth and gravitational effects (Gomez et al., 2015; Konrad et al., 2015)' [Tamsin Edwards, UK]	See above - comment 7554
23202	3	18	45	18	45	If Edwards et al. is still under review when this gets closer to publication, it is suggested not to use this one. Tehre is enough references. [Anthony Lupo, USA]	See above - comment 7554
1324	3	18	49	18	56	I think Marzeion et al. also provided some update projections from their glacier model. (I am not sure for Giese and Oerlemans). Slangen et al. 2017, A Review of Recent Updates of Sea-Level Projections at Global and Regional Scales, Survey of Geophysics is a good starting point. Also Huss and Hock is not an update projection: it is a new projection that was not included in AR5. [Etienne Berthier, France]	Accepted: We have revised what was section 3.2.4.3 'Polar Glaciers' (projections), and it is now incorporated in the Polar Glacier section (3.3.3.2). The revised section includes a broader range of references including those cited in this comment.
1426	3	18	49	18	50	for polar glaciers'. Would maybe be good to change to 'for all polar glaciers', as there are several recent studies (after AR5) that focus on projections of individual polar ice caps [Harry Zekollari, Switzerland]	Accepted - text revised in section Section 3.3.3.2
1428	3	18	49	19	5	Global studies (Radic et al., 2014; Huss and Hock, 2015) and regional studies (Clarke et al., 2015; McNabb et al., 2015) are presented in this section. As described in the text, they rely on several simplifications. It would be nice to here also acknowledge some recent 3-D modelling studies on the future evolution of polar glaciers (e.g. Gilbert et al., 2017, GRL doi: 10.1002/2016GL072394, who model the future dissapearance of Barnes Ice cap; Zekollari et al., 2017, TC, doi:10.5194/tc-11-805-2017, who model the future disappearance of the world's northernmost ice cap), as these provide detailed insight in the future evolution of these ice bodies and thereby inform more simplified studies. This would be in line with chapter 2, where detailed studies on mountain glaciers are also acknowledged (section 2.2.3.2, e.g. p2-20, l.16-18) [Harry Zekollari, Switzerland]	Accepted - text revised and citation added to Section 3.3.3.2

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
1720	3	18	49	18	56	What is the reason the for the difference in sensitivity between glaciers in Artic Canada and other regions? [Mark England, UK]	For larger ice masses such as in the Canadian Arctic, % mass loss relates the mass loss to a bigger number (more initial volume/mass), i.e. for the same average thinning the total lost in % is less if the initial volume is more. In the revised text it is now clear that we are dealing with relative (%) ice losses, and that the smaller % ice losses in Canada and Antarctica will actually cause larger sea level changes.
2672	3	18	49	18	57	It is necessary to provide further explanations about the results of this researches [Mohammad Javad Zareian, Iran]	See above
11608	3	18	49	18	49	This section starts from "only". That sounds negative sentence in this report. Here, it is not necessary to emphasize "only". Hirabayashi et al. (2013) also estimated glacier mass change for some areas in the world and sea level change reflecting RCP 8.5. Hirabayashi, Yukiko, et al. "Projection of glacier mass changes under a high-emission climate scenario using the global glacier model HYOGA2." Hydrological Research Letters 7.1 (2013): 6-11. [Keiko Konya, Japan]	Accepted; Hirabayashi et al. study is included in GlacierMIP study which is now the focus of this section. 'Only' has also been removed.
19238	3	18	49	18	50	More details about climate impacts on land ice are reported in the latest SWIPA assessment (Box and Sharp, 2017). Check also Lang et. al 2015 [Marianne Kroglund, Norway]	Accepted; Box and Sharp now cited
14280	3	18	52			century' (no caplital 'c' needed) [Christopher Fogwill, UK]	Accepted - text revised
19892	3	18	52	18	52	Do not capitalize "century" [Michelle A. North, South Africa]	See above
13072	3	18	54	18	54	Can you specify why Canadian glaciers might be less sensitive? [Gerhard Krinner, France]	For larger ice masses such as in the Canadian Arctic, % mass loss relates the mass loss to a bigger number (more initial volume/mass), i.e. for the same average thinning the total lost in % is less if the initial volume is more. In the revised text it is now clear that we are dealing with relative (%) ice losses, and that the smaller % ice losses in Canada and Antarctica will actually cause larger sea level changes.
7604	3	19	0	22		In this section 3.3.1 Observed changes, is there a reason why the figures that show these changes quantitatively (Fig 3.6 and 3.7) are regional maps, and why there are no time-mean change plot for the entire region? Adding above each map a plot of the mean annual SST, SIC and snow cover (Time on x-axis and annual mean on Y-axis) for the region showed on each map would help the reader integrate the change. This would work well for the Arctic region (Fig 3.6) but maybe less useful in the Antarctic case (Fig 3.7) where the trends are very regional? Still such subplot would nicely illustrate the statements line 30-31 and line 31-33. [APECS Group Review, Germany]	Taken into account; we have revised the figure to incorporate both observed and projected temporal change.
1430	3	19	2	19	4	Recommendations are given to improve projections. The insulating effect of surface debris cover is very important in certain regions, but this rather applies to the previous chapter (high mountain areas) than to this chapter (polar regions). In the recommendations, I would also suggest adding a better representation of surface mass balance processes and possible tipping points (e.g. related to refreezing), and hereby refer to the recent study of Noël et al. (2017, Nature Comm., doi: □10.1038/ncomms14730) [Harry Zekollari, Switzerland]	Accepted: reference to debris cover removed, citation to Noel et al. added

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
1432	3	19	2	19	2	When it comes to incorporating ice dynamics in a regional/global model: i.e. "utilise dynamic glacier models" (btw, check typo here), the recently released Open Global Glacier Model (OGGM) should also be mentioned (Maussion et al., 2018, GMDD, doi: 10.5194/gmd-2018-9) [Harry Zekollari, Switzerland]	Accepted: reference added
1842	3	19	4	19	4	There was high confidence in the updated glacier ice loss projections just a half a page ago, now only medium confidence? [Aku Riihelä, Finland]	Accepted - text revised
6210	3	19	4	19	4	There may be medium confidence in the amount of future glacier mass loss but there is very high confidence that mass loss will continue. [Regine Hock, USA]	Accepted - text revised to make this clear at start of paragraph
7598	3	19	8	19	9	The current title for this section 'Implications of Climate Change for Polar Oceans and Sea Ice: Feedbacks and Consequences for Ecological and Social Systems' is currently slightly misleading: it makes it sound more ecological and social systems orientated when it really is not for a majority of the section. Suggestion for more accurate title 'Observed and Projected Changes in Polar Oceans and Sea Ice and Implications for Ecological and Social Systems'. [APECS Group Review, Germany]	Taken into account: all section headers are being revisited and potentially revised in preparation of the SOD
18530	3	19	11	19	11	Completely missing in this chapter is snow on sea ice - this is important for sea ice mass balance, fluxes through sea ice and thus ocean/atmosphere interaction, and the light regime and thus both energy budgets as well as marine biology. In the Arctic, precipitation patterns coupled with thinning of Arctic sea ice make it a very different habitat with heavy snow load, more widespread snow-ice formation, and potentially more similar to Antarctic sea ice. [Angelika Renner, Norway]	A new section addressing snow on sea ice was added (3.2.1.1.6)
19242	3	19	12	19	12	Is it needed with an overarching text here, similar to the one under 3.3.5? [Marianne Kroglund, Norway]	Rejected: Contextual text is available in the introductions to the sub-sections.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
7602	3	19	13			There seems to be missing in this 3.3.1.1 'Sea ice' section a subsection about sea ice snow cover. Even if historically there is little data sea ice snow cover in the Arctic, climatologies exist. The recent N-ICE2015 expedition in the Arctic provided interresting insights on currently on-going snow cover changes in the Eurasian Basin. As Grankskog et al. (2018) summarizes well: ' [During the N-ICE2015 expedition,] thick snow (0.3–0.5 m) was found on both first-year and older ice (Gallet et al., 2017; Merkouriadi et al., 2017b; Rosel et al., 2016a, 2018). Already in January, the snow pack was about 0.5 m thick on SYI (Merkouriadi et al., 2017a; Rosel et al., 2016a, 2018), much thicker than one could expect from climatology (Warren et al., 1999) and in contrast to the reports of thinning snow on sea ice in the western Arctic (Webster et al., 2014). In recent years, observations have pointed toward rather thick snow in the area north of Svalbard (Haapala et al., 2013), although scarce data in the region hint toward increasing snow depth on sea ice north of Svalbard (Rosel et al., 2018). Thick snow limited thermodynamic bottom ice growth in winter and spring (Rosel et al., 2018). Two mechanisms contributed to flooding of the sea ice and snow-ice formation: ice breakup during storms and basal ice melt when the sea ice drifted into the main pathways of warmer Atlantic waters north of Svalbard (Provost et al., 2017). Sea ice cores indicated that snow contributed significantly to the mass balance of SYI (almost 10% by mass and 20–30% of thickness) (Granskog et al., 2017). These are the first reports of widespread flooding (Rosel et al., 2018) and snow-ice formation for pack ice in the central Arctic, a potential consequence of the thinning of sea ice in the Transpolar Drift (Haas et al., 2008; Hansen et al., 2013) and the regionally higher snow accumulation in the area north of Svalbard and the Barents Sea (Merkouriadi et al., 2017a, 2017b).'I suggest the above findings to be added to Chapter 3, maybe between sections 3.3.1.1.4 and 3.3.1.1.5. It could be entitles 'Sea ice snow cover'. In particular, the observations of snow-ice formation in the Arctic is a new phenomenon with large implications for current and future sea ice mass balance and ecosystems. [Granskog, M. A., Fer, I., Rinke, A., & Steen, H. (2018). Atmosphere-iceocean-ecosystem processes in a thinner Arctic sea ice regime: The Norwegian young sea iCE (N-ICE2015) expedition. Journal of Geophysical Research: Oceans, 123, 1586–1594. https://doi.org/10.1002/2017JC013328.] [APECS Group Review, Germany]	Accepted: snow depth on sea ice text added.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
15616	3	19	13	19	27	The 'Chapter 3: Polar Regions' of the 'IPCC SR Ocean and Cryosphere' by coordinating lead authors M. Meredith and M. Sommerkorn provides a comprehensive account of Earth's cryosphere's current status and future projections based on evidences from plethora of observations and model results. I would like to congratulate the authors and all the contributors to come up with a very well written draft. My expertise lies in the physical processes in the Arctic marginal ice zone (MIZ), sea ice thickness, sea ice roughness using the remote sensing and field observations. It is important to mention the following (high confidence) in the upcoming IPCC report. Please see below (3 points): 1. The occurrences of regions identified as MIZ are now commonly encountered across the Arctic with the growing reduction of sea ice extent and thickness. Strong, C., and I. G. Rigor (2013), Arctic marginal ice zone trending wider in summer and narrower in winter, Geophys. Res. Lett., 40, 4864–4868, doi:10.1002/grl.50928. Cole, S. T., Toole, J. M., Lele, R., Timmermans, M. L., Gallaher, S. G., Stanton, T. P., ... & Ortiz, M. (2017). Ice and ocean velocity in the Arctic marginal ice zone: Ice roughness and momentum transfer. Elem Sci Anth, 5. [Mukesh Gupta, Spain]	Rejected: The suggested reference for MIZ trends only covers the 1987-2011 period. Second suggested reference is a process study which does address trends/changes in the MIZ
4072	3	19	15	19	15	I suggest to include also other trophic levels than mammals when addressing the role of sea ice as a habitat. [Sebastian Gerland, Norway]	Accepted: text revised.
6394	3	19	15	19	26	The structure of the chapter is puzzling. In this paragraph and the following ones, the role of sea ice is described and observed changes are documented. However, earier (p.9, lines 25-31), there was a paragraph on the future Antarctic sea ice. That does not flow logically. In the same way, the paragraph at p. 19 line 15 describes the Arctic and Antarctic geography and explains the role of sea ice. It is not expected that such an introductory paragraph come so late in the text. [François Massonnet, Belgium]	Rejected: previous text on sea ice occurs within Box 3.1 in the context of connections between changes in polar regions and midlatitude weather. Section 3.2.1 is the first sea ice section in the main chapter text, hence the contextual paragraph.
6764	3	19	15	19	16	Move "provides an essential habitat for mammals" to after "access to the polar regions," for improved clarity. [James Pope, UK]	Accepted: text revised.
14282	3	19	15	19	17	Needs some reference to influence on thermohaline circulation [Christopher Fogwill, UK]	Accepted: text revised.
19240	3	19	15	19	15	Sea ice is essential habitat for more than marine mammals. Consider to write "ice-associalted species". Consider to cross reference to section 3.3 on marine ecosystems. [Marianne Kroglund, Norway]	Accepted: text revised.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
22546	3	19	15	19	17	"Sea ice insulates the ocean from the atmosphere, provides an essential habitat for mammals, influences navigation and access to the polar regions, and is of high importance to the traditional lifestyle of northern communities" This line includes an important role of sea ice (insulation) that was left out of Chapter 1, but then this line in Chapter 3 leaves out albedo and deep ocean circulation. I suggest that a cross-comparison of text is carried out. For Chapter 1, I have noted: p.1-8, ll.5-8: "Sea ice provides many critical functions in the Earth system; providing essential habitat for polar species, affecting climate change through amplification of surface warming via albedo effects, driving global deep ocean circulation via dense water formation, and providing livelihoods for people in the Arctic. " An important function has been missed out here. Suggest rewording this as: "Sea ice provides many critical functions in the Earth system; providing essential habitat for polar species, affecting climate change through amplification of surface warming via albedo effects, driving global deep ocean circulation via dense water formation, providing an insulating layer that regulates heat transfer between the ocean and atmosphere, and providing livelihoods for people in the Arctic. " [Inga Smith, New Zealand]	Accepted: will check on text revision in Chapter 1.
23740	3	19	15	19	15	Sea ice provides a habitat also for other groups, not only mammals; suggest rewording to "organisms" [Hans-Otto Poertner and WGII TSU, Germany]	Accepted: see 19240
24914	3	19	15	19	41	Very nicely written. [Elizabeth Weatherhead, USA]	Thank-you
7600	3	19	16	19	17	The term '… of northern communities.' here refers to 'human communities' but without being specific, it could be misinterpreted as other biological communities, such as algal communities. Please clarify the term if possible, using for example 'of northern indigenous communities', or 'northern human communities'. [APECS Group Review, Germany]	Accepted: text revised.
22592	3	19	16	19	17	Add "Indigenous" to say "northern Indigenous communities". [Eva Kruemmel, Canada]	Accepted: text revised.

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1924	3	19	18	19	18	Section 3.3.1.1.1 talks about changes in ice extent and concentration. It may be worthwhile to include information about the seasonally varying sea ice cover changes in the North Pacific (the Okhotsk Sea and the Bering Sea). Studies indicated that the internal variability may be important for sea ice change in these regions (e.g., Wu, R. and Z. Chen, 2016, An interdecadal increase in the spring Bering Sea ice cover in 2007, Frontiers in Earth Science, doi: 10.3389/feart.2016.00026). The sea ice trend in the Bering Sea during January-February is positive (e.g., Parkinson, C. L. and D. J. Cavalieri, 2008, Journal of Geophysical Research, Vol. 113, C07003, doi: 10.1029/2007JC004558), different from the other regions. This is visible on Figure 3.6 (b). [Renguang Wu, China]	Rejected: the suggested references (1) focus on a single season; (2) do not provide an update since AR5
22378	3	19	20	19	21	« … sea ice, which interacts with the Southern Ocean » : reads strange, as in a way sea ice is part of the ocean. I would suggest « which interacts with the upper layers of the Southern Ocean ». [Matthieu Chevallier, France]	Accepted: text revised.
3594	3	19	21	19	21	It says "nearly all Antarctic sea ice is seasonal". This is essentially true, but misleading. Haine & Martin (2017, cited above) objectively quantify sea ice seasonality (for both sea ice extent and sea ice volume). They show that indeed the Antarctic sea ice system is in the seasonal regime, but that the Arctic sea ice system, traditionally considered to be perennial, is now equally seasonal as the Antarctic. [Thomas Haine, USA]	Accepted: text revised.
23734	3	19	21	19	22	Consider providing a reference in which Southern Ocean summer/winter sea ice extent is shown or modelled [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account: this is provided in Section 3.2.1.1.1
22380	3	19	22	19	24	Reformulate : long sentence with lots of information that are difficult to relate (datasets, physical processes, trends). [Matthieu Chevallier, France]	Accepted: text revised.
7606	3	19	23	19	24	The word "mean" could be confusing here when it is often invoked for "average". Suggest changing to "result in/produce quite different observed trends and model performance between…" to make this sentence clearer. [APECS Group Review, Germany]	Accepted: text revised.
10704	3	19	24	19	26	It means, that the Local Knowledge from Eurasia is not taken into the assessment. Please add, or mention, that you collected LK only from America, so you have a large gap here. [Oxana Lipka, Russian Federation]	Taken into account: text revised, and as a general statement this covers both the North American and Eurasian Arctic.
22594	3	19	24	19	26	Please separate Indigenous knowledge from local knowledge. Also please write "from Indigenous communities across the circumpolar Arctic". Please note that Inuit, who have much knowledge about sea ice and the Arctic environment in general, live also in Greenland and Chukotka (Russia), not just in Alaska and Arctic Canada. You may also refer to the reports from the Inuit Circumpolar Council "The sea ice is our highway", and "The sea ice never stops", which can be found on ICC's website (www.inuitcircumpolar.com) - at least one of them is also already referenced later on. [Eva Kruemmel, Canada]	Accepted: text revised.
6076	3	19	25			The Inuit Circumpolar Council is very opposed to the term ILK (which we have articulated in detail in our commets on Ch. 1). Please do not lump IK and local knowledge together and refer instead to IK and LK as distinct and different knowledge systems. [Joanna Petrasek Macdonald, Canada]	Accepted: text revised.
23736	3	19	25	19	25	"Knowledge on Arctic sea ice…": Knowledge on what? Trends, dynamics? Please specify or revise [Hans-Otto Poertner and WGII TSU, Germany]	Accepted: text revised.

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23738	3	19	25	19	26	Provide link to Cross-Chapter Box 3 on ILK [Hans-Otto Poertner and WGII TSU, Germany]	Accepted: text revised.
19244	3	19	28	19	41	Perhaps self evident, but would be nice to spell out that loss of Arctic ice means more open water. [Marianne Kroglund, Norway]	Rejected: self evident
10870	3	19	31	19	32	Meier et al. (2014) should be cited here. This paper is a multi-centre review article which i find provides a comprehensive and very useful overview of observed Arctic sea ice changes. Although Meier et al (2014) is already cited in this draft chapter, under the ecology chnages section, I feel this should be cited here too where it is even more relevant. [Ed Blockley, UK]	Accepted: reference added
6390	3	19	32	19	35	With respect to what are the percentage changes expressed here? [François Massonnet, Belgium]	Accepted: text revised to state % changes are relative to 1981-2010
10842	3	19	33	19	34	Sea ice declines are listed in terms of percentages here. Whilst I am very much in favour of this - as it helps the lay reader to get to grips with the magnitude of the decline - one needs to be careful to ensure the numbers are quantified to avoid being misleading. The best way to do this is for percentage reductions to be presented along the lines of (say) "a decline of 2.7% per decade relative to the 1981-2010 mean value of XX million sq km)" [Ed Blockley, UK]	Accepted: text revised to state % changes are relative to 1981-2010
10706	3	19	35	19	41	Roshydromet publishes every year special reports: The report on the peculiarities of climate on the territory of the Russian Federation in 2017. - Moscow, 2018. - 69 p. (the latest one). It includes comprehensive information on changes of ice in Russian Arctic seas, with graphs and figures. Plese use it as the best source of information and add the reference. [Oxana Lipka, Russian Federation]	Rejected: published literature cited in Section 3.2.1.1 covers the Russian Arctic
16326	3	19	35	19	35	I question that „very high confidence“ can be attached to the actual numbers of the trend. There are substantial differences between different satellite data sets. [Dirk Notz, Germany]	Accepted: text revised. Confidence language text moved to reflect confidence in seasonality and direction of trend, not absolute value of trend.
22382	3	19	35	19	37	The sentence should be reformulated : « Spatially, summer sea ice loss is larger in the East Siberian Sea ». [Matthieu Chevallier, France]	Accepted: text revised.
14284	3	19	40			two decades' not '2 decades' [Christopher Fogwill, UK]	Accepted: text revised.
414	3	20	1	20	1	Four parts of Fig 3.5. should be labeled on the figure. What are these 4 examples? [George Burba, USA]	Reject; there are 4 panels simply to accomodate the amount of material, there is no arbitrary divsion
416	3	20	1	20	1	Numbers in black circles are too small to read. Consider making them larger. [George Burba, USA]	Accept; numbers enlarged
3514	3	20	1	20	1	I wouldn't have represented snow cover with a brown colour in Fig. 3.5 (6). Some white shading (like for the Greenland ice cap) seems appropriate. [Deborah Verfaillie, Spain]	Taken into account; the shading schematically denotes not snow per se, but its retreat and greater land exposure. Shading has been adjusted though.
13290	3	20	1	20	12	The country labels are almost invisible in Figure 3.5. Also, if possible, Russia should be spelled out in full in the 2 panels on the right-hand side (for consistency) [Katherine Bishop-Williams, Canada]	Accept; labels enlarged and names given in full
22384	3	20	1	20	12	In figure 3.5, I would add subtitles in the different subfigures (for instance, freshwater, sea ice and snow, ocean, biogeochemistry). [Matthieu Chevallier, France]	See response to comment 414
3512	3	20	3	20	10	Number (3) is missing in the legend of Fig. 3.5 [Deborah Verfaillie, Spain]	Accepted; now included.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
7608	3	20	3	20	10	Figure 3.5 is great. Some of the information of the figure is color coded (sea ice retreat, snow retreat, and increase primary production). Yet the caption does not explain these color code. Add necessary information in caption such as '(5) retreat of sea ice with the red area representing sea ice loss over the past xx years.' and '(6) retreat of seasonal snow cover on land with the brown (?) area representing snow cover loss over the past xx years' etc… [APECS Group Review, Germany]	Taken into account: Figure 3.5 was revised, and we cite the relevant sections where timescales etc are detailed.
7610	3	20	3	20	10	Figure 3.5: Does it make the figure too busy if the name of each change (Ocean circulation, Freshwater discharge, Efflux, Glacial loss, Sea ice retreat…) is added on the schematic itself? It would help the reader put these in perspective. [APECS Group Review, Germany]	See response to comment 414
20974	3	20	3	20	3	Figure 3.5 ignores the Barents Sea and suggests Svalbard and Franz Josef Land are surrounded by deep water. This is misleading, as they are part of the Barents shelf! [Claudio Richter, Germany]	Accepted; figure redrawn accordingly
22880	3	20	3	20	10	There seems to be missing a number (3) in legend. Also it is unfortunate from a geographical/topographical pont of view that the illustration in Figure 3.5 gives the visual impression of the Barents sea being very deep and comparabel to rest of arctic ocean in depth - this confuses understanding of oceans and ocean currents in general. [Lena Rubensdotter, Norway]	See response to comment 20974 and comment 3512
1722	3	20	4	20	4	Missed number (3) before 'strengthening efflux' [Mark England, UK]	See response to comment 3512
16868	3	20	4	20	5	missing "3)" between "the Arctic Ocean {3.3.1.2.2};" and "strengthening efflux" [Anthony Mémin, France]	See response to comment 3512
19894	3	20	4	20	5	The label (3) is missing from the figure legend [Michelle A. North, South Africa]	See response to comment 3512
22386	3	20	4	20	4	Item (3) is missing… [Matthieu Chevallier, France]	See response to comment 3512
1844	3	20	5	20	5	The number for change item (3) is missing from the caption [Aku Riihelä, Finland]	See response to comment 3512
4074	3	20	5	20	5	"(3)" is missing ahead of "strengthening efflux …" [Sebastian Gerland, Norway]	See response to comment 3512
7612	3	20	5	20	5	Missing the reference to one of the change in the caption: '; strengthening efflux to…' should be '; (3) strengthening efflux to… ' [APECS Group Review, Germany]	See response to comment 3512
15992	3	20	5	20	50	The number (3) is missing from the figure caption to denote the "strengthening efflux [Patrick Taylor, USA]	See response to comment 3512
13468	3	21	0			Fig 3.6 It is confusing that in (a) the land masses are grey, and the sea is coloured, while in (b) the sea is mostly white, except for where it is brown. A different palette that doesn't end in white, or where the land is not grey may be better. Snow and SIC should have a different colour palette (preferable), or the same colour should have the same meaning. Also (a) shows a smaller area than (b). Possibly use same latitude cutoff for both. The text "annual 1982-2016" should be removed. What does linear trend mean exactly? The mean annual change between 1982 and 2016? The total change from 82 to 2016 assuming a linear trend? Or mean change per decade, as in palette legend (oC dec-1)? [Debra Roberts and Durban Team, South Africa]	Taken into account: Figure 3.6 was revised

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
3992	3	21	1	21	1	I wonder if figure 3.6.1 could be improved by showing a) SST change b) sea ice change c) surface air temperature change and d) snow cover change. I found that in the current figure, the detail in SST in 3.6a) was not matched by the sea ice in 3.6b) as 3.6b) extends to lower latitudes to include snow [Helene Hewitt, UK]	Taken into account: Figure 3.6 was revised
7614	3	21	1	21	1	Figure 3.6: Nice data. On the figure itself, can the acronyms SST and SIC be either changed to full name or removed for clarity? [APECS Group Review, Germany]	Taken into account: Figure 3.6 was revised
7616	3	21	1	21	1	Figure 3.6: Can the units provided on the figure (oC dec-1 and % dec-1) be explained or given as a full standard name in the figure legend? [APECS Group Review, Germany]	Taken into account: Figure 3.6 was revised
10844	3	21	1			Figure 3.6 displays trends in SST, SIC and terrestrial snow cover for the Northern Hemisphere but does not contain any information on significance. It would be nice to see stippling/shading added to areas where trends are NOT significant. [Ed Blockley, UK]	Taken into account: Figure 3.6 was revised
13292	3	21	1	21	10	For consistency and ease of reading, it would be ideal to show the northern hemisphere to the same latitude in each panel of Figure 3.6. This will help to orient the reader to the content. (A similar problem persists in Figure 3.7) [Katherine Bishop-Williams, Canada]	Taken into account: Figure 3.6 was revised
19896	3	21	1	21	1	It would be easier to compare the two parts of Figure 3.6 if map (b) was on the same scale as (a) [Michelle A. North, South Africa]	Taken into account: Figure 3.6 was revised
19904	3	21	1	22	5	For the figures, could you please explain what the units are (e.g., °C dec-1 or % dec-1?) and what the headings SST trend and SIC trend are referring to (explain the acronyms) [Michelle A. North, South Africa]	Taken into account: Figure 3.6 was revised
3996	3	21	7	21	7	I think it would be better if panels a and b of figure 3.7 showed the same latitude range in the polar stereographic projection [Helene Hewitt, UK]	Taken into account: Figure 3.7 was revised
15416	3	21	8	21	8	Brun et al., 2012 to be replaced by Brun et al. 2013 : Brun, E., V. Vionnet, A. Boone, B. Decharme, Y. Peings, R. Valette, F. Karbou and S. Morin, Simulation of northern Eurasian local snow depth, mass and density using a detailed snowpack model and meteorological reanalyses, J. Hydrometeorol., 14, 203–219, doi :10.1175/JHM-D-12-012.1, 2013. [Samuel Morin, France]	Accepted: text revised.
2316	3	21	11	21	26	With the open water, ocean waves are able to grow larger and become more destructive to the ice, which induces additional break-up of the ice. Similarly, cyclones in the Arctic Ocean lead to fragmentation, deformation, and movement of the ice—all of which contribute to breaking up the ice. (Zhang J., et al. (2012) Recent changes in the dynamic properties of declining Arctic sea ice: A model study, GEOPHYSICAL RESEARCH LETTERS 39(L20503):1–6; Thompson J. & Rogers W. E. (2014) Swell and sea in the emerging Arctic Ocean, GEOPHYSICAL RESEARCH LETTERS 41:3136–3140; Day J. J. & Hodges K. I. (2018) Growing Land-Sea Temperature Contrast and the Intensification of Arctic Cyclones, GEOPHYSICAL RESEARCH LETTERS 45:3673–3681; Zhang J., et al. (2013) The impact of an intense summer cyclone on 2012 Arctic sea ice retreat, GEOPHYSICAL RESEARCH LETTERS 40:720–726.) [Kristin Campbell, USA]	Accepted: text revised and references added

Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
2442	3	21	11	21	26	With the open water, ocean waves are able to grow larger and become more destructive to the ice, which induces additional break-up of the ice. Similarly, cyclones in the Arctic Ocean lead to fragmentation, deformation, and movement of the ice—all of which contribute to breaking up the ice. (Zhang J., et al. (2012) Recent changes in the dynamic properties of declining Arctic sea ice: A model study, GEOPHYSICAL RESEARCH LETTERS 39(L20503):1–6; Thompson J. & Rogers W. E. (2014) Swell and sea in the emerging Arctic Ocean, GEOPHYSICAL RESEARCH LETTERS 41:3136–3140; Day J. J. & Hodges K. I. (2018) Growing Land-Sea Temperature Contrast and the Intensification of Arctic Cyclones, GEOPHYSICAL RESEARCH LETTERS 45:3673–3681; Zhang J., et al. (2013) The impact of an intense summer cyclone on 2012 Arctic sea ice retreat, GEOPHYSICAL RESEARCH LETTERS 40:720–726.) [Durwood Zaelke, USA]	Same comment as 2316
12940	3	21	11	21	26	With the open water, ocean waves are able to grow larger and become more destructive to the ice, which induces additional break-up of the ice. Similarly, cyclones in the Arctic Ocean lead to fragmentation, deformation, and movement of the ice—all of which contribute to breaking up the ice. (Zhang J., et al. (2012) Recent changes in the dynamic properties of declining Arctic sea ice: A model study, GEOPHYSICAL RESEARCH LETTERS 39(L20503):1–6; Thompson J. & Rogers W. E. (2014) Swell and sea in the emerging Arctic Ocean, GEOPHYSICAL RESEARCH LETTERS 41:3136–3140; Day J. J. & Hodges K. I. (2018) Growing Land-Sea Temperature Contrast and the Intensification of Arctic Cyclones, GEOPHYSICAL RESEARCH LETTERS 45:3673–3681; Zhang J., et al. (2013) The impact of an intense summer cyclone on 2012 Arctic sea ice retreat, GEOPHYSICAL RESEARCH LETTERS 40:720–726.) [Gabrielle Dreyfus, USA]	Same comment as 2316
15566	3	21	11	22	36	How can we strengthen links to Anthropogenic warming to phenomena observed in the Southern Ocean. Ozone situation is an interesting one given the role of Short Lived Climate Pollutants in warming. [Melinda Kimble, USA]	Not clear what the reviewer is suggesting
16314	3	21	11	21	15	I do not share the view tht the finding that „50 to 60 %“ of the ice loss is caused by external forcing is robust enough to warrant the statement „very high confidence“. There is substantial disagreement among the cited references as to the exact contribution of external forcing to the long-term trend. [Dirk Notz, Germany]	Accepted: confidence language text revised
19246	3	21	11	21	15	Could this statement qualify as a key message? Important information for policy makers. [Marianne Kroglund, Norway]	Taken into account: key messages are being revised in preparation of the SOD
5366	3	21	16	21	16	"certainly": isn't this an overly strong statement (based on one paper), although it is no uncertainty language? [Roderik Van De Wal, Netherlands]	Accepted: text revised
16316	3	21	18	21	19	It should be made clearer that the statement „ice-albedo feedback is important for the evolution of summer sea ice“ is only true for the evolution within a specific year from spring to summer. It is not true for the long-term evolution of summer sea ice, where the ice-albedo feedback is more than offset by negative feedbacks during winter, as described later in this paragraph. Please examine whether „very high confidence“ of this claim is indeed only supported by the single study cited here. [Dirk Notz, Germany]	Accepted: text revised

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
3994	3	21	19	21	19	Is Schroeder at al (2014) the right reference here? Does the text mean to refer to meltponds? [Helene Hewitt, UK]	Accepted: reference removed
15994	3	21	19	21	19	Here is an additional reference that supports the influence of atmospheric advection and downwelling LW radiation to initiating melt onset. Hegyi, B.M. and Y. Deng, 2017: Dynamical and Thermodynamical Impacts of High- and Low-Frequency Atmospheric Eddies on the Initial Melt of Arctic Sea Ice. J. Climate, 30, 865–883, https://doi.org/10.1175/JCLI-D-15-0366.1 [Patrick Taylor, USA]	Accepted: text revised and citation added
15996	3	21	19	21	26	Additionally, there have been several studies that indicate that moisture transport into the Arctic can influence winter ice growth partly offsetting these negative feedbacks stabilizing Arctic sea ice cover. Hegyi, B. M., P. C. Taylor, 2018: The unprecedented 2016-17 Arctic sea ice growth season: The crucial role of atmospheric rivers and longwave fluxes. Geophys. Res. Lett., 45, 5204–5212. https://doi.org/10.1029/2017GL076717 Hegyi, B. M. and P. C. Taylor, 2017: The Arctic Oscillation and Arctic Dipole regionally influence the wintertime surface radiation budget. Geophys. Res. Lett. 44, doi: 10.1002/2017GL073281. [Patrick Taylor, USA]	Taken into account: text revised on the negative feedbacks; Hegyi and Taylor (2018) citation added.
1846	3	21	21	21	21	The overall decrease of the albedo of the Arctic Ocean and its sea ice, resulting from changes in both extent and surface state, has also been reported from observations over decadal scales (Riihelä et al., 2013). [Aku Riihelä, Finland]	Rejected: suggested citation covers the 1982-2009 time period.
5368	3	21	22	21	26	The first negative feedback needs a bit more rigorous explanation (it is too compact; comparison between two situations) to be made clear what the acting feedback is. [Roderik Van De Wal, Netherlands]	Accepted: text revised
1304	3	21	23	21	24	A shorter snowfall accumulation period may be offset by increased cold season precipitation… the potential for white ice formation from slushing may be increased in this case which could be seen as another negative feedback. [Ross Brown, Canada]	Taken into account: new text on snow depth on sea ice now includes discussion of the potential increase in Arctic white ice (snow ice) formation.
5370	3	21	28	21	30	Why is high confidence chosen? [Roderik Van De Wal, Netherlands]	Accepted: text revised
7618	3	21	30	21	31	Consider including here the radiative balance differences between the two poles as well. Goosse et al 2018 specify greater negative cloud feedback and a smaller lapse rate feedback as well as ocean heat uptake as to why Antarctic sea ice is less sensitive than Arctic sea ice to warming (Goosse, H., Kay, J. E., Armour, K. C., Bodas-Salcedo, A., Chepfer, H., Docquier, D., … & Park, H. S. (2018). Quantifying climate feedbacks in polar regions. Nature communications, 9(1), 1919.). [APECS Group Review, Germany]	Accepted: text revised and citation added
7620	3	21	32	21	32	Between 1979 and when? [APECS Group Review, Germany]	Accepted: text revised
6766	3	21	33	21	33	"But with a very sharp decline since 2016", since implies a change in sea ice regime, when in fact 2016 and 2017 could just be anomalous years. I believe that the sentence should be amedned to highlight that we are currently unsure of how sea ice trends in Antarctic will develop in the coming years [James Pope, UK]	Accepted: text revised
16328	3	21	33	21	33	I question that „high confidence“ can be attached to the actual numbers of the trend. There are substantial differences between different satellite data sets. [Dirk Notz, Germany]	Accepted: text revised. Confidence language text moved to reflect confidence in seasonality and direction of trend, not absolute value of trend.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
13470	3	22	0			Fig 3.7 Please define 'linear trend', as for previous figure. The text refers to a general increase and then a sudden decline since 2016. A graph could help visualise this. A few labels of areas mentioned in the text would help the reader know what to look at (Ross Sea, Bellingshausen Sea, etc) [Debra Roberts and Durban Team, South Africa]	Taken into account: Figure 3.5 was revised
14286	3	22	1			no hyphen needed in 'statistically significant' [Christopher Fogwill, UK]	Accepted: text revised
16332	3	22	1	22	1	The assessment of the Ross-Sea trend as being significant can only be robust if we have a robust understanding of the internal variability that would determine the significance of the trend. I don‘t believe this to be the case and suggest removing the term „significant“ here. [Dirk Notz, Germany]	Accepted: text revised
19900	3	22	1	22	2	Include a term indicating the direction of the overall trend in autumn (e.g., "…overall trend is greatest in autumn, with an increase of … per year…") [Michelle A. North, South Africa]	Accepted: text revised
16330	3	22	2	22	2	I question that „high confidence“ can be attached to the actual numbers of the trend. There are substantial differences between different satellite data sets. [Dirk Notz, Germany]	Accepted: text revised
10846	3	22	5			Figure 3.6 displays trends in SST and SIC for the Southern Hemisphere but does not contain any information on significance. It would be nice to see stippling/shading added to areas where trends are NOT significant. [Ed Blockley, UK]	Taken into account: Figure 3.6 was revised
19902	3	22	5	22	5	As with the previous figure, it would be best if maps (a) and (b) were depicted on the same scale, so that Antarctica is the same size in both [Michelle A. North, South Africa]	Taken into account: Figure 3.6 was revised
7622	3	22	24	22	24	What is the statement 'there is low confidence in their overall importance' based on? Add reference or source. [APECS Group Review, Germany]	Accepted: text revised
2318	3	22	26	22	36	Note that the ozone layer is starting to show signs of repair with the success of the Montreal Protocol. (Solomon S., et al. (2016) Emergence of healing in the Antarctic ozone layer, SCIENCE 353(6296):269–274.) [Kristin Campbell, USA]	Not clear what is being requested
2444	3	22	26	22	36	Note that the ozone layer is starting to show signs of repair with the success of the Montreal Protocol. (Solomon S., et al. (2016) Emergence of healing in the Antarctic ozone layer, SCIENCE 353(6296):269–274.) [Durwood Zaelke, USA]	See 2318
5236	3	22	26	22	27	I'll suggest to reverse the two parts of the sentence so that it is clear that ozone depletion is a factor explaining the [Laurie Menviel, Australia]	Accepted: text revised
5238	3	22	26	22	27	strenghtening of the SH westerlies and SAM [Laurie Menviel, Australia]	See 5236
12942	3	22	26	22	36	Note that the ozone layer is starting to show signs of repair with the success of the Montreal Protocol. (Solomon S., et al. (2016) Emergence of healing in the Antarctic ozone layer, SCIENCE 353(6296):269–274.) [Gabrielle Dreyfus, USA]	See 2318
21180	3	22	26	22	26	The strengthening westerlies are linked to the ozone depletion rather than the reverse as expressed here. [Andrew Constable, Australia]	Accepted: text revised
19906	3	22	27	22	27	The acronym "SAM" has not been introduced in this section [Michelle A. North, South Africa]	Accepted: text revised

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2244	3	22	32	22	36	I disagree that "Most studies conclude that glacial freshwater input is insufficient to cause a significant [sea ice] extension", I would rather say that this is still a matter of debate because it is very sensitive to the experimental design. Indeed Merino et al. (2018) show that although winds explain most of the sea ice trends, ice-shelf meltwater does affect sea ice trends. At most locations, increased ice shelf melting leads to more sea ice, except in the Amundsen Sea where increased ice shelf melt induced upward heat transport through entrainment (see also Jourdain et al. 2017). This is only captured if the ice-shelf meltwater is injected at depth. Merino, N., Jourdain, N. C., Le Sommer, J., Goosse, H., Mathiot, P., & Durand, G. (2018). Impact of increasing antarctic glacial freshwater release on regional sea-ice cover in the Southern Ocean. Ocean Modelling, 121, 76-89. // Jourdain, N. C., Mathiot, P., Merino, N., Durand, G., Le Sommer, J., Spence, P., ... & Madec, G. (2017). Ocean circulation and sea-ice thinning induced by melting ice shelves in the Amundsen Sea. Journal of Geophysical Research: Oceans, 122(3), 2550-2573. [Nicolas Jourdain, France]	Accepted: text revised and moved to Section 3.2.1.2.3
7626	3	22	32	22	36	These sentences are repeated almost word-for-word in Section 3.3.1.2.3. Consider deleting them here to save space, and adding additional information in Section 3.3.1.2.3 instead, where it is in better context. [APECS Group Review, Germany]	Accepted: text revised and moved to Section 3.2.1.2.3
6396	3	22	35	22	36	If there is medium confidence that historical trends in Antarctic sea ice extent have NOT been driven by input of glacial meltwater, can we say that there is medium confidence that they have been driven by input of glacial meltwater? Semantically speaking, this former sentence is hard to get and I would replace it by the latter. [François Massonnet, Belgium]	Accepted: text revised and moved to Section 3.2.1.2.3
7624	3	22	35	22	35	Can you provide a source of reference for the statement ' there is medium confidence that historical sea ice trends have not been driven by glacial meltwater.'? [APECS Group Review, Germany]	Accepted: text revised and moved to Section 3.2.1.2.3
15620	3	23	5	23	23	3. Section 3.3.1.1.2 (Thickness and age). Sea ice thickness retrieval using passive microwave satellite data is being increasingly explored now and have been quite successful. This provides all-weather and near-real-time coverage of the Arctic sea ice thickness. Kaleschke, L., Tian-Kunze, X., Maaß, N., Beitsch, A., Wernecke, A., Miernecki, M., ... & Pohlmann, T. (2016). SMOS sea ice product: Operational application and validation in the Barents Sea marginal ice zone. Remote sensing of environment, 180, 264-273. Huntemann, M., Heygster, G., Kaleschke, L., Krumpen, T., Mäkynen, M., & Drusch, M. (2014). Empirical sea ice thickness retrieval during the freeze up period from SMOS high incident angle observations. The Cryosphere, 8(2), 439-451. [Mukesh Gupta, Spain]	Accepted: text revised and Kaleschke et al citation added

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22388	3	23	5	23	23	There isn't any information on the quality and relevance of information provided by reanalyses on sea ice thickness in the polar regions. « Calibrated model simulations » are mentioned, thus there is no reason not to mention sea ice thickness information from reanalyses. Maybe refer to Chevallier M. and co-authors, 2017, Intercomparison of the Arctic sea ice cover in global ocean-sea ice reanalyses from the ORA-IP project, Climate Dynamics, doi:10.1007/s00382-016-2985-y. [Matthieu Chevallier, France]	Accepted: text revised and citation added
22404	3	23	5	23	23	If a word is said on melt pond coverage being a predictor of September sea ice extent (p23, L35-36, see my comment #8), there may be relevant to say that the winter sea ice thickness distribution is also a predictor / a preconditioner of September sea ice extent, according to a wide body of literature (e.g. Guémas et al., 2016, QJRMS, A review on Arctic sea ice predictability and prediction on seasonal-to-decadal timescales, 10.1002/qj.2401). [Matthieu Chevallier, France]	Accepted: text revised and citation added
22496	3	23	5	23	23	The section on sea ice thickness is weak. There are more investigations on sea ice thickness in the literature. Two examples: Haas, et al. (2017), Ice and Snow Thickness Variability and Change in the High Arctic Ocean Observed by In Situ Measurements ,Geophysical Research Letters, 44 .doi:10.1002/2017GL075434 , hdl:10013/epic.51862. Ricker et al. (2017), A weekly Arctic sea-ice thickness data record from merged CryoSat-2 and SMOS satellite data , Cryosphere, 11 (4), pp. 1607-1623 .doi:10.5194/tc-11-1607-2017 , hdl:10013/epic.51337 [Peter Lemke, Germany]	Accepted: text revised and Ricker et al citation added
2322	3	23	6	23	17	Thinner sea ice is also more prone to disintegration from increase ocean swells and cyclones. (Zhang J., et al. (2012) Recent changes in the dynamic properties of declining Arctic sea ice: A model study, GEOPHYSICAL RESEARCH LETTERS 39(L20503):1–6; Thompson J. & Rogers W. E. (2014) Swell and sea in the emerging Arctic Ocean, GEOPHYSICAL RESEARCH LETTERS 41:3136–3140; Day J. J. & Hodges K. I. (2018) Growing Land-Sea Temperature Contrast and the Intensification of Arctic Cyclones, GEOPHYSICAL RESEARCH LETTERS 45:3673–3681; Zhang J., et al. (2013) The impact of an intense summer cyclone on 2012 Arctic sea ice retreat, GEOPHYSICAL RESEARCH LETTERS 40:720–726.) [Kristin Campbell, USA]	Taken into account: text revised and Zhang et al paper was already cited.
2448	3	23	6	23	17	Thinner sea ice is also more prone to disintegration from increase ocean swells and cyclones. (Zhang J., et al. (2012) Recent changes in the dynamic properties of declining Arctic sea ice: A model study, GEOPHYSICAL RESEARCH LETTERS 39(L20503):1–6; Thompson J. & Rogers W. E. (2014) Swell and sea in the emerging Arctic Ocean, GEOPHYSICAL RESEARCH LETTERS 41:3136–3140; Day J. J. & Hodges K. I. (2018) Growing Land-Sea Temperature Contrast and the Intensification of Arctic Cyclones, GEOPHYSICAL RESEARCH LETTERS 45:3673–3681; Zhang J., et al. (2013) The impact of an intense summer cyclone on 2012 Arctic sea ice retreat, GEOPHYSICAL RESEARCH LETTERS 40:720–726.) [Durwood Zaelke, USA]	See 2322

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
12946	3	23	6	23	17	Thinner sea ice is also more prone to disintegration from increase ocean swells and cyclones. (Zhang J., et al. (2012) Recent changes in the dynamic properties of declining Arctic sea ice: A model study, GEOPHYSICAL RESEARCH LETTERS 39(L20503):1–6; Thompson J. & Rogers W. E. (2014) Swell and sea in the emerging Arctic Ocean, GEOPHYSICAL RESEARCH LETTERS 41:3136–3140; Day J. J. & Hodges K. I. (2018) Growing Land-Sea Temperature Contrast and the Intensification of Arctic Cyclones, GEOPHYSICAL RESEARCH LETTERS 45:3673–3681; Zhang J., et al. (2013) The impact of an intense summer cyclone on 2012 Arctic sea ice retreat, GEOPHYSICAL RESEARCH LETTERS 40:720–726.) [Gabrielle Dreyfus, USA]	See 2322
3704	3	23	8	23	11	I agree that we have „high confidence“ that the ice has thinned. I disagree that this „high confidence“ is also true for the actual amount of the thinning, as is implied by the current text. [Dirk Notz, Germany]	Accepted: text revised
19250	3	23	11	23	17	Include thinning and age of sea ice in key message on sea ice? [Marianne Kroglund, Norway]	Taken into account: key messages are being revised for the SOD
4076	3	23	17	23	17	When discussing sea ice thickness and related trends in the Arctic, also information from regional studies with panarctic relevance could be included, for example the studies about sea ice thickness from moorings/upward looking sonars, airborne or in situ surveys in Fram Strait (Hansen, E. et al. 2013 (Journal of Geophysical Research Oceans 118), Renner, A. et al. 2014 (Geophysical Research Letters 41), Krumpen et al. 2016 (The Cryosphere 10; already cited in the section 3.3.1.1.4 on motion)), in the Barents Sea (King, J. et al. 2017 (Journal of Geophysical Research Oceans 122), and north of Svalbard (Rösel, A. et al. 2018 (Journal of Geophysical Research Oceans 123)). [Sebastian Gerland, Norway]	Accepted: text revised and Renner et al citation added
2246	3	23	19	23	23	Merino et al. (2018) show that changes in freshwater forcing may induce large changes in sea-ice thickness, explaining about one half of the total change due to the combination of atmospheric and freshwater changes. In other words, ice-shelf meltwater has stronger relative influence on trends in sea ice thickness than on trends in sea ice area. [Nicolas Jourdain, France]	See 2244: text on freshwater impacts on Antarctic sea ice moved to Section 3.2.1.2.3
10848	3	23	20	23	23	I'm not sure that I follow the reasoning here. The Antarctic extent is increasing by about 20,000 sq km per year and these model simulations suggest that volume is increasing by 30 cubic km per year. This is exactly the volume increase I would expect if the ice were 1.5 m thick on average (i.e, 0.0015km thick => 20,000 *0.0015 = 30). So I don't think it necessarily follows that this implies a thickneing of the ice. More justification/information is required here. [Ed Blockley, UK]	Accepted: text revised
16870	3	23	22	23	22	correct "30 km3/y" to "30 km3/yr" [Anthony Mémin, France]	Accepted: text revised
16986	3	23	22	23	22	Should give a sense of whether this is a lot or rather little. [Markku Rummukainen, Sweden]	Accepted: text revised
19248	3	23	25	23	25	Perhaps explain that phenology means timing of events? [Marianne Kroglund, Norway]	Rejected: term is used widely

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7628	3	23	26	23	26	Check the definition of sea ice melt season in brackets: 'onset of liquid water within the snowpack' which seems to define the onset, not the season. Rephrase as necessary... Should it be 'period during which liquid water is found in the snowpack'? [APECS Group Review, Germany]	Accepted: text revised
10850	3	23	26	23	29	It is said that the Arctic melt season has increased by 10 days per decade but no time-frame/period is provided. Presumably this is overall during the satellite era (i.e., since 1979)? [Ed Blockley, UK]	Accepted: text revised
16322	3	23	27	23	27	I question that „very high confidence“ on the actual lengthening of the melt rate exists. Besides, I do not see how „very high confidence“ can be established from a single study. [Dirk Notz, Germany]	Accepted: text revised
22390	3	23	28	23	28	Number is missing for « earlier melt onset ». [Matthieu Chevallier, France]	Accepted: text revised
22392	3	23	35	23	38	Paper by D. Schröder and co-authors is controversial, since the melt-pond predictor is based on model simulations without using any observation. I would suggest rewording « the timing and magnitude of spring melt pond coverage could also be a predictor of the September ice extent ». Maybe refer to Liu and coauthors (2015, Revisiting the potential of melt pond fraction as a predictor for the seasonal Arctic sea ice extent minimum, ERL, doi :10.1088/1748-9326/10/5/054017), who use satellite retrievals of melt ponds from MODIS and found a higher link at subseasonal time scales. [Matthieu Chevallier, France]	Accepted: text revised and Liu et al reference added
5372	3	23	40	23	44	Why is very high confidence chosen? It seems inappropriate, since only one study is used. [Roderik Van De Wal, Netherlands]	Accepted: text revised
16324	3	23	44	23	44	I question that „very high confidence“ on the actual lengthening of the melt rate exists. Besides, I do not see how „very high confidence“ can be established from a single study. [Dirk Notz, Germany]	Accepted: text revised
15618	3	23	46	24	7	2. The incidents of waves passing through Arctic sea ice creating MIZ have been reported since AR5. It would be worth mentioning in the IPCC report. Ardhuin, F., Boutin, G., Stopa, J., Girard-Ardhuin, F., Melsheimer, C., Thomson, J., ... & Wadhams, P. (2018). Wave attenuation through an Arctic Marginal Ice Zone on October 12, 2015. Part 2: numerical modeling of waves and associated ice break-up. [Mukesh Gupta, Spain]	Rejected: while interesting, this paper focuses on a single case study
3706	3	23	47	23	57	The term „ice“ should be changed to „sea ice“ throughout this paragraph [Dirk Notz, Germany]	Accepted: text revised
14288	3	23	48			...the Fram Strait...' [Christopher Fogwill, UK]	Accepted: text revised
3708	3	23	50	23	51	Olason and Notz (JGR, 2014) give a more nuanced view of the drift acceleration, which is for example not significant in spring and barely significant in winter. [Dirk Notz, Germany]	Accepted: text revised and citation added
1724	3	23	51	23	52	Should it be 'the Fram Strait' rather than 'Fram Strait' twice in this sentence? [Mark England, UK]	Accepted: text revised
3596	3	23	51	23	51	There are other papers apart from Rampal et al. that are relevant. E.g. Kwok et al. (2013, cited on line 55) and Spreen et al. (2011, Trends in Arctic sea icedrift and role of wind forcing: 1992–2009, Geophys. Res. Lett., 38,L19501, doi:10.1029/2011GL048970). [Thomas Haine, USA]	Accepted: Spreen et al citation added

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3740	3	23	51	23	51	Cite also Vihma, T., Tisler, P., & Uotila, P. (2012). Atmospheric forcing on the drift of Arctic sea ice in 1989-2009. Geophysical Research Letters, 39(2), doi:10.1029/2011GL050118. They confirmed the Rampal et al. 2009 main result that the ice thinning is the reason, not wind changes, for faster moving ice n contrast to Hakkinen et al. (2008) and Spreen et al. (2011) who attributed the drift speed increase to wind increase, at least partially. [Petteri Uotila, Finland]	Accepted: text revised and Vihma et al reference added
15998	3	23	52	23	52	Should this be km^3 in stead of km^2; ice volum export? [Patrick Taylor, USA]	Rejected: this is an ice area estimate
5374	3	23	56	23	57	The paper about this, is not describing advancements in tracking algorithms and satellite radar coverage, but about advancements in modelling of Canadian Arctic Archipelago ice. [Roderik Van De Wal, Netherlands]	Accepted: sentence removed.
8202	3	23	56	23	57	I would add the paper of Howell et al. 2018 as a reference here as it shows even more improvement in ice motion tracking than his previous 2016 paper. (Stephen E. L. Howell, Alexander s. Komarov, Mohammed Dabboor, Benoit Montpetit, Micheal Brady, Randall K. Scharien, Mallik S. Mahmud, Vishnu Nandan, Torsten Geldsetzer and John Yackel. 2018. Comparing L- and C-band synthetic aperture radar estimates of sea ice motion over different ice regimes, Remote Sensing of Environment, vol. 204, pp. 380-391.) [Benoit Montpetit, Canada]	Taken into account: sentence was removed in response to other review comments
16988	3	23	56	23	57	Not clear how this sentence adds to the assessment. Is it needed? [Markku Rummukainen, Sweden]	Accepted: sentence removed.
8204	3	24	6	24	17	I would add a sentence or two about in situ measurements of sea ice thickness done with electromagnetic devices (Haas et al., 2017; Haas and Howell, 2015, 2015; Haas 2012). These measurements have been used in many recent sea ice studies in the Arctic and the EM instrument is even mounted on sleds for the communities to start using and monitor sea ice conditions around their communities. "Haas C., Beckers J., King J., Silis A., Stroeve J., Wilkinson J., Notenboom B., Schweiger A. and Hendricks S. 2017. Ice and Snow Thickness Variability and change in the high arctic ocean observed by in situ measurements. Geophysical Research Letters, vol. 44 (20), pp. 10462-10469." ; "Haas C. and Howell S. E. L. 2015. Ice Thickness in the Northwest Passage, Geophysical Research Letters, vol. 42 (18), pp. 7673-7680." ; "Haas C. 2012. Airborne observations of the distribution, thickness and drift of different sea ice types and extreme ice features in the Canadian Beaufort Sea, Society of Petroleum Engineers - Arctic Technology Conference 2012, vol. 2, pp. 887-894." [Benoit Montpetit, Canada]	Rejected: while valuable studies, there is insufficient trend information from the EM surveys
3710	3	24	9	24	35	The term „ice“ should be changed to „sea ice“ throughout this paragraph [Dirk Notz, Germany]	Accepted: text revised
10854	3	24	9	24	35	Although observations are sparse, some estimates of landfast ice thinning are provided within subsection 3.3.1.1.5. However no statements are made regarding confidence or uncertainty regarding these reported changes/results. [Ed Blockley, UK]	Taken into account: confidence statements are being revisited for the entire chapter.
1726	3	24	10	24	10	It seems 'fast ice' is not defined, suggest using 'landfast ice' [Mark England, UK]	Accepted: text revised
7630	3	24	10	24	10	Since you use both 'landfast' and 'fast ice' further in the text, rephrase the first sentence to match: 'Immobile sea ice anchored to land is referred to as landfast or fast ice.' [APECS Group Review, Germany]	Changed to landfast through entire section

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
10852	3	24	10			It is odd that 'landfast' ice is defined in sentence 1 and then 'fast ice' is usede in sentence 2. Either 'landfast' should be used throughout oif sentence 1 can be expanded to say: "Immobile sea ice anchored to land is referred to as 'landfast ice' or simply 'fast ice'". [Ed Blockley, UK]	Changed to landfast through entire section
10992	3	24	10	24	25	This is a main finding. [Connie Lovejoy, Canada]	Taken into account: Key messages are being revised for the SOD
7632	3	24	11	24	12	Add a statement of confidence at the end of this sentence if possible: '... with a high degree of regional variability in reported trends (Fraser et al 2011) leading to xx (low?) confidence in these trends.' [APECS Group Review, Germany]	Accepted: text revised
22922	3	24	12	24	12	There are published multi-decadal fast ice thickness records for Eurasian Seas showing for a number of statios negligible trends; sections needs correction [Vasily Smolyanitsky, Russian Federation]	Suggested references need to be provided
5376	3	24	16	24	18	One of the numbers (25) was incorrectly rounded and the notion that this is about winter time, is missing. [Roderik Van De Wal, Netherlands]	Accepted: Good catch. Corrected.
22406	3	24	21	24	21	Perrenial → perennial [Matthieu Chevallier, France]	Accepted: text revised
7634	3	24	23	24	23	Rephrase 'These ice-plugs were both removed during the anomalously warm summer...' to something more representative of what actually happened ' These ice-plugs both melted/broke/drifted/disappeared during the anomalously warm summer...' [APECS Group Review, Germany]	Accepted: text revised
7636	3	24	29	24	29	The term '... for northern communities.' here means 'human communities' but without being specific, it could be misinterpreted as other biological communities, such as algal, reindeer, and other communities. Please clarify the term if possible, using for example 'for northern indigenous communities', or 'for northern human communities'. [APECS Group Review, Germany]	Accepted: text revised
22596	3	24	33			I assume Chukotka is meant here? The report says "Siberian Yupik" on the map - but refers to the region of Chukotka in the text, where most Inuit live. In fact, all circumpolar Inuit (i.e. from Alaska, Greenland, Canada and Chukotka) have been reporting unsafe ice conditions, as described in the "Sea Ice Never Stops" report from ICC. [Eva Kruemmel, Canada]	Accepted: text revised
4078	3	24	36	24	36	I suggest to include more information from studies on snow and rain on sea ice, including snow thickness levels and trends, and snow-on-sea ice processes (for example formation of snow ice and superimposed ice). The snow cover and precipitation are important components/topics of the sea ice system. Newer studies dealing with this are for example Bintanja, R. and Andry, O. 2017 (Nature Climate Change 3240), Granskog, M.A. et al. 2017 (Journal of Geophysical Research Oceans 122), Haas, C. et al. 2017 (Geophysical Research Letters 44), Bintanja, R. et al. 2018 (Oceanography 31 (2)), and Rösel, A. et al. 2018 (Journal of Geophysical Research Oceans 123)). Or, if these topics as a part of the sea ice system already are considered in another part of the report (which I have not seen), one could refer to that in section 3.3.1. [Sebastian Gerland, Norway]	Taken into account: new snow on sea ice text was written (see response to 18530)

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
7638	3	24	37			There seems to be missing in this 3.3.1.1 'Sea ice' section a mention of new observations of the increased coupling of the ocean and atmosphere and growing importance of the ocean in the melting of sea ice in the Eurasian Basin, along and nearby the Atlantic Water inflow. The recent N-ICE2015 expedition in the Arctic provided new insight on this subject with the first observations of mid-winter sea ice ocean-driven basal melt (Koenig et al., 2016 Winter ocean-ice interactions…); new results also from the N-ICE2015 expedition quantified impact of combined atmospheric storms and shallow warm inflowing Atlantic Water resulting in large transfer of heat from the ocean to the sea ice leading to observed 25 cm/day sea ice melt (Meyer et al., 2017 Mixing rates and vertical heat fluxes …). The increase in heat content of the Atlantic Water inflow (discussed further along in this document Line 1-2 page 25) combined with increased storm frequency could lead to a significant reduction in sea ice cover further along the Atlantic Water inflow in the near future. If appropriate, a summary of these findings could be added to subsection 3.3.1.1.2 'Thickness and age' as mechanisms that are playing a more and more important role for sea ice thickness in the Eurasian Basin, and likely being amplified by climate change. These observations could also fit in section 3.3.1.2.1 'Temperature' along with the discussion of Atlantification of the Eurasian Basin, or a altogether new subsection entitled 'Ice-Ocean interactions' could be created. [Meyer, A., I. Fer, A. Sundfjord, and A. K. Peterson (2017), Mixing rates and vertical heat fluxes north of Svalbard from Arctic winter to spring, J. Geophys. Res. Oceans, 122, doi:10.1002/2016JC012441.] [APECS Group Review, Germany]	Taken into account. We do not seek to cite results from specific individual field campaigns, though the important broader points are covered.
3958	3	24	38	26	14	This section should discuss thermocline depth as well as temperature and salinity, due to the impact on ice shelves. [Ben Webber, UK]	Taken into account. A separate section on stratification is included, and ice shelf-ocean interaction is covered elsewhere in the chapter.
19908	3	24	39	24	39	Modify to read: " The Polar Oceans are among the most rapidly changing oceans of the world…" [Michelle A. North, South Africa]	Accepted; text revised
5378	3	24	42	24	42	There are two numbers given for the uncertainty range (which is strange to me); the largest number is the one that should be given to cover the full range? [Roderik Van De Wal, Netherlands]	Accepted; text corrected
10856	3	24	42			I struggle to work out what "…for 75 ± 6–22% of the total global ocean heat uptake and 43% ± 3%…" means. I presume the latter should be "43 ± 3%" but I wouldn't like to guess about the former. [Ed Blockley, UK]	Accepted; text corrected
16990	3	24	42	24	42	Difficult expression (75 +/- 6-22 %). Is the 6-22% error estimate model range? [Markku Rummukainen, Sweden]	Accepted; text corrected
19910	3	24	42	24	42	Is "75 ± 6-22%" correctly written? It doesn't follow typical scientific error notation [Michelle A. North, South Africa]	Accepted; text corrected
6428	3	24	46	24	46	Calculate-sea lower temperature (SLT) [Leila Rashidian, Iran]	Rejected; suggestion not clear.
7644	3	24	48	24	48	Perhaps specify the section in AR5 to which this is referring to make it easier for the reader to find the previous reference if needed (this comment applies throughout the chapter). [APECS Group Review, Germany]	Accepted; AR5 section numbers included

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
7640	3	24	49	24	51	Add a statement of confidence for the summer mixed layer temperature increase of about 0.5oC per decade provided in this sentence. Is it low, medium, high, or virtually certain? [APECS Group Review, Germany]	Accepted; added
7646	3	24	49	24	49	"Atlantic Water Layer". Can you explain to the non-expert what this is? Perhaps a figure would be useful here. [APECS Group Review, Germany]	Accepted; sentence added
17552	3	24	52	24	54	The text discusses the sea ice loss related increase in solar energy input (shortwave) to the Arctic. However, the solar input is only one of four components of the net energy flux - reductions in sea ice are also likely to cause increased latent, sensible and longwave losses. How large are these likely to be? And to what extent do they offset the quoted 6.4 Wm-2 solar energy gain? These need to be included for a balanced discussion, at present it reads like the only change in the Arctic net heat flux is the increased solar energy supply which is not the case. [Simon Josey, UK]	Taken into account; added a clause "that is, the main source of heat for the surface ocean is solar radiation absorbed in open-water areas (see e.g. Perovich et al. 2011)". Changes in sensible, latent and longwave are much smaller factors.
1728	3	24	54	24	55	I found the last sentence in this paragraph, about excess solar heat mitigating sea ice growth, rather unclear. I think it is the choice of word 'mitigating' which is confusing. [Mark England, UK]	Accepted; changed "mitigates" to "reduces"
7642	3	24	54	24	54	This excess solar heat likely mitigate the growth of sea ice...' Usually the word mitigate is used when speaking about making something bad less severe. I don't think that this is what is meant here. Please change the sentence to reflect the meaning. For example ' This excess solar heat likely reduces the growth of sea ice...'. [APECS Group Review, Germany]	Accepted; changed "mitigates" to "reduces"
13472	3	24	54			The word 'mitigates' has 'human intervention' implications. Counteracts? [Debra Roberts and Durban Team, South Africa]	Accepted; changed "mitigates" to "reduces"
7648	3	25	1	25	2	Add a statement of confidence about 'the total heat content in this layer continues to increase'. Is it low, medium, high, or virtually certain? [APECS Group Review, Germany]	Accepted; added
7650	3	25	1	25	2	Add a statement of confidence about 'While AW layer temperatures have stabilized since 2008'. Is it low confidence, medium confidence, high confidence, or virtually certain? [APECS Group Review, Germany]	Accepted; added
7652	3	25	4	25	4	Clarify what type of heat fluxes you are talking about: upper ocean heat fluxes? Ocean-ice heat fluxes? [APECS Group Review, Germany]	Taken into account; changed "upward" to "Atlantic Water Layer"
7654	3	25	6	25	6	If possible, add a statement of confidence for 'explaining about 18-40 cm of sea ice loss...' [APECS Group Review, Germany]	Rejected; this statement is simply putting the changed heat fluxes, for which a statement of confidence has already been given, in terms of changed ice growth

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
7656	3	25	12	25	13	The statement here 'During 2006–2013, the Southern Ocean accounted for 67–98% of total heat gain in the upper 2000 m of the global ocean (Roemmich et al., 2015)' is repeating similar findings but from a different reference and slightly different numbers from page 24 line 41-42: 'For example, in coupled climate models possessing a carbon cycle, the Southern Ocean accounts for 75 ± 6–22% of the total global ocean heat uptake and 43% ± 3% of carbon (Frölicher et al., 2015)'. As it is, it might confuse the reader. In reality, the numbers page 24 are from models while the numbers from page 25 are observations. For clarity either remove one of the quote or add info page 25. For example 'Observations for the 2006–2013 period show that the Southern Ocean accounted for 67–98% of total heat gain in the upper 2000 m of the global ocean (Roemmich et al., 2015) (high confidence), matching estimates from coupled climate models.' [APECS Group Review, Germany]	Accepted; text revised
7666	3	25	12	26	18	These two paragraph are currently partly overlapping in content, both describing the heat uptake of SO in terms area and of depth ranges. Both also mention Isopycnal heave as the main factor of change in the upper ocean layer in the first paragraph and in AABW in the second paragraph. It looks like these paragraphs were written by 2 different people. Please read through and merge them if possible, avoiding repeating the same information in slightly different ways. [APECS Group Review, Germany]	Taken into account; paragraphs refer to different depth ranges, specifically the upper and lower cells respectively. The language of the second paragraph mentioned has been modified to make this distinction clearer
1730	3	25	13	25	13	Space required between reference and (high confidence) [Mark England, UK]	Accepted – text revised
7668	3	25	14	25	14	Suggest moving 'however' to the start of the sentence instead of the middle. [APECS Group Review, Germany]	Accepted – text revised (No however found at line 14 of page 25. However from end of sentence on line 22 page 25 fixed, however.)
19912	3	25	16	25	16	Define SST (or simply write out and remove the acronym) [Michelle A. North, South Africa]	Accepted; acronyms now included in accordance with IPCC policy.
3998	3	25	18	25	20	Modelling results suggest that isopycnal mixing is a major component of Southern Ocean heat uptake see Gregory (2000), Banks and Gregory (2006), Morrison et al. (2016) [Helene Hewitt, UK]	Accepted. The term ‘upper cell circulation’ used in the text implicitly includes circulation resulting from mixing. The Morrison reference is a useful (post-AR5) suggestion and the text has been revised to incorporate this.
7664	3	25	21	25	21	too deep to be caused trivially by air-sea fluxes' Trivially from trivial means of very little importance or value. Maybe here you meant to say 'too deep to be caused solely/only/just by air-sea fluxes' ? Please adjust for clarity. [APECS Group Review, Germany]	Accepted; text revised.
5380	3	25	27	25	30	I would have made the labelling numbers in the figure bigger. [Roderik Van De Wal, Netherlands]	Accepted; figure revised
418	3	25	28	25	29	Numbers in black circles are too small to read. Consider making them larger. [George Burba, USA]	See response to comment 5380
13474	3	25	28	25	29	Can't see '1' in the figure. Also, the scale is quite difficult to read. [Debra Roberts and Durban Team, South Africa]	Taken into account. "1" is at the very top. Numbers enlarged for readability though.
7660	3	25	29	25	29	Figure 3.8: Does it make the figure too busy if the name of each change (Atmospheric circulation, Upper ocean warming, Deep ocean warming, Ocean surface warming, Ocean surface freshening, Increased eddy activity, ...) is added on the schematic itself? It would help the reader put these in perspective and absorb the figure better. [APECS Group Review, Germany]	Rejected; as the reviewer suggests this would result in the figure becoming too busy and would obscure some of the processes/trends shown.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
4000	3	25	31	25	34	Could figure 3.8 be changed to include temperature and salinity changes? There are a lot of infographic style figures in this chapter and I think it would be better to show observational change here which would also follow better from figures 3.6 and 3.7 [Helene Hewitt, UK]	Reject, the figure is designed to shown schematically a number of processes/changes. Actual observational changes are given in other figures in this section, and in Supplementary Material.
7658	3	25	31	26	7	Figure 3.8 is great. Some of the information of the figure is color coded (Ocean warming x3, carbon drawdown). Yet the caption does not explain these color code. Add necessary information in caption such as '2. Strong warming in upper and mid-depth interior of the ocean (red dotted area).' and '9. Increased carbon drawdown from the atmosphere and ocean acidification in parts of the Southern Ocean (green regions)' etc… [APECS Group Review, Germany]	Taken into account; the figure has been revised to focus on specific aspects relevant to circulation.
7662	3	25	31	26	7	Figure 3.8 Actually, after reading line 15-18 page 25 and looking better at the dotted area in fig 3.8, I wonder if there a color range for the dots? Some surface dots are blue; is that to represent cooling? If so please clarify figure caption. Also under 3. (warming and freshening in the deep), what are the darker blueish dots in the deep waters (4000m and below)? Are they meant to represent cooling? [APECS Group Review, Germany]	See 7658
15568	3	25	32	26	7	Schematic and summary of observed changes in Southern Ocean since AR5 is excellent. Good formula for explaining what's happening to the public. [Melinda Kimble, USA]	Noted; thanks.
7670	3	26	10	26	12	Add a statement of confidence for the numbers provided in this sentence ('Globally, around 19% of the excess anthropogenic heat in the Earth system is stored in the ocean beneath 2000 m, with the largest part of this (6% of global total heat excess) located in the deep Southern Ocean south of 30°S'). [APECS Group Review, Germany]	Accepted; statement added.
19914	3	26	15	26	15	Please insert (see Glossary) after "isopycnal heave" and include the term in the glossary [Michelle A. North, South Africa]	Rejected; the term is defined in the main text upon its first use.
14106	3	26	18	26	18	Need to ireference van Wijk and Rintoul, 2014. Freshening drives, Freshening drives contraction of Antarctic Bottom Water in the Australian Antarctic Basin (2014) [Christopher Fogwill, UK]	Accepted; reference included.
10858	3	26	20	27	14	Please remove all mention of "psu" which should not be used in scientific literature. Practical Salinity is a dimensionsless quantity (defined as a conductivity ratio) and so no dimensions should be assigned to it. It is sufficient to state that salinity is measured on the Practical Salinity Scale or just to refer to salinity as "practical salinity". Failing that you could use "ppt". See the following references: Millero, Frank J. "WHAT IS PSU?" Oceanography 6, no. 3 (1993): 67. http://www.jstor.org/stable/43924646; UNESCO (1985) The international system of units (SI) in oceanography. UNESCO Technical Papers No.45, IAPSO Pub. Sci. No. 32, Paris, France. [Ed Blockley, UK]	Accepted; psu now removed.
14292	3	26	20			Need to explicitly state where the freshwater inut is coming from i.e. polar ice sheets, non-polar glaciers, sea ice melt [Christopher Fogwill, UK]	Reject; the different sources are explored fully in the subsequent text
19916	3	26	21	26	21	Modify to read: "Salinity is the dominant determinant of polar ocean density…" [Michelle A. North, South Africa]	Accepted; change made

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
7686	3	26	22	26	26	A good reference here might be Pellichero et al 2018, especially given the mention of sea ice export as a driver of surface freshening in the paragraphs following. (Pellichero, V., Sallée, J. B., Chapman, C. C., & Downes, S. M. (2018). The southern ocean meridional overturning in the sea-ice sector is driven by freshwater fluxes. Nature communications, 9(1), 1789.). [APECS Group Review, Germany]	Taken into account; the Pellichero reference is a relevant one, and is now cited two paragraphs down, which is a more appropriate place for its inclusion.
7672	3	26	24	26	24	Instead of ' Changes in freshwater discharges to polar water…' should it be 'Changes in freshwater discharges to polar and subpolar waters…' for completeness? [APECS Group Review, Germany]	Reject; the term is used here in the same context as the chapter title.
7674	3	26	28	26	30	Add a statement of confidence for the numbers provided in this sentence ('… yield a freshwater increase of 600 ± 300 km3/yr over 1992 to 2012, with about 2/3 of this trend… '). [APECS Group Review, Germany]	Accepted; statement added
7684	3	26	28	26	30	… with about 2/3 of this trend attributed to a decrease in salinity, and the remainder to a thickening of the freshwater layer.' What is driving the decrease in salinity and thickening of freshwater layer? Are there some theories? Some regional explanations are provided further down (changes in wind patterns and land freshwater fluxes) but no explanation is provided for the Arctic-wide freshening... Maybe the paragraph just needs to be rephrased slightly so the reader can come out with a better understanding of what the key drivers behind the freshening of the Arctic are. [APECS Group Review, Germany]	Taken into account; the phrase "Arctic-wide" appears in the sentence to indicate that this applies for the entire Arctic basin. The sentence sets up the causes of freshwater change that are assessed below.
22394	3	26	28	26	28	There should be a definition/explanation of what is meant by « freshwater » in the case of Polar Oceans (e.g. salinity criteria, depth…) Is there a common definition among all regions and studies refered too in this section ? [Matthieu Chevallier, France]	Accepted; added "relative to a reference salinity of 34.8"
7688	3	26	40	26	40	"with record maximum freshwater influx through Bering Strait in 2014 of around 3,500 km3". I find this a little confusing as km3 is not a unit of flux. [APECS Group Review, Germany]	Accepted; added "in that year" (the "per year" is implied)
7676	3	26	41	26	41	Either 'The freshwater flux from rivers is…' or 'Freshwater fluxes from rivers are…'. Please edit as needed. [APECS Group Review, Germany]	Accepted; changed to "Freshwater fluxes… are"
7678	3	26	45	26	47	Add a statement of confidence for the numbers provided in this sentence ('… with trends 0.01–0.05 psu/60 years in mode and intermediate waters to below 1500 m (Skliris et al., 2014)… '). [APECS Group Review, Germany]	Accepted; statement added
7690	3	26	46	26	46	"0.01–0.05 psu/60 years". Can the units here be made to be consistent with those later in the paragraph, i.e. psu/year [APECS Group Review, Germany]	Accepted; units revised
19918	3	26	46	26	46	Please explain the unit psu at first mention [Michelle A. North, South Africa]	Taken into account; see response to 10858
7680	3	26	47	26	49	Add a statement of confidence for the numbers provided in this sentence ('… a freshening south of the ACC of 0.0011 ± 0.0004 psu yr–1 in the upper 100 m since the 1960s… '). [APECS Group Review, Germany]	Accepted. The sentence: 'There is high confidence that the surface ocean is freshening south of the ACC, based on multiple studies, though there is only medium confidence in the magnitude and distribution of the trend due to the relatively low spatio-temporal resolution of observations.' has been added to the text to reflect the overall confidence in the sign of the trend, but lower confidence in quantifications.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
18386	3	26	47	26	47	I'm not sure that 'circumpolarly' is a real word [Nicholas Golledge, New Zealand]	Rejected. While seemingly not often in found in dictionaries, circumpolarly appears regularly in polar literature, particularly in the circumpolar Southern Ocean. As such it appears to be a perfectly cromulent word.
16306	3	26	50	26	54	Possible new reference to add here - Paul Holland and Andrew Meijers are co-authors, and are also contributing authors to the chapter so they could help with wording: Cerovecki, I. et al. (J. Clim. submitted) The effects of enhanced sea ice export form the Ross Sea on recent cooling and freshening of the Southeast Pacific. Also the mechanism the connects sea ice to freshening and buoyancy input was elucdidated in Abernathey, R.P., I. Cerovecki, P. Holland, E. Newsom, M. Mazloff and L. D. Talley, 2016. Water mass transformation by sea ice in the upper branch of the Southern Ocean overturning. Nature Geosciences,doi:10.1038/ngeo2749. [Lynne Talley, USA]	Accepted. The Abernathey reference is included; the Cerovicki one will be added if it clears the publication process in time.
5382	3	26	52	26	54	It seems like there is a unit missing: something per year [Roderik Van De Wal, Netherlands]	Taken into account. Salinity is a dimensionless quantity, hence has no unit. We now specify in the chapter that we are presenting salinity values on the Practical Salinity Scale, and without units.
19920	3	26	52	26	52	Please explain the unit Sv at first mention, since I would imagine that it can't be referring to the radiation dose unit sievert? [Michelle A. North, South Africa]	Accepted; Sv now defined. (It refers to a transport of water, not radiation).
7692	3	26	53	26	53	"freshening of 0.002 ± 0.001 yr–1". Should this not be freshening of 0.002 ± 0.001 psu yr–1 [APECS Group Review, Germany]	Reject; see response to 10858
19922	3	26	53	26	53	This value is missing the unit psu [Michelle A. North, South Africa]	Reject; see response to 10858
7682	3	26	56	26	57	Remove 'both' in that sentence ('For Antarctica, there is limited evidence for both an increase in snowfall in most coastal regions over the past 200 years (Thomas et al., 2017).') [APECS Group Review, Germany]	Accepted; text revised
13476	3	26	56			Both increase snowfall and…? [Debra Roberts and Durban Team, South Africa]	Taken into account-combined with comment 7682
14290	3	26	56			Says '…limited evidence for both…' but there is only one thing mentioned (increase in snowfall) [Christopher Fogwill, UK]	Taken into account-combined with comment 7682
19924	3	26	56	26	56	Remove the word "both" before "an increase", OR, rewrite this and the next sentence to ensure that this statement makes sense [Michelle A. North, South Africa]	Taken into account-combined with comment 7682
7712	3	27	1	27	2	Consider adding the vertical heat transport through ice-shelf melt-rate increases and its impact on surface warming and sea ice volume in the Amundsen Sea region (Jourdain, N. C., Mathiot, P., Merino, N., Durand, G., Le Sommer, J., Spence, P., … & Madec, G. (2017). Ocean circulation and sea-ice thinning induced by melting ice shelves in the Amundsen Sea. Journal of Geophysical Research: Oceans, 122(3), 2550-2573.). [APECS Group Review, Germany]	Taken into account – combined with comment 2248
19928	3	27	8	27	8	Antarctic Bottom Water (AABW) was introduced on the previous page [Michelle A. North, South Africa]	Taken into account. Acronym now removed thoughout.
16992	3	27	10	27	10	"representing around half of existing estimates" is not very clear. Estimates of what? [Markku Rummukainen, Sweden]	Accepted. Half of the estimated increase in ice shelf melt. The sentence has been reworded to make this clearer.
7714	3	27	11	27	11	"In some sectors AABW freshening may be accelerating". Give examples of which sectors AABW freshening is accelerating. [APECS Group Review, Germany]	Accepted – text revised to specify

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
7694	3	27	13	27	13	Rephrase '…resolution observations observe significant…' to avoid repetition. For example '… resolution observations show significant…' [APECS Group Review, Germany]	Accepted – text revised
16872	3	27	19	27	19	should "and also is a important" rather be "and also is an important" ? [Anthony Mémin, France]	Accepted; text corrected
7696	3	27	29	27	29	Atlantification is associated with weakening…' Please clarify the use of the term atlantification here. For example you could say 'Atlantification of the ocean in the eastern Eurasian Basin is associated… [APECS Group Review, Germany]	Accepted; changed to "The Atlantification in the Eurasian Basin…"
7698	3	27	29	27	31	Is it possible to have a statement of confidence with this Atlantification process? [APECS Group Review, Germany]	Taken into account; this is given where Atlantification is first introduced
7702	3	27	33	27	40	There are no statement of confidence for any of the statements in this paragraph. Please add some when possible. [APECS Group Review, Germany]	Accepted; information added
2248	3	27	34	27	37	In most Antarctic regions, discharge of freshwater can indeed increase stratification (which can be significant according to Merino et al. 2018, so I would not write "most studies"). In the Amundsen Sea, both Jourdain et al. (2017) and Merino et al. (2017) suggest that releasing more freshwater within nearly unmodified CDW induces a strong entrainment of warm water towards the surface, i.e. this increases vertical heat flux (as opposed to other regions where CDW do not reach ice shelf cavities). [Nicolas Jourdain, France]	Accepted. The text has been rewritten to include the citations below and now discusses the contrasting sets of studies alternately showing sea ice growth, loss and no significant change. Similarly the role of entrainment within ice shelf cavities is mentioned.
5384	3	27	34	27	37	This sentence is telling the same as page 22 lines 32-36, so that one of these can be left out easily. [Roderik Van De Wal, Netherlands]	Accepted; text now de-duplicated
3542	3	27	36	27	38	The statement " Recent studies provided evidence that pteropods have natural defense mechanisms that may allow repair of shells damaged by exposure to waters undersaturated with respect to aragonite (Peck et al., 2018)." should not stand alone. It is well established that pteropods are sensitive to ocean acidification and undergo dissolution in undersaturated waters (Bednarsek et al., 2012; 2014; Feely et al., 2016; Gardiner et al., 2017). Moreover, the recent work of Bednarsek et al. 2017) shows that shell repair by calcification slows down dramatically below aragonite saturation state 0.8. [Richard Feely, USA]	Accepted; this statement has been qualified in the revised version of the chapter. References for Southern Ocean pteropods are included in section 3.2.3.2.2
7700	3	27	37	27	37	… is insufficient to cause a significant expansion.' Expansion of what? Of the sea ice extent? If so add ' … is insufficient to cause the observed expansion of sea ice.' [APECS Group Review, Germany]	Taken into account-combined with comment 2248
7710	3	27	42	29	23	This section is particularly longer than previous ones (Temperature, Salinity, Stratification…) and the structure of paragraphs seems a little disjointed. The information is dense and maybe slightly overlapping between some paragraphs. Paragraphs between lines 15-47 page 28 should be checked and maybe merged. Paragraphs between P27 Line 54-P28 Line13 could also be condensed and merged? [APECS Group Review, Germany]	Accept; section has been shortened
19252	3	27	42	23	42	There will be an AMAP assessment on Arctic Ocean Acidification released in the autumn - will contain updated assessment of knowledge on chemical and physical status and trends.Contact AMAP secretariate for more information. [Marianne Kroglund, Norway]	Accepted; report now referenced

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
22598	3	27	42	29	23	This section would benefit from using input from the AMAP Arctic Ocean Acidification update, which deals with socio-economic impacts of Arctic Ocean acidification. This assessment has been peer reviewed and will be published shortly on AMAP's website (www.amap.no). [Eva Kruemmel, Canada]	Accepted; report now referenced
7704	3	27	44	27	52	This paragraph describes aragonite undersaturation levels in the Arctic Ocean but does not state why we are talking about aragonite saturation levels or the link to the Arctic biogeochemical system. Please add in a short sentence to that effect after the first sentence of paragraph. [APECS Group Review, Germany]	Accepted; sentence added
7706	3	27	44	27	52	Please add statements of confidence when possible for the numbers presented in this paragraph. [APECS Group Review, Germany]	Rejected; numbers cited are from the literature and adding confidence statements to them here is not warranted.
7708	3	27	51	27	52	Persistent acidification here is driven by…' Please define what you mean by 'here' in this sentence. Do you mean 'Persistent acidification in the Arctic'? [APECS Group Review, Germany]	Accepted; we have clarified the area being discussed.
5386	3	27	54	28	4	This section may be improved by indicating more clearly which result belongs to which study. [Roderik Van De Wal, Netherlands]	Accepted; the reference cited was moved to a more informative place
8206	3	27	55	27	56	I understand that the values of DIC concentration have been extracted from the listed references but I would suggest standardizing all the units in this section to have a better comparison for non experts with the other DIC units of this section (since µmol/kg/yr is only used in this sentence). [Benoit Montpetit, Canada]	Rejected; the numbers cited encompass concentrations, fluxes and storage changes, and conversion of the units involves would involve many assumptions and introduce significant caveats and uncertainties.
2138	3	28	6	28	10	Yamamoto et al. (2012, Biogeosciences, 9, 2365-2375, doi:10.5194/bg-9-2365-2012) also argued the impact of sea-ice reduction rate on projected pH and aragonite saturation state in the Arctic. This work should be cited. [Michio Kawamiya, Japan]	Accepted; suggested reference is now included (section 3.2.2.2)
7716	3	28	6	28	10	This sentence is too long. Consider breaking it in two at the location of current semi-colon. [APECS Group Review, Germany]	Accepted; changed to shorter sentences
1732	3	28	8	28	8	delete 'including' [Mark England, UK]	Accepted; removed
7718	3	28	8	28	8	Remove the first 'including' which is misplace ('…complex mechanisms including via which sea ice influences…') [APECS Group Review, Germany]	Accepted; removed
7720	3	28	10	28	13	Sentence is unclear as is. I think what you mean to say is that although one mechanism leads to ocean acidification, the other mechanism works against ocean acidification, right? Maybe rephrase as follow: 'Although biological uptake of CO2 in the surface water and subsequent respiration at depths has been shown to drive ocean acidification (high confidence) (Azetsu-Scott et al., 2014; Yamamoto-Kawai et al., 2016), long photoperiods in Arctic summers can sustain high pH in kelp forests, slowing ocean acidification.' [APECS Group Review, Germany]	Accepted; sentence has been clarified as indicated.
7724	3	28	15	28	29	Missing the statements of confidence (IPCC confidence language) throughout the paragraph. Please add as many as possible. [APECS Group Review, Germany]	Taken into account. This paragraph provides detailed information on which confidence statements were later built. Those statements have now been moved to the end of this paragraph.
24916	3	28	15	28	47	Very well discussed. [Elizabeth Weatherhead, USA]	Noted; thank you
7722	3	28	19	28	19	This advance has…' Which one are you talking about? Several were mentioned in previous sentence. Either indicated which advance or rephrase as 'These advances have'. [APECS Group Review, Germany]	Accepted; text revised to clarify
16874	3	28	27	28	27	missing "to" between "the potential" and "make" [Anthony Mémin, France]	Accepted; fixed
7726	3	28	31	28	36	It seems that this paragraph is the continuity of the previous one and that it contains the missing statements of confidence for previous paragraph (?). If that is the case, please merge both paragraphs. [APECS Group Review, Germany]	Accepted; paragraphs merged

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
16994	3	28	39	28	39	What does the +/-50% refer to/signify? [Markku Rummukainen, Sweden]	Accepted; this has been changed to a range - see Table 2 in Section 3.A for detailed magnitudes
7728	3	28	41	28	41	What do you mean by 'mode' here? Do you mean 'decadal mode of variability'? [APECS Group Review, Germany]	Accepted; names of water masses now written in full
16996	3	28	46	28	47	Could consider indicating the confidence level(s) earlier in the paragraph, where decadal variability and wind sensitivity, respectively, are mentioned. [Markku Rummukainen, Sweden]	Accepted; revised accordingly
7730	3	28	49	28	57	Missing the statements of confidence (IPCC confidence language) throughout the paragraph. Please add as many as possible. [APECS Group Review, Germany]	Reject; the information in this paragraph does not warrant IPCC confidence language
1734	3	29	2	29	2	particular' seems wrong word here, possbily replace with 'an important aspect' [Mark England, UK]	Noted
6216	3	29	2	29	23	This discussion does not fit here since these changes are a direct consequence of the changes of the ice sheet which is treated in a different chapter (where no implications are discussed). This needs some restructuring to allow a reader to find these implications easily. [Regine Hock, USA]	Taken into account
6218	3	29	2	29	23	There is emerging literature on the effect of icebergs on seals and other animals. Where is that discussed? Another implication of ice sheet changes that does not really fit in the ocean - sea ice section [Regine Hock, USA]	accepted. We have now included a section on consequences and impacts from melting ice and consider this material
16998	3	29	2	29	23	This text uses the standardised language in different ways, could use confidence levels instead. (For example, instead of "high agreement based on limited evidence", the corresponding confidence level may be more useful for readers to take part of. [Markku Rummukainen, Sweden]	taken into account. we have better coordianted the use of confidence langauge in our chapter. However, we have kept split stateemnts where this is important an adequate
19926	3	29	16	29	16	Change "is" in "which is already observed..." to "are" [Michelle A. North, South Africa]	Editorial - copyedit to be completed prior to publication
420	3	29	25	29	26	It may be unclear to the reader what are these 3 examples. Consider labeling a), b) and c) on the figure. Also, many figures before did not have a) b) and c). Perhaps consistency would help reader to read the plots easier. [George Burba, USA]	Noted
7732	3	29	26	29	26	Nice figure! It would be good to find a name for each stage (a, b, and c) and to add them above each schematic. It would give a sense of time progression. Or add a time scale in the shape of an arrow running on the right hand side of the 3 schematic from top to bottom for example... [APECS Group Review, Germany]	Noted
3516	3	29	28	29	30	The abbreviation “F_UP” appearing in panel (a) is not explained in the legend of Fig. 3.9. [Deborah Verfaillie, Spain]	Noted
20976	3	29	28	29	28	Figure 3.9 wrongly suggests that the major part of floating ice shelves and icebergs lies above the water line. The major part lies below [Claudio Richter, Germany]	Noted
7734	3	30	6	30	7	For that first statement, are references the ones provided further in the paragraph or do you have a key one to add at the end of that first sentence? If no reference to add, maybe change the full stop to a colon at the end of the sentence. [APECS Group Review, Germany]	Accepted; added reference at end of first sentence
10708	3	30	6	30	11	Please add any information about North Atlantic current near Norway and in the Barent Sea [Oxana Lipka, Russian Federation]	Taken into account: There are no recent studies quantifying changes in the flow field in the Barents Sea Opening. Changes in other properties (temperature and stratification) in the region have been assessed elsewhere (see discussions of "Atlantification").
5388	3	30	7	30	11	It may be convenient to express both results in the same way (volume transport?) [Roderik Van De Wal, Netherlands]	Taken into account; conversion is not possible since measurement techniques differ

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
19930	3	30	9	30	9	Please be consistent with the units: cm/s should be cm.s-1 [Michelle A. North, South Africa]	Editorial - copyedit to be completed prior to publication
6220	3	30	13	30	13	What is ACC? Can this acronym be avoided? [Regine Hock, USA]	Taken into account. This is a very useful acronym which we choose to retain; we now define it at first use in the chapter in accord with IPCC policy.
7746	3	30	13	30	13	relative to what? [APECS Group Review, Germany]	Accepted; text revised
17000	3	30	13	30	17	The text could be developed into more informative one. What are the "new insight"s and the "significant responses"? [Markku Rummukainen, Sweden]	Accepted; text has been removed to focus on more pertinent issues.
7736	3	30	15	30	17	... observed significant responses of the Weddell and Ross Gyre...' It is a bit strange to mention here some significant responses but not explain what the responses are. Is it strengthening of the gyres with SAM for example? Please develop if possible in 1 or 2 sentences. [APECS Group Review, Germany]	Taken into account; text removed to focus on more relevant issues.
19932	3	30	15	30	15	"has" after Southern Ocean should be "have" [Michelle A. North, South Africa]	Accepted; text revised
422	3	30	17	30	17	Word "implicated" is not clear and seens out of place. Consider revising. [George Burba, USA]	Taken into account-combined with comment 17000
7738	3	30	21	30	29	It might be useful to the reader to include a statement here as to why satellite altimetry that is used in the Southern Ocean can't be used in the Arctic to look at eddies (sea ice presence). [APECS Group Review, Germany]	Taken into account; relevant sentences added and paragraph restructured
1736	3	30	22	30	22	delete 'be' before 'in' [Mark England, UK]	Taken into account; clause changed
14294	3	30	22			...can in principle be...' [Christopher Fogwill, UK]	Taken into account; clause changed
19934	3	30	22	30	22	Delete the "be" before "in principle" so that it reads: "Arctic Ocean can in principle be..." [Michelle A. North, South Africa]	Taken into account; clause changed
3598	3	30	23	30	23	It's worth stating that there are several theoretical and modeling papers that balance the Beaufort Gyre strength between wind forcing (Ekman pumping) and relaxation by mesoscale eddies. E.g., see Manucharyan et al. (2016, A Theory of the Wind-Driven Beaufort Gyre Variability, Journal of Physical Oceanography, 10.1175/JPO-D-16-0091.1, 46, 11, (3263-3278) and refs therein. The statement "can in principle be compensated by..." doesn't reflect the feeling of the theory/modeling community who are more confident. [Thomas Haine, USA]	Taken into account; theory/modelling references added. The theory/modelling has yet to be bettter constrained by observations. Changed "can in principle be" to "may"
17002	3	30	27	30	27	What does "medium correspondence" mean? [Markku Rummukainen, Sweden]	Accepted; changed to "a relationship (medium confidence)"
14108	3	30	33	30	33	Add after (medium-confidence)"Yet detailed empirical data fromthe Southern Ocean is exceptionally sparse' (reference Erik, v. S. et al. Pairwise surface drifter separation in the western Pacific sector of the Southern Ocean. Journal of Geophysical Research: Oceans 120, 6769-6781, doi:doi:10.1002/2015JC010972 (2015). [Christopher Fogwill, UK]	Rejected; whilst true, the statement is not necessary, and the satellite data used is comprehensive.
7740	3	30	34	30	36	... which also show such a relationship has marked regional variability...' Please clarify what you mean by 'has marked regional variability' as it is currently unclear. [APECS Group Review, Germany]	Accepted; text revised
17432	3	30	38	30	57	In the section on Observed changes, watermass production (section 3.3.1.3.3), there is no mention of Arctic watermass production changes (except a brief mention of the impact of Greenland ice melting). Are there any observed changes in the water mass formation in Arctic shelf polynyas, or sources of the Arctic halocline layer? [Sonya Legg, USA]	Noted: There are insufficient observations to allow for an assessment of change (even isolated observations of dense water formed in polynyas are rare). Changes in dense water formed in polynyas/shelf regions can only be inferred from stratification changes, which have been assessed in section 3.3.1.2.3.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
7742	3	30	39	30	49	This paragraph is a little confusing as it stands. The key points are that the MOC was previously reported to slow down but that was wrong and that now, there is low to medium confidence that it is accelerating. Please condense the paragraph. [APECS Group Review, Germany]	Accept. Text revised; Southern Ocean part now placed in a Cross Chapter Box
14112	3	30	41	30	41	AMOC reference needed suggest: Caesar, L., Rahmstorf, S., Robinson, A., Feulner, G. & Saba, V. Observed fingerprint of a weakening Atlantic Ocean overturning circulation. Nature 556, 191-196, doi:10.1038/s41586-018-0006-5 (2018). [Christopher Fogwill, UK]	Reject; the relevant literature is covered in Chapter 6 of SROCC, which is cited.
6222	3	30	51	30	51	What is AABW? Can this acronym be avoided? [Regine Hock, USA]	Accept; acronym removed.
7744	3	30	51	30	57	How does this paragraph fit with the previous one? It states with low confidence that the lower limb of Southern Ocean is slowing down. It seems counter-intuitive that AMOC is accelerating while AABW export is slowing. Please provide if possible an explanation, even if it is to say that we don't know. As it is now, the reader is left to wonder. [APECS Group Review, Germany]	Taken into account; the earlier paragraph refers to the upper limb of the overturning circulation, while this paragraph discusses the lower limb. While the two are indeed linked, it is entirely possible to have one accelerate and the other slow as they are inflenced by different processes to different degrees. We have modified the end of the first paragraph to read '…in the upper cell' and the opening of the section 'The lower cell…' to remind readers of the distinction.
14110	3	30	51	30	57	There is strong enidence that AABW has freshened and contracted, again Need to ireference van Wijk and Rintoul, 2014. Freshening drives, Freshening drives contraction of Antarctic Bottom Water in the Australian Antarctic Basin (2014) here [Christopher Fogwill, UK]	Taken into account; reference added.
19936	3	30	51	30	51	AABW? Please reduce the use of acronyms [Michelle A. North, South Africa]	Accept; acronym removed.
7748	3	30	53	30	53	"Evidence indicates that the volume of this water mass has decreased… []…This suggests that AABW export has likely slowed". Does a reduction in volume mean definitely that AABW export has slowed, or could it also reflect changes in vertical mixing across isopycanl surfaces? [APECS Group Review, Germany]	Accepted; text included to reflect this possiblility
23742	3	30	55	30	55	Observational «evidence»? [Hans-Otto Poertner and WGII TSU, Germany]	Accepted; text revised
16308	3	31	2	31	16	suggest reorganizing this to follow the nice parallel structure of all the preceding sections, with Arctic first and Antarctic second, in separate paragraphs, even though there is little information about the Arctic. [Lynne Talley, USA]	Taken into account. The Southern Ocean material has now been moved to a Cross Chapter Box.
7750	3	31	13	31	14	There is comparatively little knowledge on changing Arctic frontal positions and current cores since AR5' This statement is odd following the previous 4 sentences describing knowledge about changing Arctic frontal positions! Comparatively to what?? If the 1st and last part of paragraph were written by 2 different people, the 2 parts need to be merged better. Maybe that sentence becomes: 'There is comparatively little knowledge on changing Arctic frontal positions and current cores since AR5…' [APECS Group Review, Germany]	Taken into account. The Southern Ocean material has now been moved to a Cross Chapter Box.
10860	3	31	13	31	16	No quantification of confidence or uncertainty is given for this statement on the movement of the centre of the Beaufort gyre. [Ed Blockley, UK]	Accepted; added statement
14114	3	31	13	31	13	Add after (low-confidence)"Yet detailed empirical data fromthe Southern Ocean is exceptionally sparse' (reference Erik, v. S. et al. Pairwise surface drifter separation in the western Pacific sector of the Southern Ocean. Journal of Geophysical Research: Oceans 120, 6769-6781, doi:doi:10.1002/2015JC010972 (2015). [Christopher Fogwill, UK]	Rejected; combined with comment 14108

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15570	3	31	18	32	17	Disccussion of modelling projections and their biases is balanced; underscores relevance of GHG emission reduction to reduce impacts on the ocean, polar regions and communities. [Melinda Kimble, USA]	noted, thank you
14372	3	31	20	31	44	Potential conflict of interests.The literature of Arctic sea ice modelling cited in this part is way too biased. The works by the Serreze-Stroeve-Matrozke-Notz team are great, but there is much more going on in the Arctic sea ice modeling arena. [Sérgio Henrique Faria, Spain]	Taken into account: additional citations added and scope of assessment increased based on all expert review comments
1604	3	31	22	31	22	maybe specify climate models capture observed declines in ARCTIC sea ice extent [Maria Vittoria Guarino, UK]	Accepted: text revised
1848	3	31	22	31	43	The present discussion omits any considerations of the impacts of changing cloudiness and cloud properties over the Arctic. The representations of cloud water paths and the amounts of cloudiness vary significantly across climate models (and reanalyses), and their impacts on radiative fluxes and thereby on the sea ice (evolution) are substantial. The potential increase of low-level cloudiness with enhanced evaporation following a shrinking Arctic ice pack may also provide an energy flux feedback not currently well captured in models. I recommend that discussion around this topic be included here. Consider e.g. the works by Kapsch et al. (2013) and Sedlar (2018), as well as the discussion in the review paper by Vihma et al. (2015). [Aku Riihelä, Finland]	Taken into account: the suggested references are historical studies using satellite and reanalysis data, as such they do not appropriate for this section focused on multi-decadal projections. We have added the Kapsch et al study to Section 3.2.1.1.1
2324	3	31	22	31	30	In the mid-20th century, air pollution controls led to decreased aerosols over the Arctic that led to enhanced warming in the years following. (Gagné M.-E., et al. (2017) Aerosol-driven increase in Arctic sea ice over the middle of the twentieth century, GEOPHYSICAL RESEARCH LETTERS 44:7338–7346.) [Kristin Campbell, USA]	Taken into account:this historical study is not appropriate for citation in this section focused on multi-decadal projections, but the reference was added to Section 3.2.1.1.1
2450	3	31	22	31	30	In the mid-20th century, air pollution controls led to decreased aerosols over the Arctic that led to enhanced warming in the years following. (Gagné M.-E., et al. (2017) Aerosol-driven increase in Arctic sea ice over the middle of the twentieth century, GEOPHYSICAL RESEARCH LETTERS 44:7338–7346.) [Durwood Zaelke, USA]	See 2324
3518	3	31	22	32	17	A recent paper was published which could be included in this section: Massonet et al., 2018. Arctic sea-ice change tied to its mean state through thermodynamic processes, Nature Climate Change, doi 10.1038/s41558-018-0204-z. [Deborah Verfaillie, Spain]	Accepted: text revised and citation added
3712	3	31	22	31	22	The models do usually not capture the „observed“ decline, they simulate a decline that is often very different from the observed one. We don‘t have reliable observations of thickness declines to examine whether the models capture it. [Dirk Notz, Germany]	Accepted: text revised
6398	3	31	22	31	22	The sentence "Historical simulations from CMIP5 models capture observed declines in sea ice extent and thickness" could be misinterpreted, since it has been seen in CMIP5 that the observed trends were steeper than the average CMIP5 model. However, internal variability is pronounced. Instead of "capture" I would suggest "are not incompatible", or "are compatible". [François Massonnet, Belgium]	Accepted: text revised
7758	3	31	22	31	22	"capture observed declines in Arctic sea ice extent and thickness" - without specifically stating that this applies to the Arctic in the opening sentence, this appears to apply to both poles which is untrue. [APECS Group Review, Germany]	Accepted: text revised
10862	3	31	22			"…CMIP5 model capture observed declines in sea ice extent and thickness…". I presume this should be "…Arctic sea ice…"? [Ed Blockley, UK]	Accepted: text revised

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
10864	3	31	22	31	30	How does this fit with the findings of Rosenblum and Einenmann (2017)? E. Rosenblum and I. Eisenman (2017). Sea ice trends in climate models only accurate in runs with biased global warming. J Climate 30, 6265-6278. [Ed Blockley, UK]	Accepted: text revised and citation added
12948	3	31	22	31	30	In the mid-20th century, air pollution controls led to decreased aerosols over the Arctic that led to enhanced warming in the years following. (Gagné M.-E., et al. (2017) Aerosol-driven increase in Arctic sea ice over the middle of the twentieth century, GEOPHYSICAL RESEARCH LETTERS 44:7338–7346.) [Gabrielle Dreyfus, USA]	See 2324
16000	3	31	22	31	42	This is true earlier in the capture as well, but this report relies heavily on results from Stroeve when it comes to Arctic sea ice. Surely there are other authors that have provided results that coorobrate Stroeve et al. It appears to me that being a synthesis report tasked with summarizing the state of knowledge that sections of this report rely too heavility on a single author. [Patrick Taylor, USA]	See 14372
7752	3	31	25	31	25	Is the (high confidence) comment meant for the first part of sentence (models capture well sea ice extent and thickness changes) or for the second part (models do not capture well patterns, atmospheric circulation and drift)? Please clarify. [APECS Group Review, Germany]	Accepted: text revised
7754	3	31	25	31	30	Please add statements of confidence if possible in these 2 sentences. [APECS Group Review, Germany]	Taken into account: confidence statements have been revised for this entire section.
19940	3	31	25	31	25	"Arctic sea ice extent loss scales linearly with both…" should be rewritten as: "Loss of Arctic sea ice scales linearly with both…" [Michelle A. North, South Africa]	Accepted: text revised
19942	3	31	25	31	26	Remove either the "both" before "global temperatures and cumulative CO2" OR before "simulations and observations", or BOTH of these. [Michelle A. North, South Africa]	Accepted: text revised
3714	3	31	26	31	27	I find this sentence misleading. Most models have a lower sensitivity than what is observed (also see Rosenblum and Eisenman, 2016, 2017), so they do not „realistically capture the integrated climate sensitivity of sea ice to climate change“ [Dirk Notz, Germany]	Accepted: text revised

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
1204	3	31	27			I strongly suggest that the recent paper by Niederneck and Notz (2018) is added here, as it shows that the observational uncertaity on sea ice sensitivity is quite large (ranging from 3.3 million km2/C to 4.1 million km2/C), making model assessment challenging. And the paper Rosenblum and Eisenman (2017) also should be cited, as they showed, as their title says, that "Sea Ice Trends in Climate Models Only Accurate in Runs with Biased Global Warming". Suggested edit: Remove "suggesting that climate 27 models realistically capture the integrated climate sensitivity of sea ice to climate change". Also remove "is about half that of observations", as given the observational uncertaity shown in Niederneck and Notz, I dont think is accurate. Instead add something along these lines: However, the slope of this linear relationship differs between observational datasets and between models. While the observational unertaity of the magnitude sea ice sensitivity is quite large (, Niederneck and Notz, 2018), the modeled sensitivity (ice loss per unit of warming) is less in most models (Rosenbloom and Eisenman, 2018), due to models underestimating the increase in downwelling longwave radiation associated with increases in atmospheric CO2 (Notz and Stroeve, 2016b). Citation to add: Niederdrenk, A. L., & Notz, D. (2018). Arctic sea ice in a 1.5◦C warmer world. Geophysical Research Letters, 45, 1963–1971. https://doi.org/10.1002/2017GL076159 Rosenblum, E., and I. Eiseman (2017), Sea Ice Trends in Climate Models Only Accurate in Runs with Biased Global Warming, Journal of Climate, DOI: 10.1175/JCLI-D-16-0455.1. [Alexandra Jahn, USA]	Accepted: thanks for the suggested text. Text revised and citations added.
13074	3	31	28	31	28	Per unit of warming or per unit of emitted C? [Gerhard Krinner, France]	Accepted: text revised
2326	3	31	32	31	43	Overland and Wang (2013) provide a range of possibilities for timing of an ice-free Arctic, covering the results from modeling, stochastic, and trend studies. (Overland J. E. & Wang M. (2013) When will the summer Arctic be nearly sea ice free?, GEOPHYSICAL RESEARCH LETTERS 40:2097–2101.) [Kristin Campbell, USA]	Taken into account: this paper is cited in this paragraph.
2452	3	31	32	31	43	Overland and Wang (2013) provide a range of possibilities for timing of an ice-free Arctic, covering the results from modeling, stochastic, and trend studies. (Overland J. E. & Wang M. (2013) When will the summer Arctic be nearly sea ice free?, GEOPHYSICAL RESEARCH LETTERS 40:2097–2101.) [Durwood Zaelke, USA]	See 2326
6400	3	31	32	31	43	A reference should be added to Sigmond et al., 2018 (https://www.nature.com/articles/s41558-018-0124-y) , that goes along the same line as Jahn, 2018 [François Massonnet, Belgium]	Taken into account: Sigmond et al 2018 is cited in this paragraph
12950	3	31	32	31	43	Overland and Wang (2013) provide a range of possibilities for timing of an ice-free Arctic, covering the results from modeling, stochastic, and trend studies. (Overland J. E. & Wang M. (2013) When will the summer Arctic be nearly sea ice free?, GEOPHYSICAL RESEARCH LETTERS 40:2097–2101.) [Gabrielle Dreyfus, USA]	See 2326
4002	3	31	33	31	36	Discuss also structural uncertainty (eg, Hawkins and Sutton, 2012) in relation to spread in ice-free dates [Helene Hewitt, UK]	Taken into account: this sentence was revised to include additional sources of model uncertainty specific to sea ice. Not clear which paper is referred to here, but a general reference on the importance of model structural uncertainty is not needed.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
13076	3	31	33	31	33	Duration of ice-free conditions just as important as knowing when there is no ice in peak summer (Jahn 2018) [Gerhard Krinner, France]	Accepted: text revised
1850	3	31	34	31	34	The ice pack may disappear seasonally, but will reappear during winters for the foreseeable future. Please revise to make this point clearer. [Aku Riihelä, Finland]	Accepted: text revised
6402	3	31	36	31	36	This sentence leaves the impression that the only source of model error is in the dynamics. The thermodynamics also plays a key role, especially on sea ice volume trends. We recently published a study on that aspect: Massonnet et al., 2018 (https://www.nature.com/articles/s41558-018-0204-z) where the origins of model spread are traced to the simulation of seasonal sea ice thermodynamics. It would be good to cite this study and others to better reflect the multiple origins of model error. [François Massonnet, Belgium]	Accepted: text revised and citation added
3716	3	31	37	31	37	Could add Notz (2015) who first found this range [Dirk Notz, Germany]	Accepted: text revised and citation added
13078	3	31	37	31	37	21 years: strange number. Add "one model" [Gerhard Krinner, France]	Accepted: text revised
3720	3	31	41	31	41	Please ensure that the equivalence of 1000 Gt and 2 °C global warming is consistent with the findings of the IPCC SR15 [Dirk Notz, Germany]	Taken into account: will confirm
17004	3	31	41	31	41	"in agreement with a 2oC temperature increase" is unclear. Transient rise? Rise along trend to 2oC stabilisation? Compared to preindustrial? [Markku Rummukainen, Sweden]	Accepted: text revised to clarify
1210	3	31	42		43	Add to add citation to Sanderson et al., 2017, here in addition to Jahn, 2018 and Sigmond et al. 2018, as Sanderson et al. 2017 first showed this. Citation to add: Sanderson, B., Y. Xu, C. Tebaldi, M. Wehner, B. O'Neill, A. Jahn, A. Pendergrass, F. Lehner, W. Strand, L. Lin, R. Knutti, and J.-F. Lamarque (2017), Community Climate Simulations to assess avoided impacts in 1.5 ◦C and 2 ◦C futures, Earth Syst. Dynam., 8, 827–847, doi:10.5194/esd-8-827- 2017. [Alexandra Jahn, USA]	Accepted: text revised and citation added
3718	3	31	42	31	43	It must be clarified by what is meant with the statement that sea ice will „very likely survive at 1.5 °C global warming". For example, Niederdrenk and Notz (2018) find for their high-sensitivity observational record that at 1.5 °C global warming, 10 % of all years will be ice free. Sigmond et al. (2018) find in their bias-corrected estimate that at 1.5 °C global warming, 2.4 % of all years will be ice free. This number increases to 13 % for the model simulations without bias correction, which are less reliable. [Dirk Notz, Germany]	Accepted. See 1206
1206	3	31	43			I would strongly recommend adding: but individual ice-free years might occur even then (Jahn, 2018, Signmod et al., 2018), otherwise the statement of "very likely to survive the summer" is misleading. [Alexandra Jahn, USA]	Accepted: text revised
14296	3	31	43			How many Gt carbon is equivalent to 1.5C warming? Either in total of per year. (For comparison with the 1000Gt of the 2C scenario) [Christopher Fogwill, UK]	Taken into account: paragraph was revised and carbon emission numbers are no longer provided
17006	3	31	43	31	43	What does "survive" mean? Significant september sea ice cover every year? [Markku Rummukainen, Sweden]	Accepted: text revised
6404	3	31	45	31	53	This paragraph on Antarctic sea ice is confusing: it is about model-obs inconsistencies over the historical period, while the section is about projected changes. Please re-organize accordingly. [François Massonnet, Belgium]	Accepted: text revised

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
7756	3	31	45	32	5	These 2 paragraphs should be merged and shortened: the 1st one describes the findings and provides explanations, while the second offers 1 statement of confidence and provides more explanations. Please merge both paragraphs and restructure to have first the results with statements of confidence, and then the explanations for the low confidence in sea ice trends in the Southern Ocean. [APECS Group Review, Germany]	Accepted: text revised
10866	3	31	47			The statement that "This difference can be explained by internal variability…" may need to be toned down in relation to the findings of Rosenblum and Eisenmann (2017) who suggest that periods in control simulations with expanding Antarctic sea ice are likely to have global warming trends that are substantially below the 1979–2013 observed trend. E. Rosenblum and I. Eisenman (2017). Sea ice trends in climate models only accurate in runs with biased global warming. J Climate 30, 6265-6278. [Ed Blockley, UK]	Accepted: text revised
13080	3	31	55	31	57	Here Massonnet et al N CLimate Change 2018 comes in handy. Sea ice thickness simulation good predictor [Gerhard Krinner, France]	Rejected: this study only addresses Arctic sea ice and this paragraph is focussed on Antarctic sea ice
1606	3	31	56	31	56	check reference to section 3.3.1.4.1 (it doesn't exist in the document) [Maria Vittoria Guarino, UK]	Accepted: text revised
23744	3	31	56	31	56	There is no section 3.3.1.4.1 [Hans-Otto Poertner and WGII TSU, Germany]	Accepted: text revised
7760	3	31	57	32	3	Consider including Goosse et al 2018 in this paragraph, as it discusses ocean biases in CMIP5 models and links them to the amplification of the seasonal cycle of Southern Ocean sea ice and the implications for sea ice trends. (Goosse, H., Kay, J. E., Armour, K. C., Bodas-Salcedo, A., Chepfer, H., Docquier, D., ... & Park, H. S. (2018). Quantifying climate feedbacks in polar regions. Nature communications, 9(1), 1919.). [APECS Group Review, Germany]	Taken into account: while suggested reference discusses important feedbacks related to Antarctic sea ice, it does not specifically address CMIP5 projections of Antarctic sea ice
7768	3	32	9	32	13	These sentences could be reorganised for better narrative flow: 1) that there has been little new research on projections; 2) the known biases produce low confidence in projections; 3) meltwater from ice shelves not being represented in models; 4) how uncertainties reduce confidence in projections of the Antarctic Ice Sheet [APECS Group Review, Germany]	Accepted: text revised
7762	3	32	10	32	12	This sentence should be moved to the previous paragraph were explanations for the low confidence are given. [APECS Group Review, Germany]	Accepted: text revised
19944	3	32	10	32	11	Modify to read: "…freshening with ice shelf melt water could mitigate future…" [Michelle A. North, South Africa]	Accepted: text revised
1738	3	32	16	32	16	The following reference should be included with the Bracegirdle, in press, reference as to demonstrate the importance of sea ice on the changes in the Southern Hemisphere atmospheric jet, both in location and strength. England et al (2018) Contrasting the Antarctic and Arctic atmospheric responses to projected sea ice loss in the late 21st Century, Journal of Climate (in press), doi:10.1175/JCLI-D-17-0666.1. [Mark England, UK]	Accepted: text revised and citation added
7764	3	32	26	33	55	This whole box 3.2 Polynyas is very nicely written but lacks statements of confidence throughout. One is provided line 7 page 33 and another one in the very last sentence. Please add statements of confidence where possible in the other 8 paragraphs. [APECS Group Review, Germany]	Taken into account: confidence language being revised through the entire chapter

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
17434	3	32	26	32	55	The role of Arctic coastal polynyas in formation of dense water on the Arctic shelves should be mentioned. [Sonya Legg, USA]	Rejected: This is covered by this sentence: "The warm and exposed ocean surface creates very high heat fluxes and sea ice formation rates during winter, releasing brine and creating dense water that helps ventilate the stratified Arctic Ocean (Barber et al., 2012)."
7766	3	32	45	32	47	Check the meaning of this sentence. Do you really mean to repeat 'adapted to the early availability of energy' twice? [APECS Group Review, Germany]	Accepted: text revised
19946	3	32	45	32	47	Please rewrite this sentence [Michelle A. North, South Africa]	Accepted: text revised
23746	3	32	45	32	47	Sentence awkward, please revise [Hans-Otto Poertner and WGII TSU, Germany]	Accepted: text revised
19948	3	32	49	32	50	Please modify this sentence to read: "Because of the abundance of seals, whales, fish and other marine life in and around polynyas, they have been regular hunting areas for Arctic people for thousands of years ()" [Michelle A. North, South Africa]	Accepted: text revised
6080	3	32	51	32	55	Please remove 'traditional' in describing Inuit knowledge. Furthermore, it is important that the issue of development is properly explained here. There IS concern that increased development, whether from tourism, mining, or shipping, will have a negative impact upon the Pikialasorsuaq if the needs of development placed first. But there is a desire for development activities that occur in ways that minimize harm on the environment and wildlife on which Inuit ways of life depend. It is important that these qualifiers be understood here. [Joanna Petrasek Macdonald, Canada]	Accepted: text revised
22600	3	32	51	32	52	The Inuit Circumpolar Council prefers to just refer to "Inuit knowledge", and not use "traditional". [Eva Kruemmel, Canada]	Accepted: text revised
2250	3	33	1	33	30	In addition to the fact that iron can be present in ice-sehlf meltwater, the overturning circulation induced by ice-shelf melting is important for bringing deep iron towards the ocean surface, as shown in this publication: St-Laurent et al. (2017) have shown that . St-Laurent, P., Yager, P. L., Sherrell, R. M., Stammerjohn, S. E., & Dinniman, M. S. (2017). Pathways and supply of dissolved iron in the Amundsen Sea (Antarctica). Journal of Geophysical Research: Oceans, 122(9), 7135-7162. [Nicolas Jourdain, France]	Accepted: text revised
7772	3	33	16	33	17	An extra sentence here would be helpful to clearly explain why the retreat of ice sheets causes polynas to form - at lines 1-2, it is stated that polynas form "in the lee of coastal features that protrude into the westward current"; it could be confusing then to consider that when ice sheets retreat from the coast the polynas are forming anyway. The following sentence refers to Cape et al. 2013; in this paper, it is explained why the absence of the Larsen ice shelves leads to sensible heat polynya, so perhaps rework the paragraph to briefly include this explanation. [APECS Group Review, Germany]	Taken into account: We think the reviewer thought the "protrusions referred to in the text were ice shelves since the original text said that "The Antarctic Ice Sheet is surrounded by coastal polynyas. Changed Ice Sheet to continent to eliminate this confusion.
23750	3	33	16	33	16	the info on P33L10 is repeated [Hans-Otto Poertner and WGII TSU, Germany]	Accepted: text revised
19952	3	33	17	33	17	Collapse should be singular [Michelle A. North, South Africa]	Accepted: text revised
7774	3	33	18	33	18	Specify the "ramifications". [APECS Group Review, Germany]	Taken into account: We know that export will increase and the ecosystem will change, but we don't know how.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
7776	3	33	19	33	19	"east" in East Antarctica should have a capitalised E here. [APECS Group Review, Germany]	Accepted: text revised
7778	3	33	19	33	19	Can the alterations be specified here? This is a particularly useful example to show how these interactions can change dramatically. [APECS Group Review, Germany]	Taken into account: We know that export will increase and the ecosystem will change, but we don't know how.
14116	3	33	20	33	20	Need reference to stratification changes sugest Fogwill, C. J. et al. Brief Communication: Evidence of a developing Polynya off Commonwealth Bay, East Antarctica, triggered by grounding of iceberg. The Cryosphere Discuss. 2016, 1-13, doi:10.5194/tc-2016-19 (2016). [Christopher Fogwill, UK]	Accepted: reference added
1852	3	33	28	33	30	The conclusive sentence is somewhat ambiguous, speaking in general terms of influence and ability, but refraining from any comment as to whether or not the expected changes are positive or negative. Please consider revising for clarity to the reader. [Aku Riihelä, Finland]	Accepted: text changed to note that the ability to sequester carbon will increase
16310	3	33	32	33	55	Weddell polynya will have citations. There is a section in the new BAMS State of the Climate report, authors. Swart et al., that discuses it. There is a manuscript in progress by PhD students at UW: Campbell, E., Wilson, E. with advisor S. Riser, that should be submitted before the Oct. 15 cutoff for submitted papers. I do not know the mechanism for providing manuscripts that are not yet submitted, but would like to learn more about it. Note also that Chapter 5 has discussion of the Weddell polynya. It should probably only be in Chapter 3. [Lynne Talley, USA]	Taken into account: Weddell polynya text and citations to be updated as these publications are available.
23748	3	33	34	33	35	74-76 are only 2 years, not «several»; I suggest saying "polynya remained open for 3 winters" [Hans-Otto Poertner and WGII TSU, Germany]	Accepted: text revised
7770	3	33	35	33	37	An area of low sea ice concentration has appeared in this area, following the extreme low Antarctic sea ice extent in spring 2016, but it remains an open question whether a persistent polynya will form again' What about the opening between late September and late November 2017 (melt season)? Did it really only qualify as an area of low sea ice concentration? Why not call it a polynia? The Weddell Sea had an ice free area surrounded by sea ice for many weeks in a row. Surface area of 80,000 km2 at its peak. Are there no papers in press talking about this 2017 occurrence that could be cited? [APECS Group Review, Germany]	Taken into account: Weddell polynya text and citations to be updated as these publications are available.
22498	3	33	39	33	46	One of the first models for the evolution of the Wedell Polynya with a coupled sea ice - mixed layer model was presented by Lemke, 1987: A coupled one-dimensional sea ice - ocean model. J.Geophys.Res. 92, 13164-13172. Followed by a more sophisticated sea ice model component: Lemke et al. 1990: A coupled sea ice - mixed layer - pycnocline model for the Weddell Sea. J.Geophys.Res. 95, 9513-9525. A detailed investigation of the formation and conservation of the Weddell Polynya showing the atmospheric feedbacks is given by Timmermann et al. 1999: Formation and Conservation of a polynya in the Weddell Sea, J. Phys. Oceanogr., 29(6) 1251-1264. [Peter Lemke, Germany]	Rejected: These references provide important background material but are beyond the scope of the box.
19954	3	33	42	33	43	The line: "and sea ice formation causes mixing of warm, deep waters to the surface, sufficient to melt newly-formed sea ice..." doesn't make sense, please revise [Michelle A. North, South Africa]	Accepted: text revised

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
3748	3	33	55	33	55	Moreover, the atmospheric forcing has an important role as ocean models forced with prescribed atmospheric states mostly fail to reproduce the historical Weddell polynya in 1970s (Downes et al. 2015). Downes, S. M., Farneti, R., Uotila, P., Griffies, S. M., Marsland, S. J., Bailey, D., … Yeager, S. G. (2015). An assessment of Southern Ocean water masses and sea ice during 1988-2007 in a suite of interannual CORE-II simulations. Ocean Modelling, 94, 67–94. doi:10.1016/j.ocemod.2015.07.022. [Petteri Uotila, Finland]	Rejected: While It is certainly true that atmospheric forcing is important in the Weddell Polynya,this comment focusses on model performance, note to understanding of the polynya itself.
5390	3	34	3	36	7	Very extensive section. Although well written,can be difficult to read since it contains a lot of information. Would a figure showing an overview of the processes with projections help? [Roderik Van De Wal, Netherlands]	Accepted. The section has been condensed and repartitioned to help readability.
7780	3	34	3	34	3	Since this subsection is part of the section 'Projected changes in ocean and sea ice', it might be more accurate to call it 'Projected ocean properties and circulation'. [APECS Group Review, Germany]	Taken into account. Section headings have been revised and focussed.
19202	3	34	5	34	6	This section starts with a clear statement (which could also qualify as a key message) -- that's nice and eases the read.. [Marianne Kroglund, Norway]	Noted
7782	3	34	16	34	23	If possible please add statements of confidence in this paragraph. [APECS Group Review, Germany]	Accepted; text revised
7786	3	34	16	34	32	If possible please add statements of confidence in these 2 paragraphs. [APECS Group Review, Germany]	Accepted; text revised
3746	3	34	22	34	22	2degC and 6degC [Petteri Uotila, Finland]	Accepted; text revised
7784	3	34	25	34	32	If possible please add statements of confidence in this paragraph. [APECS Group Review, Germany]	Accepted; text revised
14298	3	34	25			21st not 'twenty first' [Christopher Fogwill, UK]	Accepted; correction made
17008	3	34	25	34	25	"consistent but uncertain" is difficult to decipher. How is it consistent? Across what? [Markku Rummukainen, Sweden]	Accepted; text revised
1854	3	34	26	34	28	Does "this" here refer to the Barents Sea? And does the ice-free winter state occur with all RCP scenarios? Be specific, please. [Aku Riihelä, Finland]	Accepted; text revised
14300	3	34	26	34	27	From about 2050 onwards…' [Christopher Fogwill, UK]	Accepted; text revised
19956	3	34	34	34	35	"…in the future because an intensified hydrological cycle will increase river runoff" or similar [Michelle A. North, South Africa]	Accepted; revision made as suggested
13478	3	34	36	34	36	At what depth? [Debra Roberts and Durban Team, South Africa]	Accepted; information included
19958	3	34	36	34	36	Change to: "…warming of the deep Atlantic Water layer, as upward vertical mixing will be reduced" [Michelle A. North, South Africa]	Accepted; text revised
17010	3	34	37	34	39	What do these biases imply? Their significance? [Markku Rummukainen, Sweden]	Accepted; statement of implications included
19960	3	34	37	34	37	Change to: "There are, however, salinity biases…" [Michelle A. North, South Africa]	Accepted; text revised
3744	3	34	39	34	39	Ilicak et al. (2016) did not study CMIP5 models, as is expressed here, but CORE-II ocean-ice models driven by prescribed atmospheric states. This error needs to be corrected. [Petteri Uotila, Finland]	Accepted; text revised. Most models were the ocean + sea ice version used for CMIP5 though.
7790	3	34	49	34	49	"significant biases in historical water mass properties". Add a sentence to say in why and in what direction the historical water mass properties are biased. [APECS Group Review, Germany]	Accepted; text revised. The continuation of the quoted sentence immediately states that the biases are up to 3 degrees too warm. We have changed ‘significant biases’ to ‘significant warm biases’ to aid the reader.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
7788	3	34	52	35	7	If possible please add statements of confidence in this paragraph. [APECS Group Review, Germany]	Accepted; statement added
14118	3	34	53	34	53	add reference after Downes et al., 2018, Erik, v. S. et al. Pairwise surface drifter separation in the western Pacific sector of the Southern Ocean. Journal of Geophysical Research: Oceans 120, 6769-6781, doi:doi:10.1002/2015JC010972 (2015). [Christopher Fogwill, UK]	Rejected; this sentence refers to climate model eddies and uptake efficiency rather than any observational assessment of mixing that may be relevant from the suggested paper. We have added '…in climate models' at the end of the sentence to clarify this.
19962	3	35	12	35	13	Move "also" to before "significant differences" to read: "There are also significant differences in subpolar gyre strength…" [Michelle A. North, South Africa]	Taken into account; text removed to focus on more pertinent issues
19964	3	35	19	35	20	Change to: "is predicted to continue decreasing ()…" [Michelle A. North, South Africa]	Accepted – text revised
424	3	35	25	35	25	Replace saturationin" with "saturation in" [George Burba, USA]	Accepted; corrected
14302	3	35	25			saturation' not' saturationin' [Christopher Fogwill, UK]	Accepted; corrected
16312	3	35	25	35	25	saturation in' [Lynne Talley, USA]	Accepted; corrected
16876	3	35	25	35	25	missing space between "saturation" and "in" in "saturationin" [Anthony Mémin, France]	Accepted; corrected
19966	3	35	25	35	25	There is a space missing between "saturation" and "in" [Michelle A. North, South Africa]	Accepted; corrected
19968	3	35	26	35	27	Modify to read: "The impact and spatial heterogeneity of climate change play a strong role…" [Michelle A. North, South Africa]	Taken into account; sentence deleted as became redundant.
7792	3	35	37	35	57	This paragraph would benefit from being condensed. The discussion around the year of onset of month long and annual mean undersaturation in various scenarios could be removed (Line 42-47). As it is currently presented, that discussion is a bit obscure. [APECS Group Review, Germany]	Rejected, though the text has been edited to make it clearer. These are important projections with significant impacts on ecosystems which may be irreversible in scenarios RCP4.5/8.5
7794	3	35	37	35	57	For this paragraph, all statements of confidence are kept to the end, and presented in a single sentence that encompasses all discussed predictions. If individual statements of confidence can't be provided throughout the paragraph, then the final sentence should contain a little more detail: 'Although the confidence level for the onset of reduced buffering capacity and undersaturation is high to very high, the model projections [of what?] are still temporally and spatially uncertain so the overall confidence levels [for what?] are medium to high.' [APECS Group Review, Germany]	Accepted - suggested sentence edit was adopted
19970	3	35	41	35	41	I don't understand what is meant by: "the influence of anthropogenically-forced reduced buffering trend on the seasonal cycle…", please try to rewrite this so that it is more comprehensible [Michelle A. North, South Africa]	Accepted - meaning clarified
21182	3	35	44	35	44	What is the 'tipping point' referred to here. I recommend that the term 'tipping point' be reserved for when a system changes from one state to another or, at least, has been set on a path to a different state, where that path is then difficult to reverse. If it is simply a specified value for a forcing variable or that the rate of change in the forcing variable itself has changed in a significant way (such as at the inflexion point in a logistic curve) then it would be preferred to call this a 'threshold' or 'critical threshold' of some such. The term tipping point is used in many different contexts which make it confusing. Please define it clearly. [Andrew Constable, Australia]	Accepted - the term abrupt change threshold was used to replace tipping point
426	3	35	47	35	47	Consider removing term "tipping point". It does not seem to be actual tipping point, and also, "tipping point" is economic term that may be confusing to many readers. [George Burba, USA]	Accepted - the term abrupt change threshold was used to replace tipping point

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
19210	3	36	0	49		Qheck for overlaps to/consistancy with chapter 5 [Marianne Kroglund, Norway]	Taken into account; checks made + new cross-chapter box created with Chapter 5
19994	3	36	0	39		Please be consistent with use of latin names of all species: either include them at first mention for everything, or remove them. [Michelle A. North, South Africa]	Accepted. We now include latin names upon first mention
7796	3	36	2	36	7	If possible please add statements of confidence in this paragraph. [APECS Group Review, Germany]	Accepted; text revised and confidence statement added
15572	3	36	9	45		Discussion of marine ecosystems and variable impacts on the food chain, fish, benthic communities and marine mammals is excellent. [Melinda Kimble, USA]	Accepted, thanks for the positive response.
23764	3	36	9	52	32	there is some overlap and duplication between sections 3.3.3 (implication for marine ecosystems) and 3.3.4 (sectoral consequences) which should be reduced (consider restructuring) [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account, should be rewritten (but keep main structure)
5814	3	36	11	36	11	Does "cryosphere" refer specifically to sea ice and ice sheets since these are the only two cryosphere mentioned prior to this in any detail. [Sharon Smith, Canada]	Taken into account. In the context of marine ecosystems sea ice and ice sheets are the most important parts of the cryosphere
12610	3	36	11			Would like to see some discussion of the role of release of contaminants from sea ice into the important food webs and incorporation into lower trophic levels up to fish and fisheries [Alexander Milner, UK]	Time and page limits impacted our ability to address this issue. We will strive to research this issue and add text in the Third order draft.
19204	3	36	11	36	14	cross-refernce to chapter 5? [Marianne Kroglund, Norway]	We have worked closely with the authors of Chapter 5 and did not see a reason to cross reference this here.
1330	3	36	13			could add text to emphasise range shifts and impacts on existing management arrangements [Marcus Haward, Australia]	Taken into account. This is (briefly) dealt with in section 3.3.4.1.1
1856	3	36	14	36	19	The Figure describing the Ecosystems areas appears to be missing. [Aku Riihelä, Finland]	Taken into account. Reference to no-longer-existing figure removed
5392	3	36	14	36	14	How is the "severity of change" defined? [Roderik Van De Wal, Netherlands]	We added supplementary material to clarify how different scenarios differ with respect to the regional severity of change. We also added some summary text in the introduction of this section
5816	3	36	18	36	18	See earlier comment regarding need for map to clearly define regions considered. [Sharon Smith, Canada]	The map of the ecoregions are now included in supplementary material.
6224	3	36	18	36	18	the domain should be defined at the very beginning and not after 36 pages of text [Regine Hock, USA]	Taken into account. The definition is already given in 3.1, p 6. Deletet from here.
19206	3	36	18	36	19	Already said in introduction [Marianne Kroglund, Norway]	Accepted
23754	3	36	18	36	19	This definition is already given in 3.1, p 6 [Hans-Otto Poertner and WGII TSU, Germany]	Accepted
7800	3	36	19	36	21	This sentence is a little confusing as it is not clear what these ecoregions are (both in the text and in the cited reference) and it's not clear how they provide a framework for the rest of the discussion. [APECS Group Review, Germany]	Taken into account. The definition and reference is already given in 3.1, p 6.
22410	3	36	19	36	19	Figure 3.x [Matthieu Chevallier, France]	Taken into account. Reference to non-existing figure removed
23756	3	36	19	36	19	Figure 3.x??? [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account. Reference to non-existing figure removed
23752	3	36	23	38	3	I suggest removing the subtitles (prim pro, zooplankton,...) here. Not necessary [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account. Subtitles are removed
10994	3	36	24	36	30	see recent paper by Joli et all 2018, Scientific Reports on species distributions. [Connie Lovejoy, Canada]	Taken into account. This reference was added
23758	3	36	24	36	34	what about Macroalgae??? They are briefly discussed below under benthos, but macroalgae are also low tropic level primary producers. Consider restructuring of changing the titles of subsections [Hans-Otto Poertner and WGII TSU, Germany]	space did not permit us to include a section on macroalgae in the main text but an appendix is available that provides detailed information.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
23760	3	36	24	36	34	What about the impact of temperature and/or Ocean acidification on phytoplankton? No effect? Should be at least mentioned [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account. We added a sentence on this issue.
7798	3	36	25	37	41	In these 2 subsections, no IPPC langage is used, concerning the confidence in the different results shown here. They would be useful to get an idea of the limitations of the studies cited here. [APECS Group Review, Germany]	Confidence was based on the assessment of the author team
19208	3	36	25	36	26	Qualifies as key message? [Marianne Kroglund, Norway]	Thank you good idea
22412	3	36	26	36	26	Tropic → trophic [Matthieu Chevallier, France]	Accepted
7802	3	36	36	36	38	…blooms of this size and intensity…' is a bit vague as there is no mention of what size they are. The sentence could include more specific details such as: '…intense phytoplankton blooms that develop under first year sea ice, extending >100 km into the ice pack with a biomass 4 times greater than observed in open water.' [APECS Group Review, Germany]	Taken into account. We have added size scale and units
23762	3	36	36	36	37	Please explain why an increase in intense blooms is «dramatic» [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account. We removed the word dramatic
5394	3	36	38	36	39	“Blooms of this size and intensity were thought to be restricted to the marginal ice zone and the open ocean where ample light reaches the surface ocean for rapid phytoplankton growth” Can a quote be added? [Roderik Van De Wal, Netherlands]	Taken into account. The sentence was modified to include more and more precise information
19972	3	36	42	36	42	What are "large lead fractions"? Is this a discipline-specific term that can be rephrased or explained? [Michelle A. North, South Africa]	Taken into account. This refers to cracks in the ice. is now explained in text
7808	3	37	1	37	3	This sentence is too vague as it doesn't indicate how long ago 'previously' was. Include more specific detail such as '…accounting for up to 8.6% of total NPP in 2014 (Song et al., 2016) compared to just 2-5% in 1994 (Gosselin et al., 1997, Deep Sea Research Part II, 44) [APECS Group Review, Germany]	Taken into account. The sentence was modified
7806	3	37	3	37	3	It would be interested to add a very recent reference in this paragraph : Fernández-Méndez, M., Olsen, L. M., Kauko, H. M., Meyer, A., Rösel, A., Merkouriadi, I., ... & Ervik, Å. (2018). Algal hot spots in a changing Arctic Ocean: Sea-ice ridges and the snow-ice interface. Frontiers in Marine Science, 5, 75. This reference will fit perfectly in this paragraph and will show a new evidence of the impact of climate change on the ecosystems. [APECS Group Review, Germany]	This reference was added
5396	3	37	17	37	17	"[…] with consequences to fisheries." Such as? [Roderik Van De Wal, Netherlands]	Taken into account. Text has been rewritten as support for " consequences to fisheries" is weak. Now says pollock recruitment
5398	3	37	18	37	18	"[…] long-term increases in large copepods" How much time does long-term mean in this situation? [Roderik Van De Wal, Netherlands]	Taken into account. A time frame was added
5400	3	37	22	37	32	What is the level of confidence of the models? [Roderik Van De Wal, Netherlands]	Confidence for the SRES models are available in AR4
19974	3	37	22	37	23	Modify to read: "…transitioning from a benthic-dominated system to a more pelagic-dominated one…" [Michelle A. North, South Africa]	Taken into account. Text has been rewritten
23766	3	37	22	37	23	"benthic-/pelagic-dominated systems": Dominated in term of what? Species number? Biomass? Interactions? Please clarify [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account. Text has been rewritten to highlight shift in biomass production
19976	3	37	23	37	23	SRES? Please write out, even if it is an IPCC Special Report [Michelle A. North, South Africa]	Taken into account. Written out and reference provided
23768	3	37	23	37	23	please provide full name of SRES report [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account. Written out and reference provided

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
4644	3	37	34	37	36	Some important reference in regards to affected calcifying zooplankton communities affected by the undersaturated waters in the natural environment are missing. Pteropod shell dissoltuion as a direct OA effect has been demonstrated in the Southern Ocean already. The missing reference that needs inclusion is: • Bednaršek, N., Tarling, G.A., Bakker, D.C.E., Fielding, S., Jones, E.M., Venables, H.J., Ward, P., Kuzirian, A., Lézé, B., Feely, R.A. and Murphy, E.J., 2012. Extensive dissolution of live pteropods in the Southern Ocean. Nature Geoscience, 5(12), p.881. [Nina Bednarsek, USA]	References were added
7804	3	37	34	37	34	« undersatured waters » : with respect to what? Aragonite? Not clear to a non-specialist. [APECS Group Review, Germany]	This was addressed
20978	3	37	34	37	34	"undersaturated" with what? "aragonite" ? Please specify! [Claudio Richter, Germany]	This was addressed
23770	3	37	34	37	34	"undersaturated" in terms of what? CaCO3 forms? [Hans-Otto Poertner and WGII TSU, Germany]	This was addressed
4646	3	37	36	37	38	The sentence about the natural defense mechanisms in pteropods is skewed by not providing equal weighting of evidence of other studies that have shown that pteropods do not have natural defense mechanisms. In addition, there are several shortcomings of the Peck et al 2018 study that qualify this statement as a low confidence. First, in the study by Peck et al. (2018), the sample size was very low, making it very difficult to extrapolate the finding across. In addition, no clue is provided for how long pteropods can sustain the repair process. Given that this is energetically expensive process, the repair might actually occur on a very short-term and locally-limited basis and not help pteropod counteract shell dissolution in the real time exposure at all. So, caution is needed interpreting this sentence in the the report (p. 37, line 36-38). Moreover, there are several other studies that are showing that pteropods do not have sufficient repair mechanisms to counteract shell dissolution in the timeframe of OA exposure. References are demonstrating severe shell dissolution occurring over the large spatial shell scales and very fast dissolution rates, providing strong evidence that despite evidence of repair, shell dissolution will override repair processes. The references to be considered: • Bednaršek, N., Tarling, G.A., Bakker, D.C.E., Fielding, S., Jones, E.M., Venables, H.J., Ward, P., Kuzirian, A., Lézé, B., Feely, R.A. and Murphy, E.J., 2012. Extensive dissolution of live pteropods in the Southern Ocean. Nature Geoscience, 5(12), p.881. • Bednaršek, N., Tarling, G.A., Bakker, D.C., Fielding, S. and Feely, R.A., 2014. Dissolution dominating calcification process in polar pteropods close to the point of aragonite undersaturation. PLoS One, 9(10), p.e109183. • Bednaršek, N., Feely, R.A., Reum, J.C.P., Peterson, B., Menkel, J., Alin, S.R. and Hales, B., 2014. Limacina helicina shell dissolution as an indicator of declining habitat suitability owing to ocean acidification in the California Current Ecosystem. Proc. R. Soc. B, 281(1785), p.20140123. [Nina Bednarsek, USA]	Taken into account. We now state:The literature is mixed with respect to the projected severity of these impacts on pteropods.
14304	3	37	38			In contrast, ocean, although acidification is expected...' [Christopher Fogwill, UK]	accepted
23772	3	37	38	37	41	revise sentence [Hans-Otto Poertner and WGII TSU, Germany]	revised

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
7810	3	37	39	37	39	Include a conjunction to join the two parts of the sentence i.e. '...ocean acidification is expected to negatively impact survival of some crab and shellfish species in the future, though current ocean conditions do not appear to have negatively impacted...' [APECS Group Review, Germany]	revised
19978	3	37	39	37	40	Add 'however' before "current ocean conditions" to read: "expected to negatively impact survival of some crab and shellfish species in the future, however, current ocean conditions do not appear to have..." [Michelle A. North, South Africa]	revised
6226	3	37	43	37	57	repetition from page 29 [Regine Hock, USA]	Taken into account. Text on marine terminating glaciers has been edited
12612	3	37	51			amplify nutrient fluxes by stimulating upwelling of nutrient replete ocean water at the calving front - well stated but this can lead to hotspots of production particulalry species like shrimp which can be of commerical value [Alexander Milner, UK]	Taken into account. Text on marine terminating glaciers has been edited
1866	3	37	53	37	54	The fact that "glacier fronts" play an important role in sustaining high productivity in Arctic fjords is not that obvious. It may be true for some glacier fronts in some fjords but not all, so this sentence should be toned down (..."may play an important role..."). [Sebastien Descamps, Norway]	Taken into account. Text on marine terminating glaciers has been edited
5120	3	38	7	38	7	Not only "production" but also composition and diversity... I'd recommend writing: "... Arctic benthic biodiversity and production..." [Dieter Piepenburg, Germany]	Accepted
5118	3	38	9			delete "of" (after "on") [Dieter Piepenburg, Germany]	Accepted
13480	3	38	9	38	9	Delete 'of'. [Debra Roberts and Durban Team, South Africa]	Accepted
5122	3	38	10			A former version of Chapter 3, which I assessed in the course of internal review, contained the sentence "Biodiversity of benthic fauna in these Arctic regions is an important ecosystem service, with understanding status and change of benthic organisms over continental shelves, slope regions, and the high Arctic deep basins, being a priority for evaluating climate change impacts on ecosystem function" after the assertion about the generally great significance of biological productivity for benthic fauna. I found this sentence important - and am somewhat surprised that is has been slashed in the current version. I'd strongly recommend re-introducing it at this place, with the reference "(Bluhm et al. (2011)" for the deep-sea basins and "Piepenburg et al. (2011)" for the continental shelves. > References: - Bluhm BA et al. (2011) Diversity of the arctic deep-sea benthos. Marine Biodiversity 41:87–107. doi:10.1007/s12526-010-0078-4 - Piepenburg D et al. (2011) Towards a pan-Arctic inventory of the species diversity of the macro- and megabenthic fauna of the Arctic shelf seas. Marine Biodiversity 41:51-70. doi:10.1007/s12526-010-0059-7 [Dieter Piepenburg, Germany]	Rejected. We unfortunately had to remove this sentence as part of a general need to shorten, not because there being anything wrong with the content.
5124	3	38	14	38	15	The two references Jørgensen et al. (2012) and Fossheim et al. (2015) do no really fit here, as they both are explictly addressing FISH (not benthos) communities. They should be disregarded here. [Dieter Piepenburg, Germany]	Taken into account. There was a mistake here. References to Jørgensen et al. (2012) and Fossheim et al. (2015) have been replaced by Kortsch et al. (2012)

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
5126	3	38	18			Kortsch et al. (2015) has no reference to the assertion of this sentence and should be disregarded. The clearly more appropriate reference for the assertion "... northward shift... and the Barents Sea" would be Jørgensen LL et al. (2017) Chapter 3.3: Benthos. in: Conservation of Arctic Flora and Fauna (CAFF) (eds) State of the Arctic Marine Biodiversity Report. CAFF Secretariat, Akureyri, pp 85-107. [Dieter Piepenburg, Germany]	Taken into account. There was a mistake here. Kortsch et al (2015) has been removed. We strive to refer to primary litterature where possible so have not included ref. to CAFF report.
5128	3	38	25	38	33	Compared to the other parts of the Arctic benthos sup-chapter, this paragraph on Arctic crabs seems to be unproportionally long. Crabs are important components of (sub-)Arctic benthic communities, indeed, but considering the amount of knowledge about the impacts of climate change on other benthic ecosystem compartments, the range of ramifications investigated and found, and the sheer number of scientific publications about these topics, the 'crab part' should be condensed - or even better, the other parts should be expanded. [Dieter Piepenburg, Germany]	Rejected. In parts of the Arctic king and snow crabs are of direct and pronounced importance both through changing the environment and because of commercial value.
23774	3	38	25	38	33	please provide likelihood or confidence for statements [Hans-Otto Poertner and WGII TSU, Germany]	Accepted
7814	3	38	28	38	28	...has declined, during a warm oceanographic regime' is a bit confusing. Perhaps change wording slightly such as '..has declined as a result of a warming oceanographic regime.' [APECS Group Review, Germany]	Rejected. The suggested wording implies clear causality, which is too strong here.
5402	3	38	32	38	33	“May potentially spread further north and east along the Euro-Arctic shelves within three decades or less” Can the level of confidenc be estimatede? [Roderik Van De Wal, Netherlands]	Accepted
23776	3	38	35	39	31	Adapt titles of 3.3.3.1.3 and 3.3.3.1.4 to each other; use either «...spatial distribution and production...» OR «...production and spatial distribution...» [Hans-Otto Poertner and WGII TSU, Germany]	Addressed
23780	3	38	35	39	29	The paragraphs in this subsection seem somehow isolated from each other; I suggest to revise this section [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account. We have revised this whole section
23784	3	38	41	38	44	This section needs references [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account. References were added
19980	3	38	43	38	43	Move the comma to in front of "whereas" [Michelle A. North, South Africa]	Accepted
7816	3	38	44	38	44	Can simpler language be used instead of 'gadids' (not familiar to a non-specialist), perhaps use 'codifshes', or 'gadids (codfishes)'. [APECS Group Review, Germany]	Accepted
23778	3	38	45	38	45	Clarify that you are talking about fish food/diet here [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account.
1868	3	38	47	38	47	typo "time-series" [Sebastien Descamps, Norway]	Taken into account. Changed
3620	3	38	47			sereies change to series [Angelika Brandt, Germany]	Taken into account. Changed
7812	3	38	47	38	48	The sentence should be : « Time series of anadromous ... stocks will also be exposed ... » [APECS Group Review, Germany]	Taken into account. Changed
7818	3	38	47	38	47	Can 'anadromous' be defined (not familiar to non-specialists). E.g. '...anadromous fish (which migrate up rivers to spawn in freshwater)...' [APECS Group Review, Germany]	Taken into account.
13482	3	38	47	38	47	Change 'sereies' to 'series'. [Debra Roberts and Durban Team, South Africa]	Taken into account. Changed
19982	3	38	47	38	47	Series is misspelt [Michelle A. North, South Africa]	Taken into account. Changed

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
22602	3	38	47	38	48	I asume that time "series" is meant here. While scientific data may be limited, there is a lot of Indigenous knowledge on anadromous fish in the Arctic. Also, the following part of the sentence contains both "are" and "will" - which one is meant? [Eva Kruemmel, Canada]	Taken into account. Misspellings corrected. We are generally aware of published indigenous knowledge, just not used in this sub-section due to space restrictions
19984	3	38	48	38	48	Delete "are" so that it reads: "although these stocks will also be exposed…" [Michelle A. North, South Africa]	Accepted
7820	3	38	50	38	52	This sentence is a bit vague. Interannual and decadal variability of what exactly? Environmental conditions/climate change? Be more specific. This sentence may also need a reference. [APECS Group Review, Germany]	Taken into account. "Environmental" is now included and some further rewording has been done. References are given in the sentence immediately following
13484	3	38	52			Gamut not gauntlet [Debra Roberts and Durban Team, South Africa]	Taken into account. "gauntlet" replaced with "array"
23782	3	38	56	38	56	should say "morhua" [Hans-Otto Poertner and WGII TSU, Germany]	Accepted. We generally now give latin names first time a species is mentioned.
19986	3	39	4	39	4	Add "and salmon", and provide some examples of the species you are referring to, e.g. "brown trout (latin name), and salmon (e.g., x and y species), through its influence on environmental stressors…" [Michelle A. North, South Africa]	Taken into account. The sentence relates to Atlantic salmon (Salmo salar)
23798	3	39	4	39	4	there are several species of salmon; please provide the scientific species name [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account. The sentence relates to Atlantic salmon (Salmo salar)
23786	3	39	7	39	10	based on what was this "high confidence" assessment done? Please ensure traceability of such statements [Hans-Otto Poertner and WGII TSU, Germany]	The information supporting this statement is in box 3.3. and the supporting material in this section of the report
7826	3	39	13	39	13	Can 'demersal' be defined (not familiar to non-specialists). E.g. '…demersal fish (those living near the sea floor)…' [APECS Group Review, Germany]	Taken into account
19988	3	39	13	39	13	Add (see Glossary) after demersal fish and include a definition of demersal in the glossary [Michelle A. North, South Africa]	Taken into account
1742	3	39	15	39	15	delete comma after 'is' [Mark England, UK]	corrected
5404	3	39	15	39	15	The use of the word "cod" is imprecise. It usually refers to Gadus morhua, but it could refers to a different especies from the family Gadidae. In this sentence it seems like it refers to Melanogrammus aeglefinus, which is not right. [Roderik Van De Wal, Netherlands]	Taken into account. Mention of cod is removed.
19990	3	39	15	39	15	When you say "or cod", are you referring to a separate species (then please include the latin species name in parentheses), or are you referring to a different common name for the Atlantic haddock (in that case, please insert "or cod" to lie before Melanogrammas aeglfinus within the same parentheses)? Also, move the comma to before the "is" so that "is expected to be limited" is not interrupted [Michelle A. North, South Africa]	Taken into account. Mention of cod is removed.
19992	3	39	16	39	16	Please include the latin name for capelin after its' mention: "The pelagic capelin (Mallotus villosus)…" [Michelle A. North, South Africa]	Accepted
23788	3	39	16	39	16	add species name for capelin [Hans-Otto Poertner and WGII TSU, Germany]	Accepted
1740	3	39	20	39	20	Under some RCPs' sounds very vague, can you be more specific? [Mark England, UK]	Corrected
23790	3	39	20	39	21	this was already said several times above in this sub-section; please avoid duplication/redundancy [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account. Has been rewritten, but the original sentence was the first on projections
7822	3	39	24	39	25	The sentence should be : « These scenarios project future decline in the… » [APECS Group Review, Germany]	Accepted

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
19996	3	39	24	39	24	Please include the latin name for groundfish after its' mention [Michelle A. North, South Africa]	Rejected as such since groundfish isn't a species, but term for fish species living close to the sea floor. Groundfish/demsal fish explained
13486	3	39	25	39	25	Delete one 'in' [Debra Roberts and Durban Team, South Africa]	Accepted
1870	3	39	31	40	42	Seabirds are completely overlooked in this section which is highly biased towards sea mammals. Lots of studies have described the effects of a warmer Arctic on their life history or distribution but virtually none of these studies are mentionned here (e.g. work by Descamps in Svalbard, by Gremillet in the Russian Arctic and Greenland, by Hunt/Divoky in the Pacific Arctic, by Jakubas in Svalbard, by Gilchrist/Gaston in Canadian Arctic…) [Sebastien Descamps, Norway]	Taken into account. The section is now rewritten so that there is a balance between seabirds and marine mammals
23792	3	39	31	40	42	make use of IPCC calibrated language (likelihood/confidence) [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account. This is now done throughout
23794	3	39	31	40	42	provide species names for seal and whale species (at first mention) [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account. Latin names first time a species is mentioned
7824	3	39	32	40	42	In these 2 subsections, no IPPC langage is used, concerning the confidence in the different results shown here. They would be useful to get an idea of the limitations of the studies cited here. [APECS Group Review, Germany]	Taken into account. Confidence statements now given.
22604	3	39	32	39	37	You may want to include McKinney et al. (Global Change Biology (2013) 19, 2360–2372, doi: 10.1111/gcb.12241) here, who found health impacts from these changes and resulting contaminant exposures for East Greenland polar bears. [Eva Kruemmel, Canada]	Rejected. Space is very restricted so we had to leave this out
1744	3	39	48	39	50	There are two 'because's in this sentence, I suggest changing the second because to 'due to', or splitting sentences up. [Mark England, UK]	Accepted
19998	3	39	48	39	50	Please rewrite this sentence to make it more concise [Michelle A. North, South Africa]	Accepted
5406	3	39	51	39	51	Ice seal. Imprecise term. Does it refer to every kind of seal? [Roderik Van De Wal, Netherlands]	Taken into account. Text rewritten
20000	3	39	55	39	55	"abundance declines" could be better written as "reductions in abundance" [Michelle A. North, South Africa]	Taken into account. Text rewritten
23796	3	39	55	39	55	I suggest saying «…availability of appropriate prey resources"; climate impacts may also cause shifts in prey species and/or size composition, so that some prey is theoretically available but e.g. less energy rich or less efficiently exploitable [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account. Text rewritten
7830	3	40	1	40	1	Unclear what is meant by '…finding less sympagic food (less ice-associated diving)..' May need to be rephrased or better defined. [APECS Group Review, Germany]	Taken into account. Text rewritten
20002	3	40	1	40	1	Please insert (see Glossary) after "sympagic food" and include the term in the glossary [Michelle A. North, South Africa]	corrected
12134	3	40	11			and ringed seals sensu: [Andrew Lowther, Norway]	corrected
12140	3	40	11			Lowther, A. D., Fisk, A., Kovacs, K. M., and Lydersen, C. 2017. Interdecadal changes in the marine food web along the west Spitsbergen coast detected in the stable isotope composition of ringed seal (Pusa hispida) whiskers. Polar Biology, 40. [Andrew Lowther, Norway]	Accepted. Reference now included

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22606	3	40	21	40	23	This is actually causing distress in some Inuit communities, where polar bears can become quite abundant and have been reported to raid food caches. [Eva Kruemmel, Canada]	Rejected here, outside the scope of this section. Direct impacts on humans not the topic of this section.
23800	3	40	22	40	23	provide example(s) for new food sources [Hans-Otto Poertner and WGII TSU, Germany]	corrected
7832	3	40	25	40	25	Time series of what? Maybe should say 'time series of population abundance..' [APECS Group Review, Germany]	Taken into account. Text rewritten
7834	3	40	27	40	31	This is a very long and complex sentence. Would be easier to read if split into two or three sentences. [APECS Group Review, Germany]	Taken into account. Text rewritten
20004	3	40	28	40	28	"...in the Bering and Chukchi Seas..." [Michelle A. North, South Africa]	Taken into account. Text rewritten
20006	3	40	33	40	33	Provide the latin name for killer whales, please [Michelle A. North, South Africa]	Taken into account. Latin names are now given first time a species is mentioned
12132	3	40	42			This is not known. Suggest finishing the preceding sentence with ", showing capacity for flexibility" and then delete this last sentence. [Andrew Lowther, Norway]	editted in SOD
23802	3	40	44	41	17	Not clear what is the purpose of this section. It is almost exclusively about fish, as 3.3.3.1.3 [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account. This section is removed as such. Most of the content is assimilated into the intro to 3.3.3.1, our fish and benthos subsections. Misspellings and unclear language dealt with
20008	3	40	46	40	47	Modify to read: "...with associated implications for species composition, productiona and ecosystem structure (medium confidence)(...)." [Michelle A. North, South Africa]	Accepted
3622	3	40	47			arctic - change to Arctic [Angelika Brandt, Germany]	Accepted
7828	3	40	52	40	53	The sentence « Northwards expansion... athways » is unclear, maybe the word « causing » is just a mistake. [APECS Group Review, Germany]	Taken into account. Rewritten.
7836	3	40	52	40	55	These sentences are a bit vague and have some typos. Could this include some specific details about how the euphausiids and amphipods are likely to change, and what impact this could have on fish feeding dynamics? [APECS Group Review, Germany]	Taken into account. Rewritten to include more precise information
20010	3	40	52	40	53	This sentence doesn't make sense, please rewrite [Michelle A. North, South Africa]	Accepted
13294	3	40	54	40	54	There is an extra word in this line that does not fit. [Katherine Bishop-Williams, Canada]	Accepted
13488	3	40	54	40	54	Detele 'of' [Debra Roberts and Durban Team, South Africa]	Accepted
20012	3	40	54	40	55	Modify to read: "...are a major food source for Arctic fish, such that changes in prey species composition may impact the feeding dynamics of these fish ()." Is this sentence important? Maybe emphasize why the feeding dynamics of the fish matters? [Michelle A. North, South Africa]	Taken into account. Rewritten to include more precise information
13490	3	41	1			If this figure 3.10 is important enough to include in the report, it should get a little more text dedicated to it, explaining what it shows and why it is important. [Debra Roberts and Durban Team, South Africa]	Taken into account. Rewritten to include more precise information on what is shown and why it is important
7838	3	41	2	41	2	Reference required for last sentence. [APECS Group Review, Germany]	Taken into account. Rewritten
12614	3	41	2			Table 31. - could a similar table be created for the Arctic? [Alexander Milner, UK]	Rejected. Such a table for the Arctic would become very large and complex
7840	3	41	4	41	6	This is quite vague. Could there be more detail about how climate change is impacting benthic species? [APECS Group Review, Germany]	Taken into account. Rewritten
1872	3	41	25	41	25	typo "plays" [Sebastien Descamps, Norway]	Rejected - 'krill' is plural here
23804	3	41	25	41	27	provide references [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - reference added

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
6410	3	41	26			There has been little to no migration of the location of the polar front over the period 1993–2014 (Chapman 2017) an d the resilience seems largely due to the importance of topographic pinning forcing the location of the ACC. As arming is predicted to occur both north and south of the front and the thermal gradient will be retained. Thus the polar front would be expected to remain a significant biological boundary to poleward movement of marine species, this contrasts with the Arctic where there is a more gradual temperature gradient from temperate to polar region. [Keith Reid, Australia]	Taken into account - this point is made in the revised version of Box 3.3.
20014	3	41	26	41	26	What is meant by "consumers of productivity"? Please check that this sentence conveys the intended meaning [Michelle A. North, South Africa]	Accepted - changed to 'grazers'
23806	3	41	26	41	26	"consumers of productivity": guess you mean "consumers of primary producers/phytoplankton"? [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - changed to 'grazers'
3624	3	41	35			Constable et al., 2016)(medium confidence). - please insert hyphen between brackets [Angelika Brandt, Germany]	Editorial - copyedit to be completed prior to publication
20016	3	41	39	41	39	Remove "circumpolar" from parentheses since it isn't another way of saying "long-term". Rather modify to read: "...part of long-term circumpolar modelling designs..." [Michelle A. North, South Africa]	Accepted
3544	3	42	2	42	2	Table 3.1 Please add a downward arrow for zooplankton under ocean acidification based on the work of Bednarsek et al 2012 and Gardiner et al 2017) [Richard Feely, USA]	Accepted
5408	3	42	2	42	12	Very good figure. Could the question mark be changed for a different sign? I find them a bit confusing. [Roderik Van De Wal, Netherlands]	Accepted - question marks have been changed to symbols representing either nonlinear responses (i.e. not monotonic increasing or decreasing) or an uncertain monotonic response.
20980	3	42	2	42	2	Table 3.1: Southern sea elephant foraging behaviour is negatively affected by temperature (McIntyre et al. 2011, doi: 10.3354/meps09383). Gardner et al. (2018, https://doi.org/10.1007/s00227-017-3261-3) found negative temperature and acidification effects on shell formation and integrity in Antarctic pteropods. Benthic communities are affected by landfast-ice duration and iceberg scour: more fast-ice less scour and mortality (Barnes & Souster 2011, DOI: 10.1038/NCLIMATE1232). Temperature-induced ice-shelf collapse opens up new habitat for benthic communities (Gutt et al. 2011, https://doi.org/10.1016/j.dsr2.2010.05.024) and fast growth (Fillinger et al. 2013, http://dx.doi.org/10.1016/j.cub.2013.05.051). The table appears poorly balanced: there are six categories of plankton, but only one for the benthos. [Claudio Richter, Germany]	Taken into account - Table 3.1 has been updated to include these findings, with the exception of temperature-induced ice-shelf collapse which is discussed in Section 3.3.2.5 (additional references providedin this comment have been included in the revision). The balance of functional groups in the table is dictated by the paper it is taken from.
20018	3	42	6	42	6	I would emphasize that a positive relationship also includes the fact that a decrease in the physical variable will result in a decrease in the taxon, because for some of the factors included in the table, a decrease is the more concerning state (e.g., decreasing sea ice). Not all readers will understand that the 'positive relationship' terminology means both increase - increase and decrease - decrease, I think the table legend needs to make this clear. [Michelle A. North, South Africa]	Taken into account - table 3.1 has been updated to include these findings, with the exception of temperature-induced ice-shelf collapse which is discussed in Section 3.3.2.5 (additional references providedin this comment have been included in the revision
7842	3	42	8			Table 3.1 caption: use a different term instead of 'likely' where it is a not a specific likelihood statement. E.g. '...where evidence suggests there will be a response...' [APECS Group Review, Germany]	Taken into account - in the revised table caption this sentence has been replaced with a description of the new symbol used for non-linear responses to drivers.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
1874	3	42	13	42	13	Table 3.1: the relation between sea-ice and Antarctic flying seabirds is not simple and both positive and negative effects have been observed (see work from Jenouvrier/Barbraud/Weimerskirch on snow petrels). Sea-ice extent in one season may have a different effect than sea-ice extent in a different season, and these effects may vary among colonies. This should be detailed in section 3.3.3.2.4. references Barbraud et al Oecologia 2000, Barbraud et al J Avian Biol 2001, Jenouvrier et al 2005 Ecology, Olivier et al Polar Biol 2005 could be relevant (snow petrel studies). [Sebastien Descamps, Norway]	Taken into account - the table has been updated to reflect that flying seabird responses to sea-ice extent can be positive or negative (references included as footnotes). These references weren't added to the main text as they are not sufficiently recent to warrant consideration in this report (which is an update since AR5).
20020	3	42	13	42	13	For Table 3.1, I would recommend changing the use of arrows to differentiate between positive and negative relationships. An alternative would be to use + and - signs (or even different colours) instead of the up- or down-arrows, because even though I know what the terminology means, I find it hard to get my head around what a down arrow for diatoms and sea-ice actually means in real life (decreasing sea ice = increasing diatoms? - the arrow direction is confusing). Colours or symbols that are not intrinsically associated with a certain meaning may be more effective [Michelle A. North, South Africa]	Accepted - in the revised version of the table upwards and downwards arrows have been replaced with symbols that represent increasing or decreasing monotonic individual responses to drivers, or a non-linear response (in place of question marks)
20606	3	43	0	43		Description about the Figure 3.10 is not clear. Please provide more details. [Pushp Raj Tiwari, UK]	redone and still not final figure
3626	3	43	3			(Kim et al., 2018)(medium confidence). - please insert hyphen between brackets [Angelika Brandt, Germany]	Editorial - copyedit to be completed prior to publication
20022	3	43	4	43	4	Delete "positive" after significant (it is redundant to say a positive increase) [Michelle A. North, South Africa]	Accepted
20024	3	43	5	43	5	Delete "the" before "twenty years" [Michelle A. North, South Africa]	Accepted
20026	3	43	7	43	7	Delete "towards" [Michelle A. North, South Africa]	Accepted
3628	3	43	8			(Arrigo et al., 2017b)(low confidence). - please insert hyphen between brackets [Angelika Brandt, Germany]	Editorial - copyedit to be completed prior to publication
7844	3	43	16	43	39	Table 3.2 and paragraph below: there should be consistency in the terminology used for the different regions to make it easier to link what is shown in the table with the paragraph below i.e. either subpolar or subantarctic, and either Antarctic or polar waters. It's not clear whether these refer to the same regions or not. The paragraph itself is a bit confusing and doesn't seem to have a clear structure. It goes from discussing the effects of temperature on phytoplankton in polar waters, to the effects of temperature and other factors on a subantarctic diatom, back to the effects of temperature and other factors on phytoplankton in polar waters, then acidification on coastal phytoplankton. Perhaps this could be more clearly split up into the three defined regions and discuss model results vs. manipulation studies. [APECS Group Review, Germany]	Accepted - this section has been restructured to remove inconsistent terminology and to better distinguish model results from manipulation studies
1876	3	44	1	44	1	Section 3.3.3.2.2: reference Atkinson et al Nature 2002 could be mentionned here (i.e. decline in krill abundance in the Southern Ocean) [Sebastien Descamps, Norway]	An error occurred when chapter 3 references were compiled in Endnote by the TSU resulting in a displacement of some references. These displaced references have been fixed in the revised draft.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
20028	3	44	3	44	3	What is meant by "a step changes"? Please check this sentence correctly conveys what is intended [Michelle A. North, South Africa]	Accepted - 'step change' has been replaced with 'sudden, discontinuous change'
7846	3	44	6	44	7	Not sure what is meant by '...as emphasized by Pinones and Federov (2016) in AR5..'. Perhaps this should read '..and AR5'. [APECS Group Review, Germany]	An error occurred when chapter 3 references were compiled in Endnote by the TSU resulting in a displacement of some references. These displaced references have been fixed in the revised draft.
20030	3	44	10	44	11	Please make this sentence more concise [Michelle A. North, South Africa]	Accepted - text revised
7848	3	44	13	44	19	Reference missing. [APECS Group Review, Germany]	Accepted - reference added
7850	3	44	22	44	22	Wrong reference. Not Tarling et al. 2017 [APECS Group Review, Germany]	An error occurred when chapter 3 references were compiled in Endnote by the TSU resulting in a displacement of some references. These displaced references have been fixed in the revised draft.
7852	3	44	27	44	27	Wrong reference. Should be Tarling et al. 2017 instead of Steinberg et al. 2015 [APECS Group Review, Germany]	An error occurred when chapter 3 references were compiled in Endnote by the TSU resulting in a displacement of some references. These displaced references have been fixed in the revised draft.
4640	3	44	31	44	32	This is wrong refence - Manno 2016 is not related to this [Nina Bednarsek, USA]	An error occurred when chapter 3 references were compiled in Endnote by the TSU resulting in a displacement of some references. These displaced references have been fixed in the revised draft.
7854	3	44	31	44	31	Could this be more specific? '...evidence of directional trends...' Which direction? Could it say something like: ...'evidence of varying directional trends, with some species increasing and others decreasing in response to various environmental parameters...' [APECS Group Review, Germany]	Acceped - specified as an increasing trend for some species
7856	3	44	32	44	32	Wrong reference. Should be Steinberg et al. 2015 instead of Manno et al. 2016 [APECS Group Review, Germany]	An error occurred when chapter 3 references were compiled in Endnote by the TSU resulting in a displacement of some references. These displaced references have been fixed in the revised draft.
3630	3	44	33			(Manno et al., 2016)(low confidence). - please insert hyphen between brackets [Angelika Brandt, Germany]	Editorial - copyedit to be completed prior to publication
4642	3	44	33	44	35	This is wrong reference - should be Manno and it has not been categorised by the confidence scale yet, so the last part of the sentence needs to be removed. [Nina Bednarsek, USA]	An error occurred when chapter 3 references were compiled in Endnote by the TSU resulting in a displacement of some references. These displaced references have been fixed in the revised draft. The last part of the sentence has been removed as suggested.
7858	3	44	34	44	34	Wrong reference. Should be Manno et al. 2016 instead of Mintenbeck et al. 2012 [APECS Group Review, Germany]	An error occurred when chapter 3 references were compiled in Endnote by the TSU resulting in a displacement of some references. These displaced references have been fixed in the revised draft.
23808	3	44	34	55	35	Mintenbeck et al 2012 is the wrong reference, here [Hans-Otto Poertner and WGII TSU, Germany]	An error occurred when chapter 3 references were compiled in Endnote by the TSU resulting in a displacement of some references. These displaced references have been fixed in the revised draft.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
23810	3	44	37	44	53	Section 3.3.3.2.3 Southern Ocean fish is weak and should be expanded a bit (compare length and level of details to the Arctic fish section) [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - this section has been expanded and the issues with misplaced references due to Endnote compliation by TSU have been fixed. The resulting section is still shorter than the equivalent Arctic fish section, which reflects the number of published studies and the number of finfish fisheries in each region.
23812	3	44	37	44	53	When talking about fisheries in this section (or later in the fisheries section), Mackerel icefish Champsocephalus gunnari should be mentioned; also lack of recovery of the C. gunnari Kerguelen population after cessation of fisheries and the potential impact of environmental change. [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account - this has been added to section 3.2.4.1.2 on Southern Ocean fisheries
24564	3	44	37	44	53	This section clearly needs much widening of literature base to cover the relevant functional aspects of fish and invertebrate fauna under climate change, e.g. physiological and related molecular mechanisms as well as addressing limits to adaptation. This will help a cause and effect understanding, enhance confidence and provide a basis for comparison with biota in other climate zones. [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - further information and references on physiological and molecular adaptations of Antartic fish, and the implications for impacts of climate change on these groups
7860	3	44	38	44	38	A bit complex for non-specialists. Could this read something like: '...may displace ice fishes (of the Channichthyidae family)..' [APECS Group Review, Germany]	Accepted
20032	3	44	38	44	38	Please add (see Glossary) after "notothenioid fishes" and explain the term in the glossary [Michelle A. North, South Africa]	Taken into account - this term has been replaced with "icefish" as per comment 7860
1878	3	44	41	44	41	typo "is an important prey species" [Sebastien Descamps, Norway]	Accepted
23814	3	44	41	44	41	the accepted name is "PleurAgramma antarctica" [Hans-Otto Poertner and WGII TSU, Germany]	Accepted
23816	3	44	42	44	42	Cite also Vacchi et al. (2012) A nursery area for the Antarctic silverfish Pleuragramma antarcticum at Terra Nova Bay (Ross Sea): first estimate of distribution and abundance of eggs and larvae under the seasonal sea-ice. Polar Biology 35(10): 1573-1585 [Hans-Otto Poertner and WGII TSU, Germany]	Accepted
3632	3	44	43			(Larsen et al., 2014a; Parker et al., 2015)(low confidence). - please insert hyphen between brackets [Angelika Brandt, Germany]	Editorial - copyedit to be completed prior to publication
23818	3	44	46	44	53	which "toothfish" species are you talking about? Antarctic toothfish, Dissostichus mawsoni? Or Patagonian toothfish? Or both? Please specify [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - the revised text refers to Antarctic and Patagonian toothfish separately
3634	3	44	50			(Larsen et al., 2014a)(low confidence). - please insert hyphen between brackets [Angelika Brandt, Germany]	Editorial - copyedit to be completed prior to publication
23820	3	44	50	44	53	The information and assessment provided here for Antarctic toothfish is a bit weak. Toothfish is slow-growing and reaches maturity not before an age of 13-17 years and Egg incubation time is 4-5 months long. i.e. population doubling time is long and potential for recovery after stock decline is limited. To my knowledge, D. mawsoni only occurs in waters between -1,8 and +2°C, which might indicate a limited tolerance towards warmer temperatures. Where should they move to? Their options to move are strongly limited by the Antarctic continent. [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account - the assessment for toothfish has been strengthened and supported with references in the revised draft
3636	3	44	53			(Bost et al., 2009)(low confidence). - please insert hyphen between brackets [Angelika Brandt, Germany]	Editorial - copyedit to be completed prior to publication
23822	3	44	53	44	53	Bost et al 2009 is not the correct reference! Please check [Hans-Otto Poertner and WGII TSU, Germany]	Accepted. The reference misplacement was a result of a problem with Ch03 references overall. It has been corrected on the SOD

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
1880	3	44	55	45	35	SEE PREVIOUS COMMENT ON THE TABLE (role of sea-ice is complex and varies among seasons, sites and species). [Sebastien Descamps, Norway]	Taken into account, table will be reviewed
23824	3	44	55	46	35	provide spoecies names for all the bird and mammal species mentioned [Hans-Otto Poertner and WGII TSU, Germany]	Accepted. I agree with the need for the inclusion of the proper scientific notation, however the addition of scientific names for all species into the main text will influence the final word count and may hinder our ability to convey the proper message/assessment.
20034	3	44	56	44	56	Please move "in time and space" to after "of marine mammals and seabirds" [Michelle A. North, South Africa]	Taken into account. Thank you for the suggestion but since this is 'editorial' copyedit to be completed prior to publication .
12126	3	44	57			shouldnt this be high confidence ? given the 'high confidence' given to what alters the predictability of foraging grounds ? [Andrew Lowther, Norway]	Taken into account. Confidence statements were assigned as per IPCC guidelines. Will evaluate suggestion, though. Thank you.
14120	3	45	1	45	1	Include reference Wilson, K.-J., et al.,. The impact of the giant iceberg B09B on population size and breeding success of Adélie and penguins in Commonwealth Bay, Antarctica. Antarct. Sci. FirstView, 1-7, doi:doi:10.1017/S0954102015000644 (2016), and WILSON, K.-J., et al., 2015. Low numbers and apparent long-term stability of South Polar skuas Stercorarius maccormicki at Commonwealth Bay, Antarctica. Marine Ornithology, 43, 103–106. [Christopher Fogwill, UK]	Rejected. Given our limited word count, discussion of some aspects was restricted. Will keep it mind for SOD if possible. Thank you for the suggestion
7862	3	45	4	45	4	Southern Ocean (SO) abbreviation should be introduced earlier in the chapter if used. [APECS Group Review, Germany]	Taken into account. Thank you for the comment but will require integration with the whole chapter and assessment of other (conflicting) review comments. We will consider the suggestion once the whole chapter is reviewed but it will be decided taking into account IPCC guidelines, word count restrictions and consistency. See comment 20036.
20036	3	45	4	45	4	Please remove the acronym for Southern Ocean, it is not necessary [Michelle A. North, South Africa]	Taken into account. Thank you for the comment but will require integration with the whole chapter and assessment of other (conflicting) review comments. We will consider the suggestion once the whole chapter is reviewed but it will be decided taking into account IPCC guidelines, word count restrictions and consistency. See comments 7862 and 7866.
7864	3	45	10	45	10	Use a different term instead of 'likely' where it is a not a specific likelihood statement. E.g. '...evidence suggests that...will change with changing climate...' [APECS Group Review, Germany]	Accepted. Good point, Thank you!
7866	3	45	13	45	13	Use SO abbreviation for Southern Ocean after it's been introduced. [APECS Group Review, Germany]	Taken into account. Thank you for the comment but will require integration with the whole chapter and assessment of other (conflicting) review comments. We will consider the suggestion once the whole chapter is reviewed but it will be decided taking into account IPCC guidelines, word count restrictions and consistency. See comment 20036.
18474	3	2	0			All other Chapters have FAQ. I think it would be good to include that also in this Chapter. [Anette Jönsson, Sweden]	accepted. FAQs now included in chapter
7868	3	45	18	45	19	Over what time period have these penguins increased/decreased? Years/decades? [APECS Group Review, Germany]	Taken into account. Given that responses are species specific, we will try to convey a more precise message for the SOD. Thank you.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
20038	3	45	19	45	19	Please replace "declined" with "decreased" [Michelle A. North, South Africa]	Taken into account. Thank you for the suggestion but will keep it as is. The intent is to convey the idea of the population decline rather than decrease in the number of penguins. Additionally we have considered similarity checks with other published information.
7872	3	45	20	45	24	Sentence is not very clear and doesn't seem to accurate reflect conclusions of the cited reference. Could re-word slightly such as: Youngflesh et al. (2017) suggest that population shifts observed in Adélie penguins were a result of strong phenological mismatch, driven by interannual environmental variability rather than climate-change.' [APECS Group Review, Germany]	Accepted. The text has been changed to reflect this and will be carried over into the SOD text. Thank you.
8208	3	45	21	45	21	Suggest changing "...population shifts observed in Adelie penguin populations..." to "...shifts observed in Adelie penguin populations..." [Benoit Montpetit, Canada]	Accepted. The text has been changed which will carry over into the SOD text. Thank you. We have however to be careful with the wording given similarity checks with published literature.
20040	3	45	21	45	21	Please delete "populations" before shifts, so that it reads: "...suggest that shifts observed in Adelie penguin populations..." [Michelle A. North, South Africa]	Accepted. Thank you for the suggestion. We have adopted a different structure in the SOD
13296	3	45	26	45	33	To facilitate readers with visual impairments, consider also adding a number for each of the study sites as the colours will be particularly difficult for some to differentiate. [Katherine Bishop-Williams, Canada]	Thank you. Point taken and the issue was raised at the Chapter meeting to make the text and figure/tables
24390	3	45	26	45	31	Is this figure for Adelie penguins only? I suggest not using this figure as it shows no climate change signal. [Hans-Otto Poertner and WGII TSU, Germany]	Accepted. Thank you. This figure was a place holder for the different species-specific responses at different sectors. However, given limited page and word counts, the figure will be removed.
1334	3	45	29	45	32	specifically mention expeditions (tourism ad scientific from both no -governmental and governmental sectors) [Marcus Haward, Australia]	There is a mistake with this comment's placement. Not p45. Likely p80, section 3.5.4.6. However, the sugested material is now accomodated in (new) section 3.2.4.2
1332	3	45	17	45	19	Good point, could emphasise more the need for adequate management responses – adaptive management actions [Marcus Haward, Australia]	There is a mistake comment page reference - it is not p45. We are not able to identify the correct page reference.
7870	3	45	45	21		Avoid using 'likely' where it is a not a specific likelihood statement. In this case 'more likely' can be removed from the sentence. [APECS Group Review, Germany]	Accepted. Thank you. Will do.
12128	3	46	3			my understanding from the Jenouvrier paper is that Emperor penguins are more susceptible to sea ice variability, not just decline per se ? [Andrew Lowther, Norway]	Taken into account. Susceptibility of Emperor penguins to sea ice variability has been added.
23826	3	46	3	46	4	Please do not combine likelyhood and confidence for one statement; use either the one or the other [Hans-Otto Poertner and WGII TSU, Germany]	Accepted. Thank you. Will do.
20042	3	46	4	46	4	Replace "has suggested" with "suggests" [Michelle A. North, South Africa]	Accepted.
7874	3	46	10	46	12	Could brielfy explain why sea ice has affected the fulmars. E.g. ...'due to foraging trips becoming greater in distance and duration.' [APECS Group Review, Germany]	Taken into account. Thank you. Will consider/try.
8210	3	46	10	46	10	Remove "de" in "... Terre de Adélie". The correct name is Terre Adélie. [Benoit Montpetit, Canada]	Taken into account. Reference to the specific location has been deleted in the revised text.
20044	3	46	11	46	13	Include the latin names for Southern Fulmars and Black-browed albatrosses (and capitalize the latter where appropriate) [Michelle A. North, South Africa]	Accepted
12130	3	46	13			Please examine the following from Descamps et al. on the demographic linkages with climate of the largest Antarctic Petrel colony in Antarctica: [Andrew Lowther, Norway]	Taken into account. Thank you. Will look into these references as well as other recent ones. The main scope of this assessment is to convey new information since AR5. We are however bound by word count restrictions and consistency.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
12136	3	46	13			Descamps, S., Tarroux, A., Varpe, Ø., Yoccoz, N. G., Tveraa, T., and Lorentsen, S. H. 2015. Demographic effects of extreme weather events: Snow storms, breeding success, and population growth rate in a long-lived Antarctic seabird. Ecology and Evolution, 5: 314–325. http://onlinelibrary.wiley.com/doi/10.1002/ece3.1357/full (Accessed 21 October 2016). [Andrew Lowther, Norway]	Taken into account. Thank you. Will look into these references as well as other recent ones. The main scope of this assessment is to convey new information since AR5. We are however bound by word count restrictions and consistency.
12138	3	46	13			Descamps, S., Tarroux, A., Lorentsen, S. H., Love, O. P., Varpe, Ø., and Yoccoz, N. G. 2016. Large-scale oceanographic fluctuations drive Antarctic petrel survival and reproduction. Ecography, 39: 496–505. http://onlinelibrary.wiley.com/doi/10.1111/ecog.01659/pdf (Accessed 21 October 2016). [Andrew Lowther, Norway]	Taken into account. Thank you. Will look into these references as well as other recent ones. The main scope of this assessment is to convey new information since AR5. We are however bound by word count restrictions and consistency.
20046	3	46	15	46	31	Delete the acronym SO throughout, replace with Southern Ocean [Michelle A. North, South Africa]	Taken into account. Thank you. We will consider the suggestion once the whole chapter is reviewed but it will be decided taking into account IPCC guidelines, word count restrictions and consistency. See previous comments and replies.
20048	3	46	15	46	19	Modify sentence to read: "For marine mammals in the Southern Ocean, local and regional-scale oceanographic features and bathymetry that control prey aggregations, will affect their ecological responses and biological traits… and explain most of the observed marine mammal population shifts ()." OR "Local and regional-scale oceanographic features and bathymetry controlling prey aggregations affect the ecological responses and biological traits of marine mammals in the Southern Ocean (…) and explain most of their observed population shifts ()." [Michelle A. North, South Africa]	Accepted. Thank you. The text has been changed for the SOD and we will consider the suggestion once the whole chapter is reviewed but it will be decided taking into account IPCC guidelines, word count restrictions and consistency.
20050	3	46	20	46	23	Why would you need to make an acronym for Southern elephant seals? Please remove SES throughout this section, replace with the appropriate animal species name [Michelle A. North, South Africa]	Taken into account. Thank you. We had considered spelling out Southern Elephant Seals and inclusion of the scientific name (Mirounga leonina) where appropriate but given word count restrictions of each report section, the final text might lack the proper scientific notation. We are aware of this issue and will look into it.
20052	3	46	20	46	23	Once you're replaced the acronyms, please rewrite this sentence to be more concise [Michelle A. North, South Africa]	Taken into account. Thank you. Once a decision is made about the use of acronyms, we will look into this
3638	3	46	23			(medium confidence)(Hindell et al., 2016). - please insert hyphen between brackets [Angelika Brandt, Germany]	Taken into account but since it is an editorial comment, copyedit to be completed prior to publication
20054	3	46	23	46	26	Please rewrite this sentence, removing redundant terms [Michelle A. North, South Africa]	Taken into account but since it is an editorial comment, copyedit to be completed prior to publication
23828	3	46	24	46	24	please specify "Antarctic pack ice seal species" [Hans-Otto Poertner and WGII TSU, Germany]	Accepted. Thank you. It has been introduced into the main text but has also been suggested as a Glossary term.
20056	3	46	26	46	26	Replace "have suggested" with "suggests" [Michelle A. North, South Africa]	Taken into account. It will be reviewed with the new text: copyedit to be completed prior to publication.
7876	3	46	30	46	33	Sentence is not very clear. May be missing some detail or require re-wording. [APECS Group Review, Germany]	Taken into account but since it is an editorial comment, copyedit to be completed prior to publication
1336	3	45	42			include latest numbers ? [Marcus Haward, Australia]	There is a mistake with this comment's placement. Not p45. We have not been able to locate the page reference for this comment.

SROCC First Order Draft Expert Review Comments - Chapter 3							
Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
23830	3	46	37			For the impact of glacier retreat on Antarctic benthic communities, see also, e.g. Sahade et al (2015) Science Advances 1(10), e1500050 DOI: 10.1126/sciadv.1500050 [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - reference added
7878	3	46	39	46	39	A bit unclear, especially for non-specialists. '..alternative energy pathways..' - alternative to what? Traditional pathways? How are they defined? Need a bit more explanation. [APECS Group Review, Germany]	Accepted - 'alternative' has been replaced with 'dominant'
7880	3	46	43	46	43	Wrong reference. Should be Klein et al. 2018 instead of Hauquier et al. (2016) [APECS Group Review, Germany]	An error occurred when chapter 3 references were compiled in Endnote by the TSU resulting in a displacement of some references. These displaced references have been fixed in the revised draft.
20058	3	46	45	46	46	What do you mean by "declining below a depletion threshold"? The information "(75% of unimpacted levels)" isn't helpful - is this referring to less than 75% of the unimpacted population size (i.e., decrease in numbers), or... does this imply that if a population loses >25% of its members then it has past a threshold of no return? This sounds implausible [Michelle A. North, South Africa]	Accepted - reworded as 'declining to less than 75% of modelled abundances in reference scenarios...'
23832	3	46	46	46	48	provide reference for this statement (consider mentioning CCAMLR) [Hans-Otto Poertner and WGII TSU, Germany]	Accepted
7882	3	46	48	46	48	Reference missing. [APECS Group Review, Germany]	Accepted - references added
7884	3	46	50	46	51	Ice-shelf retreat or collapse not clearly shown in Figure 3.12 [APECS Group Review, Germany]	Accepted - figure has been updated
3642	3	46	55			(Trathan et al., 2013)(medium confidence). - please insert hyphen between brackets [Angelika Brandt, Germany]	Editorial - copyedit to be completed prior to publication
13492	3	47	0			These picture schematics are really very helpful for non-specialists. Thank you! How about another schematic to show what all these things are: Talik? Thermokarst, aquifer? Etc [Debra Roberts and Durban Team, South Africa]	For section 3.4?
7886	3	47	9	47	9	Wrong reference. Should be Griffiths et al. 2017a instead of Barnes 2017. [APECS Group Review, Germany]	An error occurred when chapter 3 references were compiled in Endnote by the TSU resulting in a displacement of some references. These displaced references have been fixed in the revised draft.
7888	3	47	14	47	14	Reference missing. [APECS Group Review, Germany]	Accepted - reference added
7890	3	47	16	47	16	Define blue carbon (not clear for non-specialists). E.g. '..blue carbon storage (that which is captured in coastal and marine ecosystems)...' [APECS Group Review, Germany]	Taken into account - replaced with 'Carbon uptake and storage by benthic communities...'
3644	3	47	17			(Clark et al., 2015)(low confidence). - please insert hyphen between brackets [Angelika Brandt, Germany]	Editorial - copyedit to be completed prior to publication
7892	3	47	17	47	17	Wrong reference. Should be Barnes 2017 instead of Clark et al. 2015 [APECS Group Review, Germany]	An error occurred when chapter 3 references were compiled in Endnote by the TSU resulting in a displacement of some references. These displaced references have been fixed in the revised draft.
3646	3	47	21			Clark et al., 2017)(low confidence). - please insert hyphen between brackets [Angelika Brandt, Germany]	Editorial - copyedit to be completed prior to publication
7894	3	47	21	47	21	Wrong reference. Should not include Ingvaldsen and Gjosaester, 2013. [APECS Group Review, Germany]	An error occurred when chapter 3 references were compiled in Endnote by the TSU resulting in a displacement of some references. These displaced references have been fixed in the revised draft.

SROCC First Order Draft Expert Review Comments - Chapter 3							
Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
7896	3	47	23	47	24	Figure 3.12 - could be more informative by including more processes and make it clearer what changes are happening, e.g. ice retreat/changes in light levels, also indication of effects on different groups e.g. phytoplankton [APECS Group Review, Germany]	Accepted - the figure has been updated
13298	3	47	26	47	26	There is an extra word in this line that does not fit. [Katherine Bishop-Williams, Canada]	Accepted
1882	3	48	1	49	39	Box 3.3: the case of the northern gannet in the Arctic might worth being mentionned. Northern gannets are a temeprate species but have been colonizing Bear Island in recent years (see Barrett et al Polar research 2017). [Sebastien Descamps, Norway]	Added seabird text to the section
7898	3	48	10	48	10	Define demersal (not clear for non-specialist) e.g. '...demersal fish species (living near the sea floor).' [APECS Group Review, Germany]	Defined in the text
20060	3	48	10	48	10	I would recommend adding pelagic and demersal (fish) to the glossary and referring to it here [Michelle A. North, South Africa]	Defined in the text
3648	3	48	16			(Kotwicki and Lauth, 2013) . Please omit blank before . [Angelika Brandt, Germany]	accepted
13494	3	48	17			Size of what? [Debra Roberts and Durban Team, South Africa]	The text for the box was re-written
7900	3	48	18	48	22	The cited references don't seem to match up with what is stated here. There may be a reference missing e.g. Kjesbu et al. (2014). The sentence says that ocean conditions in the last 1970s and 1980s is compared with present (2004) conditons. Landa et al. (2014) look at 1981-2008, while Eriksen et al. (2017) look at 1993 - 2013, and compared before and after 2004. So perhaps the sentence should instead say 'Comparison of ocean condition before and after 2004...' [APECS Group Review, Germany]	The text for the box was re-written
7902	3	48	21	48	21	Wrong reference. Should not include Ingvaldsen and Gjosaester, 2013. [APECS Group Review, Germany]	Corrected
7904	3	48	25	48	25	Wrong reference. Should be Ingvaldsen and Gjosaester, 2013 instead of Nottestad et al. 2016. [APECS Group Review, Germany]	Corrected
6412	3	48	26			citation CCAMLR 1982 should be replaced with Tarling et al., 2017) [Keith Reid, Australia]	taken into account - in several places our bibliogpaphy was one reference offset
7906	3	48	28	48	28	Reference missing. [APECS Group Review, Germany]	taken into account - in several places our bibliogpaphy was one reference offset
5410	3	48	32	48	35	High confidence: is that appropriate since it is only one study about one species that moved north in maybe a few years (persistence cannot be known yet?) [Roderik Van De Wal, Netherlands]	There is a rich body of peer reviewed literature to support this confidence level. Due to limits of the number of citations allowed in boxes we only cited one paper.
23834	3	48	40	48	40	provide species name for Barents Sea cod [Hans-Otto Poertner and WGII TSU, Germany]	All latin names now given as species is introduced
7908	3	48	41	48	41	Kvile et al. 2017 may be the wrong reference - this paper is about a copepod whereas the sentence seems to be about cod. Copepods should either be included in the sentence or this reference removed. [APECS Group Review, Germany]	We agree that this paper is relevant to zooplankton however, we reference it here because of its relevance to survival of young cod.
7910	3	48	43	48	43	Stevenson and Lauth, 2012 may be the wrong reference - this paper is about trends in Barents Sea epibenthic community whereas the sentence still appears to be about cod. The sentence should either be adjusted to reflect this or the reference removed. [APECS Group Review, Germany]	Corrected and clarified that this is not relevant to cod
7912	3	48	53	48	53	Bender et al. (2016) is the wrong reference - paper is about tourism in the Antarctic Peninsula, sentence is about fish in the Arctic. [APECS Group Review, Germany]	taken into account - in several places our bibliogpaphy was one reference offset

SROCC First Order Draft Expert Review Comments - Chapter 3							
Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
13496	3	49	0			Figure 1: Where is this? Some landmarks or country names would help. [Debra Roberts and Durban Team, South Africa]	Additional text has been added
5412	3	49	3	49	6	Very interestingt figure, since the Atlantic cod (Gadus morhua) is a keystone species in the Arctic. Could it be mentioned somewhere in the text? The scientific name is mentioned in the text, but not in the caption of the figure. Could it be mentioned there too in order to make it clearer? [Roderik Van De Wal, Netherlands]	Corrected
23836	3	49	3	49	3	Scientific name of Atlantic cod is missing (Gadus morhua) [Hans-Otto Poertner and WGII TSU, Germany]	Added latin names on first use
24392	3	49	9	49	12	is the start of this sentance missing? [Hans-Otto Poertner and WGII TSU, Germany]	Text was reviewed but the sentence seems ok. Will check.
7914	3	49	10	49	10	Avoid using 'likely' where it is a not a specific probability statement. Re-word, e.g. 'evidence suggests….' [APECS Group Review, Germany]	Need to change in new version of Box 3.3
24394	3	49	10			Any there any economic perspectives (eg numbers for losses, impacts, costs) on these? [Hans-Otto Poertner and WGII TSU, Germany]	Out of scope of Box 3.3 but relevant to section 3.5
3650	3	49	17		27	please insert several hyphens between brackets [Angelika Brandt, Germany]	taken into account. Inserted spaces betwen parentheses
7916	3	49	23	49	23	Tarling et al. 2017 is the wrong reference [APECS Group Review, Germany]	An error occurred when chapter 3 references were compiled in Endnote by the TSU resulting in a displacement of some references. These displaced references have been fixed in the revised draft.
7918	3	49	24	49	27	This sentence requires a reference - probably Tarling et al. 2017. If so, it should probably read mesozooplankton instead of macrozooplankton. [APECS Group Review, Germany]	An error occurred when chapter 3 references were compiled in Endnote by the TSU resulting in a displacement of some references. These displaced references have been fixed in the revised draft. The sentence has been edited and cross-referenced appropriately to Section 3.2.3.2.2
7920	3	49	34	49	34	It is not very clear what is meant by 'The return to the wild of rehabilitated individuals…' Another reference may be needed? [APECS Group Review, Germany]	Taken into account - this has been deleted in the revised version of the box
7922	3	49	38	49	38	Define zoonoses (not clear to non-specialist) e.g. '…zoonoses (infectious diseases which can be passed from animals to humans)…' [APECS Group Review, Germany]	Taken into account - this has been deleted in the revised version of the box
7924	3	49	38	49	38	Pacifici et al. 2015 is the wrong reference. A reference about Californian gray whales is needed. [APECS Group Review, Germany]	An error occurred when chapter 3 references were compiled in Endnote by the TSU resulting in a displacement of some references. These displaced references will be fixed in the revised draft. Nevertheless, will review reference citation. Thank you.
19220	3	50	0	52		Has it been considered to also write about off shore mining, oil and gas activity? [Marianne Kroglund, Norway]	Out of scope of Box 3.3 but relevant to section 3.5
21308	3	50	0		51	The following is not correct. "Exploitation of natural resources in the Antarctic is prohibited by the Antarctic Treaty." The Antarctic Treaty is in fact silent on the issue of natural resources. The ban on mining is under the 1992 Madrid Protocol on Environmental Protection. [Sanjay Chaturvedi, India]	Accepted - this sentence has been replaced with the following "The Protocol on Environmental Protection to the Antarctic Treaty (The Madrid Protocol) prohibits mining in Antarctica"
7926	3	50	20	50	20	Last part of sentence '…to the extent possible.' is not very clear. May need re-wording. Reference missing. [APECS Group Review, Germany]	Has been re-worded
1748	3	50	22	50	22	Can 'moderate warming' be defined please. [Mark England, UK]	Good question we will address this in the final draft

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
12060	3	50	22			Clearly neither the European Parliaments Committee on Fisheries or Barret et al have the remotest idea of the scale and speed of change underway. It is nonsense to include Barret et al as absolute future permanent changes will dwarf climate variability in ocean temperatures cited and the tonnage level of cod exports they are talking about is tiny relative to current exploitation in that analysis. I really do object to this speculative paragraph as the author of this paragraph cannot understand climate change's speed and magnitude impact on the food web. This is comparable to re-arranging deck chairs on the Titanic. [Michael Casey, Germany]	The text as written is historically correct
7928	3	50	30	50	30	Define EEZs. [APECS Group Review, Germany]	Corrected
1750	3	50	32	50	34	I am not sure I understand the word 'incitement' in this context. [Mark England, UK]	This was a typo
20062	3	50	32	50	34	"…increase the incitement"? Please rewrite this sentence for better readability and choose a different way of saying whatever is meant by increasing the incitement [Michelle A. North, South Africa]	This was a typo
7930	3	50	40	50	40	Reference missing. [APECS Group Review, Germany]	Corrected
20064	3	50	45	50	45	It by "200 nm" you mean nautical miles, then possibly consider writing it out, or use NM or nmi. nm is a SI unit of length (nanometre) [Michelle A. North, South Africa]	See text in 3.5
23838	3	50	47	51	4	In this section you provide an overview on the development and current status of (krill) fisheries in the Southern Ocean, but what is going to happen with the fisheries (krill & fish) under climate change, and fisheries management? (as discussed above for Arctic fisheries) [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account - we have included available evidence regarding future changes in krill and finfish fisheries in the Southern Ocean under climate change. Fisheries management responses are described in Section 3.5.4.1 (a cross-reference has been added)
20066	3	50	54	50	57	The seasonal fishing trends don't appear to have been reversed, please check whether your reported peak catch seasons are correct, and if so, change the terminology (they have changed, not reversed) [Michelle A. North, South Africa]	Accepted
3652	3	51	4			2016)(medium confidence). - please insert hyphen between brackets [Angelika Brandt, Germany]	Editorial - copyedit to be completed prior to publication
7944	3	51	6	51	48	This sub-section includes considerably more detail about the Arctic compared to only one short paragraph about the Antarctic. Could this be more balanced? [APECS Group Review, Germany]	Taken into account: the uneven split reflects the relative importance of Arctic vs Antarctic tourism but we will address the balance as we develop the SOD
1746	3	51	8	51	10	Specify that you are talking about the Arctic (since you are talking about sea ice reductions) [Mark England, UK]	Accepted: text revised

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
2328	3	51	8	51	18	Ship traffic is likely to increase as the Arctic loses ice, which will bring additional pollutants into the region (especially that of black carbon and methane) that will further amplify warming in the area unless it is managed. (Arctic Council Task Force on Short-Lived Climate Forcers (2013) RECOMMENDATIONS TO REDUCE BLACK CARBON AND METHANE EMISSIONS TO SLOW ARCTIC CLIMATE CHANGE; Arctic Council Secretariat (2017) EXPERT GROUP ON BLACK CARBON AND METHANE: SUMMARY OF PROGRESS AND RECOMMENDATIONS 2017; Arctic Monitoring and Assessment Programme (AMAP) (2015) SUMMARY FOR POLICYMAKERS: ARCTIC CLIMATE ISSUES 2015 SHORT-LIVED CLIMATE POLLUTANTS; International Council on Clean Transportation (ICCT) (2017) GREENHOUSE GAS EMISSIONS FROM GLOBAL SHIPPING, 2013–2015; Wan Z., et al. (2016) Pollution: Three steps to a green shipping industry, NATURE 530:275–277.) [Kristin Campbell, USA]	Taken into account: We agree in principle, and have noted the impact from local emissions in Section. 3.2.4.3. The impact is small compared to upstream (atmospheric and in the ocean) sources. In the tourist season there's likely just as many ships in some small Norwegian fjords than in the entire high Arctic. We did not add the suggested references because they are assessment documents; the Wan et al paper does not address the Arctic.
2454	3	51	8	51	18	Ship traffic is likely to increase as the Arctic loses ice, which will bring additional pollutants into the region (especially that of black carbon and methane) that will further amplify warming in the area unless it is managed. (Arctic Council Task Force on Short-Lived Climate Forcers (2013) RECOMMENDATIONS TO REDUCE BLACK CARBON AND METHANE EMISSIONS TO SLOW ARCTIC CLIMATE CHANGE; Arctic Council Secretariat (2017) EXPERT GROUP ON BLACK CARBON AND METHANE: SUMMARY OF PROGRESS AND RECOMMENDATIONS 2017; Arctic Monitoring and Assessment Programme (AMAP) (2015) SUMMARY FOR POLICYMAKERS: ARCTIC CLIMATE ISSUES 2015 SHORT-LIVED CLIMATE POLLUTANTS; International Council on Clean Transportation (ICCT) (2017) GREENHOUSE GAS EMISSIONS FROM GLOBAL SHIPPING, 2013–2015; Wan Z., et al. (2016) Pollution: Three steps to a green shipping industry, NATURE 530:275–277.) [Durwood Zaelke, USA]	See 2328
12952	3	51	8	51	18	Ship traffic is likely to increase as the Arctic loses ice, which will bring additional pollutants into the region (especially that of black carbon and methane) that will further amplify warming in the area unless it is managed. (Arctic Council Task Force on Short-Lived Climate Forcers (2013) RECOMMENDATIONS TO REDUCE BLACK CARBON AND METHANE EMISSIONS TO SLOW ARCTIC CLIMATE CHANGE; Arctic Council Secretariat (2017) EXPERT GROUP ON BLACK CARBON AND METHANE: SUMMARY OF PROGRESS AND RECOMMENDATIONS 2017; Arctic Monitoring and Assessment Programme (AMAP) (2015) SUMMARY FOR POLICYMAKERS: ARCTIC CLIMATE ISSUES 2015 SHORT-LIVED CLIMATE POLLUTANTS; International Council on Clean Transportation (ICCT) (2017) GREENHOUSE GAS EMISSIONS FROM GLOBAL SHIPPING, 2013–2015; Wan Z., et al. (2016) Pollution: Three steps to a green shipping industry, NATURE 530:275–277.) [Gabrielle Dreyfus, USA]	See 2328

SROCC First Order Draft Expert Review Comments - Chapter 3							
Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
7932	3	51	9	51	40	These three paragraphs each refer to the 'Polar regions' (lines 9, 20 and 31), yet all the references are about the Arctic only. This should either be re-worded to include references and details for the Antarctic, or the wording changed to make it clear that these statements are only true for the Arctic. [APECS Group Review, Germany]	Accepted: text revised; additional Antartic material added and wording clarified
7934	3	51	10	51	12	I suggest some of these figures are checked or more/different references are included to support them. Dawson et al. 2017 doesn't appear to mention the numbers of passengers visiting Alaska, so it is not clear where the figure of 1 million comes from. Additionally, Dawson et al. 2017 says the number of passengers to Canada is 3,500 (citing other studies), and the number in their Fig. 1 looks even less than this, so it is not clear where the 5,000-8,000 figure comes from. [APECS Group Review, Germany]	Accepted: wording clarified and reference confirmed; number of tourists to Canada corrected to 3500-5000
12616	3	51	11			This comparison with Alaska re visitor numbers is not valid as most Alaskan visitors are not polar but in southceast, and southcentral Alaska [Alexander Milner, UK]	Accepted: wording clarified
7936	3	51	18	51	18	Reference missing. [APECS Group Review, Germany]	Taken into account: this sentence was removed
2330	3	51	20	51	29	Any increase in traffic (for shipping, transport, or tourism) will bring additional pollutants into the region (especially that of black carbon and methane) that will further amplify warming in the area unless it is managed. (Arctic Council Task Force on Short-Lived Climate Forcers (2013) RECOMMENDATIONS TO REDUCE BLACK CARBON AND METHANE EMISSIONS TO SLOW ARCTIC CLIMATE CHANGE; Arctic Council Secretariat (2017) EXPERT GROUP ON BLACK CARBON AND METHANE: SUMMARY OF PROGRESS AND RECOMMENDATIONS 2017; Arctic Monitoring and Assessment Programme (AMAP) (2015) SUMMARY FOR POLICYMAKERS: ARCTIC CLIMATE ISSUES 2015 SHORT-LIVED CLIMATE POLLUTANTS; International Council on Clean Transportation (ICCT) (2017) GREENHOUSE GAS EMISSIONS FROM GLOBAL SHIPPING, 2013–2015; Wan Z., et al. (2016) Pollution: Three steps to a green shipping industry, NATURE 530:275–277.) [Kristin Campbell, USA]	See 2328
2456	3	51	20	51	29	Any increase in traffic (for shipping, transport, or tourism) will bring additional pollutants into the region (especially that of black carbon and methane) that will further amplify warming in the area unless it is managed. (Arctic Council Task Force on Short-Lived Climate Forcers (2013) RECOMMENDATIONS TO REDUCE BLACK CARBON AND METHANE EMISSIONS TO SLOW ARCTIC CLIMATE CHANGE; Arctic Council Secretariat (2017) EXPERT GROUP ON BLACK CARBON AND METHANE: SUMMARY OF PROGRESS AND RECOMMENDATIONS 2017; Arctic Monitoring and Assessment Programme (AMAP) (2015) SUMMARY FOR POLICYMAKERS: ARCTIC CLIMATE ISSUES 2015 SHORT-LIVED CLIMATE POLLUTANTS; International Council on Clean Transportation (ICCT) (2017) GREENHOUSE GAS EMISSIONS FROM GLOBAL SHIPPING, 2013–2015; Wan Z., et al. (2016) Pollution: Three steps to a green shipping industry, NATURE 530:275–277.) [Durwood Zaelke, USA]	See 2328

SROCC First Order Draft Expert Review Comments - Chapter 3							
Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
12954	3	51	20	51	29	Any increase in traffic (for shipping, transport, or tourism) will bring additional pollutants into the region (especially that of black carbon and methane) that will further amplify warming in the area unless it is managed. (Arctic Council Task Force on Short-Lived Climate Forcers (2013) RECOMMENDATIONS TO REDUCE BLACK CARBON AND METHANE EMISSIONS TO SLOW ARCTIC CLIMATE CHANGE; Arctic Council Secretariat (2017) EXPERT GROUP ON BLACK CARBON AND METHANE: SUMMARY OF PROGRESS AND RECOMMENDATIONS 2017; Arctic Monitoring and Assessment Programme (AMAP) (2015) SUMMARY FOR POLICYMAKERS: ARCTIC CLIMATE ISSUES 2015 SHORT-LIVED CLIMATE POLLUTANTS; International Council on Clean Transportation (ICCT) (2017) GREENHOUSE GAS EMISSIONS FROM GLOBAL SHIPPING, 2013–2015; Wan Z., et al. (2016) Pollution: Three steps to a green shipping industry, NATURE 530:275–277.) [Gabrielle Dreyfus, USA]	See 2328
20068	3	51	20	51	34	Please decide whether or not you wish to capiitalize "polar" and be consistent throughout [Michelle A. North, South Africa]	Taken into account: consistent capitlization being implemented across the chapter
5414	3	51	21	51	21	"Climate-change related opportunities". It seems a bit too optimistic to talk about opportunities of ice melting. [Roderik Van De Wal, Netherlands]	Accepted: text revised
7938	3	51	21	51	25	It is not clear how this sentence matches up with the figures in the cited studies. In Johnston et al. 2017, the 400% increase in pleasure craft is stated for Alaska. Dawson et al. 2018 does not specifically mention changes since 2012. [APECS Group Review, Germany]	Accepted: text revised
2332	3	51	31	51	40	Beyond the safety concerns and need for governance, there would be an increase in local emissions of climate pollutants, specifically SLCPs like methane and black carbon that can have direct climate impacts on the region that will amplify warming. (Arctic Council Task Force on Short-Lived Climate Forcers (2013) RECOMMENDATIONS TO REDUCE BLACK CARBON AND METHANE EMISSIONS TO SLOW ARCTIC CLIMATE CHANGE; Arctic Council Secretariat (2017) EXPERT GROUP ON BLACK CARBON AND METHANE: SUMMARY OF PROGRESS AND RECOMMENDATIONS 2017; Arctic Monitoring and Assessment Programme (AMAP) (2015) SUMMARY FOR POLICYMAKERS: ARCTIC CLIMATE ISSUES 2015 SHORT-LIVED CLIMATE POLLUTANTS; International Council on Clean Transportation (ICCT) (2017) GREENHOUSE GAS EMISSIONS FROM GLOBAL SHIPPING, 2013–2015; Wan Z., et al. (2016) Pollution: Three steps to a green shipping industry, NATURE 530:275–277.) [Kristin Campbell, USA]	See 2328

SROCC First Order Draft Expert Review Comments - Chapter 3							
Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
2458	3	51	31	51	40	Beyond the safety concerns and need for governance, there would be an increase in local emissions of climate pollutants, specifically SLCPs like methane and black carbon that can have direct climate impacts on the region that will amplify warming. (Arctic Council Task Force on Short-Lived Climate Forcers (2013) RECOMMENDATIONS TO REDUCE BLACK CARBON AND METHANE EMISSIONS TO SLOW ARCTIC CLIMATE CHANGE; Arctic Council Secretariat (2017) EXPERT GROUP ON BLACK CARBON AND METHANE: SUMMARY OF PROGRESS AND RECOMMENDATIONS 2017; Arctic Monitoring and Assessment Programme (AMAP) (2015) SUMMARY FOR POLICYMAKERS: ARCTIC CLIMATE ISSUES 2015 SHORT-LIVED CLIMATE POLLUTANTS; International Council on Clean Transportation (ICCT) (2017) GREENHOUSE GAS EMISSIONS FROM GLOBAL SHIPPING, 2013–2015; Wan Z., et al. (2016) Pollution: Three steps to a green shipping industry, NATURE 530:275–277.) [Durwood Zaelke, USA]	See 2328
12956	3	51	31	51	40	Beyond the safety concerns and need for governance, there would be an increase in local emissions of climate pollutants, specifically SLCPs like methane and black carbon that can have direct climate impacts on the region that will amplify warming. (Arctic Council Task Force on Short-Lived Climate Forcers (2013) RECOMMENDATIONS TO REDUCE BLACK CARBON AND METHANE EMISSIONS TO SLOW ARCTIC CLIMATE CHANGE; Arctic Council Secretariat (2017) EXPERT GROUP ON BLACK CARBON AND METHANE: SUMMARY OF PROGRESS AND RECOMMENDATIONS 2017; Arctic Monitoring and Assessment Programme (AMAP) (2015) SUMMARY FOR POLICYMAKERS: ARCTIC CLIMATE ISSUES 2015 SHORT-LIVED CLIMATE POLLUTANTS; International Council on Clean Transportation (ICCT) (2017) GREENHOUSE GAS EMISSIONS FROM GLOBAL SHIPPING, 2013–2015; Wan Z., et al. (2016) Pollution: Three steps to a green shipping industry, NATURE 530:275–277.) [Gabrielle Dreyfus, USA]	See 2328
7940	3	51	39	51	39	I suggest that pleasure crafts is defined earlier on and there is consistency in the terminology used, i.e. yachts vs. pleasure craft. [APECS Group Review, Germany]	Accepted: text revised
23106	3	51	39			The International Maritime Organisation (IMO) has adopted the international code for ships operating in polar water (Polar Code) and related amendments to make it mandatory under both SOLAS (security) and MARPOL (prevention of pollution) conventions. This code entered into force in january 2017. Most of the rules apply to ship constructer on or after 1 january 2017. What about particular private pleasure crafts? [Jacques Beall, France]	Rejected: Not clear what is being requested. The Polar Code does not apply to pleasure craft specifically.SOLAS and MARPOL applies to all vessels.

SROCC First Order Draft Expert Review Comments - Chapter 3							
Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
23108	3	51	40			We should put emphasis on risks related to cruise tourism . Nowaday huge cruise ships are constructed and sail with more than 5000 passengers, seafarers and others on board. A german university did a study to find out how it would be possible to evacuate so many people in a short time, they found out that it was not possible, because of ship inner design ; size of corridors, stairs, lifts ... a few marine casualty happened (Costa Concordia, 2012) in recent years in accessible seas : lack of formation for seafarer, lack of emergency security training with passenger, inefficient controls, etc. What 's going to happen in the polar seas, if such a casulty happens in harsh environment , with no harbour and rescue ship around, eventhough there is less than 1000 passengers on board ? IMO is working on new conception rules for big cruise ships to ensure stability of the ship after accident. It's not yet ready. [Jacques Beall, France]	Taken into account: wording revised to reflect risks related to search and rescue; beyond scope to provide additional details
2334	3	51	42	51	48	Include that there would be similar concerns regarding pollutants as in the Arctic with the potential for emissions. [Kristin Campbell, USA]	Taken into account: to avoid duplication, environmental concerns about increased ship activity in the polar regions (including emissions, pollutants, impacts on wildlife, etc.) are in Section 3.2.4.3 (Transportation)
2460	3	51	42	51	48	Include that there would be similar concerns regarding pollutants as in the Arctic with the potential for emissions. [Durwood Zaelke, USA]	See 2334
12958	3	51	42	51	48	Include that there would be similar concerns regarding pollutants as in the Arctic with the potential for emissions. [Gabrielle Dreyfus, USA]	See 2334
5416	3	51	45	51	47	“The biodiversity supported by ice-free areas, particularly those on the Antarctic Peninsula, has been identified as being particularly vulnerable to the changing climate and to the introduction of terrestrial alien species”.Wouldn't it be interesting to mention if there are also vulnerabl species to the increase in tourism? [Roderik Van De Wal, Netherlands]	Accepted: text and citation added
23840	3	51	45	51	48	refer to the section discussion the introduction of alien species [Hans-Otto Poertner and WGII TSU, Germany]	Accepted: reference added to Box 3.3
7942	3	51	46	51	47	Tin et al., 2013 reference is a book - can the specific chapter be mentioned in the reference list? [APECS Group Review, Germany]	Accepted: reference removed
3654	3	51	48			al., 2017a)(medium confidence). - please insert hyphen between brackets [Angelika Brandt, Germany]	Rejected: Not standard IPCC format (check AR5)
7946	3	51	52	52	4	More references are needed as not all of this detail appears to be covered in Smith and Stephenson, 2013. [APECS Group Review, Germany]	Taken into account: text changed during revision
1858	3	51	55	51	57	The text assumes that all readers are familiar with the four trade routes mentioned. A figure showing the routes would help non-expert readers to understand the following discussion. [Aku Riihelä, Finland]	Rejected: unfortunately there is no space for illustrative figure due to page constraints
7948	3	51	56	51	56	Suggest the Northwest Passage (NWP) abbreviation is introduced earlier on (e.g. page 51, line 21) [APECS Group Review, Germany]	Taken into account: acronyms removed (see 20070)
20070	3	51	56	52	26	Please remove all acronyms and write out the Arctic trade route names out in full [Michelle A. North, South Africa]	Accepted: text revised

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
8228	3	52	1	59	1	Even though it is mentionned in some ways along this chapter, I feel like Arctic coastal erosion deserves a bit more attention in this section of the chapter (Couture et al., 2018). Coastal erosion has majpor impacts on wildlife, infrastructures and marine trafficability. There is already some brief discussions on how erosion affects the carbon cycle but I feel this could be addressed a bit more in depth. Also, high levels of mercury in the oceans have been linked to coastal erosion in the Arctic (Obrist et al. 2018). This has major impacts for the wildlife and arctic communities as the entire food chain sees higher concentration of mercury. "Obrist D., Kirk J.L., Zhang L., Sunderland E.M., Jiskra M. and Selin N.E. 2018. A review of global environmental mercury processes in response to human and natural pertubations: Changes of emissions, climate and land use, Ambio, vol. 47 (2), pp.116-140." ; "Couture N.J., Irrgang A., Polland W., Lantuit H. and Fritz M. 2018. Coastal erosion of permafrost soils along the Yukon coastal plain and fluxes of organic carbon to the Canadian Beaufort Sea, Journal of Geophysical Research: Biogeosciences, vol. 123 (2), pp. 406-422." [Benoit Montpetit, Canada]	Taken into account: including coastal erosion is beyond the scope of this section, but it is discussed within cross-chapter box on low lying islands and coastal regions.
20072	3	52	1	52	2	"...Suez and Panama Canals..." [Michelle A. North, South Africa]	Accepted: text revised
5418	3	52	4	52	4	"Ice-infested waters" feels like having ice in places that used to be covered in it is a bad thing. Is it possible to use a different term? [Roderik Van De Wal, Netherlands]	Accepted: text revised
2336	3	52	6	52	12	Increased shipping will also lead to increased emissions of SLCPs in the area, which will amplify warming in the area. (Arctic Council Task Force on Short-Lived Climate Forcers (2013) RECOMMENDATIONS TO REDUCE BLACK CARBON AND METHANE EMISSIONS TO SLOW ARCTIC CLIMATE CHANGE; Arctic Council Secretariat (2017) EXPERT GROUP ON BLACK CARBON AND METHANE: SUMMARY OF PROGRESS AND RECOMMENDATIONS 2017; Arctic Monitoring and Assessment Programme (AMAP) (2015) SUMMARY FOR POLICYMAKERS: ARCTIC CLIMATE ISSUES 2015 SHORT-LIVED CLIMATE POLLUTANTS; International Council on Clean Transportation (ICCT) (2017) GREENHOUSE GAS EMISSIONS FROM GLOBAL SHIPPING, 2013–2015; Wan Z., et al. (2016) Pollution: Three steps to a green shipping industry, NATURE 530:275–277. [Kristin Campbell, USA]	See 2328
2462	3	52	6	52	12	Increased shipping will also lead to increased emissions of SLCPs in the area, which will amplify warming in the area. (Arctic Council Task Force on Short-Lived Climate Forcers (2013) RECOMMENDATIONS TO REDUCE BLACK CARBON AND METHANE EMISSIONS TO SLOW ARCTIC CLIMATE CHANGE; Arctic Council Secretariat (2017) EXPERT GROUP ON BLACK CARBON AND METHANE: SUMMARY OF PROGRESS AND RECOMMENDATIONS 2017; Arctic Monitoring and Assessment Programme (AMAP) (2015) SUMMARY FOR POLICYMAKERS: ARCTIC CLIMATE ISSUES 2015 SHORT-LIVED CLIMATE POLLUTANTS; International Council on Clean Transportation (ICCT) (2017) GREENHOUSE GAS EMISSIONS FROM GLOBAL SHIPPING, 2013–2015; Wan Z., et al. (2016) Pollution: Three steps to a green shipping industry, NATURE 530:275–277. [Durwood Zaelke, USA]	See 2328

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
12960	3	52	6	52	12	Increased shipping will also lead to increased emissions of SLCPs in the area, which will amplify warming in the area. (Arctic Council Task Force on Short-Lived Climate Forcers (2013) RECOMMENDATIONS TO REDUCE BLACK CARBON AND METHANE EMISSIONS TO SLOW ARCTIC CLIMATE CHANGE; Arctic Council Secretariat (2017) EXPERT GROUP ON BLACK CARBON AND METHANE: SUMMARY OF PROGRESS AND RECOMMENDATIONS 2017; Arctic Monitoring and Assessment Programme (AMAP) (2015) SUMMARY FOR POLICYMAKERS: ARCTIC CLIMATE ISSUES 2015 SHORT-LIVED CLIMATE POLLUTANTS; International Council on Clean Transportation (ICCT) (2017) GREENHOUSE GAS EMISSIONS FROM GLOBAL SHIPPING, 2013–2015; Wan Z., et al. (2016) Pollution: Three steps to a green shipping industry, NATURE 530:275–277. [Gabrielle Dreyfus, USA]	See 2328
20074	3	52	6	52	6	Modify to read: "There is very high confidence that Arctic shipping activity has increased over the past decade…" (it is very obvious that this data was observed and not modelled). [Michelle A. North, South Africa]	Accepted: text revised
21306	3	52	6		12	The first sentence and the last sentence more or less convey similar meaning. Both talk of Arctic shipping! [Sanjay Chaturvedi, India]	Accepted: text revised
7950	3	52	10	51	12	Not sure the Dawson et al. 2017 reference leads to the conclusion stated here as this paper has no mention of sea ice and focusses on regulatory processes. Suggest more/different references are included. [APECS Group Review, Germany]	Accepted: text revised so this reference is no longer associated with this statement
20076	3	52	10	52	12	This is a very complicated way of saying that: "…the reductions in Arctic sea ice (because of climate change) is the main driver of these observed changes in shipping activity (high confidence) (…).". Are you intending your readers understand and internalize your message? Then try to write accordingly [Michelle A. North, South Africa]	Accepted: text revised
2338	3	52	14	52	26	Increased emissions from transportation within the region will have negative impacts directly on the region. (Arctic Council Task Force on Short-Lived Climate Forcers (2013) RECOMMENDATIONS TO REDUCE BLACK CARBON AND METHANE EMISSIONS TO SLOW ARCTIC CLIMATE CHANGE; Arctic Council Secretariat (2017) EXPERT GROUP ON BLACK CARBON AND METHANE: SUMMARY OF PROGRESS AND RECOMMENDATIONS 2017; Arctic Monitoring and Assessment Programme (AMAP) (2015) SUMMARY FOR POLICYMAKERS: ARCTIC CLIMATE ISSUES 2015 SHORT-LIVED CLIMATE POLLUTANTS; International Council on Clean Transportation (ICCT) (2017) GREENHOUSE GAS EMISSIONS FROM GLOBAL SHIPPING, 2013–2015; Wan Z., et al. (2016) Pollution: Three steps to a green shipping industry, NATURE 530:275–277.) [Kristin Campbell, USA]	See 2328

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
2464	3	52	14	52	26	Increased emissions from transportation within the region will have negative impacts directly on the region. (Arctic Council Task Force on Short-Lived Climate Forcers (2013) RECOMMENDATIONS TO REDUCE BLACK CARBON AND METHANE EMISSIONS TO SLOW ARCTIC CLIMATE CHANGE; Arctic Council Secretariat (2017) EXPERT GROUP ON BLACK CARBON AND METHANE: SUMMARY OF PROGRESS AND RECOMMENDATIONS 2017; Arctic Monitoring and Assessment Programme (AMAP) (2015) SUMMARY FOR POLICYMAKERS: ARCTIC CLIMATE ISSUES 2015 SHORT-LIVED CLIMATE POLLUTANTS; International Council on Clean Transportation (ICCT) (2017) GREENHOUSE GAS EMISSIONS FROM GLOBAL SHIPPING, 2013–2015; Wan Z., et al. (2016) Pollution: Three steps to a green shipping industry, NATURE 530:275–277.) [Durwood Zaelke, USA]	See 2328
12962	3	52	14	52	26	Increased emissions from transportation within the region will have negative impacts directly on the region. (Arctic Council Task Force on Short-Lived Climate Forcers (2013) RECOMMENDATIONS TO REDUCE BLACK CARBON AND METHANE EMISSIONS TO SLOW ARCTIC CLIMATE CHANGE; Arctic Council Secretariat (2017) EXPERT GROUP ON BLACK CARBON AND METHANE: SUMMARY OF PROGRESS AND RECOMMENDATIONS 2017; Arctic Monitoring and Assessment Programme (AMAP) (2015) SUMMARY FOR POLICYMAKERS: ARCTIC CLIMATE ISSUES 2015 SHORT-LIVED CLIMATE POLLUTANTS; International Council on Clean Transportation (ICCT) (2017) GREENHOUSE GAS EMISSIONS FROM GLOBAL SHIPPING, 2013–2015; Wan Z., et al. (2016) Pollution: Three steps to a green shipping industry, NATURE 530:275–277.) [Gabrielle Dreyfus, USA]	See 2328
20078	3	52	14	52	16	This sentence is incomprehensible. Try: "It is projected that shipping activity will continue to rise across the Arctic as northern routes become increasingly accessible, and as insurance companies respond to reduced risk with lower premiums for polar travel." [Michelle A. North, South Africa]	Accepted: text revised
20082	3	52	14	52	16	Do you think there will be decreased risk associated with polar travel? All the things you discuss later in the paragraph suggest that there will still be high risk, and I don't see insurance companies reducing premiums within the foreseeable future… [Michelle A. North, South Africa]	Accepted: this is a good point. Text revised to remove speculation.
7952	3	52	21	52	21	Avoid using 'likely' where it is a not a specific probability statement. In this case, the word 'likely' can simply be removed. [APECS Group Review, Germany]	Accepted: text revised
20080	3	52	23	52	26	"i.e.," implies that you are providing a complete list of all the factors alluded to, whereas "e.g.," allows that the examples provided in parentheses are only a few representatives from a longer list. Please modify this sentence accordingly [Michelle A. North, South Africa]	Accepted: text revised
7954	3	52	28	52	30	Not sure the Lieser et al. 2013 reference is relevant as it doesn't seem to make the conclusion that is stated here. Another reference may be required. [APECS Group Review, Germany]	Accepted: citation removed
20084	3	52	28	52	29	Rewrite this sentence [Michelle A. North, South Africa]	Accepted: text revised
23110	3	52	33			Polar code apply to all those ships. It's interesting to note that Heavy Fuel Oil (HFO) are forbiden for transport and for propulsion [Jacques Beall, France]	Comment not clear; no response needed

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
5818	3	52	35			Section 3.4 It might make more sense to discuss the terrestrial cryosphere components and how they are changing first before discussing impacts such as impact on freshwater systems (3.4..1.2) since this does have linkages to other cyrospheric components that haven't been discussed yet. For examply there are references in this section to changes in permafrost conditions (and thermokarst) but permafrost is not discussed until section 3.4.1.3. [Sharon Smith, Canada]	Accepted: sections were re-ordered so that permafrost comes before hydrology/freshwater
21184	3	52	35			At 20 pages, Section 3.4 could be shortened by half and the repetition with earlier sections removed. It seems overly long for the points that it is making. [Andrew Constable, Australia]	Taken into acount: Section 3.4 revised and shortened
23842	3	52	35			The entire section 3.4 is exclusively considering the Arctic; but seasonal snow cover is also present and changing on e.g. Antarctic Islands. It should be at least explained in one or two sentences why focus is here on the Arctic only [Hans-Otto Poertner and WGII TSU, Germany]	A description of the importance of snow to the Arctic is provided at the beginning of 3.4.1.1; Any suggested references on changing snow cover on Antarctic islands?
5420	3	52	40	52	40	Section 3.4 is supposed to be global. However, not a word is said about the Antarctic region, everything is about the Arctic. At leas it should be mentioned why is not considered in the report. [Roderik Van De Wal, Netherlands]	See 23842
5422	3	52	40	52	40	Figures would be a valuable addition to this section. [Roderik Van De Wal, Netherlands]	Taken into account: a new figure is under development for the main text, and figures were prepared for SOM
6228	3	52	47	53	12	avoid acronyms SCE and SCD and Sdmax, SD [Regine Hock, USA]	Accepted: text revised
13498	3	52	52			Percent of what? compared to original extent or previous decade? [Debra Roberts and Durban Team, South Africa]	Accepted: text revised
7956	3	53	1	53	12	What about the uncertainty in May and June derived from the NOAA-CDR? Hernàdez-Henríquez et al. (2015) note that there are strong inconsistencies in October, and that although there is notable overestimation in June, the NOAA record is a reliable source for studies investigating spring trends in snow cover. However, Mudiryk et al. (2016) conclude that the trends from the months of October, November, May and June should all be interpreted with "considerable caution". The text in the SROCC highlights the higher uncertainty associatied with the fall months, but not in the spring. Although the uncertainty does not seem as important in the spring for the NOAA-CDR, I think it should be mentionned somewhere. [APECS Group Review, Germany]	Taken into account: good point, and we agree that uncertainty in the NOAA-CDR in some months (both fall and spring) should be clear. Text has been revised to clarify.
20086	3	53	1	53	12	This paragraph contains a lot of information - yes. However, it could be simplified such that it becomes unnecessary to abbreviate 'snow cover extent' or 'snow cover duration'. These terms are making it harder to understand, when all you are talking about is the area of land under snow and the length of time that it is under snow. Thus, the sentences could be modified to talk about decreasing area covered by snow each decade as measured in spring, and the fact that the number of days that land is covered with snow is decreasing by 0.7 to 3.9 days per decade... please rewrite this to be more understandable [Michelle A. North, South Africa]	Accepted: text revised for clarity
7962	3	53	14	53	29	This section has a lot of uncertainty and does not provide much reliable information. If there were parts to cut, I would say this is one. [APECS Group Review, Germany]	Taken into account: text shortened
7958	3	53	15	53	15	What is pre-melt maximum snow depth? Is it the maximum depth before the snow melts in the spring? It should be explained. [APECS Group Review, Germany]	Accepted: text revised

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
20088	3	53	15	53	16	"emerging evidence of negative trends…" - this data has been collected over decades, and the publications were published 4-7 years ago. Do you not think this counts as: "Maximum (pre-melt) snow depth measured at weather stations in the Russian Arctic decreased between 1966 and 2014 (…)"? Also, delete 'time period' , it is implied by the very fact that 1966 and 2014 were years and thus the range between them must cover a period of time [Michelle A. North, South Africa]	Accepted: text revised
20090	3	53	15	53	22	Please delete SDmax and only use 'maximum snow depth' instead. SD is accepted as an acronym for standard deviation (in statistical analyses) and therefore is confusing in this context [Michelle A. North, South Africa]	Accepted: text revised
12246	3	53	20	53	21	"SDmax trends from northeast Greenland (Pedersen et al. 2016) and over the North.." Ref: Pedersen, S. H., Tamstorf, M. P., Abermann, J., Westergaard-Nielsen, A., Lund, M., Skov, K., Sigsgaard, C., Mylius, M. R., Hansen, B. U., Liston, G. E., Schmidt, N. M., 2016: Spatiotemporal characteristics of seasonal snow cover in Northeast Greenland from in situ observations. Arctic, Antarctic, and Alpine Research, 48: 653-671. DOI: 10.1657/AAAR0016-028 [Torben Christensen, Sweden]	Rejected: this paper present trends over only 18 years for a single location.
20094	3	53	24	53	29	What are 'gridded products … driven by reanalyses'? Please consider rephrasing, omitting the unnecessary acronym SWE and simplifying [Michelle A. North, South Africa]	Accepted: text revised for clarity
7960	3	53	25	53	25	What is maximum pre-melt snow water equivalent? Is it the maximum amount of water in the form of snow before it melts in the spring? In winter? (same comment as above about the "pre-melt"). [APECS Group Review, Germany]	Accepted: text revised for clarity
20092	3	53	25	53	25	"over the 1981-2016 period" could easily be rewritten as: "between 1981 and 2016". [Michelle A. North, South Africa]	Accepted: text revised
20096	3	53	35	53	35	"…observed changes in the extent and duration of Arctic snow cover…" - No acronyms needed [Michelle A. North, South Africa]	Accepted: text revised
5424	3	53	45	53	45	An introductory sentence would help the flow of this section and this paragraph [Roderik Van De Wal, Netherlands]	Taken into account: paragraph structure changed so there is introductory material
20100	3	53	45	53	50	I think it may be important to make it clear that the units are land area (in km2) per degree temperature change (in K) - these are very hard facts that could do well in the SPM with the numbers written in a more understandable format (e.g., loss of 700,000 - 800,000 km2 snow cover in spring per 'C increase) - the 10^6 is not publicly well understood notation, and few people know the Kelvin temperature scale. It would be better to use something familiar (or consider a footnote with a translation to 'C and 'F) [Michelle A. North, South Africa]	Accepted: text revised
6768	3	53	46	53	46	Space needed in "for spring(Brown et" [James Pope, UK]	Accepted: text revised
14306	3	53	46			Space needed between 'spring' and parenthesis [Christopher Fogwill, UK]	Accepted: text revised
6770	3	53	47	53	47	Space needed in "for fall(Derksen and" [James Pope, UK]	Accepted: text revised
14308	3	53	47			Space needed between 'fall' and parenthesis [Christopher Fogwill, UK]	Accepted: text revised
23844	3	54	2	54	2	"little recent evidence": is this supposed to be a confidence statement? Please clarify and/or revise [Hans-Otto Poertner and WGII TSU, Germany]	Accepted: text revised

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
2376	3	54	4	54	10	On the Arctic Ocean, the delayed freezing in autumn causes smaller sea-ice extent in October-November, which are months of heavy snowfall; this means that the snow falls into water instead of onto sea ice. The result is thinner snow on sea ice through the winter and spring (Webster et al., 2014). Reference: Webster, M.A., I.G. Rigor, S.V. Nghiem, N.T. Kurtz, S.L. Farrell, D.K. Perovich, and M. Sturm, 2014: Interdecadal changes in snow depth on Arctic sea ice. J. Geophys. Res. Oceans 119, 5395-5406, doi:10.1002/2014JC009985. [Stephen Warren, USA]	Rejected: this section deals solely with snow on land. Note that a new snow on sea ice section was added and the Webster et al paper is cited in that section.
7964	3	54	12	54	19	Shrubs can affect snowmelt and the ground thermal regime in numerous ways and their effect is mixed. It would be interesting to highlight what seems to be the dominating factor or effect (if any) or at least mention the different effects in addition to trapping of snow, i.e. shrubs branches protruding above the snowpack and also below it can accelarate snowmelt due to lower albedo (Sturm et al., 2005), tall shrubs can provide shading on the ground and delay snowmelt, etc. Marsh et al. (2010) list a number of those factors in their introduction and conclude that the overall effect of shrubs is to accelarate melt. [APECS Group Review, Germany]	Rejected: beyond the scope of the report to do into additional detail on snow/shrub interactions
14310	3	54	12			Regional-scale' (Hyphen needed) [Christopher Fogwill, UK]	Accepted: text revised
3864	3	54	13	54	13	Change "greater snow catchment" to "greater snow trapping" [Howard Epstein, USA]	Accepted: text revised
20926	3	54	14	54	19	It could be interesting to note that "In contrast, indigenous reindeer herders and hunters of Eastern Siberia are focussing on the impacts of the disruptions of snow falls and snow cover, joint to the temperature jumps raised by CC upon the abnormal development of vegetal cover (changes in vegetal species, in shrub expansion, tree increasing size, etc) (Lavrillier and Gabyshev 2017, p.30-32 et passim), at the exception of an anomaly when river bushes foster the abnormal melting of snow and ice during an abnormal winter (Lavrillier and Gabyshev 2017, 435-436)". References: Lavrillier A. & S. Gabyshev, 2017 An Arctic Indigenous Knowledge System of Landscape, Climate, and Human interactions. Evenki Reindeer Herders and Hunters, Studies in Social and Cultural Anthropology, Kulturstiftung Sibirien, Fürstenberg/Havel, Germany 467p./ [Alexandra Lavrillier, France]	Rejected: too much detail for this section on snow/vegetation interactions
3520	3	54	15	54	16	In this sentence, the recent article by Druel et al., 2017 should be cited alongside Gouttevin et al., 2012: Druel et al., 2017. Towards a more detailed representation of high-latitude vegetation in the global land surface model ORCHIDEE (ORC-HL-VEGv1.0), Geosci. Model Dev., 10, 4693–4722, doi: 10.5194/gmd-10-4693-2017. [Deborah Verfaillie, Spain]	Accepted: citation added
3866	3	54	15	54	15	I am not sure that effects of shrub cover on the ground thermal regime "are well understood" [Howard Epstein, USA]	Accepted: text revised
5426	3	54	18	54	19	It should be mentioned what was found in these papers [Roderik Van De Wal, Netherlands]	Accepted: text revised
20104	3	54	21	54	21	Delete "potential" [Michelle A. North, South Africa]	Accepted: text revised
20106	3	54	22	54	22	"...suggest increasing atmostpheric moisture in the Arctic" rather than "moistening" [Michelle A. North, South Africa]	Accepted: text revised

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
20108	3	54	24	54	24	What do you mean by "Temperature and snowfall departures"? Consider using a different word [Michelle A. North, South Africa]	Accepted: text revised
3736	3	54	26	54	27	enhanced downward longwave radiation, [Petteri Uotila, Finland]	Accepted: text revised
5428	3	54	26	54	28	In what way does this variables interact? [Roderik Van De Wal, Netherlands]	Taken into account: this sentence was removed
7966	3	54	27	54	27	"hydrological terms", is it possible to change it to something else? I am not sure what you mean by those terms. [APECS Group Review, Germany]	Taken into account: this sentence was removed
5430	3	54	30	54	30	Fiigures would help to convey the message of this section [Roderik Van De Wal, Netherlands]	Taken into account: an integrative figure for Section 3.4 is in development for the SOD
12620	3	54	39			Interesting section but would like to see some info on contaminants in river ice accumulated in these large northerly flowing rivers and effects on estuaries particularly with breeding birds [Alexander Milner, UK]	This is a good suggestion and will be considered within 3.4.3.2.1
17012	3	54	39	54	55	There are also - sometimes rather long - river ice data series, such as the Torne älv i Northern Sweden/Finland (data from late 1700th C onwards), see for example J. Quart. Sci 26:6, 566-570 (2011); Sci. Rep. 6:25061 (2016). [Markku Rummukainen, Sweden]	Rejected: this paper presents multi-century results but for only a single site in the polar regions. We will consider this further and possibly integrate in the next round of revision
20110	3	54	45	54	46	"consistent with a separate analysis…" [Michelle A. North, South Africa]	Accepted: text revised
14312	3	55	1			Analyses…show' or "Analysis…shows' [Christopher Fogwill, UK]	Accepted: text revised
5820	3	55	3	55	3	You could say this results in the development of taliks [Sharon Smith, Canada]	Taken into account: section restructured; this text no longer appears
7974	3	55	3	55	4	"This can result in degradation of underlying permafrost", but why? I'm not sure this is obvious to non-permafrost experts. You should add something like "due to a better heat exchange between water and permafrost, causing permafrost to thaw". [APECS Group Review, Germany]	Taken into account: section restructured; this text no longer appears
6230	3	55	7	55	7	Structure: shouldn't the consequences of permafrost degradation be discussed under permafrost and after the permafrost changes have been dealt with. Seems out of scope here: The header says "surface water and runoff" and the first sentence starts with "Permafrost ….". More logical would be to have a sections permafrost and river runoff or so later once the permafrost changes have been introduced. [Regine Hock, USA]	Accepted: Sections order changed so permafrost appears before freshwater
12622	3	55	7			This section needs more on glacial runoff and how that will be changed and relation to groundwater. Also need to consider nutrients like N & P in runoff in addition to DOC etc [Alexander Milner, UK]	Rejected: polar glaciers are treated in a separate sub-section of Section 3.3; discussion will need to also occur with chapter 2; provision of specific references would be helpful
7968	3	55	8	55	8	Permafrost is not defined here, but rather later in the chapter (P56, L38-40). I understand that the section on permafrost comes later, but maybe adding at least '(frozen ground)' or '(perennially frozen ground)' would help the non-familiar reader here. [APECS Group Review, Germany]	Taken into account: Sections order changed so permafrost appears before freshwater
20112	3	55	11	55	11	Include thermokarst and paludification in the glossary [Michelle A. North, South Africa]	Terms must be cited in more than 1 chapter to appear in the glossary

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
5824	3	55	18	55	29	More recent Canadian papers related to thermokarst lakes etc. may be relevant to this section including Lantz & Turner (2015); Perrault et al. (2017): Lantz, T.C. and Turner, K.W., 2015. Changes in lake area in response to thermokarst processes and climate in Old Crow Flats, Yukon. Jounal of Geophysical Research (Biogeosciences), 120: 513-524. Perrault, N., Levesque, E., Fortier, D., Gratton, D. and Lamarque, L.J., 2017. Remote sensing evaluation of High Arctic wetland depletion following permafrost disturbance by thermo-erosion gullying processes. Arctic Science, 3(2): 237-253. [Sharon Smith, Canada]	Accepted: references added
7970	3	55	18	55	18	As mentioned above for permafrost: the term 'thermokarst' is not defined here. Suggestion: add '(thawing of ice-rich permafrost)' or '(melting of ground ice)'. [APECS Group Review, Germany]	Taken into account: Sections order changed so permafrost appears before freshwater
7972	3	55	20	55	22	What about lake level drop, in addition to surface area reduction? Some studies have documented such lake-level drawdowns from evaporation, even complete desiccation of shallow lakes from discontinuous permafrost, e.g. Bouchard et al. 2013 in Canada. Full citation here: https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1002/2013GL058635. Bouchard F, Turner KW, MacDonald LA, Deakin C, White H, Farquharson N, Medeiros AS, Wolfe BB, Hall RI, Pienitz R, Edwards TWD (2013). Vulnerability of shallow subarctic lakes to evaporate and desiccate when snowmelt runoff is low. Geophysical Research Letters, 40(23), 6112-6117, doi: 10.1002/2013GL058635. [APECS Group Review, Germany]	Accepted: text revised and reference added
5822	3	55	24	55	24	Continuous permafrost coverage - incorrect terminology. Permafrost is below the surface so does not cover the land. Suggested revision "...plain of Alaska where permafrost is continuous" [Sharon Smith, Canada]	Accepted: text revised
7976	3	55	25	55	26	"Increased evaporation [...]", are there sources to substantiate this? Many reports expect increased precipitations over the next century (e.g. Actic Climate Assessment Report 2004; IPCC 2014), so increased precipitations could offset higher rates of evaporation. It's actually what is predicted on page 60, line 55. I think the deepening of the active layer leading to better surface drainage and the formation of taliks could be a greater factor in pond reduction and disappearance. [APECS Group Review, Germany]	Taken into account: in response to comment 7972, we have added a citation which provides evidence for increased evaporation influencing pond levels. It is true that projected increases in precipitation could offset evaporative losses, but there is little observed evidence of Arctic precipitation increases at present.
13500	3	55	27	55	27	Add 'as' before ''ice-jam' [Debra Roberts and Durban Team, South Africa]	Accepted: text revised
5826	3	55	31	55	43	Walvoord & Kurlyk (2016), which is included in ref. list would also be relvant to this section. [Sharon Smith, Canada]	Accepted: citation added
17014	3	55	34	55	34	Are these trends over the whole 40-year period? [Markku Rummukainen, Sweden]	Yes, these are the trends for the entire record; Accepted: text revised
12624	3	55	46	55	47	Seems strange to talk rising air temperature being linked to water temperature - the relationship is the other way around. [Alexander Milner, UK]	Accepted: text revised for clarity
23846	3	55	46	55	50	Low agreement? Limited evidence? Make use of IPCC language [Hans-Otto Poertner and WGII TSU, Germany]	Accepted: text revised
5432	3	55	48	55	49	The sudden introduction of carbon cuts the flow of this section [Roderik Van De Wal, Netherlands]	Accepted: text removed

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
12618	3	55	53			Need to qualify this is air temperature and not water temperature - need to ensure this is consistent throughout the document. [Alexander Milner, UK]	Accepted: text revised for clarity
14314	3	55	53			Anthropogenically-driven [Christopher Fogwill, UK]	Accepted: text revised for clarity
17016	3	56	9	56	9	A 2006 reference feels a bit old in the context - would there be anything more recent? [Markku Rummukainen, Sweden]	Accepted: reference not essential and removed
20114	3	56	14	56	33	Please avoid making an acronym from evapotranspiration [Michelle A. North, South Africa]	Accepted: text revised
20116	3	56	15	56	15	The unit mm/y/y should rather be mm.y^-2 to be consistent with other parts of this chapter [Michelle A. North, South Africa]	Accepted: text revised
15422	3	56	17	56	18	We do not agree with lines 17-18, which state that "..because time series are not current (typically ending before 2010) and updated Arctic ET assessments are sparse." Suzuki et al. (2016) and Suzuki et al. (2018) demonstrated that summer warming in the pan-Arctic tundra region cause positive evapotranspiration trends in summer with decreasing terrestrial water storage. References: Suzuki, K., K. Matsuo, and T. Hiyama (2016), Satellite gravimetry-based analysis of terrestrial water storage and its relationship with run-off from the Lena River in eastern Siberia, International Journal of Remote Sensing, 37(10), 2198-2210, doi: 10.1080/01431161.2016.1165890. Suzuki, K., K. Matsuo, D. Yamazaki, K. Ichii, Y. Iijima, F. Papa, Y. Yanagi, and T. Hiyama (2018), Hydrological Variability and Changes in the Arctic Circumpolar Tundra and the Three Largest Pan-Arctic River Basins from 2002 to 2016, Remote Sensing, 10(3), 402, doi: 402 10.3390/rs10030402. [Kazuyoshi Suzuki, Japan]	Accepted: text revised and citation added
5828	3	56	22	56	33	Additional Canadian papers on landscape changes in permafrost regions (which can impact freshwater systems)and also impact of changes in vegetation include: Perrault, N., Levesque, E., Fortier, D., Gratton, D. and Lamarque, L.J., 2017. Remote sensing evaluation of High Arctic wetland depletion following permafrost disturbance by thermo-erosion gullying processes. Arctic Science, 3(2): 237-253. Rudy, A.C.A., Lamoureux, S.F., Kokelj, S.V., Smith, I.R. and England, J.H., 2017. Accelerating thermokarst transforms ice-cored terrain triggering a downstream cascade to the ocean. Geophysical Research Letters, 44: 11080–11087. Lantz, T.C., Marsh, P. and Kokelj, S.V., 2013. Recent shrub proliferation in the Mackenzie Delta uplands and microclimatic implications. Ecosystems, 16: 47-59. Segal, R.A., Lantz, T.C. and Kokelj, S.V., 2016. Acceleration of thaw slump activity in glaciated landscapes of the Western Canadian Arctic. Environmental Research Letters, 11(2016)034025. [Sharon Smith, Canada]	Accepted: literature reviewed and 1 citation added
10996	3	56	22	64	57	this should be in the summary. [Connie Lovejoy, Canada]	Rejected: page and line numbers not clear
7984	3	56	26	56	27	Added reference to this sentence: Walvoord and Kurylyk (2016) Hydrologic Impacts of Thawing Permafrost—A Review, DOI: 10.2136/vzj2016.01.0010 [APECS Group Review, Germany]	Accepted: text revised and reference added

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
20118	3	56	27	56	30	Please include "taliks" in the glossary and insert (see Glossary) here [Michelle A. North, South Africa]	Talik will be in glossary - confirmed with Chapter 2
20120	3	56	27	56	30	Please consider breaking this sentence into two, it is very long [Michelle A. North, South Africa]	Accepted: text revised
5830	3	56	35	56	35	"Permafrost" is sufficient so "ground' can be deleted as it is redundant. Permafrost is perennially frozen ground as mentioned in the introductory sentence. [Sharon Smith, Canada]	Accepted: text revised
5832	3	56	35			section 3.4.1.3 - There should be an introductory paragraph defining permafrost and its important characteristics including importance of ground ice. This can then be followed by a discussion on indicators of change and the impacts etc. in following sections. [Sharon Smith, Canada]	Noted-background material largely deleted and/or placed in glossary
7978	3	56	35	56	35	Sorry for being a bit picky here... As stated two lines below, permafrost is "perennially frozen ground...". So permafrost is frozen ground by definition. Then why add the word 'ground' in the title here, after permafrost? Stickly speaking, one could read 'perennially frozen ground ground'... Just 'Permafrost' (or 'Frozen ground') is enough for this title. Likewise, the title of sub-section 3.4.1.3.1 could be labelled 'Ground Temperature'. [APECS Group Review, Germany]	Accepted-text revised
23112	3	56	35			There is no paragraph on what's going on under the sea related to distrubances on frozen sea floor. This could be relatively sudden and important. It could impair shipping, mainly in swallow waters (Northen sea route). Even for authorities it's complicate to set up precise routes with incomplete and changing hydrographic charting. [Jacques Beall, France]	Accepted-text revised
5846	3	56	37			Section 3.4.1.3.1 - Is the Antarctic to be considered in this discussion? The latest BAMS State of Climate documents permafrost temperature and active layer in Antarctica (see section by Noetzli et al). SoC in 2016 is available and SoC in 2017 should be out in the next month or two. Even though the records are limited compared to those for the Arctic there should at least be a brief mention of this region. [Sharon Smith, Canada]	Accepted-text revised
5848	3	56	37			Section 3.4.1.3.1 including figure 3.13. The records presented appear to be from the 2017 Arctic Report Card, with the most recent data collected in 2016. However, the Arctic permafrost section (Romanovsky et al. in press) in the BAMS State of Climate in 2017 report will have updated records reflecting data collected in 2017. This report will be released in the next month or two so the graphs could be updated along with the summary in the text. [Sharon Smith, Canada]	Accepted-latest data provided by CA Romanovsky for text and figure
2340	3	56	38	57	2	Include that the permafrost line is migrating poleward. (Vaughan D. G., et al. (2013) CHAPTER 4: OBSERVATIONS: CRYOSPHERE, in IPCC (2013) CLIMATE CHANGE 2013: THE PHYSICAL SCIENCE BASIS, Working Group I Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change; World Bank & International Cryosphere Climate Initiative (ICCI) (2013) ON THIN ICE: HOW CUTTING POLLUTION CAN SLOW WARMING AND SAVE LIVES.) [Kristin Campbell, USA]	Accepted-new publications on permafrost extent are cited

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
2466	3	56	38	57	2	Include that the permafrost line is migrating poleward. (Vaughan D. G., et al. (2013) CHAPTER 4: OBSERVATIONS: CRYOSPHERE, in IPCC (2013) CLIMATE CHANGE 2013: THE PHYSICAL SCIENCE BASIS, Working Group I Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change; World Bank & International Cryosphere Climate Initiative (ICCI) (2013) ON THIN ICE: HOW CUTTING POLLUTION CAN SLOW WARMING AND SAVE LIVES.) [Durwood Zaelke, USA]	Accepted-new publications on permafrost extent are cited
12964	3	56	38	57	2	Include that the permafrost line is migrating poleward. (Vaughan D. G., et al. (2013) CHAPTER 4: OBSERVATIONS: CRYOSPHERE, in IPCC (2013) CLIMATE CHANGE 2013: THE PHYSICAL SCIENCE BASIS, Working Group I Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change; World Bank & International Cryosphere Climate Initiative (ICCI) (2013) ON THIN ICE: HOW CUTTING POLLUTION CAN SLOW WARMING AND SAVE LIVES.) [Gabrielle Dreyfus, USA]	Accepted-new publications on permafrost extent are cited
13502	3	56	38			Definitions like this should be given early in the report. Or perhaps refer to this section when first talking about permafrost. [Debra Roberts and Durban Team, South Africa]	Accepted-text revised
17018	3	56	39	56	39	What does "narrowly" imply here? [Markku Rummukainen, Sweden]	Accepted-text revised
19164	3	56	39			consider replacing "and some high altitude areas of Earth" by "and high mountains". This will be more consistent with chapter 2 [Goncalo Vieira, Portugal]	Accepted-text revised
6754	3	56	40	56	40	"at or below 0°C" and not just < 0°C (?) [Jan Hjort, Finland]	Accepted-text revised
7980	3	56	41	56	41	...at a depth where seasonal temperature variation is negligible...'. Shouldn't it rather be the 'depth of zero annual amplitude', mentioned in caption of Figure 3.13 (next page)? [APECS Group Review, Germany]	Accepted-text revised to eliminate technical terms in both places
5834	3	56	42	56	43	You should mention that active layer is the near surface layer above the permafrost. "Surface" active layer is not quite correct as this is a sub surface layer which can in some areas be a few metres thick. "Surface" implies this is a thin layer. [Sharon Smith, Canada]	Accepted-text revised
7986	3	56	42	56	42	I think it would be worthwhile adding why it is a good indicator of long-term climate change. [APECS Group Review, Germany]	Taken into account - space limitations prevent additional detail
5836	3	56	43	56	43	Delete "on permafrost" as it is the effects on active layer that are being recorded. [Sharon Smith, Canada]	Accepted-text revised
5838	3	56	44	56	47	We should not be highlighting only AK here as permafrost temperature has been increasing over the last 3 decades across the circumpolar regions, with record high temperatures being observed at many sites recently. [Sharon Smith, Canada]	Accepted-geographical extent of records is circumpolar
7988	3	56	44	56	44	"Continuing the trend from AR5", do you mean that the temperatures that have been recorded align with the trends predicted in the AR5? If so, it is not clear the way it is currently phrased. [APECS Group Review, Germany]	Accepted-text revised
3656	3	56	47			(high confidence)(AMAP, 2017b) - please insert hyphen between brackets [Angelika Brandt, Germany]	Editorial
5840	3	56	47	56	48	Regarding statement that at some sites temperatures are 2-3°C higher than 30 years. You probably should be more specific here and mention that this is primarily in colder permafrost of the higher latitudes as mentioned in the following sentence. [Sharon Smith, Canada]	Accepted-text revised
7982	3	56	47	56	47	Insert a space between '(high confidence)' and '(AMAP, 2017b)'. [APECS Group Review, Germany]	Editorial

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
5434	3	56	50	56	52	I think the link between a smaller increase in permafrost temperature in warmer sites and degrading of permafrost due to an increasing active layer thickness should shortly be explained. [Roderik Van De Wal, Netherlands]	Accepted-text revised
5842	3	56	50	56	52	There is a smaller change for warmer permafrost (especially if high ice/moisture content) because latent heat effects associated with phase change that occurs as temperatures approach 0°C (i.e. energy is going into melting of ground ice rather than raising the temperature) - see Romanovsky et al. 2010 (in ch ref list). This would be a clearer statement than what is there now. [Sharon Smith, Canada]	Accepted-text revised
3868	3	56	54	56	54	Briefly explain why mechanical probing underestimates degradation of surface permafrost. [Howard Epstein, USA]	Accepted-text revised
5844	3	56	54	57	2	The summary of active layer changes could be better presented. Also the comment regarding issues related to mechanical probing etc are partly related to it not capturing the actual amount of thaw that has occurred as settlement of the ground surface may occur - this should be mentioned in Steletskiy et al. For ice rich soils there may be very small increases in active layer thickness recorded because signifcant ground settlement accompanies thaw. Other references that comment on settlement include: Duchesne, C., Smith, S.L., Ednie, M. and Bonnaventure, P.P., 2015. Active layer variability and change in the Mackenzie Valley, Northwest Territories, GEOQuébec 2015 (68th Canadian Geotechnical Conference and 7th Canadian Conference on Permafrost). GEOQuébec 2015 Organizing Committee, Québec, pp. Paper 117. Duchesne, C., Smith, S., Ednie, M. and Chartrand, J., 2015. 20 years of active layer monitoring in the Mackenzie Valley, Northwest Territories Geological Survey of Canada, Scientific Presentation SP31.doi:10.4095/296513 Smith, S.L. et al., 2009. Data for Geological Survey of Canada active layer monitoring sites in the Mackenzie valley, N.W.T., Geological Survey of Canada Open File 6287. doi:10.4095/248197 [Sharon Smith, Canada]	Accepted-text revised; new citations considered and included where appropriate and space permitted
5130	3	56	55			Currently missing: work of, e.g., Gutt et al. on the effects of shelf-ice loss on BENTHIC communities (e.g., Gutt,et al. (2013). Shifts in Antarctic megabenthic structure after ice-shelf disintegration in the Larsen area east of the Antarctic Peninsula. Polar Biology, 36(6), 895–906. http://doi.org/10.1007/s00300-013-1315-7). At least one sentence should be added for comprehensiveness. [Dieter Piepenburg, Germany]	Line numbers entered by reviewer do not seem to correspond to permafrost issues
7990	3	56	55	57	2	Nothing on Eastern Canada? There is information about the active layer thickness in Smith et al. (2010, DOI: 10.1002/ppp.690) for the lower Eastern Canada. In addition, the Centre d'études nordiques operated by Laval University in Québec, Canada, has an extensive database (http://www.cen.ulaval.ca/nordicanad/en_liste.aspx) with borehole data going from lower Nunavik all the way up to Ellesmere Island. Many boreholes go several meters deep. They could also be used to identify active layer trends. [APECS Group Review, Germany]	Taken into account; geographical scope of data-For the most part the text relies on higher level synthesis and is not a review of individual site variables due to limited space

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12248	3	56	55	57	2	Add reference: Lund, M. 2018: Uncovering the unknown—climate interactions in a changing arctic tundra. Environmental Research Letters, 13, 061001, https://doi.org/10.1088/1748-9326/aac63f [Torben Christensen, Sweden]	Taken into account - For space reasons not all references could be cited if they duplicated others
12250	3	56	55	57	2	Increasing active layer thickness in northeast Greenland 1.6 cm yr-1 (Lund et al., 2014). Ref: Lund, M., B.U. Hansen, S.H. Pedersen, C. Stiegler and M.P. Tamstorf, 2014: Characteristics of summer-time energy exchange in a high Arctic tundra heath 2000-2010. Tellus B, 66, 21631, http://dx.doi.org/10.3402/tellusb.v66.21631 [Torben Christensen, Sweden]	Taken into account; geographical scope of data-For the most part the text relies on higher level synthesis and is not a review of individual site variables due to limited space
19168	3	56	58			Description of thermal state and characteristics of Antarctic permafrost is completely absent and this cannot be neglected. Antarctic permafrost is significant for terrestrial ecosystems, hydrology, nurient fluxes to the ocean, erosion, as well as to the stability of infrastructure in a region which has a special conservation status. I strongly reccommend including updated information on Antarctic permafrost. If necessary, I am happy to contribute. [Goncalo Vieira, Portugal]	Accepted-text revised
13300	3	57	4	57	12	Ideally all 4 panels should have the same axis scale, if possible. [Katherine Bishop-Williams, Canada]	Accepted-figure revised
20122	3	57	5	57	5	I would suggest removing the decimal places after all (or most) of the depth measurements - most of them are 0 and add clutter to the figures. [Michelle A. North, South Africa]	Accepted-figure revised
20124	3	57	5	57	5	Would it be possible to have all the graphs on the same y-axis scale to provide better comparison among sites? [Michelle A. North, South Africa]	Accepted-figure revised
20126	3	57	5	57	5	Could you please explain the choice of colours used for the graphs [Michelle A. North, South Africa]	Accepted-figure revised
2674	3	57	7	57	12	The relationship between the different sections in this chart is not well defined [Mohammad Javad Zareian, Iran]	Accepted-figure revised
2676	3	57	7	57	12	There is no explanation about the “discontinuous permafrost in Scandinavia” [Mohammad Javad Zareian, Iran]	Noted; text gives higher level overview with space limitations generally preventing an analysis of all regions individually
5854	3	57	15			Section 3.4.1.3.2 Some of the general information on ground ice should probably be included in an introduction to section 3.4.1.3 (see earlier comment) as this is an important factor that influences the impact of thawing permafrost with respect to ecosystems, infrastructure etc. Although ground ice is discussed in this section, is relevance to impacts is not really mentioned elsewhere in the discussion of changes in permafrost conditions. [Sharon Smith, Canada]	Accepted-text revised
15574	3	57	15	59	1	Better understanding of high ice permafrost is important to highlight; need for more studies of carbon and methane release is appropriately stressed. [Melinda Kimble, USA]	Noted
7992	3	57	16	57	16	Same as above: no need to put the word 'ground' after permafrost. Suggestion: "… distribution of ice within permafrost is controlled by…". [APECS Group Review, Germany]	Accepted-text revised
5850	3	57	19	57	19	Some of this massive ice is buried glacial ice rather than being formed after sediments deposited. The type of ice will therefore depend on the Quaternary (glacial) history of the region. [Sharon Smith, Canada]	Accepted-text revised
19166	3	57	21			Replace "high-ice permafrost" by "ice-rich permafrost", continuing to next line, ice-poor if more frequently called dry-permafrost, which is quite frequent in the Antarctic Dry Valleys [Goncalo Vieira, Portugal]	Accepted-text revised

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
5852	3	57	24	57	26	Note that these zones of ice content are from the Circumpolar Permafrost Map by (Brown et al. 1998). Zhang et al (2000) used these in estimating the area within each zone but did not do the categorization of ground ice content. [Sharon Smith, Canada]	Accepted-text revised
7996	3	57	24	57	24	Added reference to this sentence: Nelson et al. (2001, doi: 10.1038/35073746), Jorgenson et al. (2006, doi:10.1029/2005GL024960), Raynolds et al. (2014, doi: 10.1111/gcb.12500), Stephani et al. (2014, http://dx.doi.org/10.1016/j.coldregions.2013.12.006) [APECS Group Review, Germany]	Taken into account - For space reasons not all references could be cited if they duplicated others
17020	3	57	24	58	9	This seems a bit like text-book kind of text. Could it be deleted? [Markku Rummukainen, Sweden]	Accepted-text revised
7994	3	57	25	57	25	Some sites in the continuous permafrost zone were shown to have much higher ice content by volume than 20%. For example, in the Canadian Arctic (Bylot Island, Nunavut), values of up to 70-80% were measured (Fortier et al. 2006). So should we talk about 'very high' ice content here? Full citation: http://journals.sagepub.com/doi/abs/10.1191/0959683606hl960rp. Fortier D, Allard M, Pivot F (2006). A late-Holocene record of loess deposition in ice-wedge polygons reflecting wind activity and ground moisture conditions, Bylot Island, eastern Canadian Arctic. The Holocene, 16(5), 635-646, doi: 10.1191/0959683606hl960rp. [APECS Group Review, Germany]	Taken into account - For space reasons not all references could be cited if they duplicated others
7998	3	58	1	58	3	See comment just above (p57, L25). The eastern Canadian Arctic (Nunavut), although not in the Yedoma region, also includes sites with 50-80% ice content by volume. [APECS Group Review, Germany]	Accepted-text revised
5856	3	58	12	58	44	"Deep carbon" is not defined well in the text. I agree that carbon may be present to depths >1m or >3m in thick accumulation of peat for example, but it might be useful to give a better idea of the maximum depth that significant carbon may exist in permafrost affected sediments. [Sharon Smith, Canada]	Noted-text defines surface and deep carbon
3870	3	58	17	58	17	Unclear what is meant by the parenthetical "(yedoma / loess)" and yedoma neeeds to be defined. [Howard Epstein, USA]	Accepted-text revised
8000	3	58	20	58	23	This sentence seems to indicate that permafrost thaw will lead to the release of ALL carbon that is stored in permafrost, whereas in fact there is still a lot of uncertainty about this. Interactions with shifts in vegetation and hydrological conditions can significantly affect carbon release processes. The sentence should be tuned down, adding something like "rapidly decayed and transferred in part to the atmosphere". [APECS Group Review, Germany]	Accepted-text revised
2342	3	58	25	58	35	Furthermore, if 1% of the permafrost carbon emitted is methane, the rate of warming could be doubled. (World Bank & International Cryosphere Climate Initiative (ICCI) (2013) ON THIN ICE: HOW CUTTING POLLUTION CAN SLOW WARMING AND SAVE LIVES.) [Kristin Campbell, USA]	Noted-text on methane revised
2468	3	58	25	58	35	Furthermore, if 1% of the permafrost carbon emitted is methane, the rate of warming could be doubled. (World Bank & International Cryosphere Climate Initiative (ICCI) (2013) ON THIN ICE: HOW CUTTING POLLUTION CAN SLOW WARMING AND SAVE LIVES.) [Durwood Zaelke, USA]	Noted-text on methane revised

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
8002	3	58	25	58	31	There is medium confidence in the total organic soil carbon (1460 to 1600 Pg), but high confidence in the 3m-deep estimate. I understand that there is more uncertainty associated with deep-permafrost carbon (below 3m), but I find it unrealistically optimistic to have high confidence in the amount estimated in the first 3 meters. Despite the increasingly big database, estimates cover very large areas of permafrost and we know that there is very high spatial variability, even at the meter scale. I would suggest considering reducing the confidence level of those estimates because the datapoints are highly concentrated in certain areas and other areas are highly under-represented (e.g. the High Arctic). [APECS Group Review, Germany]	Noted; confidence language was evaluated and retained in current form
12966	3	58	25	58	35	Furthermore, if 1% of the permafrost carbon emitted is methane, the rate of warming could be doubled. (World Bank & International Cryosphere Climate Initiative (ICCI) (2013) ON THIN ICE: HOW CUTTING POLLUTION CAN SLOW WARMING AND SAVE LIVES.) [Gabrielle Dreyfus, USA]	Noted-text on methane revised
3872	3	58	26	58	29	Clarify the difference between the 1460-1600 Pg and the 1035 Pg. Does the first estimate include C deeper than 3m? [Howard Epstein, USA]	Accepted-text revised
5436	3	58	32	58	32	Even the unit equivalents were mentioned above it would be better to use Pg throughout the text to make it clearer [Roderik Van De Wal, Netherlands]	Accepted-text revised
8004	3	58	32	58	32	Change billon tons to Pg [APECS Group Review, Germany]	Accepted-text revised
17022	3	58	47	58	47	The text sounds like that there is low confidence on the poor quantification of these carbon pools. Is the meaning to state that confidence is low on the quantification of these carbon pools? [Markku Rummukainen, Sweden]	Noted; calibrated uncertainty language reports on the state of the scientific information, not the structure of the sentence
5438	3	58	48	58	48	Introduce the yedoma concept [Roderik Van De Wal, Netherlands]	Accepted-text revised
14316	3	58	57			modeling' not 'modelling' in US English [Christopher Fogwill, UK]	Editorial
5440	3	59	4	59	4	Maybe is better to introduce the paragraph saying that there are two types of drivers. (Press and pulse) [Roderik Van De Wal, Netherlands]	Accepted-text revised
5866	3	59	4			Section 3.4.1.3.4 - As well as climate and fire other drivers of change in permafrost conditions can be human impact. For example disturbance related to infrastructure construction and other activities - this includes vegetation clearing, disturbance or removal of organic layer etc. which can affect the ground thermal regime. Should this also be mentioned in this section? [Sharon Smith, Canada]	Rejected; this section was meant to be landscape-level (widespread) drivers of change but due to chapter formatting, the header does not contain that description, which excludes infrastructure impacts
8006	3	59	4	59	4	Same as above: please only use 'permafrost' or replace by 'frozen ground', not both. [APECS Group Review, Germany]	Accepted; text revised
19170	3	59	4	59	52	Information should be added on increased coastal erosion along permafrost coasts and its linkages to decreasing duration of sea-ice, warmer oceans and changes in storm regimes. These lead to fast changes and affect mass fluxes (e.g. carbon, nutrients, contaminants) from the terrestrial to the nearshore zone and are hence very significant drivers of change in permafrost [Goncalo Vieira, Portugal]	Noted; material along these lines are included in the cross-chapter box on low-lying islands and coasts and are not repeated here
5858	3	59	5	58	6	Revise both sentences: "Changes in air temperature and precipitation...." "Trends in air temperature and precipitation...." Since permafrost temperature is also discussed, the text should be clear that reference is being made to air temperature in these senteneces. [Sharon Smith, Canada]	Accepted-text revised

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
8010	3	59	5	59	14	LTER (2007) coined the terms pulse and press, but I believe that Grosse et al. (2011, doi:10.1029/2010JG001507) were the ones that introduced those terms to permafrost disturbances. I think there should be reference to their work in this first paragraph. [APECS Group Review, Germany]	Accepted-text revised
17024	3	59	6	59	8	The sentence "Trends in temperature…" could be deleted. It does not say very much. [Markku Rummukainen, Sweden]	Accepted-text revised
5860	3	59	8	59	8	Biskaborn et al. (2015) only discusses a data management system for borehole temperature and does not document permafrost temperature or its trends. A more appropriate reference would be Romanovsky et al. (2017, SWIPA report) as this does present permafrost temperature data and discusses links to climate. [Sharon Smith, Canada]	Text revised to clarify
428	3	59	13	59	13	This line is not clear. Consider revising. [George Burba, USA]	Accepted-text revised
8008	3	59	13	59	13	What do you mean by "characteristic permafrost"? Do you mean that the characteristics of permafrost are defined by the ecosystem and climate state? Maybe rephrase it or just change to "characteristics of permafrost". [APECS Group Review, Germany]	Accepted-text revised
430	3	59	21	59	21	"… limited to.." [George Burba, USA]	Accepted-text revised
432	3	59	23	59	23	"…Canada…" [George Burba, USA]	Accepted-text revised
8212	3	59	23	59	23	Change "western Canadian" to "western Canada". [Benoit Montpetit, Canada]	Accepted-text revised
5862	3	59	26	59	27	References for these statements regarding area burned in 2014 and 2015? (refs provided are for the annual average rather than area burned during the years mentioned). Also "northwestern Canada" is probably a better description of the area. [Sharon Smith, Canada]	Accepted-citations updated
10710	3	59	26	59	30	Please add information about catastrophic boreal fiers in Russia in 2010. [Oxana Lipka, Russian Federation]	Rejected-some limited information showed that economic losses of 2010 fires were substantial but this did not correspond with a large area burned, which is the subject of this section
17026	3	59	26	59	28	The text quotes events in 2014-2015, but the references are older (2010-2013). What is the source of the more recent information? [Markku Rummukainen, Sweden]	Accepted-citations updated
5442	3	59	32	59	32	It would be useful to say what is the historic succesional cycle [Roderik Van De Wal, Netherlands]	Noted-text revised where space permitted
5864	3	59	35	59	52	You should probably mention that the susceptible areas are those underlain by ice rich permafrost. Also is it always the thaw that is abrupt or the impact that occurs. Warming and thawing of permafrost may occur gradually but the impact or failure may occur quickly (or an aburpt failure that might be due to wet conditions and then leads to thaw and further failure). [Sharon Smith, Canada]	Noted-text revised where space permitted
8012	3	59	35	59	35	Added reference to this sentence: Saito et al. (2013, doi:10.1890/11-1062.1) and references therein. [APECS Group Review, Germany]	Rejected-citation was not added due to space limitations and that it did not add new information that was not already cited elsewhere
8014	3	59	36	59	37	Added reference to this sentence: Kurylyk et al. (2014, https://doi.org/10.1016/j.earscirev.2014.06.006) [APECS Group Review, Germany]	Rejected-citation was not added due to space limitations and that it did not add new information that was not already cited elsewhere
3874	3	59	41	59	41	Change "affects" to "affect" [Howard Epstein, USA]	Accepted-text revised
434	3	59	44	59	44	"…because of the rapid changes in these locations…" [George Burba, USA]	Accepted-text revised
13504	3	59	45			Why is this figure given as 3.6x106? [Debra Roberts and Durban Team, South Africa]	Accepted-text revised
20128	3	59	45	59	45	There is a typo in the value here - I think it should contain a superscript (i.e., 3.6 x 10^6 km^2 rather than 3.6 x 106 km^2, as it is currently) [Michelle A. North, South Africa]	Accepted-text revised
2344	3	59	51	59	51	TYPO: two “the”s in a row. [Kristin Campbell, USA]	Accepted-text revised

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
2470	3	59	51	59	51	TYPO: two “the”s in a row. [Durwood Zaelke, USA]	Accepted-text revised
12968	3	59	51	59	51	TYPO: two “the”s in a row. [Gabrielle Dreyfus, USA]	Accepted-text revised
13506	3	59	51	59	52	This sentence is not clear. The same processes and features that leads to abrupt thaw, also lead to storage of carbon? Can this be deduced just because 20% of area contains 31% of shallow and 50% of deep carbon? Or is there other evidence for this? [Debra Roberts and Durban Team, South Africa]	Accepted-text revised
20130	3	60	0			SCD, RCP, CMIP5, SCE, SWE, SWEmax… This section contains excessive use of acronyms, most of which were introduced in previous sections, and at the very least need to be re-introduced at the beginning of this section, if not eradicated entirely. [Michelle A. North, South Africa]	Accepted: text revised and acronyms removed
20132	3	60	8	60	8	Surely a negative reduction = an increase? Consider whether you mean 15-25% reduction, or if you want to say a change of -15 to - 25% [Michelle A. North, South Africa]	Accepted: text revised
17028	3	60	10	60	12	Should be made clear over which time horisons such cooling trends extend may extend (decadal? Longer? End-of-century?), for clarity. [Markku Rummukainen, Sweden]	This text no longer appears
17030	3	60	14	60	19	It does not seem to be mentioned what actually is projected for SCE, only about the projections being underestimates. [Markku Rummukainen, Sweden]	Accepted: text revised. This sentence refers to CMIP5 model performance during the historical period. Paragraphs have been shifted for improved flow and clarity.
20134	3	60	14	60	14	If you wrote the acronym out into it's composite words, you would realize that it is not appropriate to refer to "historically observed spring SCE reductions" (i.e., historically observed spring snow cover extent reductions). It would be better English to say something like: "…CMIP5 models underestimate the historic reductions in observed spring snow cover extent…" or similar [Michelle A. North, South Africa]	Accepted: text revised
8016	3	60	21	60	21	It is still unclear to me what is SWEmax, so I'm having a hard time understanding the projections. [APECS Group Review, Germany]	Accepted: text revised
20136	3	60	22	60	24	As with the previous comment, this should be written "projected increases in SWEmax" if you insist upon using the acronym [Michelle A. North, South Africa]	Accepted: text revised and acronyms removed
8214	3	60	36	60	38	Though this statement is true I would add that physical modeling with remotely sensed data assimilation as well as climate forcing (Côté et al., 2017) is needed to monitor the changes in snow properties. One recent paper that tried data assimilation of remotely sensed data in a physical model is Sandells et al. (2017) and a paper that proved remotely sensed data can detect changes in the snowpack is Montpetit et al. (2013). "Côté K., Madore J.-B. and Langlois A. 2017. Uncertainties in the SNOWPACK multilayer snow model for Canadian Avalanche context: sensitivity to climate forcing data, Physical Geography, vol. 38 (2), pp. 124-142." ; "Sandells M., Essery R., Rutter N., Wake L., Leppänen L., Lemmetyinen J. 2017. Microstructure representation of snow in coupled snowpack and microwave emission model, The Cryosphere, vol. 11 (1), pp. 229-246." ; "Montpetit B., Royer A., Roy A., Langlois A. and Derksen C. 2013. Snow microwave emission modeling of ice lenses within a snowpack using the microwave emission model for layered snowpacks, IEEE Transactions on Geoscience and Remote Sensing, vol. 51 (9), pp. 4705-4717." [Benoit Montpetit, Canada]	Rejected: interesting papers but not relevant to climate model projections.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
17032	3	60	45	60	47	It does not seem to be mentioned what actually is projected for relative humidity. [Markku Rummukainen, Sweden]	Accepted: text revised
1860	3	60	53	60	53	the statement that "occurrences of rain on snow events are expected to increase" is in direct conflict with another on pg. 56 about there being no significant trends in rain on snow events (with high confidence). The text should either be harmonized or a statement added about the lack of consensus on this topic. [Aku Riihelä, Finland]	Rejected: text on page 56 refers to historical period, for which there is no observed increase in rain on snow events. This sentence refers to a study which focused on projected changes in rain on snow events.
20138	3	60	53	60	53	"…rain-on-snow events are expected to increase…" - this directly contradicts the statement on page 56, lines 10-12. [Michelle A. North, South Africa]	See 1860
436	3	60	55	60	55	Was abbreviation "P-E" explained before? [George Burba, USA]	Accepted: text revised; acronym removed
17034	3	60	55	60	55	Is the P/E ratio meant? [Markku Rummukainen, Sweden]	Accepted: text revised; acronym removed
20140	3	60	55	60	55	Please explain P-E [Michelle A. North, South Africa]	Accepted: text revised; acronym removed
17036	3	60	56	60	56	What is the corresponding forcing scenario/ global warming /RCP? [Markku Rummukainen, Sweden]	Accepted: text revised to state RCP4.5
20142	3	61	1	61	1	"1 degree warmer" - what units? F, C or K? [Michelle A. North, South Africa]	Accepted: text revised
5868	3	61	18	61	18	Poor title for section. This section considers changes in permafrost including climate change in general not just fire. The sub-title should just be "Permafrost" similar to the titles for other sections with in 3.4.2. [Sharon Smith, Canada]	Accepted-text revised
13508	3	61	18			This topic has already been partially discussed in the section on Permafrost. Here we also find definitions for terms used before. A table showing predicted changes to different aspects (such as permafrost, snow cover extent and duration, etc) under different models would be helpful. [Debra Roberts and Durban Team, South Africa]	Accepted; text revised.The headers need to be clear that this section is modeling and the previous section was observations
5870	3	61	20	61	37	Statements in this section are misleading. In this section you need to be clear that you are not referring to complete permafrost loss as these models (to my knowledge) only consider the upper few metres of the ground (3 m? - the so called near-surface permafrost extent that is not defined). Permafrost cand be 10s to 100s of meters thick and these estimates of area do not refer to complete loss of permafrost. Better terminology could be used and instead of refering to areal extent of permafrost decreasing you could refer to increases in thaw depth to greater than 3m over significant areas OR refer to permafrost being in a degrading state over large areas. Many of models referenced are related to projects interested in carbon feedbacks so only consider the upper few metres. Just because those studying carbon budgets are not concerned with deeper permafrost that doesn't mean that it isn't important (e.g. engineers, hydrologists and hydrogeoligists etc. are interested in the deeper permafrost conditions). [Sharon Smith, Canada]	Accepted-text revised
3876	3	61	21	61	21	For readers unfamilar with what a talik is, this sentence might be somewhat misleading as it is only one tallik-forming scenario - potentially change to "forming a perrenially unfrozen layer, which is called a talik" [Howard Epstein, USA]	Accepted-text revised
5444	3	61	21	61	23	The formation of a layer called a talik is explained here. In the rest of the section, taliks are not further mentioned. It would make more sense to either not mention taliks at all, or also discuss changes in the amount of taliks in this section. [Roderik Van De Wal, Netherlands]	Accepted-text revised

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
3878	3	61	26	61	26	Add "a" after "caused by" [Howard Epstein, USA]	Accepted-text revised
8020	3	61	28	61	30	What is meant by reduction in near-surface permafrost extent? Is it that the active layer is deeper? Or is there complete loss of permafrost when permafrost does not go deep? [APECS Group Review, Germany]	Accepted-near surface permafrost added to glossary
20144	3	61	28	61	29	There is a problem with these two sentences, I think something has been omitted [Michelle A. North, South Africa]	Accepted-text revised
3880	3	61	29	61	29	Sentence seems to be lacking a beginning. [Howard Epstein, USA]	Accepted-text revised
5446	3	61	30	61	30	Values were given above in percentage, these should also be in percentage to allow for direct comparisson [Roderik Van De Wal, Netherlands]	Text revised so that actual numbers and percentages can be compared
8022	3	61	30	61	33	Will there be loss of continuous permafrost, or just discontinuous and sporadic permafrost? [APECS Group Review, Germany]	Accepted-text revised
3882	3	61	32	61	32	Remove one "around" [Howard Epstein, USA]	Accepted-text revised
3884	3	61	32	61	33	"Northern" should be lower case in both instances. [Howard Epstein, USA]	Accepted-text revised
11970	3	61	33	61	37	I draw the chapter authors to recent literature on changes in permafrost area from permafrost thaw: (1) Chadburn et al., 2017: An observation-based constraint on permafrost loss as a function of global warming, Nature Climate Change, 7, 340, doi: 10.1038/NCLIMATE3262; (2) Burke et al., 2018: CO2 loss by permafrost thawing implies additional emissions reductions to limit warming to 1.5 or 2◦C, Env. Res. Lett., 13, 024024, https://doi.org/10.1088/1748-9326/aaa138; (3) Comyn-Platt et al., 2018: Carbon budgets for 1.5 and 2 °C targets lowered by natural wetland and permafrost feedbacks, Nature Geoscience, in press, doi: 10.1038/s41561-018-0174-9. The first paper describes an observation-based constraint on permafrost loss. The other two papers include modelled estimates of future permafrost areas. [Garry Hayman, UK]	Noted; citations added where space and content permitted
438	3	61	35	61	37	The last sentence in the paragraph clerly has zero confidence regarding 2300 events. It also may make the report appear very unreliable to a casual reader. Consider removing this sentence entirely. [George Burba, USA]	Rejected-long-term model projections have learning value
8018	3	61	35	61	35	Insert a space between '(13.1-19.3 million km2)' and '(McGuire et al., 2016)'. [APECS Group Review, Germany]	Editorial
5874	3	61	39	61	40	Thaw can also be gradual following a fire. The impact of fire on ground thermal regime depends on severity of fire and in particular damage to the organic layer (see for example Smith et al. 2015; Fisher et al. 2016). References: Smith, S.L., Riseborough, D.W. and Bonnaventure, P.P., 2015. Eighteen year record of forest fire effects on ground thermal regimes and permafrost in the central Mackenzie Valley, NWT, Canada. Permafrost and Periglacial Processes, 26(4): 289-303. Fisher, J.P. et al., 2016. The influence of vegetation and soil characteristics on active-layer thickness of permafrost soils in boreal forest. Global Change Biology, 22: 3127-3140. [Sharon Smith, Canada]	Noted; citations added where space and content permitted

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
15580	3	61	39	61	56	There is no mention of Siberian fire regimes, yet there are large areas of boreal forest underlain by permafrost with as least as much area burned as N. America. This seems like a large and important source of uncertainty worth mentioning (e.g; Loranty, M. M., Liberman-Cribbin, W., Berner, L. T., Natali, S. M., Goetz, S. J., Alexander, H. D., & Kholodov, A. L. (2016). Spatial variation in vegetation productivity trends, fire disturbance, and soil carbon across arctic-boreal permafrost ecosystems. Environmental Research Letters, 11(9), 1–13. http://doi.org/10.1088/1748-9326/11/9/095008) [Michael Loranty, USA]	Eurasian fires, including Siberia are mentioned, but much more detail is recorded for N America in the case of fires on permafrost ground
5872	3	61	40	61	40	Delete "ground" after "permafrost" as it is redundant (permafrost refers to frozen ground) [Sharon Smith, Canada]	Accepted-text revised
20146	3	61	43	61	44	The fires in British Columbia (Canada) in the summer of 2017 were the worst they've had in history, consider adding that year to your list of record years [Michelle A. North, South Africa]	Rejected-these fires were largely outside of the spatial domain considered by the chapter
3886	3	61	51	61	51	Change "increases" to "increase" [Howard Epstein, USA]	Accepted-text revised
20148	3	61	52	61	52	Please add "graminoid" to the glossary [Michelle A. North, South Africa]	Accepted-text revised
11972	3	62	1	63	35	I draw the chapter authors to recent literature on carbon feedbacks from permafrost thaw: (1) Burke et al., 2018: CO2 loss by permafrost thawing implies additional emissions reductions to limit warming to 1.5 or 2◦C, Env. Res. Lett., 13, 024024, https://doi.org/10.1088/1748-9326/aaa138; (2) Comyn-Platt et al., 2018: Carbon budgets for 1.5 and 2 °C targets lowered by natural wetland and permafrost feedbacks, Nature Geoscience, in press, doi: 10.1038/s41561-018-0174-9. The papers describe the impact of the carbon releases from permafrost thaw on the allowable anthropogenic carbon budgets to meet warming targets of 1.5 or 2◦C. In the first paper, the IMOGEN climate emulator used pattern scaling of 22 CMIP3 GCMs. In the second paper, IMOGEN was updated to use 34 GCMs from CMIP5 and inverted to follow prescribed temperature pathways. [Garry Hayman, UK]	Noted; citations added where space and content permitted
12268	3	62	3			Section 3.4.3.1 in general is extremely biased towards recent US based studies. It seems as if it could be taken out of an IPCC for the US (not even North America as Canadian studies are also largely ignored). This problem is extreme in the case of subsection 3.4.3.1.1 where, except for a few general synthesis works, not a single study based outside the US is cited. A major revision is needed to get this balance corrected. The time passed away decades ago where Alaska represented the place where almost all arctic feedback oriented terrestrial ecosystem research were conducted. Some of what this reviewer includes as comments can help but it is certainly not enough for this document to claim being a truly circumpolar authoritative review. [Torben Christensen, Sweden]	Accepted; the geographical scope of the chapter is circumpolar and literature was revised to better account for studies in multiple regions. Due to extreme space constraints, a full region by region analysis is outside the scope of this topic.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
12270	3	62	5			Along the lines of the comment above unbiased and fully IPCC citeable recent highly relevant assessment work for section 3.4.3.1.1 include the following and references therein: Christensen, TR, Rysgaard, S, Bendtsen, J, Glud, RN, Else, B, van Huissteden, K, Parmentier, F-JW, Sachs, T & Vonk, JE 2017, Arctic carbon Cycling. in: Snow, Water, Ice and Permafrost in the Arctic. AMAP Technical Report. [Torben Christensen, Sweden]	Accepted: Primary references within this report are cited here where appropriate
17040	3	62	5	64	37	Possible additional references for this section (highlight changing regional forcing, carbon cycle and methane, vegetation-temperature change feedback): (1) Zhang et al. (2013) ERL 8, 034023, (2) Zhang et al. (2014) Biogeosciences 11, 5503-5519. [Markku Rummukainen, Sweden]	Noted; citations added where space and content permitted
2346	3	62	6	62	25	Arctic could become a carbon source as early as the mid-2020s. (Schaefer K., et al. (2011) Amount and timing of permafrost carbon release in response to climate warming, TELLUS SERIES B CHEMICAL & PHYSICAL METEOROLOGY 63(2):165–180.) [Kristin Campbell, USA]	Already cited this in the next paragraph
2472	3	62	6	62	25	Arctic could become a carbon source as early as the mid-2020s. (Schaefer K., et al. (2011) Amount and timing of permafrost carbon release in response to climate warming, TELLUS SERIES B CHEMICAL & PHYSICAL METEOROLOGY 63(2):165–180.) [Durwood Zaelke, USA]	Already cited this in the next paragraph
12970	3	62	6	62	25	Arctic could become a carbon source as early as the mid-2020s. (Schaefer K., et al. (2011) Amount and timing of permafrost carbon release in response to climate warming, TELLUS SERIES B CHEMICAL & PHYSICAL METEOROLOGY 63(2):165–180.) [Gabrielle Dreyfus, USA]	Already cited this in the next paragraph
13510	3	62	6	62	6	Change 'a' to 'as' before 'feedback' [Debra Roberts and Durban Team, South Africa]	Accepted-text revised
3888	3	62	10	62	11	This sentence might need to be split into two sentences to explain what is meant by the "divergent" evidence. The way it reads now, the sentence is unclear. [Howard Epstein, USA]	Accepted-text revised
12252	3	62	13			Add reference Lopez-Blanco et al. 2018 ESD (in review). Ref: Lopez-Blanco, E. et al. 2018: Evaluation of terrestrial pan-Arctic carbon cycling using a data-assimilation system. Earth System Dynamics, in review. https://doi.org/10.5194/esd-2018-19 [Torben Christensen, Sweden]	Noted; citations added where space and content permitted
2606	3	62	16	62	18	This sentence is incomplete. There is at least one word missing. [Patrik Winiger, Netherlands]	Accepted-text revised
3890	3	62	16	62	16	Add "during the" before "non-summer season" [Howard Epstein, USA]	Accepted-text revised
8030	3	62	16	62	18	E1a: " The discrepancy may be a result of CO2 release rates during the non-summer season that are now thought to be higher than previously estimated (high confidence) (Webb et al., 2016), or the separation of upland and wetland ecosystems types that can differ in carbon sink/source strength." [APECS Group Review, Germany]	Noted

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
12254	3	62	16			Change "… Ueyama et al., 2013)." To "… Ueyama et al., 2013), possibly as a response to arctic greening as gross primary production has been found to scale with vegetation density (Lund et al., 2010; Mbufong et al., 2014)". Refs: Lund, M. et al. 2010: Variability in exchange of CO2 across 12 northern peatland and tundra sites. Global Change Biology, 16, 2436–2448, doi: 10.1111/j.1365-2486.2009.02104.x; Mbufong, H.N. et al. 2014: Assessing the spatial variability in peak season CO2 exchange characteristics across the Arctic tundra using a light response curve parameterization. Biogeosciences, 11, 4897-4912, oi:10.5194/bg-11-4897-2014 [Torben Christensen, Sweden]	Accepted; citations added where space and content permitted
8024	3	62	18	62	18	Please provide the reference for the separation of upland and wetland ecosystem types being responsible for current discrepancy in annual CO2 estimations [APECS Group Review, Germany]	Accepted; citations added
5876	3	62	22	62	25	How representative are the Alaska results of the entire circumpolar region, particularly of the large region above treeline with much different terrain and vegetation conditions. [Sharon Smith, Canada]	Noted-text revised for clarity
14318	3	62	23	62	25	How realistic/useful an estimate is this? [Christopher Fogwill, UK]	Noted-this helps to compare to circumpolar numbers. Text revised for clarity
8026	3	62	24	62	25	In order to clearly show that this region-wide net C source estimate is from CO2 emissions only (not including CH4), I suggest using the designation "0.3 Pg CO2-C" instead of "0.3 Pg C". [APECS Group Review, Germany]	Accepted-text revised
15576	3	62	27	63	26	Focus on CH4 fluxes in permafrost is important and discussion is well-balanced. We need better understanding of how much is released and how to control these releases. [Melinda Kimble, USA]	Noted
3658	3	62	28			(high confidence)(Schuur et al. 2018 - please insert hyphen between brackets [Angelika Brandt, Germany]	Editorial
3892	3	62	28	62	28	"the" before "Carbon"? [Howard Epstein, USA]	Accepted-text revised
3894	3	62	29	62	29	Change "an" to "a" [Howard Epstein, USA]	Accepted-text revised
3660	3	62	32			(RCP8.5)(Schädel - please insert hyphen between brackets [Angelika Brandt, Germany]	Editorial
17038	3	62	35	62	35	"high emission" or "non-mitigation" [climate warming trajectory] is probably a better term here than "current climate warming" [Markku Rummukainen, Sweden]	Editorial
8028	3	62	44	62	44	The contents in the parentheses here could include slightly more detail. For example: "… (through enhanced soil nutrient availability, a warmer and/or longer growing season, CO2 fertilization) [APECS Group Review, Germany]	Rejected-space constraints relative to information gain
12272	3	62	52	63	9	A lot of references and chapters specifically targetting the discrepancy mentioned in this section is included in AMAP Assessment 2015: Methane as an Arctic climate forcer. Arctic Monitoring and Assessment Programme (AMAP), Oslo, Norway (2015). [Torben Christensen, Sweden]	Noted-more recent citations were added to this section
440	3	62	53	62	53	It may be vbest to remove word "direct" from this line. There were no flux stations or chamber measurements there till probably mid 1990s. [George Burba, USA]	Rejected-the word direct makes the same point as the review comment
2608	3	63	3	63	6	This sentence is incomplete. There is at least one word missing. [Patrik Winiger, Netherlands]	Accepted-text revised
442	3	63	5	63	5	"…emissions which can be >50%…" [George Burba, USA]	Accepted-text revised
3896	3	63	5	63	5	Add "that" after "emissions" [Howard Epstein, USA]	Accepted-text revised

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
936	3	63	12			The text even goes so far as to say that model estimates of methane fluxes are small, when recent satellite maps of Arctic and near-Arctic methane concentrations so huge concentrations. When models conflict with observations, results from the models should be discounted. [William Clarke, Australia]	Noted-models and observations (and other assessment tools) are considered together
3738	3	63	12	63	12	explain what GWP acronym stands for [Petteri Uotila, Finland]	Accepted-text revised
20150	3	63	12	63	12	What is GWP? Please introduce acronyms at first use [Michelle A. North, South Africa]	Accepted-text revised
3898	3	63	14	63	14	Change "to" to "as a result of" [Howard Epstein, USA]	Accepted-text revised
444	3	63	24	63	24	"…CH4 fluxes can cause…" [George Burba, USA]	Accepted-text revised
2610	3	63	24	63	25	This sentence is incomplete. There is at least one word missing. [Patrik Winiger, Netherlands]	Accepted-text revised
3900	3	63	24	63	24	Remove "in" after "fluxes" [Howard Epstein, USA]	Accepted-text revised
5448	3	63	24	63	24	In the sentence "CH4 fluxes in can cause up to 40%" the word in should be deleted [Roderik Van De Wal, Netherlands]	Accepted-text revised
940	3	63	25	26		This sentence "Similarly, no global models currently consider the effects of warming on CH4 emissions from 26 coastal and ocean shelf systems in the Arctic." should be a red light to the authors of Chapter 5 to employ other systems-based or expert assessment methods of forecasting here - and preferably not those who have been proven wildly optimistic or complacent in the past. [William Clarke, Australia]	Noted-other forecasting methods are also considered in the text
12670	3	63	26	63	30	The title and part of the y-label of Figure 3.14 has been cut off - is this accidental? [Gillian Young, UK]	Accepted-figure revised
446	3	63	28	63	29	The top of Figure 3.14 is cut off, so units and title are not visible [George Burba, USA]	Accepted-figure revised
448	3	63	28	63	29	If there are any experimenatl data (such as tower flux measurements or chamber measurements) to show here, in addition to estimates, this would be very valubalke and much more convincing to a reader. [George Burba, USA]	Rejected-this is a modeling projection figure
20152	3	63	29	63	29	Figure 3.14 is partially cut off and the blurry text at the bottom indicating the sources of the data is not necessary, since this information is also presented in the Figure caption. [Michelle A. North, South Africa]	Accepted-figure revised
23848	3	63	29	63	29	I would exclude the references in the figure. They are repeated in the figure caption, and like this, it looks quite crowded [Hans-Otto Poertner and WGII TSU, Germany]	Accepted-figure revised

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
15530	3	64	1	64	37	This section needs to have significant material added regarding the longwave energy budget and its imporance to polar regions. Well-known effects such as the increase in atmospheric opacity due to rising water vapor need to be mentioned. Also, a number of recent papers have demonstrated insufficiency in the representation of basic radiation physics in model parameterized radiative transfer: models assume no longwave scattering and ideal surface emissivity. These assumptions lead to biases of several W/m2 and can easily explain modeledwintertime cold-pole biases relative to observations (see Feldman et al, 2014, doi:10.1073/pnas.1413640111; Kuo et al, 2017, doi:10.1002/2017JD027595; Kuo et al, 2017, doi:10.1002/2017MS001117; Huang et al, 2018, doi:10.1175/JCLI-D-17-0125.1) Furthermore, the sole emphasis on shortwave radiative processes ignores the fact that model biases are largest in polar night and therefore cannot possibly be directly related shortwave radiation. [Daniel Feldman, USA]	Taken into account: statement on the importance of the longwave energy budget added to section; discussion of model biases is out of scope for this section. Huang et al citation added.
14320	3	64	2			Warming-induced (hyphen needed) and 'lower' not 'lowers' [Christopher Fogwill, UK]	Accepted: text revised
21100	3	64	2	64	37	Consider insert Kylling et al., 2018; and Wittmann et al., 2017; Kylling A., Groot Zwaaftink, C. D., Stohl, A., 2018. Mineral dust instantaneous radiative forcing in the Arctic. Geophysical Research Letters, 45. doi: 10.1029/2018GL077346. and Wittmann M., Groot Zwaaftink, C. D., Steffensen Schmidt, L., Guðmundsson, S., Pálsson, F., Arnalds, O., Björnsson, H., Thorsteinsson, T., and Stohl, A., 2017. Impact of dust deposition on the albedo of Vatnajökull ice cap, Iceland, The Cryosphere, 11, 741-754. [Pavla Dagsson Waldhauserova, Iceland]	Accepted: text revised and Kylling et al citation added
2612	3	64	3	64	5	"The corresponding increase in net radiation..." . Net radiation does not increase, unless cloud cover changes. Suggestion, change sentence to: "The corresponding increase in net radiation absorption..." [Patrik Winiger, Netherlands]	Accepted: text revised
20154	3	64	3	64	4	Is it correct to say "increase in net radiation" here? Isn't there a decrease in radiation as a result of reduced snow cover? Just check that this sentence is correct [Michelle A. North, South Africa]	See 2612
450	3	64	4	64	4	Consider removeing word "small". We do not know this. [George Burba, USA]	Accepted: text revised
12256	3	64	5			Add reference (Stiegler et al., 2016). Ref: Stiegler, C. M Johansson, T.R. Christensen, M Mastepanov, A Lindroth. 2016. Tundra permafrost thaw causes significant shifts in energy partitioning. Tellus B 68. [Torben Christensen, Sweden]	Rejected: this sentence refers to albedo change from snow to snow-free surface which is not a focus of this paper.
20156	3	64	7	64	14	The acronyms TOA, SSRE, NH are unnecessary and overly complicate the paragraph; also, NH has not been introduced [Michelle A. North, South Africa]	Accepted: text revised
12258	3	64	17			Change "… influenced by vegetation (Loranty et al., 2014)." To "… influenced by vegetation and permafrost (Loranty et al., 2014; Lund et al., 2014)." Ref: Lund, M., B.U. Hansen, S.H. Pedersen, C. Stiegler and M.P. Tamstorf, 2014: Characteristics of summer-time energy exchange in a high Arctic tundra heath 2000-2010. Tellus B, 66, 21631, http://dx.doi.org/10.3402/tellusb.v66.21631 [Torben Christensen, Sweden]	Accepted: citation added as part of the response to 12260
14322	3	64	19	64	22	Semicolons not commas between list items [Christopher Fogwill, UK]	Accepted: text revised

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
12260	3	64	23			After ”(Fisher et al., 2016).”, add ”Since permafrost is a heat sink, decreasing permafrost extent and increasing permafrost temperature and active layer thickness (see Section 3.4.1.3) will increase surface temperature and turbulent heat fluxes (Lund et al., 2014; Lund et al., 2017).” Ref: Lund, M., B.U. Hansen, S.H. Pedersen, C. Stiegler and M.P. Tamstorf, 2014: Characteristics of summer-time energy exchange in a high Arctic tundra heath 2000-2010. Tellus B, 66, 21631, http://dx.doi.org/10.3402/tellusb.v66.21631; Lund, M., C. Stiegler, J. Abermann, M. Citterio, B.U. Hansen and D. van As, 2017: Spatiotemporal variability in surface energy balance across tundra, snow and ice in Greenland. Ambio, 46, 81-93, DOI 10.1007/s13280-016-0867-5 [Torben Christensen, Sweden]	Accepted: text revised and citation added
2348	3	64	25	64	37	While deposition of impurities (like black carbon) have been decreasing over Greenland, current melting is exposing previously deposited impurities that are contributing to further melting. (Tedesco M., et al. (2016) The darkening of the Greenland ice sheet: trends, drivers, and projections (1981–2100), THE CRYOSPHERE 10:477–496; Tedesco M., et al. (2016) The darkening of the Greenland ice sheet: trends, drivers, and projections (1981–2100), THE CRYOSPHERE 10:477–496.) [Kristin Campbell, USA]	Rejected: citation refers to the Greenland ice sheet; not appropriate for this section
2474	3	64	25	64	37	While deposition of impurities (like black carbon) have been decreasing over Greenland, current melting is exposing previously deposited impurities that are contributing to further melting. (Tedesco M., et al. (2016) The darkening of the Greenland ice sheet: trends, drivers, and projections (1981–2100), THE CRYOSPHERE 10:477–496; Tedesco M., et al. (2016) The darkening of the Greenland ice sheet: trends, drivers, and projections (1981–2100), THE CRYOSPHERE 10:477–496.) [Durwood Zaelke, USA]	See 2348
5450	3	64	25	64	26	It is not clear to me why black carbon and other light absorbing impurities are only important on seasonal snow. It would be good to explain the difference between the forcing of deposition on seasonal snow and depostion on an always snow-covered area. [Roderik Van De Wal, Netherlands]	Taken into account: BC paragraph moved to the snow drivers section (3.4.1.1.3) so it is now more clearly associated with seasonal snow, not the cryosphere in broader terms. Discussion of BC effects on land ice, sea ice, etc is appropriate for those specific sections.
8034	3	64	25	64	37	This paragraph on black carbon effects on snow albedo should also mention the bio-albedo effect from algae blooms in snow. Snow algae are found ubiquitously across the Arctic, and algae growing in snow during the spring melt period can decrease snow albedo by 13%. This albedo effect is likely to become an increasingly greater issue as the climate warms further and algae grow faster (Lutz et al. 2016). Reference: The biogeography of red snow microbiomes and their role in melting arctic glaciers. Stefanie Lutz, Alexandre M. Anesio, Rob Raiswell, Arwyn Edwards, Rob J. Newton, Fiona Gill & Liane G. Benning. Nature Communications volume 7, Article number: 11968 (2016) [APECS Group Review, Germany]	Rejected: the suggested citation is focused on land ice not seasonal snow.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
12972	3	64	25	64	37	While deposition of impurities (like black carbon) have been decreasing over Greenland, current melting is exposing previously deposited impurities that are contributing to further melting. (Tedesco M., et al. (2016) The darkening of the Greenland ice sheet: trends, drivers, and projections (1981–2100), THE CRYOSPHERE 10:477–496; Tedesco M., et al. (2016) The darkening of the Greenland ice sheet: trends, drivers, and projections (1981–2100), THE CRYOSPHERE 10:477–496.) [Gabrielle Dreyfus, USA]	See 2348
1306	3	64	26	64	26	The key point is that this forcing varies strongly at local-regional scales, is declining since ~1980, and is projected to decline further in the future. The other key point is that this forcing is more important over perennial snow and ice where LAP accumulate on the surface over successive melt seasons [Ross Brown, Canada]	Taken into account: discussion of LAP and perennial ice is covered within chapter 2; text revised to reflect regional variability
4990	3	64	26	64	27	SUGGEST TO ADD (after "...melt earlier and drive positive albedo feedback (REFS)": The various processes related to melt and albedo effects of light absorbing impurities can be highly variable depending on, e.g., soot and dust particle type and amount (more details in 2.2.1.4 Aerosol deposition) [Outi Meinander, Finland]	Rejected: this is true, but this level of detail is beyond scope
2614	3	64	27	64	31	This sentence is quite long and should be broken up. Suggestion: The IPCC AR5 adopted a global direct radiative forcing of 0.04 W m–2 for BC in snow and sea-ice, based largely on the industrial-era (1750–2010) radiative forcing for BC in land-based snow (Bond et al. 2013). However, the effective forcing is about 3-fold greater than the direct forcing, due to a strong albedo feedback triggered by the initial darkening. [Patrik Winiger, Netherlands]	Accepted: text revised
14324	3	64	30			threefold not 3-fold [Christopher Fogwill, UK]	Accepted: text revised
5294	3	64	37	64	37	Only BC now included although according to latest knowledge other impurities may have a big influence depending on the location and conditions etc. -> SUGGEST TO ADD: In addition to BC, other impurities may cause significant surface darkening, including, e.g., high latitude dust (Bullard et al. 2016) and biological impacts (e.g., Benning et al. 2014). [Outi Meinander, Finland]	Taken into account: we specify "BC and other light absorbing impuritities" in the introductory sentence of this paragraph
5296	3	64	37	64	37	citation: Bullard et al. 2016, https://doi.org/10.1002/2016RG000518 [Outi Meinander, Finland]	Accepted: citation added
5298	3	64	37	64	37	citation: Benning, L. G., Anesio, A.M., Lutz, S. & Tranter, M. Biological impact on Greenland's albedo, Nature Geoscience 7, 691, 2014. [Outi Meinander, Finland]	Rejected: this citation refers to the Greenland ice sheet
8036	3	64	39	64	39	E2: In the executive summary the reference on page 4 line 55 "{3.4.3.2}" is linked to the wrong sub heading it should be "{3.4.3.3}" [APECS Group Review, Germany]	Incorrect page/line reference for this comment
3300	3	64	41	64	46	Local disappareance of some types of vegetation (e.g. some types of bogs) should be also considered here. [Castor Muñoz Sobrino, Spain]	Accepted: text revised
14326	3	64	42	64	49	define technical terms, e.g., 'riparian', 'allochthonous', 'lotic'.The whole of section 3.4.3.2.1 could do with de-jargonizing. [Christopher Fogwill, UK]	Accepted: text revised
8032	3	64	43	64	43	I would appreciate an explanation/description of 'aquatic greening and browning' here [APECS Group Review, Germany]	Accepted: text revised
20158	3	64	46	64	46	Please add "allochthonous" to the glossary and reference it here [Michelle A. North, South Africa]	Terms must appear in 2 chapters to qualify for the glossary; text revised to remove these terms
20160	3	64	47	64	47	Please add "lotic food webs" to the glossary and reference it here [Michelle A. North, South Africa]	Terms must appear in 2 chapters to qualify for the glossary; text revised to remove these terms

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
3302	3	64	48	64	50	Depending of the morphology of the basin it may be compensated by the sea-level rise (e.g. Muñoz Sobrino et al. (2018). Vegetation History and Archaeobotany 27: 551-576). [Castor Muñoz Sobrino, Spain]	Rejected: more specific information required; reference is not relevant
5878	3	64	52	65	19	Impacts on water quality could also be associated with various slope failures (thaw slumps, active layer detachments) that may result from changes to permafrost conditions, inlcuding increase sediment input into water bodies etc. See for example: Rudy, A.C.A., Lamoureux, S.F., Kokelj, S.V., Smith, I.R. and England, J.H., 2017. Accelerating thermokarst transforms ice-cored terrain triggering a downstream cascade to the ocean. Geophysical Research Letters, 44: 11080–11087.: Kokelj, S.V. et al., 2013. Thawing of massive ground ice in mega slumps drives increases in stream sediment and solute flux across a range of watershed scales. Journal of Geophysical Research Earth Surface, 118: 681-692. [Sharon Smith, Canada]	Accepted: text revised and Kokelj et al (2013) citation added
20164	3	65	0	66		Please include "lentic" and "lotic" systems in the glossary and reference it in this section [Michelle A. North, South Africa]	Terms must appear in 2 chapters to qualify for the glossary; text revised to remove these terms
8038	3	65	11	65	19	Five referals to 'DOC' in this paragraph but no explanation that DOC is dissolved organic carbon. Line 11 is the first mentioning of DOC in Chapter 3. [APECS Group Review, Germany]	Accepted: text revised
20162	3	65	11	65	22	DOC and DIC have not been introduced in this section, neither have any of the pollutants (POPs, HCHs, PAHs, PCBs), and since they are not used again the acronym is unnecessary. Please write out in full [Michelle A. North, South Africa]	Accepted: text revised
14328	3	65	21			black carbon and POPs' [Christopher Fogwill, UK]	Accepted: text revised
22608	3	65	21	65	29	There are also papers that have shown that many persistent organic pollutants, including those with lower volatilities, are being remobilized into the air from repositories in the Arctic region as a result of sea-ice retreat and rising temperatures. Ma et al. 2011 | DOI: 10.1038/NCLIMATE1167. Please also see the AMAP 2016 report on Influence of Climate Change on Transport, Levels, and Effects of Contaminants in Northern Areas [Eva Kruemmel, Canada]	See 19258
23850	3	65	21	66	19	make use of likelyhood/confidence language [Hans-Otto Poertner and WGII TSU, Germany]	Accepted: text revised
24918	3	65	21	65	29	Quite possibly references should be made to the considerable work on pollution by AMAP. They have addressed some of the unique pathways for pollutants in cryospheric conditions. [Elizabeth Weatherhead, USA]	See 19258
19258	3	65	29	65	29	Consider to add: The limited amount of human development in the Arctic has traditionally meant that local sources of chemical pollution were low. Increased human activity in the Arctic is likely to lead to local sources of chemicals of emerging Arctic concern, including siloxanes, parabens, flame retardants, and per- and polyfluoroalkyl substances (PFASs). (AMAP, 2017). Ref: AMAP Assessment 2017: Chemicals of Emerging Arctic Concern. Arctic Monitoring and Assessment Programme (AMAP),Oslo, Norway. [Marianne Kroglund, Norway]	Accepted: text and citation added
5452	3	65	51	65	51	It is not entirely clear to which "small connecting channels" this sentence refers. [Roderik Van De Wal, Netherlands]	Accepted: text revised
13512	3	66	6	66	19	Lentic, lotic, anadromous: these terms need to be defined [Debra Roberts and Durban Team, South Africa]	Accepted: text revised

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
3304	3	66	8	66	8	spp.: remove the italics. [Castor Muñoz Sobrino, Spain]	Taken into account: editorial guidance will be provided
20166	3	66	12	66	14	Please rewrite this sentence and cite relevant literature where possible [Michelle A. North, South Africa]	Accepted: text revised
5880	3	66	15	66	15	The following may be relevant to the discussion of impacts of permafrost thaw on aquatic ecosystems: Jolivel, M. and Allard, M., 2017. Impact of permafrost thaw on the turbidity regime of a subarctic river: the Sheldrake River, Nunavik, Quebec. Arctic Science, 3(2): 451-474. Bouchard, F., Francus, P., Pientz, R., Laurion, I. and Feyte, S., 2014. Subarctic thermokarst ponds: Investigating recent landscape evolution and sediment dynamics in thawed permafrost of northern Québec (Canada). Arctic, Antarctic, and Alpine Research, 46(1): 251-271. [Sharon Smith, Canada]	Rejected: regionally focused studies
23208	3	66	21	68	22	3.4.3.2.2. Terrestrial ecosystems contains two contents: vegetation and wildlife. Recent papers showed that permafrost thawing is closely related to the changes of microbial composition and function. And these chenges might rerult in the flux changes of greenhouses such as carbon dioxide and methane. Therefore, the responce of permafrost microbes to climate change has to be included. [Yoo Kyung Lee, Republic of Korea]	Accepted - Wildlife section has been augmented in main text and Box 3.3
12266	3	66	22			This section is only talking about vegetation and reindeer. A sentence like the following should be included: Species respond differently to climate change, resulting in temporal mismatch between interacting species, which in turn may impact important ecosystem services, such as pollination (Høye et al. 2013, Schmidt et al. 2017). Ref: Høye T.T., E. Post, N.M. Schmidt, K. Trøjelsgaard, and M.C. Forchhammer (2013), Shorter flowering seasons and declining abundance of flower visitors in a warmer Arctic. Nature Clim.Change, 3, 759-763, 10.1038/nclimate1909.; Schmidt N.M., B. Hardwick, O. Gilg, T.T. Høye, P.H. Krogh, H. Meltofte, A. Michelsen, J.B. Mosbacher, K. Raundrup, J. Reneerkens, L. Stewart, H. Wirta, and T. Roslin (2017), Interaction webs in arctic ecosystems: Determinants of arctic change? Ambio, 46, S12-S25, 10.1007/s13280-016-0862-x. [Torben Christensen, Sweden]	Accepted - Wildlife section has been augmented in main text and Box 3.3
5882	3	66	23	66	64	Lantz et al. (2013) may be relevant : Lantz, T.C., Marsh, P. and Kokelj, S.V., 2013. Recent shrub proliferation in the Mackenzie Delta uplands and microclimatic implications. Ecosystems, 16: 47-59. Eushkirchen et al. (2016) may also be relvant: Eushkirchen et al. 2016. Consequences of changes in vegetation and snow cover for climate feedbacks in Alaska and northwest Canada. Environmental Research Letters 11 (2016) 105003 doi:10.1088/1748-9326/11/10/105003 [Sharon Smith, Canada]	Noted-citations added when content and space allowed
8040	3	66	24	66	24	Add reference on shrub effects on permafrost and C cycling. For example Nauta A. L. et al. Nature Climate Change 5, 67–70 (24 November 2014) [APECS Group Review, Germany]	Accepted-citation added
12262	3	66	24			Add reference (Lund, 2018). Ref Lund, M. 2018: Uncovering the unknown—climate interactions in a changing arctic tundra. Environmental Research Letters, 13, 061001, https://doi.org/10.1088/1748-9326/aac63f [Torben Christensen, Sweden]	Rejected-due to space constraints citation does not contain new information
3850	3	66	27	66	27	We can change this to 36-year record (1982-2017) [Howard Epstein, USA]	Accepted-text revised
5454	3	66	48	66	48	"Other environmental factors" are mentioned, they should be listed [Roderik Van De Wal, Netherlands]	Accepted-text revised

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12274	3	66	48			Add reference (Westergaard-Nielsen et al., 2017). Ref: Westergaard-Nielsen, A. et al 2017: Transitions in high-Arctic vegetation growth patterns and ecosystem productivity tracked with automated cameras from 2000 to 2013. Ambio, 46, 39-52, DOI 10.1007/s13280-016-0864-8 [Torben Christensen, Sweden]	Accepted-citation included
3852	3	66	49	66	49	Change to "suggests that vegetation decreases are driven by changes in winter climate" [Howard Epstein, USA]	Accepted-text revised
8042	3	66	49	66	49	E1a: incomplete sentence: "Research on tundra browning is more limited but suggests that changes in winter climate is the cause" [APECS Group Review, Germany]	Accepted-text revised
3854	3	66	51	66	51	Change the comma after "dessication" to a hyphen to indictate the end of the qualifier that begins with "specifically…" [Howard Epstein, USA]	Accepted-text revised
1862	3	66	55	66	57	The sentence here is unclear. The greening/browning trends are consistent with what? What kind of regional differences are there? Please revise for clarity. [Aku Riihelä, Finland]	Accepted-text revised for clarity
3856	3	66	55	66	55	Add "in" after "trends" [Howard Epstein, USA]	Accepted-text revised for clarity
8044	3	66	55	66	55	E1a: incomplete sentence: "Similar to tundra, boreal forest vegetation shows consistent trends "of/in" greening and browning over multiple…" [APECS Group Review, Germany]	Accepted-text revised for clarity
20868	3	66	55	67	2	1st part of comment (chap 3, 66-67): It could be interesting to note that indigenous peoples of Eastern Siberia also unanimously notice this greening and browning (and shrubification) of the boreal forest, as well as other disruptions in the vegetation and identify these changes are linked to CC, and especially to CC impacts that raise the many disruptions in the snow cover and ices (Lavrillier, Gabyshev & Rojo, 2016, pp.. 9, 119. Another quote for this could be Lavrillier and Gabyshev 2017 (this book is already quoted in the report), p.30 ("Abnormal winter and summer analysis as well as analysis of events considered 'extreme' by the nomads (conducted with reference to both TEK and social anthropology). This demonstrated frequent anomalies in the evolution of the snow and ice covers and significant variations in different topographies. In addition, these anomalies seem to be causing significant changes in the vegetal cover. (cf. Evenki climatology, snow and ice typology, Part III)" [Alexandra Lavrillier, France]	Noted
20882	3	66	55	67	2	2nd part of comment (chap 3, 66-67): References: Lavrillier A. & S. Gabyshev, 2017 An Arctic Indigenous Knowledge System of Landscape, Climate, and Human interactions. Evenki Reindeer Herders and Hunters, Studies in Social and Cultural Anthropology, Kulturstiftung Sibirien, Fürstenberg/Havel, Germany 467p./ Lavrillier, A., Gabyshev, S and Rojo, M., 2016 The Sable for Evenk Reindeer Herders in Southeastern Siberia: Interplaying Drivers of Changes on Biodiversity and Ecosystem Services: Climate Change, Worldwide Market Econonomy and Extractive Industries, in M. Roué and Z. Molnar (eds.), Indigenous and Local Knowledge of Biodiversity and Ecosystems Services in Europe and Central Asia: Contributions to an IPBES regional assessment. Knowledge and Nature 9. UNESCO: Paris, p. 111-128. [Alexandra Lavrillier, France]	Taken into account: major editorial changes were made to this section, including a review of relevant references

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
5884	3	67	1		30	The following may be relvant to this discussion (see other comments regarding impacts related to permafrost): Walker et al. 2018. Cross-scale controls on carbon emissions from boreal forest megafires. Global Change Biology 2018;1–15. DOI: 10.1111/gcb.14287. : Walker et al. 2018. Soil organic layer combustion in boreal black spruce and jack pine stands of the Northwest Territories, Canada. International Journal of Wildland Fire 2018, 27, 125–134 https://doi.org/10.1071/WF17095 [Sharon Smith, Canada]	Noted-Citation included elsewhere in the terrestrial section
3858	3	67	3	67	3	Change "is" to "are" [Howard Epstein, USA]	Accepted-text revised
3860	3	67	3	67	3	Do we need to spell out and define NDVI? [Howard Epstein, USA]	Accepted-text revised to eliminate acronym
452	3	67	4	67	4	Remove "persistently" [George Burba, USA]	Accepted-text revised
454	3	67	12	67	12	Remove "tipping", just say "…cross a point, where…". There seem to be no tipping here. Tipping point implies no return, and it is also is an economic term that may be confusing to many readers. [George Burba, USA]	Accepted-text revised
3862	3	67	13	67	13	Italicize Larix [Howard Epstein, USA]	Accepted-text revised
5456	3	67	13	67	15	An increased fire severity leading to increased tree density and forest expansion seems quite remarkable to me. Therefore, I think that an explanation for how this process works would be useful to add. [Roderik Van De Wal, Netherlands]	Accepted-text revised
20870	3	67	13	67	15	Perhaps add: "In eastern Siberia, from the point of view of indigenous communities, the increasing density of the larix forest and bushes is raised by CC which delays the installation of the snow cover and shorten the coldest part (=/<-50°C) of the winter (1-2 months). It creates perturbations in the evolution of snow cover (internal snow physical transformation); and it acts upon the formation of the vegetal cover (Lavrillie, Gabyshev, Rojo 2016, p. 116; Lavrillier and Gabyshev 2017, pp. 243-283; 300-445,and specifically on snow cover and ice anomalies ibid - p. 400-445)" (OR in next comment) References: Lavrillier A. & S. Gabyshev, 2017 An Arctic Indigenous Knowledge System of Landscape, Climate, and Human interactions. Evenki Reindeer Herders and Hunters, Studies in Social and Cultural Anthropology, Kulturstiftung Sibirien, Fürstenberg/Havel, Germany 467p./ Lavrillier, A., Gabyshev, S and Rojo, M., 2016 The Sable for Evenk Reindeer Herders in Southeastern Siberia: Interplaying Drivers of Changes on Biodiversity and Ecosystem Services: Climate Change, Worldwide Market Econonomy and Extractive Industries, in M. Roué and Z. Molnar (eds.), Indigenous and Local Knowledge of Biodiversity and Ecosystems Services in Europe and Central Asia: Contributions to an IPBES regional assessment. Knowledge and Nature 9. UNESCO: Paris, p. 111-128. [Alexandra Lavrillier, France]	Noted-space limitation has prevented expansion of text here
456	3	67	14	67	14	Remove "severely", we do not know that. [George Burba, USA]	Rejected; the study focused on the impact of fire severity on seedling establishment, which is what the sentence describes.
458	3	67	14	67	14	Remove "in forest areas". It already says "tree density" meaning forest. [George Burba, USA]	Rejected - this wording was used to differentiate effects within current forests and effects in tundra that may shift to forest with increased fires
1864	3	67	14	67	15	The mechanism by which increased fire severity leads to increased tree density and forest expansion is not intuitively clear. Please add a description of why this happens. [Aku Riihelä, Finland]	Accepted-text revised

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
20168	3	67	25	67	27	Please cite the section where you discuss the change in tundra burning rate, rather than just saying "discussed earlier in this chapter" [Michelle A. North, South Africa]	Accepted-text revised
23852	3	67	26	67	26	"as discussed earlier in this chapter": please specify section [Hans-Otto Poertner and WGII TSU, Germany]	Accepted-text revised
20174	3	67	32	68	22	This section on wildlife is very limited - what about the effects on other large mammals (e.g., moose, muskox, bears, wolves), small mammals (rodents, foxes, etc), other wildlife, wild birds (geese etc)? Note also the increase in parasites and disease into Arctic areas where they previously could not overwinter or spread among susceptible hosts - e.g., the range expansion of winter tick in northern British Columbia that has added increased burden to caribou and moose. Range expansion of disease is an important consideration when regarding the consequences of climate change to wildlife populations. Caribou/reindeer are not the only large terrestrial mammals in the Arctic. Muskoxen (also a key species for Iniut food security) are suffering severe declines as a result of increased summer temperatures (among other factors) impacting on their breeding and survival, as well as increased disease and parasite burdens (e.g., erysipelothrix, brucella and lung worm) which show documented range expansion into Victoria Island. Please refer to publications by Susan Kutz and her students (e.g., https://www.sciencedirect.com/science/article/pii/S1471492215000471, https://www.sciencedirect.com/science/article/pii/S000632071731515X, https://www.sciencedirect.com/science/article/pii/S2213224414000029, http://science.sciencemag.org/content/341/6145/519, http://www.bioone.org/doi/full/10.1093/icb/44.2.109, https://www.sciencedirect.com/science/article/pii/S0304401709003495). The increase in hybridization between grizzly and polar bears because of increasing range overlap? etc. [Michelle A. North, South Africa]	Accepted-text added on other wildlife here and in Box 3.3
3902	3	67	33	67	36	Rangifer should be in Italics [Howard Epstein, USA]	Accepted: text revised
13514	3	67	33			Reindeer and caribou are same species (Rangifer tarandus), different subspecies (there are others). Rangifer is a genus name and should be italicised. Or else just explain this once and then just use one of the common names (eg reindeer) [Debra Roberts and Durban Team, South Africa]	Accepted: text revised
23854	3	67	33	67	33	provide species names for reindeer and caribou [Hans-Otto Poertner and WGII TSU, Germany]	Accepted: text revised
6078	3	67	35			Change 'indigenous Arctic people' to 'Arctic Indigenous Peoples' [Joanna Petrasek Macdonald, Canada]	Taken into account: text no longer in section
3904	3	67	40	67	40	Do we need to be more explict about the "Arctic Islands"? [Howard Epstein, USA]	Accepted: text revised
20170	3	67	43	67	45	Please include some citations for these statements [Michelle A. North, South Africa]	Accepted: text revised
460	3	67	44	67	44	Something is off here. Consider replacing this line with "…the ciurrent rates of decline are higher and low numbers are lower compared to historical numbers for many herds…" [George Burba, USA]	Accepted: text revised

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
8216	3	67	47	67	57	Though rain on snow events and ice layers have been reported to be related to caribou die-offs, there does not seem to be a direct link. A good study was done in the Canadian Archipelago by Langlois et al., (2017). Langlois A., Johnson C.-A., Montpetit B., Royer A., Blukacz-Richards E.A., Neave E., Dolant C., Roy A., Arhonditsis G., Kim D.-K., Kaluskar S. and Brucker L. 2017. Detection of rain-on-snow (ROS) events and ice layer formation using passive microwave radiometry: A context for Peary Caribou habitat in the Canadian Arctic, Remote Sensing of Environment, vol. 189, pp. 84-95. [Benoit Montpetit, Canada]	Accepted: text revised and citation added
8218	3	67	47	67	57	A good study has been recently published showing that not only rain-on-snow events and ice layers are creating difficult foraging conditions for caribou and resulting in caribou die-offs. Severe wind events creating dense wind slabs at the surface can also result in caribou die-off like the one on Prince Charles Island in the Canadian Arctic Archipelago (Dolant et al., 2018). I would add a sentence on this topic of difficult dense snow layers. Dolant C., Montpetit B., Langlois A., Brucker L., Zolina O., Johnson C.A., Royer A. and Smith P. 2018. Assessment of Barren Ground Caribou die-off during winter 2015-2016 using passive microwave observations, Geophysical Research Letters, vol. 45 (10), pp. 4908-4916. [Benoit Montpetit, Canada]	Accepted: text revised and citation added
3906	3	67	50	67	50	Remove the colon and insert "and" [Howard Epstein, USA]	Accepted: text revised
20172	3	67	51	67	51	Delete (ROS) - the acronym is not used again and is unecessary [Michelle A. North, South Africa]	Accepted: text revised
22156	3	67	52	67	52	a reference has been mixed up, it should be (instead of Bartsch et al. 2017, which covers a different topic) Bartsch et al. 2010 (Annett Bartsch, Timo Kumpula, Bruce C Forbes, Florian Stammler: Detection of Snow Surface Thawing and Refreezing in the Eurasian Arctic Using QuikSCAT: Implications for Reindeer Herding. Ecological Applications 12/2010; 20(8):2346-58., DOI:10.1890/09-1927). Note, the reference Bartsch et al. 2017 itself is valid in the reference list as it is cited in an earlier section. [Annett Bartsch, Austria]	Accepted: text revised
3908	3	67	55	67	55	Change "relationship between" to "relationships among" [Howard Epstein, USA]	Accepted: text revised
12264	3	67	55			Add "..Albon et al., 2017). These changes also impact other polar species, such as muskox (Ovibos moschatus; Schmidt et al. 2015). As polar trophic systems are highly interlinked (Schmidt et al. 2017), changes will eventually propagate through ...." Ref: Schmidt N.M., S.H. Pedersen, J.B. Mosbacher, and L.H. Hansen (2015), Long-term patterns of muskox (Ovibos moschatus) demographics in high arctic Greenland. Polar Biol., 38, 1667-1675, 10.1007/s00300-015-1733-9.; Schmidt N.M., B. Hardwick, O. Gilg, T.T. Høye, P.H. Krogh, H. Meltofte, A. Michelsen, J.B. Mosbacher, K. Raundrup, J. Reneerkens, L. Stewart, H. Wirta, and T. Roslin (2017), Interaction webs in arctic ecosystems: Determinants of arctic change? Ambio, 46, S12-S25, 10.1007/s13280-016-0862-x. [Torben Christensen, Sweden]	Accepted: text revised and citations added
3306	3	67	56	67	57	Consistent evidences of this may be also found in palaeorecords, even in non-Artic highlands. For example data relating the disappearance of rangifer and other cold tolerant species from NW Iberia highlands due to the ecological changes occured in the area during the Early Holocene warming (e.g. Iriarte-Chiapusso et al., 2016, Quaternary International 403: 211-236). [Castor Muñoz Sobrino, Spain]	Rejected: suggested reference does not address the polar regions

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
3910	3	67	56	67	57	Change to "geese and voles, as well as predators" [Howard Epstein, USA]	Accepted: text revised
20872	3	67	57	67	57	Perhaps add about the increase of predators: "For example, according to Eastern Siberian indigenous herders climate change also provokes an increase in the number of fires, which reduces the amount of pasture available for domestic reindeer and thus endangers their health. Moreover, the fires reduce the natural space for wild animals which forces them to migrate to other areas (often the same as the lands occupied by the nomads): this then triggers an increase in the number of predators on herding lands and the killing of the easiest prey, the domestic reindeer. The nomads have also noticed that the sable fur is not as thick as it used to be in the past" (Lavrillier, Gabyshev, Rojo 2016, p. 115; Lavrillier and Gabyshev 2018) References: Lavrillier, A., Gabyshev, S and Rojo, M., 2016 The Sable for Evenk Reindeer Herders in Southeastern Siberia: Interplaying Drivers of Changes on Biodiversity and Ecosystem Services: Climate Change, Worldwide Market Econonomy and Extractive Industries, in M. Roué and Z. Molnar (eds.), Indigenous and Local Knowledge of Biodiversity and Ecosystems Services in Europe and Central Asia: Contributions to an IPBES regional assessment. Knowledge and Nature 9. UNESCO: Paris, p. 111-128. / Lavrillier A. and S. Gabyshev 2018, An Emic Science of Climate: a Reindeer Evenki Environmental Knowledge and the Notion of an Extreme Process of Change, in A. Lavrillier, A. Dumont, D. Brandisauskas (eds) Human-environment relationships in Siberia and Northeast China: Skills, Rituals, Mobility and Politics among the Tungus Peoples, accepted, EMSCAT, 48. [Alexandra Lavrillier, France]	Accepted: text revised and citation added
23856	3	67	57	67	57	provide examples for "predators" [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - text revised
14330	3	68	0	4		no hyphen needed in sea ice [Christopher Fogwill, UK]	Accepted - text revised
10714	3	68	2	68	22	Please add some information about mosquitoes and other blood-sucking insects. Summer temperature raising led to increase of them in tundra, so the disturb reindeers much more, than before. As a result anymals suffer and become more weak [Oxana Lipka, Russian Federation]	Rejected: literature citations needed
3912	3	68	5	68	5	Remove the apostrophe in "1980's" [Howard Epstein, USA]	Accepted - text revised
3914	3	68	6	68	6	Are the Dolphin and Union one herd or two herds? [Howard Epstein, USA]	One herd
3916	3	68	6	68	6	Add "Canadian" before "mainland" [Howard Epstein, USA]	Accepted - text revised
3918	3	68	11	68	11	What is the debate? [Howard Epstein, USA]	Accepted - text revised
3920	3	68	12	68	12	Change the colon to a semi-colon. [Howard Epstein, USA]	Accepted - text revised
22158	3	68	13	68	13	while an increases in winter precipitation -> while an increase in winter precipitation [Annett Bartsch, Austria]	Accepted - text revised
22610	3	68	15	68	16	please consistently refer to "Arctic Indigenous Peoples" [Eva Kruemmel, Canada]	Accepted - text revised
23858	3	68	24	72	15	Here in Section 3.4.3.3 it is decribed what can be already observed – but what is to be expected for the future? This assessment is often lacking [Hans-Otto Poertner and WGII TSU, Germany]	Checking with Anne Gunn
23860	3	68	24	72	15	Please make use of IPCC calibrated language! [Hans-Otto Poertner and WGII TSU, Germany]	Noted and addressed where possible

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
22612	3	68	27	68	30	It is far more than "evoking a sense of home, freedome and belonging", it has been a crucial part of the culture, life and survival. It may be better to refer to Arctic Indigenous Peoples' reports/publications here. [Eva Kruemmel, Canada]	Accepted. Text and references added.
20176	3	68	37	68	38	Include ice roads in this list as they are vital for transportation to/between many of these remote communities [Michelle A. North, South Africa]	Accepted. Text revised.
22614	3	68	42	68	51	Not sure where the rating of "high confidence" comes from, but it's a fact - so should probably be higher - many papers have been published on the topic. An additional factor of climate change are higher concentrations of contaminants in Arctic wildlife (as mentioned in previous comments), which also impacts food security of Arctic Indigenous Peoples. [Eva Kruemmel, Canada]	Accepted. The "high confidence" language reflects IPCC calibrated language. The text has been revised to clarify that the high confidence is in the estimates related to rising food insecurity.
20178	3	68	49	68	51	"Environmental changes to animal habitat and movement…" - please include animal numbers to this list, or population size [Michelle A. North, South Africa]	Accepted. Text revised.
20874	3	68	49	68	52	Could be good to add ref to some Siberian studies; "; Lavrillier, 2013; Lavrillier, Gabyshev, Rojo 2016)" References: Lavrillier, A. 2013 Climate change among nomadic and settled Tungus of Siberia: continuity and changes in economic and ritual relationships with the natural environment, Polar Record, Vol. 49, issue 03, pp. 260-271; Lavrillier, A., Gabyshev, S and Rojo, M., 2016 The Sable for Evenk Reindeer Herders in Southeastern Siberia: Interplaying Drivers of Changes on Biodiversity and Ecosystem Services: Climate Change, Worldwide Market Econonomy and Extractive Industries, in M. Roué and Z. Molnar (eds.), Indigenous and Local Knowledge of Biodiversity and Ecosystems Services in Europe and Central Asia: Contributions to an IPBES regional assessment. Knowledge and Nature 9. UNESCO: Paris, p. 111-128. [Alexandra Lavrillier, France]	Accepted. References added.
20876	3	68	49	68	52	Perhaps add "In eastern Siberia, from the point of view of indigenous communities, the increasing density of the larix forest and bushes is raised by CC which delays the installation of the snow cover and shorten the coldest part (=/<-50°C) of the winter (1-2 months). It creates perturbations in the evolution of snow cover (internal snow physical transformation according to ILK); and it acts upon the formation of the vegetal cover, that determines the distribution of the sable population and threatens the subsistance economy of nomads (Lavrillier,Gabyshev, Rojo 2016, p. 116; Lavrillier and Gabyshev 2017, pp. 243-283; 300-445,and specifically on snow cover and ice anomalies ibid - p. 400-445)" References: Lavrillier A. & S. Gabyshev, 2017 An Arctic Indigenous Knowledge System of Landscape, Climate, and Human interactions. Evenki Reindeer Herders and Hunters, Studies in Social and Cultural Anthropology, Kulturstiftung Sibirien, Fürstenberg/Havel, Germany 467p./ Lavrillier, A., Gabyshev, S and Rojo, M., 2016 The Sable for Evenk Reindeer Herders in Southeastern Siberia: Interplaying Drivers of Changes on Biodiversity and Ecosystem Services: Climate Change, Worldwide Market Econonomy and Extractive Industries, in M. Roué and Z. Molnar (eds.), Indigenous and Local Knowledge of Biodiversity and Ecosystems Services in Europe and Central Asia: Contributions to an IPBES regional assessment. Knowledge and Nature 9. UNESCO: Paris, p. 111-128. [Alexandra Lavrillier, France]	Taken into consideration by author team. References added.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
8046	3	68	54	68	57	Overlap of text on rain-on-snow effects on caribou/reindeer here and with lines 51-55 on page 67 [APECS Group Review, Germany]	Accepted. Text revised.
352	3	69	1	69	1	Insert "negatively" before "impacts" [F Stuart Chapin, USA]	Accepted. Text revised.
20180	3	69	2	69	3	Please also include the effects of changing sea ice conditions on the narwhal/seal populations and how this impacts on the Iniut food security and reference section 3.3.3.1.4. Also, under changing fishing conditions, please also reference section 3.3.3.1.3 (marine fish), not just freshwater consequences [Michelle A. North, South Africa]	Taken into account: this is covered in Section 3.2.3.1
462	3	69	9	69	9	Remove "unpredictable winds". They are predictable. Consider replacing with "Changes in dominant wind direction and wind speed reduce the reliability…" [George Burba, USA]	Accepted. Text revised.
5458	3	69	9	69	9	The changes in wind seem really important, they should be mentioned and analysed in the text [Roderik Van De Wal, Netherlands]	Rejected: while wind speeds are important for local navigation, literature in this area is lacking
14332	3	69	18	69	19	…consequences for the use…' [Christopher Fogwill, UK]	Accepted. Text revised.
13516	3	69	19	69	19	Add 'for' before 'the use of ice' [Debra Roberts and Durban Team, South Africa]	Accepted. Text revised.
23862	3	69	22	69	28	Shouldn't this paragraph be part of section 3.3 dealing with sea ice? [Hans-Otto Poertner and WGII TSU, Germany]	Rejected: this text speaks to the impacts of changing sea ice conditions on communities, not the actual physical changes
354	3	69	28	69	28	Add the following sentence: "In boreal communities, wildfire disrupts hunting trails and declines in summer discharge make sloughs, rivers, and streams less accessible to people who hunt and fish (Brinkman et al. 2016). There is extensive literature on this point, but I'm not familiiar with it. [F Stuart Chapin, USA]	Accepted: text revised and citation added
356	3	69	34	69	34	Insert after "water": and for access to hunting and fishing areas [F Stuart Chapin, USA]	Taken into consideration in "food security" section.
5460	3	69	36	69	36	Is the impact in hydrolgy positive or negative? [Roderik Van De Wal, Netherlands]	Accepted. Text revised.
464	3	69	41	69	41	Replace "access these water resources" with "these resources" [George Burba, USA]	Accepted. Text revised.
13302	3	69	45	70	3	The ideas in this section are strong, and the cited literature is highly influential; however, extending this to include the importance of mental health is important. The literature cited in this section, and particularly that by Cunsolo et al., highlights the importance of polar ice and seas in mental health. [Katherine Bishop-Williams, Canada]	Taken into consideration in Section 3.4.3.3.3.
20878	3	69	55	70	2	1st part of the comment: This assessment, does not represent the situation in Siberia (at least eastern part), where climate change is still faced only thanks to traditional knowledge and to its adaptability and creativity in face of new extreme events (Bogoslovskaia 2008; Lavrillier 2013, Lavrillier, Gabyshev, Rojo, 2016, Lavrillier and Gabyshev 2017, 2018, Golovnev 2018) (for detailed references, see 2nd part comment) [Alexandra Lavrillier, France]	Accepted. Text revised to reflect the region where this is taking place.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
20880	3	69	55	70	2	2nd part of the comment: References - Bogoslovskaia, Liudmila Sergeevna, Vdovin, Boris Innokentevich, and V. V. Golbtseva 2008. Izmeneniia klimata v regione Beringova proliva. Traditsionnnye i nauchnye znaniia [Climate Change in the Bering Strait Region: Integration of Scientific and Indigenous Knowledge], Ekologicheskoe planirovanie i upravlenie, 3–4(8–9):36–48./ Lavrillier, A. 2013 Climate change among nomadic and settled Tungus of Siberia: continuity and changes in economic and ritual relationships with the natural environment, Polar Record, Vol. 49, issue 03, pp. 260-271 / Lavrillier A. and S. Gabyshev 2018, An Emic Science of Climate: a Reindeer Evenki Environmental Knowledge and the Notion of an Extreme Process of Change, in A. Lavrillier, A. Dumont, D. Brandisauskas (eds) Human-environment relationships in Siberia and Northeast China: Skills, Rituals, Mobility and Politics among the Tungus Peoples, accepted, EMSCAT, 48; Golovnev, A. 2018 Challenges to Arctic Nomadism: Yamal Nenets Facing Climate Change Era Calamities, Arctic Anthropology, vol 54, 2, pp.40-51. [Alexandra Lavrillier, France]	Accepted. Text revised to reflect the region where this is taking place.
22616	3	69	55	70	2	"Eroding" confidence may be a bit strong, "threaten" might be a better word. Indigenous knowledge also evolves with the changes, so with time it will adapt just as the people do. That's why it should be called "Indigenous knowledge" and not "traditional knowledge". [Eva Kruemmel, Canada]	Accepted. Text revised.
8048	3	69	70	69	70	Consider changing 'vegetation stages' to 'plant phenological stages' [APECS Group Review, Germany]	Accepted. Text revised.
13522	3	70	0	70	56	Why treat 'Health and well-being' and 'Health and well-being' under different subheadings? [Debra Roberts and Durban Team, South Africa]	Aceepted. Sub-headings revised.
13518	3	70	1	70	1	Do not understand what is meant by 'leading to emotional and cultural responses' [Debra Roberts and Durban Team, South Africa]	Accepted. Text revised.
24920	3	70	5	70	12	Economics should include at least a mention of fishing, oil, tourism and transportation, even though these are discussed separately. [Elizabeth Weatherhead, USA]	Accepted. Text revised.
20884	3	70	7	70	9	About this topic there is Nuttal et al. 2005 - Nuttall, Mark, Fikret Berkes, Bruce Forbes, Gary Kofinas, Tatiana Vlassova, and George Wenzel 2005. Hunting, Herding, Fishing and Gathering: Indigenous Peoples and Renewable Resource Use in the Arctic. In ACIA Arctic Climate Impact Assessment: Scientific Report, 649–690. Cambridge: Cambridge University Press. [Alexandra Lavrillier, France]	Rejected: focus is on text citations since IPCC AR5
20886	3	70	7	70	9	For Siberia add "Lavrillier, Gabyshev, Rojo 2016" - (Lavrillier, A., Gabyshev, S and Rojo, M., 2016 The Sable for Evenk Reindeer Herders in Southeastern Siberia: Interplaying Drivers of Changes on Biodiversity and Ecosystem Services: Climate Change, Worldwide Market Econonomy and Extractive Industries, in M. Roué and Z. Molnar (eds.), Indigenous and Local Knowledge of Biodiversity and Ecosystems Services in Europe and Central Asia: Contributions to an IPBES regional assessment. Knowledge and Nature 9. UNESCO: Paris, p. 111-128.), Golovnev 2018 (Golovnev, A. 2018 Challenges to Arctic Nomadism: Yamal Nenets Facing Climate Change Era Calamities, Arctic Anthropology, vol 54, 2, pp.40-51.) [Alexandra Lavrillier, France]	Accepted. References added.
13520	3	70	9	70	9	Suggest you rephrase the sentence: 'It is difficult to assess the impact of climate change on local subsistence activities and…' [Debra Roberts and Durban Team, South Africa]	Accepted. Text revised.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
8050	3	70	27	70	27	C5: "Driscoll et al., 2013" is missing in the References [APECS Group Review, Germany]	References corrected.
8052	3	70	31	70	31	C5: "Clark et al., 2016" is missing in the References [APECS Group Review, Germany]	References corrected.
8054	3	70	32	70	32	C5: "Driscoll et al., 2016, 2013" is missing in the References [APECS Group Review, Germany]	References corrected.
8056	3	70	33	70	33	C5: "Durkalec et al., 2014" is missing in the References [APECS Group Review, Germany]	References corrected.
13304	3	70	35	70	44	See forthcoming work by Manore et al. about contamination of clams related to climate change in Iqaluit, NV, Canada. [Katherine Bishop-Williams, Canada]	Taken into consideration by author team. Reference will be added if accepted before 15 May 2019 cut-off date.
8058	3	70	40	70	40	C5: "McLaughlin al., 2005 & Young et al., 2015" are missing in the References [APECS Group Review, Germany]	References corrected.
13308	3	70	47	70	54	See also work by Wright et al. (2018) about perceptions of safety of drinking water in Labrador Inuit communities. (Citation: Wright, Carlee J., et al. "How are perceptions associated with water consumption in Canadian Inuit? A cross-sectional survey in Rigolet, Labrador." Science of The Total Environment 618 (2018): 369-378.) [Katherine Bishop-Williams, Canada]	Accepted: Work from Wright et al is now cited.
8060	3	70	48	70	49	C5: "Brubaker et al., 2011 & Parkinson et al., 2005,2009" are missing in the References [APECS Group Review, Germany]	References corrected.
8062	3	70	50	70	50	C5: "Harper et al., 2011" is missing in the References [APECS Group Review, Germany]	References corrected.
13306	3	70	54	70	54	See also work by Wright et al. (2017) about contamination of drinking water containers among Labrador Inuit. (Citation: Wright, Carlee J., et al. "Water quality and health in northern Canada: stored drinking water and acute gastrointestinal illness in Labrador Inuit." Environmental Science and Pollution Research (2017): 1-13.) [Katherine Bishop-Williams, Canada]	Accepted: citation added
8064	3	71	6	71	8	C5: "Bunce et al., 2015, 2016; Harper et al., 2015; Ostapchuk et al., 2015 & Petrasek MacDonald et al., 2015,2016" are missing in the References [APECS Group Review, Germany]	References corrected.
8066	3	71	9	71	10	C5: "Harper et al., 2015 & Bunce et al., 2015" are missing in the References [APECS Group Review, Germany]	References corrected.
14334	3	71	9			semicolon not comma after parenthisis [Christopher Fogwill, UK]	Copyediting will occur prior to publication.
5462	3	71	16	72	15	This part discusses only infrastructure in the Arctic region. I think that a discussion about the Antarctic would also be interesting to include here (for example about transport there, research facilities, etc.). [Roderik Van De Wal, Netherlands]	Noted
20888	3	71	16	71	51	There should be somewhere some assessment on the many consequences on local and indigenous communities from thoses infrastructures, well literature exist, for instance in Siberia with F.Stammler & Forbes or S. Dudeck [Alexandra Lavrillier, France]	Noted but not incorporated in this draft due to space constraints
5886	3	71	18	71	21	A change in ground thermal regime does not necessarily threaten structural stability of infrastructure. The impact will depend on ground ice content, type of surficial material (fine-grained vs coarse grained vs bedrock), drainage and the design of the infrastrucutre itself. Impacts will be greater where peramfrost is ice-rich especially if changes to permafrost are not adequately considered in the design. Some further explanation is therefore required. Also, the last part of this sentence regarding foundations on ice-free land is unclear. [Sharon Smith, Canada]	Accepted-text revised

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
5888	3	71	23	71	23	Some old references here including ACIA (Instanes) and SWIPA 2011 (Calaghan et al. - note ref. list gives snow cover not permafrost chapter) - too some extent these have been updated in SWIPA2017, specifically Romanovsky et al. (2017). Also, you could refer to a recent Canadian assessment focussing on northern transportation : Pendakur, K., 2017. Northern Territories. In: K. Palko and D.S. Lemmen (Editors), Climate risks and adaptation practices for the Canadian transportation sector 2016. Government of Canada, Ottawa, ON, pp. 27-64. http://www.nrcan.gc.ca/environment/resources/publications/impacts-adaptation/reports/assessments/2017/19623 [Sharon Smith, Canada]	Accepted-citation included; older citation removed
5890	3	71	26	71	28	Development of standards and guidelines are also important for both adaptation of existing infrastructure and construction of new infrastructure. An example from Canada is Northern Infrastructure Standardization Initiative. https://www.scc.ca/en/nisi [Sharon Smith, Canada]	Noted
5892	3	71	30	71	35	Everywhere or just Russia which is the case with Shiklomanov 2017b). Publication only submitted so approach to generate these results is unclear. [Sharon Smith, Canada]	Noted-publication is available as a 'submitted' publication
3922	3	71	42	71	42	Spelling - "continued" [Howard Epstein, USA]	Accepted-text revised
20182	3	71	42	71	42	"continued" is missing it's 'c' [Michelle A. North, South Africa]	Accepted-text revised
1752	3	71	46	71	51	The past tense used in this paragraph should be changed to future (and these are projections so words uncertainty should be highlighted). It sounds like past damages are being referred to but I think the author is referring to future projections. [Mark England, UK]	Accepted-text revised
3924	3	71	47	71	48	Put a hyphen between "damage" and "related" [Howard Epstein, USA]	Accepted-text revised
3926	3	71	51	71	51	Change to "damage-related" [Howard Epstein, USA]	Accepted-text revised
5894	3	71	53	71	53	"Winter roads" would be better title as it is more inclusive. The following text includes roads constructed on frozen water bodies or ice roads and those constructed over frozen ground. [Sharon Smith, Canada]	Accepted-text revised
21076	3	72	0	91		This section is called, "Responding" but it's really just about adaptation strategies for Arctic peoples. [Thomas Wagner, USA]	good point. But res pathways overlaps with adaptation
21078	3	72	0	91		While indigenous people are mentioned repeatedly, the section overall seems to lack their complex and varied perspective on climate change. When I've heard it articulated at meetings, some clear statements are 1) It's our Arctic and we need to be involved in decision making. 2) We want commercial development--resource extraction among other-- to help mitigate the impacts of climate change. 3) We are suffering now from everything from coastal erosion to human health issues and we need help. I realize some of these points are raised indirectly, but they seem lost, and there are likely references. [Thomas Wagner, USA]	chapter makes extensive reference to indigenous people;text changed to accommodate.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
5896	3	72	7	72	15	The following is a more appropriate reference for impacts on winter road operation including economic impacts etc. and the report also focusses on Tibbitt to Contwoyto road. This is probably the first study to do this and consider impacts to ice thickness etc. Perrin, A., Dion, J., Eng, S., Sawyer, D., Nodleman, J.R., Comer, N., Auld, H., Sparling, E., Harris, M., Nodelman, J.Y.H., and Kinnear, L. 2015. Economic implications of climate change adaptations for mine access roads in northern Canada, Northern Climate ExChange, Yukon Research Centre, Yukon College. available at: https://www.yukoncollege.yk.ca/research/our-research/northern-climate-exchange/economic-implications-of-climate-change-adaptations-for-mine-access-roads-in-northern-canada [Sharon Smith, Canada]	thank you, taken into account
13006	3	72	18			Under section 3.5: a discussion of potential mitigation measures to slow ice loss in particularly vulnerable areas appears to be missing. ((Desch S. J., et al. (2017) Arctic ice management, EARTH'S FUTURE 5:107–127; Field L. A., et al. (2017) Ice911 Research: A Reversible Localized Geo-Engineering Technique to Mitigate Climate Change Effects: Field Testing, Instrumentation and Climate Modeling Results, AGU Fall Meeting 2017, abstract #GC43H-1161; Wolovick, M. J., and J. C. Moore (2018) Stopping the Flood: Could We Use Targeted Geoengineering to Mitigate Sea Level Rise?, The Cryosphere Discuss., https://doi.org/10.5194/tc-2018-95.) [Gabrielle Dreyfus, USA]	included references
17350	3	72	18	72	18	This section is really about "Adaptation and Resiliece," suggest title change as another "Human Response" (eg mitigation) is not included here. [Pamela Pearson, USA]	changed
2616	3	72	22	72	31	This paragraph does not really convey much knowledge and is generic in a way that applies to the entire planet. I suggest to remove it and use the first paragraph of 3.5.2 as Introduction (3.5.1). [Patrik Winiger, Netherlands]	removed to cross chapter box and modified to only address the polar system
5464	3	72	22	72	31	This section contains multiple summations in only a few sentences, which makes it hard to read. Could this be rewritten to be more readable? [Roderik Van De Wal, Netherlands]	changed
8068	3	72	22	72	31	An enumeration in every sentence makes the Introduction a bit hard to follow. Wherever it is not crucial please consider replacing by a generalization, e.g. "be they by a family, decision makers of all levels of government, a local community, national-level agencies, or the Arctic Council (AC)" by "of all levels". [APECS Group Review, Germany]	not sure that this reviewer is asking -- but will simplify to improve readability.
20184	3	72	26	72	26	"Arctic Council" does not need to have an acronym, please remove [Michelle A. North, South Africa]	changed
19222	3	72	30	72	30	consider to include reference to Arctic Council/AMAP regional reports on adaptation actions for a changing arctic (AACA). [Marianne Kroglund, Norway]	now included

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
21186	3	72	40	72	44	The outline of "stakeholders" in the polar regions should include the peoples and nations that have a relationship with these regions other than for direct material purpose. There is a widespread literature on the importance of polar regions to regional and distant societies for spiritual purpose, psychological well-being and also that the polar regions are sentinels for prospects for the Earth systems. There is an increasing fear that the contraction of polar systems spells the imminent loss of the integrity of these systems. Attention needs to be given to this component of their signfiicance that also has societal and economic consequences for peoples and nations in these regions or related to these regions in some way. [Andrew Constable, Australia]	accepted
8220	3	72	46	72	46	I would rephrase "Humans are relatively recent arrivals in Antarctica…". I get what the authors mean but I find it awkward. Something like "Human occupancy is relatively recent in Antartica…" [Benoit Montpetit, Canada]	accepted
21188	3	72	47	72	47	The phrase 'citizens' of Antarctica does not correctly reflect the relationship that people have with the southern polar region. If the term is meant to reflect that there are no long term resident communities as there are in the Arctic then it needs to be expressed as such. During 1980s and 1990s, there was a growing global movement that Antarctica was a key region for the globe and that everybody had a stake in the heritage and future of the southern polar region. The importance of the region to the global community is articulated in the objectives of the instruments grouped as the Antarctic Treaty System. As in the previous comment, this needs to be reflected as a valid value of the region, which, although stems only from the 19th century, is still akin to the cultural significance of the Arctic to the Arctic peoples. [Andrew Constable, Australia]	accepted
5466	3	72	49	72	49	"… non-indigenous immigrants." Does non-indigenous and immigrants not have exactly the same meaning, so that one of the two terms would be sufficient? [Roderik Van De Wal, Netherlands]	accepted
19224	3	72	49	72	49	Statement says that non-indigenous people are immigrants, which is not correct I guess [Marianne Kroglund, Norway]	accepted
22618	3	72	49			please consistently refer to "Arctic Indigenous Peoples" [Eva Kruemmel, Canada]	in some cases I did, in other cases I did not
20890	3	72	53	72	53	Error: 2% is the percentage of Minority indigenous peoples (a status attributed from the Soviet period to peoples with less than 50 000 individuals). It does not take into account the 10 other Indigenous peoples of Siberia with for each- a population aroung 200 000 to 500 000 individuals, who also suffer from CC. So you can leave "2%" if you add "Minority" or there is a need to recalculate the percentage to cover all the Siberian indigenous representatives. Up to the authors. [Alexandra Lavrillier, France]	changed
13310	3	72	54	72	54	There is a missing period at the end of this sentence. [Katherine Bishop-Williams, Canada]	accepted
20186	3	72	54	72	57	Please rewrite or punctuate this sentence (or split into two) to facilitate reading, and add references where appropriate [Michelle A. North, South Africa]	accepted
20188	3	72	54	73	2	Please capitalize "Arctic" [Michelle A. North, South Africa]	accepted

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
8070	3	72	55	72	55	Please consider replacing "southern based" by "lower latitudes based" - "southern" can be confused with tropical/equatorial or Southern Hemisphere. [APECS Group Review, Germany]	accepted
2618	3	72	57	72	57	remove "give" [Patrik Winiger, Netherlands]	accepted
13312	3	72	57	72	57	There is an extra word in this line that does not fit. [Katherine Bishop-Williams, Canada]	accepted
22620	3	72	57			"give provide for" - should rather say "have various levels of self-government". [Eva Kruemmel, Canada]	accepted
21190	3	73	1			It is not clear what 'human responses' means in this context. There is a human response to the impacts of climate change on the polar regions which is one of fear and action on the global stage, which influences attitudes, national responses and the actions that may be taken in global instruments. Here, the paragraph is reflecting on what governance arrangements are in place to manage human activities directly within the region. It is correct to say that layers of governance extend from local, national, multilateral and international (open to all nations) in the Arctic while in the Antarctic it is international, but with national and multilateral arrangements embedded in that context. At present, this paragraph does not correctly articulate the governance of the region. [Andrew Constable, Australia]	interesting points -- will incoprorate
23864	3	73	4	73	4	provide examples for "international agreements " [Hans-Otto Poertner and WGII TSU, Germany]	accepted
2620	3	73	6	73	6	"herding" is mentioned twice in the list. [Patrik Winiger, Netherlands]	accepted
20892	3	73	6	73	8	It could be eventually be added for Siberia: " Lavrillier 2013" or "Lavrillier, Gabyshev and Rojo 2016". References: Lavrillier, A. 2013 Climate change among nomadic and settled Tungus of Siberia: continuity and changes in economic and ritual relationships with the natural environment, Polar Record, Vol. 49, issue 03, pp. 260-271 / Lavrillier, A., Gabyshev, S and Rojo, M., 2016 The Sable for Evenk Reindeer Herders in Southeastern Siberia: Interplaying Drivers of Changes on Biodiversity and Ecosystem Services: Climate Change, Worldwide Market Econonomy and Extractive Industries, in M. Roué and Z. Molnar (eds.), Indigenous and Local Knowledge of Biodiversity and Ecosystems Services in Europe and Central Asia: Contributions to an IPBES regional assessment. Knowledge and Nature 9. UNESCO: Paris, p. 111-128. [Alexandra Lavrillier, France]	accepted
23866	3	73	6	73	7	This sentence needs revision (eg. herding mentioned twice, fishing instead of fish and on before the list of dependences [Hans-Otto Poertner and WGII TSU, Germany]	can't find this -- number ref is wrong
8072	3	73	14	73	15	Missing an example to the statement "in other cases they benefit financially". [APECS Group Review, Germany]	accepted
3662	3	73	16			Southcott and Natcher, 2018)(high confidence). - please insert hyphen between brackets [Angelika Brandt, Germany]	accepted

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
21192	3	73	18			This paragraph is about governance but articulates a novel system of governance that seems a mix of regulatory bodies and economic arrangements. I am not sure that such a mix is novel when there are many terrestrial and coastal counterparts with similar mixes of management of activities. My comment is to clearly separate governance (regulation) from economic activities, incentives and teh like. [Andrew Constable, Australia]	this reviewer is using a different definitiaon of governance. Governance is in fact more than regyulations, it is a PROCESS by which society navigages challenges and makes informal and formal rules.
8222	3	73	22	73	23	rephrase "..., with make multi-level linkages providing opportunities...". [Benoit Montpetit, Canada]	accepted
2622	3	73	23	73	23	remove"make" [Patrik Winiger, Netherlands]	accepted
21194	3	73	26			Section 3.5.3 could be deleted without loss to the chapter as it is textbook material that would apply anywhere. [Andrew Constable, Australia]	text modified to accept change
2624	3	73	37	73	37	The reference is double. [Patrik Winiger, Netherlands]	accepted
1338	3	73	40			agree SES approach has great utility - perhaps also include refences to Ostrom's work here? [Marcus Haward, Australia]	added
14336	3	73	47	73	48	These principles can serve both to evaluate past actions and guide...' [Christopher Fogwill, UK]	added to cross box text
1340	3	73	51	73	54	would it be useful to make explicit the link to the capitals/livelihoods approach that appears to underpin this section of analysis? [Marcus Haward, Australia]	accepted
20894	3	73	52	73	53	In the list of references, (if not cited in the previous pages) perhaps add for a Siberian examples: Lavrillier, A., Gabyshev, S and Rojo, M., 2016 The Sable for Evenk Reindeer Herders in Southeastern Siberia: Interplaying Drivers of Changes on Biodiversity and Ecosystem Services: Climate Change, Worldwide Market Econonomy and Extractive Industries, in M. Roué and Z. Molnar (eds.), Indigenous and Local Knowledge of Biodiversity and Ecosystems Services in Europe and Central Asia: Contributions to an IPBES regional assessment. Knowledge and Nature 9. UNESCO: Paris, p. 111-128 [Alexandra Lavrillier, France]	I was not able to find the last citation s (which looks interesting) in spite of several searches.
22160	3	73	56	73	56	the Yamal Penn of Siberia -> the Yamal Peninsula of Siberia ; a case e.g. reported in Bartsch et al. 2010, which is cited in an earlier section [Annett Bartsch, Austria]	accepted
20192	3	74	0	74		Please capitalize "Arctic" in both Table 3.3 and 3.4. [Michelle A. North, South Africa]	accepted
20194	3	74	0	74		Table 3.3. Consider simplifying (pr providing examples using lay language) for the "National and international initiatives that inform shadow networks and sectoral decision making through intentional processes that facilitate reflexive action" because I don't understand a word of what is intended here and I'm sure I'm not alone. [Michelle A. North, South Africa]	done!
20196	3	74	0	74		Table 3.4. Consider adding airstrips or aircraft landing facilities and boat launch sites under "Physical infrastructure" [Michelle A. North, South Africa]	accepted
21080	3	74	0	74		Table 3.3 Isn't economic opportunities a system property? --jobs, finances, infrastructure etc--play NO role in resilience? Seems like communities with resources do better. [Thomas Wagner, USA]	interesting questions. Yes -- but I would say that is an outcome of these resources, not an asset in and of itself. It is a conditions associated with many of these factors, like geography, financial reosurces, and skills..

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
21082	3	74	0	74		Table 3.4 Table title--is this really only about "subsistence harvesting"? [Thomas Wagner, USA]	yes - there is overlap. Tried to make it more specifice to subistence
5468	3	74	2	74	3	How can an uncertainty range be indicated for this statement. Is this not just true. [Roderik Van De Wal, Netherlands]	section now cut
13524	3	74	2	74	2	Full stop should be placed after the parethesis and 'However' begins a new sentence. [Debra Roberts and Durban Team, South Africa]	section now cut
20896	3	74	5	74	6	Perhaps add for Siberian examples of adaptive capacities based on mastering ILK and mobility: Lavrillier A. & S. Gabyshev, 2017 An Arctic Indigenous Knowledge System of Landscape, Climate, and Human interactions. Evenki Reindeer Herders and Hunters, Studies in Social and Cultural Anthropology, Kulturstiftung Sibirien, Fürstenberg/Havel, Germany 467p / Golovnev, A. 2018 Challenges to Arctic Nomadism: Yamal Nenets Facing Climate Change Era Calamities, Arctic Anthropology, vol 54, 2, pp.40-51. [Alexandra Lavrillier, France]	first citation is interesting -- but not polar; second is helpful - thank you
20190	3	74	10	74	10	Delete "take" so that it reads: "...do not fully account for..." [Michelle A. North, South Africa]	accepted
5470	3	74	18	74	18	The caption table 3.3 says "system properties", while the table is listing conditions. Should the caption also say "conditions"? [Roderik Van De Wal, Netherlands]	accepted
5472	3	74	18	74	18	The titles of each column in table 3.3 and 3.4 should be in bold. [Roderik Van De Wal, Netherlands]	accepted
22622	3	74	18	74	19	please refer to "Indigenous knowledge". [Eva Kruemmel, Canada]	accepted
23868	3	74	18	74	19	Table 3.3: Doesn't this «diversity/redundancy enhancing resilience» concept refers to the eco- and not the human system? I know (and fully support) this concept in regard to (resource) species diversity, functional/species redundancy, etc. But I've never heard about it in the context of human societies. [Hans-Otto Poertner and WGII TSU, Germany]	cultural diversity also contributes to resilience. Redundancy can refer to human capital as well as ecological
8074	3	74	21	74	21	Please consider replacing table 3.4 by a diagram of a figure (a schematic pie diagram or a figure in the attachment "suggested_table34replacement_DianaVladimirova.pptx" with a supporting explanation from the column 2). A reader needs a diverse way to the information representation, solely 4 tables in the section a not easily comprehensive. [APECS Group Review, Germany]	hummm will condiser this suggestion.
1754	3	74	24	82	34	I am not sure if this is the best place for this comment but I think it should be noted somewhere that the response of many sectors, such as shipping, subsistence economies and tourism, will depend on our ability to forecast Arctic/Antarctic sea ice conditions on a seasonal basis. Our current ability is little better than following the linear trend (Stroeve et al, 2014, doi:10.1002/2014GL059388) but will hopefully improve in the future. [Mark England, UK]	accepted
21196	3	74	24			Section 3.5.4 could be reduced considerably as it is restating what is in earlier sections. [Andrew Constable, Australia]	done
20202	3	75	0	76		Table 3.5. Try to reduce the text as far as possible to make the table more legible (e.g., "Policy changes" instead of "Chandes in policies", "Implement adaptive management" instead of "Implementation of adaptive management", "oil price" instead of "price of barrel of oil", etc.), and consider setting table in landscape to allow text to wrap better [Michelle A. North, South Africa]	accepted

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
21084	3	75	0	75		Table 3.5 I like this table, and in many ways it's THE BIG TABLE for the whole report for the Arctic and this chapter is about "Responding". But it's so disconnected from the discussion of policy, governance etc, that it's of limited use. Maybe add a column on the relevant governance, regulatory authority etc for each issue? and discuss it later in the chapter? [Thomas Wagner, USA]	accepted
20198	3	75	3	75	3	"potentially" [Michelle A. North, South Africa]	accepted
20200	3	75	3	75	4	Modify to read: "The sector responses assessed here are not exhaustive; but do include important activity areas of..." [Michelle A. North, South Africa]	accepted
8076	3	75	7	76	1	Was the logistics serving research and science purposes included in the transportation section? Was there an increase in the transportation intensity observed over the last years? [APECS Group Review, Germany]	accepted
8078	3	75	7	76	1	For the further political decision-making process, it would be more representative to re-arrange the raws in order to merge some of the key assets and strategies (column 4), which by one action can serve a few mitigation strategies. We can make it clear that it is not such a Herculean effort as it seems to be. E.g. merging the key assets for subsistence (raw 3), reindeer herding (raw 4) and infrastructure (raw 7) and merging the key assets for the transportation (raw 6), coastal settlements (raw 8) and tourism (raw 9). [APECS Group Review, Germany]	accepted
23870	3	75	7	75	7	Table 3.5, strategies for commercial fisheres: maybe think about including an expression such as "management in an ecosystem context" [Hans-Otto Poertner and WGII TSU, Germany]	accepted
23872	3	75	7	75	7	Table 3.5, line 5, column 3: What are «coms» regions? [Hans-Otto Poertner and WGII TSU, Germany]	accepted
12626	3	76	0			Fisheries - needs to discuss freshwater fish - less ice cover reduces time for ice fishing - sometimes an easy access to protein. [Alexander Milner, UK]	accepted
15578	3	76	0	82		Identifying resilience strategies for both communities and sectors is an important step. A critical requirement is to determine how best to move indigenous communities to sustainability. [Melinda Kimble, USA]	accepted
19226	3	76	13	76	13	Consider to add a generic text on how adaptive management and ecosystem approach management is an important tool for adaptation, before giving the examples that follows. [Marianne Kroglund, Norway]	accepted
8224	3	76	16	77	1	rephrase "... employing scenario-informed management strategy evaluations to inform management..." [Benoit Montpetit, Canada]	accepted
21086	3	77	0	78		3.5.4.1 Other than overview, what is the point of this section? This chapter is Responding, are there examples of how we have Responded? [Thomas Wagner, USA]	accepted
14338	3	77	2			science-based [Christopher Fogwill, UK]	accepted
13526	3	77	23	77	23	This is not an acceptable in-text referencing style. [Debra Roberts and Durban Team, South Africa]	accepted
23874	3	77	23	77	23	Provide appropriate reference (instead of a website) [Hans-Otto Poertner and WGII TSU, Germany]	accepted
13528	3	77	25	77	34	What is contained here (including lines 44-50) is a repeat of contents from page 50 lines 22-40 [Debra Roberts and Durban Team, South Africa]	accepted

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
17348	3	77	25	77	28	These statements are contradicted higher up in terms of projections, which note that "historical climate variability" is already exceeded. European Parliament reports are not necessarily the best citation here. Suggest remove or make more accurate by qualifying "moderate warming" which usually is meant to mean RCP4.5, which already lies outside the "historical variability" range. [Pamela Pearson, USA]	accepted
23878	3	77	25	77	32	This section is almost completely copied from P50L22-28. Either just refer to this section or rewrite. [Hans-Otto Poertner and WGII TSU, Germany]	accepted
5474	3	77	27	77	27	Maybe the temperature range correspondig to this period could be added and compared to climate change predictions. [Roderik Van De Wal, Netherlands]	accepted
13530	3	77	38			nm' what does this unit mean? [Debra Roberts and Durban Team, South Africa]	accepted
20204	3	77	38	77	38	As mentioned earlier, please ensure that the unit for nautical miles is not nm, which is nanometer, but rather NM or nmi [Michelle A. North, South Africa]	accepted
20206	3	77	42	77	44	Please rewrite the sentence: "In the Canadian sector…but climate change with decreasing ice cover together with over-havesting of fish stocks other places may increase the incitement" because it doesn't make any sense [Michelle A. North, South Africa]	accepted
1694	3	77	44	77	44	"incitement" should be "incentives" [Lawrence Hamilton, USA]	accepted
23876	3	77	52	78	16	I suggest listing/mentioning the major fishery nation exploiting Antarctic marine living resources [Hans-Otto Poertner and WGII TSU, Germany]	accepted
6414	3	77	53			Antarctic convergence zone should be replaced by Antarctic Polar Frontal [Keith Reid, Australia]	accepted
3664	3	78	8			(Brooks, 2013)(low confidence). - please insert hyphen between brackets [Angelika Brandt, Germany]	accepted
8226	3	78	19	78	19	where does the parenthesis end? [Benoit Montpetit, Canada]	accepted
5898	3	78	29	78	29	The Baffin Bay Davis Strait AACA report has also been published and is probably also relevant. [Sharon Smith, Canada]	accepted
19228	3	78	29	78	30	update with references to scientific background reports -- these references are to the overview reports. Consider also to add reference to the last of the three regional reports (Adaptation Actions for a Changing Arctic: Perspectives from the Baffin Bay/Davis Strait Region) [Marianne Kroglund, Norway]	accepted
20898	3	78	39	78	45	In eastern Siberia we notice the same (Lavrillier 2013, Lavrillier, Gabyshev and Rojo 2016), but recently the increase of predators is threatening this responsivness (Lavrillier and Gabyshev 2018). References: Lavrillier, A. 2013 Climate change among nomadic and settled Tungus of Siberia: continuity and changes in economic and ritual relationships with the natural environment, Polar Record, Vol. 49, issue 03, pp. 260-271 / Lavrillier A. and S. Gabyshev 2018, An Emic Science of Climate: a Reindeer Evenki Environmental Knowledge and the Notion of an Extreme Process of Change, in A. Lavrillier, A. Dumont, D. Brandisauskas (eds) Human-environment relationships in Siberia and Northeast China: Skills, Rituals, Mobility and Politics among the Tungus Peoples, accepted, EMSCAT, 49; [Alexandra Lavrillier, France]	accepted
14340	3	78	40			comma after e.g. [Christopher Fogwill, UK]	accepted

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
22624	3	78	42			You may want to include the reference Berner, et al. (2016) Adaptation in Arctic circumpolar communities: food and water security in a changing climate, International Journal of Circumpolar Health, 75:1, 33820, DOI:10.3402/ijch.v75.33820 [Eva Kruemmel, Canada]	accepted
1696	3	78	47	78	47	"activity areas subsistence" should be "areas of subsistence activity" [Lawrence Hamilton, USA]	accepted
5476	3	78	55	78	56	At firs it is stated that "Because Arctic residents are aware of the sources and impacts of climate change at a global scale, there are also efforts to use alternative energies". However after is said that: "To be sure, the motivation to pursue these technologies is to a great extent economic, but they are also motivated by a perceived global crisis" Are not these statements contradictory? [Roderik Van De Wal, Netherlands]	accepted
5478	3	79	1	79	1	"... the motivation to ... great extent economic ..." What is the source for this statement? [Roderik Van De Wal, Netherlands]	accepted
20218	3	79	3	79	33	Please rewrite this sentence ("In Alaska...driven by climate.") [Michelle A. North, South Africa]	accepted
6082	3	79	4			It's not only the need for cultural survival but also a fundamental issue of health and well-being (thinking of food security and POPs, for example). [Joanna Petrasek Macdonald, Canada]	accepted
22626	3	79	4			Please refer to "Arctic Indigenous Peoples". Also, since "Permanent Participants" is a specific term created by the Arctic Council, so it should be capitalized. Please also note that the Permanent Participants are not only involved in the Arctic Council Working Groups, but in ALL of Arctic Council's work (which includes higher level (including ministerial) meetings, expert groups and many other associated activities. [Eva Kruemmel, Canada]	accepted
20208	3	79	8	79	8	Please write Arctic Council out in full instead of only "AC" [Michelle A. North, South Africa]	accepted
20210	3	79	8	79	11	This is not a sentence I'm afraid, please rewrite and ensure it conveys what it is meant to [Michelle A. North, South Africa]	accepted
23880	3	79	8	79	8	Does AC stand for Arctic Council? Please use full term or define at first mention [Hans-Otto Poertner and WGII TSU, Germany]	accepted
5480	3	79	14	79	16	How can an uncertainty range be indicated for this statement? [Roderik Van De Wal, Netherlands]	accepted
20212	3	79	15	79	16	Were the hunter-proposed changes accepted? It doesn't say much for cooperation simply stating that the hunters proposed changes... and please include references for this statement [Michelle A. North, South Africa]	accepted
20214	3	79	21	79	21	"identity" not "identify" [Michelle A. North, South Africa]	accepted
23884	3	79	21	79	21	should be identity (not identify) [Hans-Otto Poertner and WGII TSU, Germany]	accepted
23882	3	79	22	79	23	Penn et al 2016 is not in the reference list [Hans-Otto Poertner and WGII TSU, Germany]	accepted

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
20900	3	79	28	79	29	This section on reindeer herding is really short regarding the impressive literature existing on this topic. For Siberian large scale herding - Golovniev 2018 (Golovnev, A. 2018 Challenges to Arctic Nomadism: Yamal Nenets Facing Climate Change Era Calamities, Arctic Anthropology, vol 54, 2, pp.40-51.) for herding with small herds (Lavrillier, A. 2013 Climate change among nomadic and settled Tungus of Siberia: continuity and changes in economic and ritual relationships with the natural environment, Polar Record, Vol. 49, issue 03, pp. 260-271 / Lavrillier A. & S. Gabyshev, 2017 An Arctic Indigenous Knowledge System of Landscape, Climate, and Human interactions. Evenki Reindeer Herders and Hunters, Studies in Social and Cultural Anthropology, Kulturstiftung Sibirien, Fürstenberg/Havel, Germany 467p./), for Sami some of the publications from Eira, I.M.G.;or Magga, O. H.; or Oskal A. or other results from EALAT project would be good here. [Alexandra Lavrillier, France]	accepted
20216	3	79	29	79	30	Modify sentence to read: "For example, in Fennoscandia, some (mostly Sami) reindeer husbandry practices include supplemental feeding..." [Michelle A. North, South Africa]	accepted
20902	3	79	39	79	43	The paper of Golovnev 2018 is supporting this argument and adds some important nuances based on the last dramatic events of 2016-2017. It should be interesting to add a sentence about this paper in this discussion. Golovnev, A. 2018 Challenges to Arctic Nomadism: Yamal Nenets Facing Climate Change Era Calamities, Arctic Anthropology, vol 54, 2, pp.40-51. [Alexandra Lavrillier, France]	accepted
20904	3	79	39	79	44	According to Lavrillier and Gabyshev 2017, pp.243-283, pp.300-444) in eastern Siberia "climate change raises many different snow anomalies the IP know/analysis well. It is not only the famous "rain on snow" or "thawing- freezing", but also many other complexe disruptions in the transformation of the different layers within the snow cover.They use their own snow typologies and methods of analysis. Abnormal winter and summer analysis as well as analysis of events considered 'extreme' by the nomads (conducted with reference to both TEK and social anthropology) demonstrated frequent anomalies in the evolution of the snow and ice covers and significant variations in different topographies (Lavrillier and Gabyshev 2017)." Lavrillier A. & S. Gabyshev, 2017 An Arctic Indigenous Knowledge System of Landscape, Climate, and Human interactions. Evenki Reindeer Herders and Hunters, Studies in Social and Cultural Anthropology, Kulturstiftung Sibirien, Fürstenberg/Havel, Germany 467p./ [Alexandra Lavrillier, France]	accepted
20906	3	79	39	79	44	Perhaps add this quotation: 'In eastern Siberian mountain regions, herders and hunters are well aware that topography and the snow typology are interconnected. Herders use the various topographies of their nomadic lands to adapt to anomalies in the snow cover and ensure that they can find better pastures for the reindeer (Lavrillier and Gabyshev 2017, 245). Reference: Lavrillier A. & S. Gabyshev, 2017 An Arctic Indigenous Knowledge System of Landscape, Climate, and Human interactions. Evenki Reindeer Herders and Hunters, Studies in Social and Cultural Anthropology, Kulturstiftung Sibirien, Fürstenberg/Havel, Germany 467p./ [Alexandra Lavrillier, France]	accepted

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
2626	3	79	51	79	53	I am not sure what the meaning of this sentence should be. Has receding sea ice and glaciers in the Arctic opened new possibilities for development, such as in Greenland or has receding sea ice and glaciers opened new possibilities in the Arctic and eastern Greenland? [Patrik Winiger, Netherlands]	accepted
5482	3	80	1	80	10	This entire section is a bit sloppy, it contains multiple spelling mistakes/missing words or letters. [Roderik Van De Wal, Netherlands]	accepted
21310	3	80	1	81	3	Demands a closer look in order to remove ambiguity. [Sanjay Chaturvedi, India]	accepted
2628	3	80	3	80	4	This sentence is incomplete. There is at least one word missing. [Patrik Winiger, Netherlands]	accepted
20220	3	80	3	80	3	Please change "in insure" to "to ensure" [Michelle A. North, South Africa]	accepted
2630	3	80	6	80	6	looding -> Flooding [Patrik Winiger, Netherlands]	accepted
20222	3	80	6	80	6	There is a missing "F" in "Flooding events" [Michelle A. North, South Africa]	accepted
22628	3	80	6			I assume "Flooding" is meant here. [Eva Kruemmel, Canada]	accepted
2632	3	80	9	80	9	Suggestion: This assessments is limited due to the lack of peer-reviewed literature on.... [Patrik Winiger, Netherlands]	accepted
20224	3	80	9	80	9	Modify so that it either reads "there are few peer-reviewed publications…" OR "there is scant (or little) peer-reviewed literature…" [Michelle A. North, South Africa]	accepted
11012	3	80	12	80	27	In your discussion of infrastructure, please add that some settlements are becoming unihabitable, due to coastal erosion following from sea ice loss and sea level rise. Here are two references to cite The Tight Dialectic: The Anthropocene and the Capitalist Production of Nature By: Millar, Susan W. S.; Mitchell, Don ANTIPODE Volume: 49 Supplement: S1 Pages: 75-93 Published: JAN 2017.... And Climate displacement in the United States The case of Newtok village, Alaska By: Bronen, Robin LAND SOLUTIONS FOR CLIMATE DISPLACEMENT Book Series: Routledge Studies in Development Displacement and Resettlement Pages: 326-340 Published: 2014 [Ben Orlove, USA]	accepted
5484	3	80	14	80	27	It would be useful if this information were summarized in a table [Roderik Van De Wal, Netherlands]	accepted
5900	3	80	14	80	27	In Canada, there has been an effort the past few years to develop standards and guidelines to address climate change impacts on northern infrastructure and to support adaptation. See Northern Infrastructure Standardization Initiative at link provided for additional information (https://www.scc.ca/en/nisi). Also there are guidelines documents from Canadian Standards Association (CSA) and Transportation Association of Canada relevant to adaptation of infrastructure in permafrost (the CSA guidelines are currently being updated). Canadian Standards Association, 2010. Technical Guide - Infrastructure in permafrost: a guideline for climate change adaptation. Plus 4011-10; Transportation Association of Canada, 2010. Guidelines for development and management of transportation infrastructure in permafrost regions, Ottawa. [Sharon Smith, Canada]	accepted

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
20226	3	80	14	80	27	This paragraph requires close editorial attention (e.g., issues, plural; polar regions (lowercase); where instead of were, etc). [Michelle A. North, South Africa]	accepted
2634	3	80	16	80	16	Insert "of", as in : as a consequence of [Patrik Winiger, Netherlands]	accepted
23888	3	80	17	80	19	Could you elaborate on the climate scenarios (also which ones would reduce the costs by half) [Hans-Otto Poertner and WGII TSU, Germany]	accepted
23886	3	80	19	80	27	provide references! [Hans-Otto Poertner and WGII TSU, Germany]	accepted
14342	3	80	24			where not were. Also, comma needed after 'where' [Christopher Fogwill, UK]	accepted
2636	3	80	26	80	26	(x) ? [Patrik Winiger, Netherlands]	accepted
5486	3	80	26	80	27	How can an uncertainty range be indicated for this statement? [Roderik Van De Wal, Netherlands]	accepted
8080	3	80	26	80	26	Something is missing in the brackets: "... of the state (x)". [APECS Group Review, Germany]	accepted
23890	3	80	26	80	26	why is there an (x)? [Hans-Otto Poertner and WGII TSU, Germany]	accepted
16550	3	80	31	80	46	Moving beyond the cruise focus, this section can also elaborate on other specific impacts from climate change on Arctic tourist demand. See e.g. Denstadli & Jacobsen (2014) "More clouds on the horizon?" and Førland et al. (2013) "Cool weather tourism under global warming" articles. [Osman Cenk Demiroglu, Sweden]	accepted
23892	3	80	33	80	33	it is, not its [Hans-Otto Poertner and WGII TSU, Germany]	accepted
14344	3	80	39			growth not grow [Christopher Fogwill, UK]	accepted
20228	3	80	39	80	39	"growth", not "grow" [Michelle A. North, South Africa]	accepted
3666	3	80	46			2016)(medium confidence). - please insert hyphen between brackets [Angelika Brandt, Germany]	accepted
19230	3	80	46	80	46	mention efforts under the Arctiv council on emergency preparedness and response and search and rescue? [Marianne Kroglund, Norway]	accepted
2638	3	80	48	80	48	This is a troubling development. Maybe it would be worthwile mentioning that Antarctic tourism has an enormous high carbon footprint (per capita) and a short visit there rivals with the annual per capita carbon emissions of average Earth citizens (see Farreny et al. 2011 10.1017/S0954102011000435). [Patrik Winiger, Netherlands]	accepted
3308	3	80	52	50	52	However, with a different font? [Castor Muñoz Sobrino, Spain]	accepted
14346	3	81	1	81	4	This sentence doesn't make sense [Christopher Fogwill, UK]	accepted
20230	3	81	2	81	2	What is ATS? Please write out in full [Michelle A. North, South Africa]	accepted
5902	3	81	6			Section 3.5.4.7 - There isn't much on roads in this section. Also there was a recent Canadian assessment on assessment of risks to transportation which includes a chapter on northern Canada - this may be relevant to this discussion. Pendakur, K., 2017. Northern Territories. In: K. Palko and D.S. Lemmen (Editors), Climate risks and adaptation practices for the Canadian transportation sector 2016. Government of Canada, Ottawa, ON, pp. 27-64. http://www.nrcan.gc.ca/environment/resources/publications/impacts-adaptation/reports/assessments/2017/19623 [Sharon Smith, Canada]	accepted

SROCC First Order Draft Expert Review Comments - Chapter 3							
Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
2350	3	81	8	81	19	Any transportation in and around the Arctic also risks direct climate impacts on the area through emissions from shipping, particularly that of black carbon and other SLCPs. (Arctic Council Task Force on Short-Lived Climate Forcers (2013) RECOMMENDATIONS TO REDUCE BLACK CARBON AND METHANE EMISSIONS TO SLOW ARCTIC CLIMATE CHANGE; Arctic Council Secretariat (2017) EXPERT GROUP ON BLACK CARBON AND METHANE: SUMMARY OF PROGRESS AND RECOMMENDATIONS 2017; Arctic Monitoring and Assessment Programme (AMAP) (2015) SUMMARY FOR POLICYMAKERS: ARCTIC CLIMATE ISSUES 2015 SHORT-LIVED CLIMATE POLLUTANTS; International Council on Clean Transportation (ICCT) (2017) GREENHOUSE GAS EMISSIONS FROM GLOBAL SHIPPING, 2013–2015; Wan Z., et al. (2016) Pollution: Three steps to a green shipping industry, NATURE 530:275–277.) [Kristin Campbell, USA]	accepted
2476	3	81	8	81	19	Any transportation in and around the Arctic also risks direct climate impacts on the area through emissions from shipping, particularly that of black carbon and other SLCPs. (Arctic Council Task Force on Short-Lived Climate Forcers (2013) RECOMMENDATIONS TO REDUCE BLACK CARBON AND METHANE EMISSIONS TO SLOW ARCTIC CLIMATE CHANGE; Arctic Council Secretariat (2017) EXPERT GROUP ON BLACK CARBON AND METHANE: SUMMARY OF PROGRESS AND RECOMMENDATIONS 2017; Arctic Monitoring and Assessment Programme (AMAP) (2015) SUMMARY FOR POLICYMAKERS: ARCTIC CLIMATE ISSUES 2015 SHORT-LIVED CLIMATE POLLUTANTS; International Council on Clean Transportation (ICCT) (2017) GREENHOUSE GAS EMISSIONS FROM GLOBAL SHIPPING, 2013–2015; Wan Z., et al. (2016) Pollution: Three steps to a green shipping industry, NATURE 530:275–277.) [Durwood Zaelke, USA]	accepted
12974	3	81	8	81	19	Any transportation in and around the Arctic also risks direct climate impacts on the area through emissions from shipping, particularly that of black carbon and other SLCPs. (Arctic Council Task Force on Short-Lived Climate Forcers (2013) RECOMMENDATIONS TO REDUCE BLACK CARBON AND METHANE EMISSIONS TO SLOW ARCTIC CLIMATE CHANGE; Arctic Council Secretariat (2017) EXPERT GROUP ON BLACK CARBON AND METHANE: SUMMARY OF PROGRESS AND RECOMMENDATIONS 2017; Arctic Monitoring and Assessment Programme (AMAP) (2015) SUMMARY FOR POLICYMAKERS: ARCTIC CLIMATE ISSUES 2015 SHORT-LIVED CLIMATE POLLUTANTS; International Council on Clean Transportation (ICCT) (2017) GREENHOUSE GAS EMISSIONS FROM GLOBAL SHIPPING, 2013–2015; Wan Z., et al. (2016) Pollution: Three steps to a green shipping industry, NATURE 530:275–277.) [Gabrielle Dreyfus, USA]	accepted
20232	3	81	8	81	9	NSR, AB, NWP and TPR? There is no reason why these areas can't be written out in full [Michelle A. North, South Africa]	accepted
20236	3	81	8	81	19	What about the risk that increased Arctic shipping provides to the marine mamal populations living in those waters? The increased shipping noise disturbance to whales? These should be mentioned in addition to that of increased risk of invasive species introduction and oil spills [Michelle A. North, South Africa]	accepted

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
20234	3	81	10	81	11	I don't understand what is meant by: " These increases are occuring in spite of the limited total savings when comparing shorter travel to increased CO2 emissions..." - what limited total savings? In distance, CO2, fuel, money? And why are there increased CO2 emissions, because ships are travelling through such a cold environment? Please consider rewriting this sentence completely [Michelle A. North, South Africa]	accepted
14348	3	81	17			modeling' not 'modelling' in US English [Christopher Fogwill, UK]	accepted
2352	3	81	21	81	34	The IMO currently has policies in place to reduce emissions of sulphur oxide and nitrogen oxide—of which black carbon reductions are a co-benefit—and policies to promote energy efficiency. Both of these could be expanded to include SLCPs. (Arctic Council Secretariat (2017) EXPERT GROUP ON BLACK CARBON AND METHANE: SUMMARY OF PROGRESS AND RECOMMENDATIONS 2017; Wan Z., et al. (2016) Pollution: Three steps to a green shipping industry, NATURE 530:275–277.) [Kristin Campbell, USA]	accepted
2478	3	81	21	81	34	The IMO currently has policies in place to reduce emissions of sulphur oxide and nitrogen oxide—of which black carbon reductions are a co-benefit—and policies to promote energy efficiency. Both of these could be expanded to include SLCPs. (Arctic Council Secretariat (2017) EXPERT GROUP ON BLACK CARBON AND METHANE: SUMMARY OF PROGRESS AND RECOMMENDATIONS 2017; Wan Z., et al. (2016) Pollution: Three steps to a green shipping industry, NATURE 530:275–277.) [Durwood Zaelke, USA]	accepted
12976	3	81	21	81	34	The IMO currently has policies in place to reduce emissions of sulphur oxide and nitrogen oxide—of which black carbon reductions are a co-benefit—and policies to promote energy efficiency. Both of these could be expanded to include SLCPs. (Arctic Council Secretariat (2017) EXPERT GROUP ON BLACK CARBON AND METHANE: SUMMARY OF PROGRESS AND RECOMMENDATIONS 2017; Wan Z., et al. (2016) Pollution: Three steps to a green shipping industry, NATURE 530:275–277.) [Gabrielle Dreyfus, USA]	accepted
20238	3	81	21	81	22	Modify to read: "...responsible for regulating international Arctic shipping.." [Michelle A. North, South Africa]	accepted
22924	3	81	21	81	45	Implications of Polar Code for the vessels should be improved, reference to polar ship certificate should be included [Vasily Smolyanitsky, Russian Federation]	accepted
23894	3	81	21	81	21	Provide the standard acronym IMO in brackets [Hans-Otto Poertner and WGII TSU, Germany]	accepted
20240	3	81	22	81	23	Please write out these acronyms: MARPOL, SOLAS, STCW... [Michelle A. North, South Africa]	accepted
2640	3	81	24	81	29	Please change. Suggestion: The Polar Code does address emerging issues, but is likely to need additions and modifications in the future. The agreement was consensus based, hence implemented at the lowest common denominator, including a call to enhance enforcement capabilities and address emerging issues such as heavy fuel oil (HFO) transport and use, black carbon emissions, and ballast water, among other environmental protection provisions (Anderson, 2012; Sakhuja, 2014; IMO, 2017). [Patrik Winiger, Netherlands]	accepted

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
20242	3	81	24	81	29	Please rewrite the sentence: "The Polar Code…and ballast water ()."; it is too long and can likely be split into two [Michelle A. North, South Africa]	accepted
20244	3	81	28	81	28	Please delete the acronym HFO for heavy fuel oil, it is completely unnecessary [Michelle A. North, South Africa]	accepted
20246	3	81	30	81	30	Please explain what is meant by "flags of convenience" [Michelle A. North, South Africa]	accepted
14350	3	81	41			delete repeated 'the' [Christopher Fogwill, UK]	accepted
14352	3	81	42			extraneous full stop between 'vessels' and 'travelling' [Christopher Fogwill, UK]	accepted
5488	3	81	43	81	45	How can an uncertainty range be indicated for this statement? [Roderik Van De Wal, Netherlands]	accepted
19260	3	81	49	81	49	Consider to add: Changing temperatures may affect human health and well being through impacts on community infrastructure (e.g. water treatment, sewage treatment, power supply) and community food and drinking water security.The combined effects of warming, pollution and zoonotic diseases also represent a significant risk to the security of subsistence food and water supply. Refernce: AMAP, 2015. AMAP Assessment 2015: Human Health in the Arctic. Arctic Monitoring and Assessment Programme (AMAP), Oslo, Norway [Marianne Kroglund, Norway]	accepted
20248	3	82	0	86		This section on governance contains far too many acronyms that are not necessary for such a short section. Please remove where possible and write out [Michelle A. North, South Africa]	accepted
8082	3	82	1	82	10	Can there be any suggestions for an "ideal" government policy regarding the health adaptation? [APECS Group Review, Germany]	accepted
13314	3	82	12	82	12	There is a missing word in this line. [Katherine Bishop-Williams, Canada]	accepted
22630	3	82	28	82	29	You may want to include the reference Berner, et al. (2016) Adaptation in Arctic circumpolar communities: food and water security in a changing climate, International Journal of Circumpolar Health, 75:1, 33820, DOI:10.3402/ijch.v75.33820 [Eva Kruemmel, Canada]	accepted
18478	3	82	36			Consider including a Section about WMO (World Meteorological Organisation) and especially its Executive Council Panel of Experts on Polar and High Mountain Observations, Research and Services (EC-PHORS) and Global Cryosphere Watch (GCW) here. EC-PHORS promotes and coordinate relevant programmes that are carried out in the Antarctic, Arctic and high mountain regions by nations and by groups of nations. GCW is an international mechanism for supporting all key cryospheric in-situ and remote sensing observations. [Anette Jönsson, Sweden]	accepted

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
21198	3	82	36			Section 3.5.5 could be reduced substantially so that it did not describe all the governance arrangements or possible arrangments but addressed the question - are the arrangements in place to be able to accommodate management requirements that enabled mitigation, adaptation and the maintenance of services as described in Chapter 1 (which I think is a good chapter to provide a framework here). In relation to Antarctic governance, the recent performance review of CCAMLR (2017) provides some guidance as to expert input on whether CCAMLR is able to respond to the challenges of climate change. For the Antarctic Treaty Consultative Meeting, they have a climate change response action plan in their Committee on Environmental Protection. Is that adequate? etc etc. There is a very real distinction between international hard law and regulations, and soft law cooperation, agreements and discussion forums. The text in this section seems far too optimistic and does not comply with confidence language of the IPCC. In my region of knowledge, the Antarctic Treaty System, the text does not satisfactorily disaggregate the regulatory bodies and mechanisms from scientific bodies from advisory bodies and unofficial bodies. In the end, what mechanisms are in place for effective management of illegal, unregulated and unreported activities? This is the important question. What is the evidence that the methods described in this section actually work? [Andrew Constable, Australia]	Rejected. The number of “all international agreements” applicable to polar international cooperation would be prohibitively large. Furthermore, the selection of agreements is not casual but fruit of a huge work of evaluation as only agreements pertinent to the nexus impacts/human adaptation and indigenous people have been chosen and this selection is strictly connected to adaptation and mitigation. Moreover, this is not an exercise to describe the “applicability” of international agreements to international cooperation. From an international law and a political science perspective, international cooperation is not comparable conceptually with the objective of Chapter 1. These chapters have a different frame, focus and approaches. Concerning the Antarctic part, the reviewer might have a point if the Antarctic part was framed as suggested but it is not. The Antarctic is different analysis compared to Arctic even if they do share the same structure in the section. We do not have to “disaggregate bodies/ institutions law on the contrary it is a holistic view and there is not such a technical confusion. In addition, Antarctic governance relates to climate change as it place for science to understand its mechanism and its real potential effects both in the AT area and on the earth system. The question is not to see a “regulatory” issue of mitigation and adaptation. The question is whether the current governance system relating to Antarctic (including SCAR) is conducive to promote climate science. Finally, admitting that the reviewer's perspective was valid in the legal and political discursive analysis, are there other sources to recommend except the one cited? (and other than the book chapter on the 2017 Handbook on Politics of Antarctic). They would be kindly received.
21244	3	82	36	86	48	A study by Aakre et al., Nature Climate Change may be relevant here. https://doi.org/10.1038/s41558-017-0030-8 [Jan Fuglestvedt, Norway]	Accepted; reference will be incorporated.
23896	3	82	36	86	48	The entire section 3.5.5 needs revision. It is a nice and comprehensive review with a lot of valuable information but not at all an assessment. Please focus on relevant information only, and shorten the rest. IPCC uncertainty language is used only 3 times on the next pages, and it is not always correctly used. Likelyhood is not used at all. Moreover, many statements are policy prescriptive or very close to. This assessment should be done based on current scientific knowledge and literature, not based on personal opinion. [Hans-Otto Poertner and WGII TSU, Germany]	Accepted. The section has been greatly revised and focussed to bring out assessment details. Some statements can give the impression of “opinion” even if there are not at all and this problem is addressed by adding references and confidence language as far as possible and by shortening the text.
1342	3	82	38	82	56	agree with focus on opportunities and challenges in multilevel governance – key issue is not only vertical integration between different governance agents – e.g. national governments and regional/international bodies but also the extent of horizontal interaction between elements of national governments and between regional /international bodies. [Marcus Haward, Australia]	Accepted. National component and the horizontal interaction now highlighted.
2642	3	82	44	82	44	This sentences doesn't really add anything. I suggest to remove it. [Patrik Winiger, Netherlands]	Accepted. Sentence removed.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
3668	3	82	49			Young, 2016)(high confidence). - please insert hyphen between brackets [Angelika Brandt, Germany]	Accepted. Actioned accordingly
23898	3	82	49	82	53	Avoind being policy prescriptive [Hans-Otto Poertner and WGII TSU, Germany]	Accepted. Text amended to avoid this.
2646	3	82	53	82	53	Our assessment -> The assessment in this chapter [Patrik Winiger, Netherlands]	Accepted. Change made
2644	3	82	54	82	54	though -> through [Patrik Winiger, Netherlands]	Accepted. Copy edit to be completed prior to publication.
23900	3	82	57	82	57	Do you mean «high agreement, robust evidence» or «high confidence»? please revise uncertainty language carefully [Hans-Otto Poertner and WGII TSU, Germany]	Accepted. “high confidence” was meant. Revision made.
19266	3	83	1	84	2	SWIPA documents status and trends. Delete portraying [Marianne Kroglund, Norway]	Accepted. Change made
13532	3	83	5			In this last section there are many references to policy interventions, saying they are 'important' but giving few specifics on what they actually try achieve. Many vague statements, little detail. [Debra Roberts and Durban Team, South Africa]	Accepted. Statements are documented, supported by references and confidence language.
1344	3	83	7	83	25	I have concerns over the language and expression in this section [Marcus Haward, Australia]	Accepted. Noting that this is a section on governance, institutions and international law, the language has been modified –legal international law language to facilitate a “non-social science audience”
19268	3	83	8	84	8	Consider to add Adaptation Actions for a Changing Arctic (AACA), which was delivered in 2017 [Marianne Kroglund, Norway]	Accepted and considered.
19270	3	83	11	84	11	Update with reference to the non-legally and aspirational target to limit black carbon (or soot) emissions between 25 and 33 percent below 2013 levels by 2025 in a bid to slow Arctic warming [Marianne Kroglund, Norway]	Accepted. Updated in the text
19272	3	83	12	84	12	It might be considered to mention AC's role in documenting and enhanging the understanding of Arctic change and its implications, and bridging Arctic knowledge into action. Consider to also mention the 2017 Ministerial Declaration which carries this legacy forward, and can substantiate local, regional and global actions. [Marianne Kroglund, Norway]	Rejected. This is a valuable comment but the section needs to be shortened and restricted to essential issues. The suggestion will add further additional information but not contribute to an essential issue of assessment.
1346	3	83	14			“This convention implement agreements on biodiversity beyond national jurisdictions” - this is not correct. UNCLOS is a framework convention that addresses the broad base of the law of the sea. UNCLOS principles and provisions are referred to in other instruments. But as yet it does not implement agreements on biodiversity. Current discussions, not concluded, are focusing on an implementing agreement on biodiversity beyond national jurisdiction that could be developed under UNCLOS. [Marcus Haward, Australia]	Accepted. The formulation used in this sentence could be misleading. Adjusted the sentence as it is the OSPAR convention (and not UNCLOS) that provides a framework for implementation of the UNCLOS and CBD. So, it is the regional conventions (OSPAR and CBD) that are providing frameworks to implement global conventions (UNCLOS).
1348	3	83	16			Reference to UNCLOS not correct “This is the case of UNCLOS implementing Annex V of the Convention on the Protection of Marine Environment of North East Atlantic (OSPAR)”. UNCLOs DOES NOT implement other Conventions. Materia needs to be restructured to refer to the correct interpretation that OSPAR Annex v measures are consistent with provisions established in UNCLOS. [Marcus Haward, Australia]	Accepted - see comment 1346.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
23902	3	83	17	83	19	Avoid being policy prescriptive; revise and provide references. Where is the proof that this is EXTREMELY relevant? Where is the section showing that mining/oil/gas activities interact NEGATIVELY with climate change and that the Arctic needs to be PROTECTED from these activities? [Hans-Otto Poertner and WGII TSU, Germany]	Accepted. Sentence deleted due to lack of strong literature supporting the argument
22632	3	83	27	83	44	Cooperation is also extremely strong on the issue of contaminants (e.g.in AMAP work) and in general Arctic monitoring. For example, there is strong cooperation of many countries, organizations and Indigenous Peoples organizations at the "Sustaining Arctic Observing Networks" (SAON, https://www.arcticobserving.org/) (which was co-developed by Arctic Council and the International Arctic Science Committee) - it is difficult to separate these activities in "formal" and "informal". Further, it is not clear why only the EU is highlighted as funding Arctic research. Particularly the Arctic states fund a lot of Arctic research, and Canada has the Northern Contaminants Program and just created the Canadian High Arctic Research Station (CHARS), which will also invite other countries to do research there. Further, in the last couple of years the organization of Arctic Ministerial Meetings (2016 in the US and 2018 in Finland and Germany) shows the interest and understanding of countries that more cooperation in Arctic research is needed. [Eva Kruemmel, Canada]	Rejected. With regards to the issue of contaminants, this is an interesting comment but, there is only limited space, and the section already contains enough information. Priority must be given to the assessment part rather that to the informative one. With regards to the comment on the European Union (EU), I disagree as it is extremely important that policy-makers at all the levels of governance are aware that due to the effects of climate change (like ice-melting) new business opportunities (but also risks for the environment) emerge, which means that new actors are entering in the scene of Arctic climate governance, actors that did not have any interests before, like the EU and the Asian Countries for example. This is the reason to mention the EU and to inform policy-makers of the huge investments the EU is undertaking in terms of research and innovation on Arctic Climatic issues (i.e. Horizon 2020). This is also a big novelty compared to the past and part of the assessment that the Arctic is becoming “global”.
22926	3	83	27	83	44	WMO initiatives like the Arctic Regional Climate Center - network, WMO-IHO GMDSS METAREAs XVII-XXI, International Ice Charting Working Group should be described in the section [Vasily Smolyanitsky, Russian Federation]	Rejected. Interesting comments but there are restrictions on space in the text and at this stage, priority must be given to assessment criteria rather than descriptive.
19262	3	83	29	83	30	Cooperation in the Arctic is wider than the issues listed, it includes not only marine environments, and is also focusing on societal systems and adaptation challenges and opportunities. Pollution prevention in relation to increased human activity is also an important cooperation issue in the Arctic. [Marianne Kroglund, Norway]	Rejected. The text in section 3.5.5.2 already includes societal system and adaptation challenges when assessing and subdividing international cooperation in three kinds: climate change, environment (marine) and scientific research. These 3 components already include adaptation (climate change) and societal system (marine/environment and scientific research), including the role of the EU in societal challenges and adaptation in the source of law mentioned in the section. In addition, there are restrictions on space in the text.
2648	3	83	31	83	33	On page 82 line 57 you mention a focus on ocean governance. Yet here, all examples are atmospheric(ally transported) pollutants. Please correct this dichotmy. [Patrik Winiger, Netherlands]	Rejected. International ocean governance in the Arctic is assessed in a holistic way and includes regulations on the nexus between climate change, law of the sea and anthropogenic effects. I do not see any “dichotomy” between the international law of the sea (which is part of ocean environmental governance) and how this is regulating and responding to the effects of climate chance in the atmosphere polluting. There are two things that should be connected and treated together rather than defined as “dichotomy”.
13534	3	83	38	83	38	This is not an acceptable in-text referencing style. [Debra Roberts and Durban Team, South Africa]	Accepted. Style adjusted.

SROCC First Order Draft Expert Review Comments - Chapter 3							
Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
18482	3	83	46	84	16	A new declaration (The Fairbank declaration) was signed in May 2017. [Anette Jönsson, Sweden]	Rejected. Although a declaration is not binding, it can have strong political messages. However, we have very limited space and need to prioritize which kind of sources to include or not within the context of international cooperation but it is not excluded.
22634	3	83	46	84	16	Please note that the Agreement on Enhancing International Arctic Scientific Cooperation will be legally binding, and the work of Arctic Council (in particularly AMAP) has also greatly contributed to the development of global, legally binding conventions, such as the Stockholm Convention on Persistent Organic Pollutants, and the Minamata Convention on Mercury, therefore AC activities already (and not just "potentially") result in "hard laws". I would further strongly suggest to revise the last sentence of this section, because it has been demonstrated throught the above mentioned examples that Arctic Council was (and continues to be) able to significantly influence action on "environmental global problems" - so it has been "dealing" with them. [Eva Kruemmel, Canada]	Accepted. It cannot be denied that the Arctic Council “has not attempted” to deal with Global problems even though this was not under discussion in the text. It cannot be adduced that the AC has been successful in dealing with global problems either. The Arctic Council is an institution that is choosing to prepare for climate change by attempting to deal with global problems.
6232	3	83	47	83	57	avoid acronym AC. When the context is clear it can be shortened to 'the Council' or it. [Regine Hock, USA]	Accepted and actioned
24922	3	83	47	84	16	The role of the Arctic Council in encouraging studies should not be underestimated. References to some of the more relevant AC assessments would be appropriate, including AMAP, CAFF and ACIA, in addition to SWIPA (which is mentioned). [Elizabeth Weatherhead, USA]	Rejected. There are limitations on space and priority should be given to assessment rather than description.
13536	3	83	48			sui generis' - 'unique'? [Debra Roberts and Durban Team, South Africa]	Accepted. It is possible to use the formulation “unique” instead of “sui generis”, which could be unsuitable for a policy report.
8084	3	83	50	83	51	Please consider mentioning the potential observers at the AC (Switzerland?) and explaining in a plain language what the status of the AC observer mean for a country. [APECS Group Review, Germany]	Rejected. Space restrictions make this addition not possible. It is not the objective of this section to be descriptive.
21312	3	83	50		51	Replace <permanent observer> with <observers>. The stauts granted under the Arctic Council is that of observer and not 'permanent observer.' [Sanjay Chaturvedi, India]	Accepted. I will replace with the word “observers”
19264	3	83	52	83	55	Check status on the agreement to reduce black carbon [Marianne Kroglund, Norway]	Accepted. I will check the status on the agreement to reduce black carbon
2650	3	83	57	84	3	Similar to AMAP 2017 aka SWIPA 2017 are the AMAP report on Black carbon and Ozone (2015) Methane (2015) and Chemicals of emerging Arcitc concer (2016). In that context, I think the paper by Aakre et al. 2018 (10.1038/s41558-017-0030-8) deserves to be mentioned, that argues for a positive effect of collaborations between small clubs of Arctic countries to limit black carbon and methane emissions. [Patrik Winiger, Netherlands]	Accepted. I will incorporate the suggestion if the part is retained.
18480	3	84	1	84	1	I am not sure that it has been metioned what the abbreviation AMAP stands for earlier in the text. [Anette Jönsson, Sweden]	Accepted. I will check and identify first.
2652	3	84	15	84	16	In that context, I think the paper by Aakre et al. 2018 (10.1038/s41558-017-0030-8) deserves to be mentioned, that argues for a positive effect of collaborations between small clubs of Arctic countries to limit black carbon and methane emissions. [Patrik Winiger, Netherlands]	Accepted. I will check and identify first.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
17352	3	84	15	84	16	The AC which encompasses the large economies of its eight member states is certainly not "too small" to effect these changes. Rather, for this long-time participant in AC processes it is more a lack of political will in deploying Council national resources to support these three noted points where AC engagement could expand. (Editorial note "through" in line 15.) [Pamela Pearson, USA]	Rejected. The argument of the lack of political will is certainly acceptable. However, it is part of the assessment of teh literature that the Arctic Council is too small and will need to revisit its existing agreements and peruse significant adjustments regarding matters of participation, programmatic structure capacity to deal with trans regional issues that cannot be dealt without drawing in a range of non-Arctic States . Accepted the comment on the editorial note “though” will be corrected. I will substitute the term “small” appearing in high impact factor literature with the expression “the council need to be reconfigured”
6084	3	84	18	84	41	The Inuit Circumpolar Council is very happy to see that our organization and work is showcased to this degree! ICC has certainly accomplished a lot through our international work and advocacy and continues to engage in these discussions and platforms. While the information included here is accurate and we're happy to have it in, we were surprised to see it included without having been contacted to have a discussion or even be notified that the IPCC report would like to showcase this work. We would have liked to have had the oportunity to contribute to preparations and drafting of text about ICC. Indeed, the IPCC remains one platform where our engagement is lacking, not because of our interest but because of the IPCC process and limitations. And this is an important platform we should be engaged in as the foundation for much discussion, research, and decision-making around climate change. This is a good example where the importance of partnership with Indigenous Peoples and Indigenous Organizations could have been demonstrated through co-authorship but falls short. Throughout this paragraph, please ensure that Peoples is plural on line 30 and Indigenous Peoples is capitalized and plural on line 34. [Joanna Petrasek Macdonald, Canada]	Noted. this section is about international governance and we are assesign the role fo ICC tthrough the scientific literature. With regards to the second part of your comment, ICC is involved in the work of the Cross-Chapter Box on Indigenous Knowledge.
17354	3	84	18	84	44	The ICC is only one of six Permanent Participant AC members, and several others are also regional in nature and perhaps equal or stronger in terms of activities. These should also be noted. [Pamela Pearson, USA]	Accepted. I will make sure that it is noted that the ICC is one of the six Permanent Participants of the AC.
21314	3	84	18			What about the Sammi Council? [Sanjay Chaturvedi, India]	Taken into acount. The comment is very interesting but for reasons of space, it is not possible to mention all Permanet Participants. We revises to make clear that ICC is one among six
21404	3	84	29	84	35	Authors should be careful to adhere to the mandate and outline of the Special Report as approved at IPCC-45. Evaluating participation in global policy frameworks falls outside the scope of this mandate. Moreover, it is premature to comment on the inputs and modalities of the Global Stocktake described by the Paris Agreement. These are under active negotiation as part of the Paris Agreement Work Programme, and have not been finalized. Sentences referring to the WIM and the Global Stocktake should be removed. [Alice Alpert, USA]	Accepted the comments with regards to the fact that it is premature to comment on the inputs and modalities of the Global Stocktake described in the Paris Agreement due to the fact that these negotiations are “ongoing”. It is a politically sensitive issue.Rejected with regards to avoiding considering evaluating participation in global policy frameworks because Polar regulatory landscape is shifting landscape due to climate change and this change has implications for the dynamics of international cooperation and is therefore part the objective assessment as described in the literature.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
17252	3	84	31	84	34	The negotiations on the sources of inputs of the Global Stocktake are ongoing under the APA. This sentence is prejudging the outcomes of these negotiations. ICC cannot " ensure" that… (Parties driven process). [Iulian Florin Vladu, Germany]	Accepted. The sentence on Global Stocktake will be removed for the same reason why the previous comment (21404) is accepted in its last part.
22636	3	84	43	85	12	Please refer to "Indigenous Peoples" and "Indigenous knowledge", as already commented on earlier. We also generally just speak of "community-based monitoring" since these activities can cover many different aspects, and not necessarily the ecosystem as such. [Eva Kruemmel, Canada]	Accepted. I will make sure to refer to Indigenous Peoples and indigenous knowledge.
23904	3	84	43			Provide link to Cross-Chapter Box 3 on ILK [Hans-Otto Poertner and WGII TSU, Germany]	Accepted. A link to Cross-Chapter Box 3 will be provided in this part as suggested
13538	3	84	44	84	44	Change 'of' before 'climate change' to 'to' [Debra Roberts and Durban Team, South Africa]	Accepted. The edit change will be followed if the sentence is retained in the new draft version to be submitted.
21316	3	85	17		18	The following sentence needs scrutiny and may be qualified and illustrated. "Currently co-operation does occur via UNCLOS…" [Sanjay Chaturvedi, India]	Rejected. The comment is interesting but for reason of space, it is not possible to develop as suggested.
1350	3	85	18	85	20	ATS and increasing intersection of regimes -utility if regime complex ideas see Haward 2017. Haward, M. 2017.Contemporary challenges to the Antarctic Treaty and The Antarctic Treaty System: Australian interests, interplay and the evolution of a regime complex. Australian Journal of Maritime and Ocean Affairs. 9, 1: 21-24. Haward, M. 2012.'Climate Change: Antarctica and the Southern Ocean, Science, Law and Policy' in R Warner and C Schofield (eds) Climate Change and the Oceans: Gauging the Legal and Policy Currents in the Asia Pacific and Beyond, Edward Elgar, Cheltenham: 107-126. Haward, M. 2014. The Southern Ocean, Climate Change and Ocean Governance in Clive Schofield, Seokwoo Lee, and Moon-Sang Kwon (eds) The Limits of Maritime Jurisdiction. Martinus Nijhoff Publishers, Leiden: 507-523. [Marcus Haward, Australia]	Rejected. Interesting references but we have limitations with space. However, it is not excluded that these will be reconsidered later in the process.
18484	3	85	20	85	21	The abbrevations of IAATO, ATS and CCAMLR are not explained until later in the text. [Anette Jönsson, Sweden]	Accepted. I will make sure to identify the abbreviations. first
23906	3	85	21	85	25	Avoid statements such as «CC is a big issue» and expressions like "big challenges"! [Hans-Otto Poertner and WGII TSU, Germany]	Accepted. I will avoid statement such as "big issue" or "big challenges" as it could be misinterpreted as a lack of objectivity in assessment terms.
23908	3	85	23	85	23	Delete «higher», the term is "ocean acification" [Hans-Otto Poertner and WGII TSU, Germany]	Accepted. The term "higher" will be deleted and replaced with the term "ocean acidification"
1352	3	85	35	85	36	need to check CCAMLR and Climate Change Response work program [Marcus Haward, Australia]	Accepted. I will check CCAMLR and Climate Change Response work program.
13540	3	85	35	85	35	Insert 'to' after 'agree' [Debra Roberts and Durban Team, South Africa]	Accepted. I will insert "to" after "agree" as suggested if the part is retained in the new draft.
22638	3	85	40	85	46	Please refer to "Indigenous Peoples", and it should read "A Circumpolar Inuit Declaration on Resource Development Principles in Inuit Nunaat" [Eva Kruemmel, Canada]	Accepted. I will refer to Indigenous Peoples and refer to the Declaration as suggested.
24924	3	85	40	85	53	Very happy to see non-state actors addressed. However, this section could be significantly improved by addressing the importance of the private sector in these issues. This includes private observations, innovations with observing capabilities, insurance and reinsurance companies. All are now focusing on potential future changes due to climate change and significant investments are going toward addressing risk and even monitoring change. [Elizabeth Weatherhead, USA]	Rejected. The comments is interesting. However, the section will be shortened as suggested by reviewers. The role of the private sector is mentioned in the section both in Arctic and Antarctic and for reasons of space I am afraid it will not be possible to develop further the private sector

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
23910	3	85	53	85	53	provide valid reference; websites are not appropriate references [Hans-Otto Poertner and WGII TSU, Germany]	Accepted. I will eliminate all the web-links from the section and provide for other valid references.
3670	3	86	23			Keil and Knecht, 2017)(low confidence). - please insert hyphen between brackets [Angelika Brandt, Germany]	Accepted. I will insert hyphens as suggested.
1354	3	86	26	86	37	goof precis on recent developments in cooperation in Antarctica [Marcus Haward, Australia]	Accepted. We updated the assessment to cinsider recent relevant developments on Antarctic.
6416	3	86	29			replace 'Convention on' with 'Commission for' [Keith Reid, Australia]	Accepted. The suggested replacement will be done.
23912	3	86	29	86	29	In this case I think its meetings of the «Commission for…» (not Convention on)?! Or simply CCAMLR [Hans-Otto Poertner and WGII TSU, Germany]	Accepted. Yes, it is simply "CCAMRL"
23914	3	86	42	86	43	Identical sentence as below p88 l50 [Hans-Otto Poertner and WGII TSU, Germany]	Accepted. For the same reason explained in your comment n. 23914
1356	3	87	0			agree with focus – extend reference support with Leith et al [Marcus Haward, Australia]	accepted
21536	3	87	0	87		Consider a graphic that could outline how national, state, local governements could put science into action, preemptively (instead of "post truth"). For example, if heavy metals (mentioned in Section 3.5.5.2) are detected in local fisheries, what can the local governement do? [Tseng Rose, USA]	accepted
22640	3	87	1	87	13	Please refer to Indigenous knowledge and local knowledge separately, to avoid the mixing of the two, which are different. The process of co-production of knowledge includes all areas of research and monitoring, from the planning stage, sampling/data collection, analysis, verification to communication. [Eva Kruemmel, Canada]	accepted
13542	3	87	2	87	2	Insert 'of' before 'perspectives' [Debra Roberts and Durban Team, South Africa]	accepted
13544	3	87	13	87	13	This is not an acceptable in-text referencing style. [Debra Roberts and Durban Team, South Africa]	accepted
13316	3	87	15	87	17	See forthcoming work by Sawatzky et al. about community-based monitoring in Inuit communities of the arctic. Information about the project itself can be found here: https://news.uoguelph.ca/2016/04/project-will-help-researchers-better-understand-climate-environment-influence-public-health/ [Katherine Bishop-Williams, Canada]	accepted
22642	3	87	17	87	32	Please refer to Indigenous knowledge and local knowledge separately. CBM in most cases saves money and enables monitoring to take place in a way not possible otherwise, so the sentence from line 22 - 25 can be very misleading and may lead to misinterpretations. The advantages of CBM are summarized by Johnson et al and should be clearly stated here. There are also many examples of CBM which uses the assistance of scientists and can be great examples for co-productin of knowledge - the sentence 31 to 32 is therfore also very misleading and should be revised. [Eva Kruemmel, Canada]	accepted
13546	3	87	18	87	18	This is not an acceptable in-text referencing style. [Debra Roberts and Durban Team, South Africa]	accepted
13548	3	87	28	87	28	This is not an acceptable in-text referencing style. [Debra Roberts and Durban Team, South Africa]	accepted

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
466	3	87	37	87	37	In this section 3.5.6.2 in table 3.6. and in policies and collaboration sections of the chapter, one important aspect seems to be missing. When one changes public policy to improve the situation, one needs to measure ifsuch change worked. This required direct measurements. For example there are nearly 30 CH4/CO2 flux stations in polar regions. They produce direct data on CH4 and CO2 emissions fromthawing permafrost. Some from 1990s. These and other direct methods need to be a part of "Linking science and decision making" and local citizen sciuence on the ground. They are the metrics to determine if policies and collaborations worked. [George Burba, USA]	accepted
20250	3	87	40	87	42	Could you please reference this sentence? I'm sure that the results of these polls would vary depending on the country / demographic polled, thus it is important that we know these details. [Michelle A. North, South Africa]	accepted
22644	3	87	45	87	46	I don't understand what is meant by scientist "perceive" little feedback. [Eva Kruemmel, Canada]	accepted
1358	3	87	51		53	some consideration of co-production concept and boundary organisation/ work scholarship [Marcus Haward, Australia]	accepted
1360	3	88	0			participatory scenario analysis as way of building capacity knowledge [Marcus Haward, Australia]	accepted
23918	3	88	2	88	2	Why are services and products written in italics? [Hans-Otto Poertner and WGII TSU, Germany]	accepted
22646	3	88	4	88	8	This is underway and one of the reasons why the "Arctic Observing Summit" (http://www.arcticobservingsummit.org/about-aos), an activity as part of SAON, was created. [Eva Kruemmel, Canada]	accepted
8086	3	88	7	88	9	"In many cases, successful efforts" also come from science communication - politicians come from the society and are affected by the opinion of the majority, which forms under the mass-media influence. [APECS Group Review, Germany]	accepted
19254	3	88	18	88	18	add that these scenario workshops have used the SSPs as basis [Marianne Kroglund, Norway]	accepted
19256	3	88	22	18	22	Consider reference to AMAP, 2015a. AMAP Assessment 2015: Human Health in the Arctic. Arctic Monitoring and Assessment Programme (AMAP), Oslo, Norway; and UNEP/AMAP, 2011. Climate change and POPs: Predicting the impacts. Report of the UNEP/AMAP Expert Group. United Nations Environment Programme (UNEP), Arctic Monitoring and Assessment Programme (AMAP). Secretariat of the Stockholm Convention, Geneva. [Marianne Kroglund, Norway]	accepted
23916	3	88	49	88	50	Identical sentence as above p86 l43 [Hans-Otto Poertner and WGII TSU, Germany]	accepted
20252	3	89	18	89	18	I think it should be "genetic connectivity" rather than "connectively" [Michelle A. North, South Africa]	accepted
13550	3	89	38	89	39	Insert a full stop after 'networks' [Debra Roberts and Durban Team, South Africa]	accepted
8088	3	89	46	90	1	Please consider highlighting in the text the category and the column titles (e.g. first line in bold, the first column in Italics) or put the numbers to categories - it is a bit hard to understand the structure skimming the table. [APECS Group Review, Germany]	accepted
468	3	90	3	90	3	Similar conclusion section seems to be missing for natural responses part. Is it on purpose or should it be added. [George Burba, USA]	accepted

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
21200	3	90	3			Section 3.5.7 - my comment from the initial summary statements applies here: I did not understand these points or their justification. I am not aware there is evidence that many of these mechanisms work in controlling illegal, unregulated and unreported activities that may undermine efforts to mitigate, adapt to or manage climate change effects (evident control is the measure of success). In my experience in the Southern Ocean, there has been no improvement related to governance measures associated with climate change other than to simply have discussions about climate change. This needs to be vastly improved, particularly in including climate change in decision making. For the Southern Ocean, there is also no relationship of the Antarctic Treaty System with global bodies responsible for climate change. In this case, the ATS could play a role in mitigation and adaptation by having each management body reporting to the UNFCCC on the impacts of climate change on their mandates. [Andrew Constable, Australia]	accepted
15538	3	90	5	90	17	This assessment of polar region change is currently deficient in that it should assess also address and prioritize research needs for raising the confidence of those changes that are most impactful. For example, the low confidence in the timing or occurrence of the WAIS collapse means that there is little planning that can be done for an event that would displace tens to hundreds of millions of people. This report needs to recommend how these glaring issues with cryospheric research can be satisfactorily addressed. [Daniel Feldman, USA]	accepted
5490	3	90	11	90	15	Why are the things listed in this sentence described as "more promising"? [Roderik Van De Wal, Netherlands]	accepted
11992	3	91	19	91	20	error in the doi [Kristian Kjellerup Kjeldsen, Denmark]	accepted
904	3	93	49	93	50	André Berger,Qiuzhen Yin ,Hervé Nifenecker ,and Jean Poitou, 2017 Earth's Future, 5, 811–822, doi:10.1002/2017EF000554. [Herve Nifenecker, France]	rejected here; pointing us to useful references is gratefully received in context of chapter sections
3546	3	95	28	95	31	Bednaršek, N., G.A. Tarling, D.C.E. Bakker, S. Fielding, E.M. Jones, H.J. Venables, P. Ward, A. Kuzirian, B. Lézé, R.A. Feely, and E.J. Murphy (2012): Extensive dissolution of live pteropods in the Southern Ocean. Nature Geosci., 5, 881–885, doi: 10.1038/ngeo1635. [Richard Feely, USA]	rejected here; pointing us to useful references is gratefully received in context of chapter sections
22162	3	96	9	96	12	two references are scrambled up. Cohen et al. 2015 is copied in the middle of Bring et al. [Annett Bartsch, Austria]	accepted
20508	3	103	12	103	13	Join lines 12 and 13 [Gennadi Milinevsky, Ukraine]	accepted
20506	3	103	14	103	14	Add reference: Evtushevsky, O. M., V. O. Kravchenko, L. L. Hood and G. P. Milinevsky, 2015: Teleconnection between the central tropical Pacific and the Antarctic stratosphere: spatial patterns and time lags. Climate Dynamics, 44(8), 1841–1855, doi:10.1007/s00382-014-2375 [Gennadi Milinevsky, Ukraine]	rejected here; pointing us to useful references is gratefully received in context of chapter sections
3548	3	105	24	105	24	Feely, R.A., S. Alin, B. Carter, N. Bednaršek, B. Hales, F. Chan, T.M. Hill, B. Gaylord, E. Sanford, R.H. Byrne, C.L. Sabine, D. Greeley, and L. Juranek (2016): Chemical and biological impacts of ocean acidification along the west coast of North America. Estuar. Coast. Shelf Sci., 183(A), 260–270, doi: 10.1016/j.ecss.2016.08.043. [Richard Feely, USA]	rejected here; pointing us to useful references is gratefully received in context of chapter sections

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
20512	3	107	10	107	11	Add reference: Grytsai, A., A., Klekociuk, G., Milinevsky, O., Evtushevsky, and K. Stone, 2017: Evolution of the eastward shift in the quasi-stationary minimum of the Antarctic total ozone column. Atmospheric Chemistry and Physics, 17, 1741-1758, doi:10.5194/acp-17-1741-2017 [Gennadi Milinevsky, Ukraine]	Accepted
3600	3	107	22	107	25	Merge the two Haine et al. (2015) references (and in the main text). [Thomas Haine, USA]	Accepted
6756	3	108	62	108	62	The current title of the Hjort et al. paper is: Degrading permafrost puts Arctic infrastructure at risk by mid-century [Jan Hjort, Finland]	Accepted
2310	3	113	4	113	5	TYPO: Joughin et al 2013 should be Joughin et al 2012 [Kristin Campbell, USA]	Accepted
2436	3	113	4	113	5	TYPO: Joughin et al 2013 should be Joughin et al 2012 [Durwood Zaelke, USA]	Accepted
12934	3	113	4	113	5	TYPO: Joughin et al 2013 should be Joughin et al 2012 [Gabrielle Dreyfus, USA]	Accepted
6376	3	123	50	123	52	Citations Notz & Stroeve 2016a and 2016b should be collapsed into one. [François Massonnet, Belgium]	Accepted
11996	3	138	12	138	13	error in the doi [Kristian Kjellerup Kjeldsen, Denmark]	Accepted
23920	3	142	1			In the final online version (final report), the supplementary material should have its own reference list [Hans-Otto Poertner and WGII TSU, Germany]	accepted
23922	3	142	1			There is no reference in either Chapter or Appendix to Appendix 3.A, Figures 3b & 4; please refer to these two Figures somewhere in the text. [Hans-Otto Poertner and WGII TSU, Germany]	accepted
23924	3	142	1			There is no reference to sections 3.A.2, 3.A.4 and 3.A.5 in the main chapter text, yet; please make sure this is done in the next draft [Hans-Otto Poertner and WGII TSU, Germany]	accepted
8090	3	142	9	142	9	this is misleading and confusing. Try "wind motion is primarily zonal jet stream that can include multiple north-south propagating watve patterns." [APECS Group Review, Germany]	accepted
8110	3	142	9	142	12	This sentence is quite long and hard to follow and the reference to Empirical Orthogonal Functions seems like a level of methodology detail that is not relevant for policymakers. Suggest rewording this to "The Northern Hemisphere atmospheric wind motion is primarily a north-south wavy jet stream pattern that can consist of propagating multiple waves. Recurring climate patterns can be described using modes of atmospheric variability." [APECS Group Review, Germany]	accepted
8112	3	142	9	142	26	The structure of these paragraphs is quite hard to follow. Suggest adding the following sentence at Line 12 to assist the reader: "The three most important patterns for Northern Hemisphere climate are centred on the North Pole, in the North Atlantic and in the North Pacific (Raute & Paethe, 2003)." [APECS Group Review, Germany]	accepted
8092	3	142	14	142	16	Cite the following AO paper: Thompson and Wallace 1998 (https://doi.org/10.1029/98GL00950) [APECS Group Review, Germany]	rejected: paper not needed to make the point and too old for SROCC scope
8098	3	142	14	142	26	using the term positive or negative "sign" is confusing. Would "phase" work better? [APECS Group Review, Germany]	accepted

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8114	3	142	14	142	23	Descriptions of "the first pattern", "the second important pattern", the "third hemispheric patterns" suggests to the reader that the patterns are ranked in order of importance for climate, which is not the case. I would suggest removing first/second/third and starting each paragraph as: "The Arctic Oscillation (AO) or Northern Annular Mode (NAM) is a ring-like pattern of sea level pressure anomalies centred on the pole. ", "The pattern in the North Pacific is either captured by the Pacific North-American pattern (PNA) ….. ", and "Another pattern of interest is the Arctic Dipole (AD), which characterizes flow across the central Arctic with high pressure in North American and low pressure in northern Asia …. " respectively [APECS Group Review, Germany]	accepted
8116	3	142	14	142	14	Replace 'Annular mode' with 'Northern Annular Mode (NAM)' [APECS Group Review, Germany]	accepted
2654	3	142	15	142	15	move -> more [Patrik Winiger, Netherlands]	accepted
8096	3	142	18	142	21	Cite the following: Mantua and Hare 2002 (https://doi.org/10.1023/A:101582061); Leathers et al. 1990 (https://doi.org/10.1175/1520-0442(1991)004<0517:TPATPA>2.0.CO;2); Leathers and Palecki 1992 (https://doi.org/10.1175/1520-0442(1992)005<0707:TPATPA>2.0.CO;2). [APECS Group Review, Germany]	rejected: papers not needed to make the point and too old for SROCC scope
8102	3	142	23	142	23	Cite the AD paper Wu et al. 2006 (https://doi.org/10.1175/JCLI3619.1) [APECS Group Review, Germany]	rejected: paper not needed to make the point and too old for SROCC scope
5492	3	142	24	142	25	Denoting more clearly where the high and low pressure is in the AD would make this line more clear. [Roderik Van De Wal, Netherlands]	taken into account; have included its dipole nature
8104	3	142	24	142	24	"circular around a given latitude" is more clear than the current wording [APECS Group Review, Germany]	accepted
8094	3	142	25	142	26	Move the NAO line to the AO paragraph (line 16) and cite the NAO paper: Hurrell 1995 (https://doi.org/10.1126/science.269.5224.676) Hurrell 2005 (https://doi.org/10.1007/1-4020-3266-8_150) [APECS Group Review, Germany]	taken into account; moved. Reject; paper not needed and very old
8100	3	142	25	142	26	the NAO is also known as the NAM. Cite Thompson and Wallace 2001 (doi: 10.1126/science.1058958) [APECS Group Review, Germany]	rejected: paper not needed and too old for SROCC scope
8118	3	142	25	142	26	The mention of the NAO should be moved to Line 16, as it is related to the AO. [APECS Group Review, Germany]	accepted
8120	3	142	25	142	26	The phrase "appears to be" introduces doubt in the definition of the NAO, although it has a clear definition. If this sentence is moved to after the mention of AO (comment above), I would reword it to "It is closely related to the North Atlantic Oscillation (NAO), which is characterized by sea level pressure differences between the Icelandic Low and the Azores High (positive when both are strengthened, negative when they are weakened)." [APECS Group Review, Germany]	accepted
8108	3	142	28	142	36	Citations for all the changes in AO, PDO, NAO, etc. would be good. It appears only the AD changes are cited. [APECS Group Review, Germany]	rejected; SROCC scoep is on updateing knowledge since AR5 an update to AR5
8106	3	142	29	142	29	Using the term global warming as an external forcing is not very precise. Could you say green house gas forcing? Because external forcing also includes volcanoes and solar radiation changes. [APECS Group Review, Germany]	accepted
8122	3	142	33	142	34	Wang et al. (2009) discusses the summers of 1995, 1999, 2002, 2005, and 2007, which are not 'earlier in the present decade' [APECS Group Review, Germany]	accepted

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
8124	3	142	35	142	35	variably -> variability [APECS Group Review, Germany]	accepted
8126	3	142	38	142	38	The subsection title refers to "Polar Amplification", but the text refers only to Arctic amplification. Discussion of the weaker Antarctic aplification could be added. See recent work: Salzmann, M.: The polar amplification asymmetry: role of Antarctic surface height, Earth Syst. Dynam., 8, 323-336, https://doi.org/10.5194/esd-8-323-2017, 2017. [APECS Group Review, Germany]	Taken into account; have changed the subsection title
3602	3	142	40	152	50	The Haine & Martin paper (cited above) directly addresses "Ice-Albedo Feedback and Polar Amplification". See above. [Thomas Haine, USA]	noted
14354	3	142	40			polar regions' is capitalized in the rest of the report [Christopher Fogwill, UK]	accepted
17548	3	142	40	142	50	Greenland temperatures are amplied from Northerh Hemispheric temperature change by 3.3-4.2 times (Kobashi et al., 2013). So, if global temperature increase by 2 C, Greenland will experience 6-8 C warming. Kobashi et al., Climate of the Past 9, 583-596 (2013). [Takuro Kobashi, Japan]	reject;, the scope of this text is pan-Arctic and amplification is not limited to Greenland
23926	3	142	46	142	46	To be clear I suggest saying «see Chapter 3, Box 3.1» [Hans-Otto Poertner and WGII TSU, Germany]	reject; IPCC style guide advises otherwise
8128	3	142	48	142	48	The reference to Perovich et al. (2008) seems misplaced, as they were not the first to describe the sea ice albedo feedback. Perovich et al. (2008) describe the summer of 2007, where sea ice extent reached a record minimum compared to previous years. Suggest changing this sentence to 'The sea ice albedo feedback has been implicated in dramatic sea ice loss events (eg. Perovich et al., 2008) and in the observed Arctic amplification" ... [APECS Group Review, Germany]	Taken into account, but Parovich et al., 2008 is about processes
5494	3	142	52	143	48	This section is a bit too extensive on all connections and trends so that a lot of readers may find it hard, possibly. [Roderik Van De Wal, Netherlands]	taken into account, but there is a need to emphasize the processes here
8130	3	142	52	143	7	The ordering of content in these paragraphs could be confusing for the reader. Suggest adding a sentence at L52 (and moving some text from L3, P132) like "Although the surface albedo feedback is important, modelling studies have shown that Arctic amplification occurs in its absence (Alexeev et al., 2005) and other processes have been shown to contribute. There is emerging evidence of increased warm, moist air intrusions in other times of the year (winter and spring)...." [APECS Group Review, Germany]	taken into account in section revisions.
8132	3	142	53	142	54	Kapsch et al., 2015 do not show "evidence of increased warm, moist air intrustions", rather they link downwelling longwave anomalies to sea ice melt onset in models. Suggest rewording to "there is emerging evidence of increased warm, moist air intrusions in both winter and spring (Boisvert et al., 2016; Cullather et al., 2016; Graham et al., 2017), which initiate earlier sea ice melt (Kapsch et al., 2015; Mortin et al., 2016). [APECS Group Review, Germany]	rejected; this is too detailed for this purpose of this text
8134	3	142	56	142	56	Should this read "intra-seasonal tropical convection oscillations"? [APECS Group Review, Germany]	reject: oscillation is not needed
8136	3	142	56	142	56	A reference to Park, H., S. Lee, S. Son, S.B. Feldstein, and Y. Kosaka, 2015: The Impact of Poleward Moisture and Sensible Heat Flux on Arctic Winter Sea Ice Variability. J. Climate, 28, 5030–5040, https://doi.org/10.1175/JCLI-D-15-0074.1 could be added here [APECS Group Review, Germany]	reject; we have included multiple reference already

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2656	3	143	3	143	5	"the largest contributor to Arctic Amplification is increased downwelling longwave radiation". This statement is incorrect. The reference (Pithan and Mauritsen 2014) indicates that the largest contributor is the Albedo change, very narrowly followed by the lapse rate, both having a very high spread (uncertainty). [Patrik Winiger, Netherlands]	accepted
5292	3	143	5	143	5	In my opinion the current text tels only half truth and lets the reader to assume that albedo feedback is not that important. Howeber, Pithan and Mauritsen (2014) say that "surface albedo feedback is the second main contributor to Arctic amplification". This I suggest to be explicitely included right after saying that the largest contributor to AA is increased downwelling longwave radiation (3.A.1.2 Ice-Albedo Feedback and Polar Amplification), ref. https://www.nature.com/articles/ngeo2071 [Outi Meinander, Finland]	accepted
8142	3	143	11	143	48	This section is quite hard to follow and I think should be re-ordered. The first sentence of the first paragraph (strong belt of westerly winds) implicitly refers to the SAM, so I would suggest moving the explicit definition on L17-22 to L12. The sentence 'Understanding decadal variability..' could be moved to the end of the subsection. A new paragraph for each mode (SAM, zonal wave 3 and PSA) could help the reader . [APECS Group Review, Germany]	Accepted; modified as suggested
8140	3	143	13	143	40	I'd suggest defining ZW3 and PSA in the first paragraph. [APECS Group Review, Germany]	Taken into account; these are now mentioned in the first paragraph
8138	3	143	24	143	26	It would be good to have some examples of the literature here e.g. does Figure 1 come from a paper? [APECS Group Review, Germany]	Taken into account; Figure 1 comes from the 2018 Ozone Assessment Report which is now cited
10648	3	143	24	143	25	Reference is made to 'significant poleward shift and strengthening of the SAM over the past 30-50 years' and yet the associated figure only shows the SAM trend pre-2000. Has, the SAM trend become insignificant in the period post-2000? If so this should be discussed together with an assessmnet of why the trend has slowed or stopped. [Simon Josey, UK]	Taken into account; The trend lines have been removed. The subsequent sentences assess the literature on pre and post 2000 trends, with the suggestion that SST warming in the tropics has been the main driver of SAM trends from 2000
8144	3	143	25	143	25	Could add some references on the shift and strengthening of the SAM (which are unprecedented over at least the last 500 years) - Abram, NJ, Mulvaney, R, Vimeux, F. (2014) Evolution of the Southern Annular Mode during the past millennium. Nature Climate Change 4(7): 564–569; Hessl, Amy, Kathryn J. Allen, Tessa Vance, Nerilie J. Abram, and Krystyna M. Saunders. "Reconstructions of the southern annular mode (SAM) during the last millennium." Progress in Physical Geography 41, no. 6 (2017): 834-849. [APECS Group Review, Germany]	accepted
10644	3	143	26	143	28	...a poleward shift in the mid-latitude jet.' is noted but no quntitative detail or reference to the literature is provided. Fig.1 of the Appendix shows jet latitude but this appears to only show a trend in MAM (and possibly JJA). Further discussion on this point is needed in the text, in particular for what seasons is the trend in jet latitude significant? And does the annual mean jet latitude exhibit a significant trend? To be useful this should be accompanied by a statement regarding the level of confidence that the authors are able to place in the poleward shift from the observations presented at seasonal and annual timescales. [Simon Josey, UK]	taken into account; We have removed discussion of changes in the mid-latitude jet as this section is focused on modes of variability

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
10646	3	143	26	143	28	No mention is made of intensification of the Southern Ocean westerly strength which is the other main element of change suggested by the literature in addition to the poleward shift. The conclusion in AR5 WGI Ch.3 was that there is only 'medium confidence' from observations that intensification of the Southern Ocean westerlies has taken place. Does this conclusion still hold? Or does subseuqent research now allow higher confidence to be placed in this finding? [Simon Josey, UK]	Taken into account; We have removed discussion of changes in the mid-latitude jet as this section is focused on modes of variability
8146	3	143	30	143	30	This paper should be referenced here: Polvani, L.M., D.W. Waugh, G.J. Correa, and S. Son, 2011: Stratospheric Ozone Depletion: The Main Driver of Twentieth-Century Atmospheric Circulation Changes in the Southern Hemisphere. J. Climate, 24, 795–812, https://doi.org/10.1175/2010JCLI3772.1 [APECS Group Review, Germany]	Rejected; For the sake of brevity we focus on more recent articles. The Waugh et al 2015 article is comprised of many of the same authors as Polvani et al 2011
8148	3	143	40	143	42	Irving & Simmonds (2016) only identify a weak relationship between the PSA and ENSO, so perhaps the reference to ENSO should be removed [APECS Group Review, Germany]	Taken into acount; Removed as suggested and changed to "tropical Pacific convective heating signals"
8150	3	143	45	143	45	There should be a reference to Irving & Simmonds (2016) after 'Weddell Seas' [APECS Group Review, Germany]	accepted
13318	3	144	1	144	9	To facilitate readers with visual impairments consider using a dashed line to represent one of the two datasets, the colours will be particularly difficult for some to differentiate. [Katherine Bishop-Williams, Canada]	taken into account. Figure redrawn using IPCC colour palette
12672	3	145	1	145	3	Again, please consider changing the colourmaps. Appendix 3.A, Fig. 2 would not be readable by someone with colourblindness. [Gillian Young, UK]	Accepted; figures now plotted with IPCC-approved colormaps
8152	3	145	14	145	14	All of the lines are black- specify thick black lines? [APECS Group Review, Germany]	Accepted; change made as suggested.
8154	3	146	1	146	8	What is the yellow shaded area in Figure 4 a? Also the caption should either describe the colour of all the lines or none it's strange to just mention the blue one. [APECS Group Review, Germany]	Accepted; the shaded area is now defined, and the confusing colour-coding of lines removed.
13320	3	146	1	146	9	To facilitate readers with visual impairments consider using a dashed line to represent one of the two datasets, the colours will be particularly difficult for some to differentiate. [Katherine Bishop-Williams, Canada]	Taken into account; figure has been replotted with IPCC approved colour scheme
8156	3	146	14	146	14	A quick definition of the Revelle Factor may help those not in the field. [APECS Group Review, Germany]	Accepted; the first sentence defines this factor
8160	3	146	16	146	17	What does "It" refer to specifically? Gamma? Or something else? [APECS Group Review, Germany]	Accepted; Revelle Factor made explicit
8158	3	146	21	146	21	Capital omega needs defining [APECS Group Review, Germany]	Taken into account; deleted
23928	3	146	34	146	34	Should say «Appenix 3.A, Figure 5b» [Hans-Otto Poertner and WGII TSU, Germany]	Accepted; correction made.
928	3	147	0			Ament "ates" to "rates" [William Clarke, Australia]	Accepted; corrected
8164	3	147	8	147	8	"rates" for the title [APECS Group Review, Germany]	Accepted; corrected
23930	3	147	8	147	8	Storage Rates? [Hans-Otto Poertner and WGII TSU, Germany]	Accepted; corrected
8162	3	147	21	147	23	Some double lines/ bold titles would help the readability of this table [APECS Group Review, Germany]	Editorial; formatting to be finalised before publication
5496	3	147	25	147	26	Table 2 is not very obvious. [Roderik Van De Wal, Netherlands]	Accepted; additional text added
23932	3	148	1	148	1	Onset of month USat: Why is the first value given as a range, and the other two as a particular year and standard deviation? Also, please define USat in the table caption. [Hans-Otto Poertner and WGII TSU, Germany]	Accepted; both points fixed

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
8166	3	148	2	148	6	The colour bar needs a label (assume it's year?) [APECS Group Review, Germany]	Noted; figure has been removed during revision process
12674	3	148	2	148	6	Again, please consider changing the colourmaps. [Gillian Young, UK]	Noted; figure has been removed during revision process
23934	3	148	6	148	7	This figure not only depicts the seasonal carbonate undersaturation in the Southern Ocean, but also in other regions. [Hans-Otto Poertner and WGII TSU, Germany]	Noted; figure has been removed during revision process
8172	3	149	1	149	38	I think integrating the high confidence into the sentence will be helpful rather than having at the end in parentheses. I find the parentheses at the end to be a bit confusing about what they refer to and the level of confidence. [APECS Group Review, Germany]	maybe spaces were meant? taken into account; spaces included between brackets
8168	3	149	2	149	2	it appears you're missing a word after subtidal. Zone? [APECS Group Review, Germany]	Accepted; missing word included.
8170	3	149	8	149	9	Are these all kelp species? Is there a reason they're not all treated the same in terms of X.NAME? [APECS Group Review, Germany]	Accepted; yes, these are all kelp species, and full names are now given for consistency with the rest of the text.
8174	3	149	18	149	18	what is turbidity and how would this impact kelp growth precisely? [APECS Group Review, Germany]	Taken into account; turbidity is a measure of the sediment content of the water; a reference is given which can be followed up for details of how this impacts kelp.