SROCC First Order Draft Expert Review Comments - Chapter 2							
Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
2080	2	0	0	0	0	1 This five-part comment is strictly speaking editorial, but it has deep substantive implications. I estimate crudely, with a generous allowance of 700 words/page, that the text of chapter 2 is about 58,000 word-equivalents (i.e. including figures and tables) long. At the IPCC guideline of 950 word-equivalents/page, this translates to a published chapter of 61 pages. The Decision and Outline of the Special Report on Climate Change and Oceans and the Cryosphere allots ~30 pages to chapter 2. In short, the chapter is twice as long as it ought to be, with section 2.4 and the FAQs not yet written. [J. Graham Cogley, Canada]	Accepted - the text has been shortened.
2082	2	0	0	0	0	2 This means that the authors should focus almost exclusively on shortening the text. It is perhaps fortunate, therefore, that my substantive comments have been few and not fundamental. At least half the text, and well over half the references, need to be deleted. [J. Graham Cogley, Canada]	Accepted - the text has been shortened.
2084	2	0	0	0	0	3 There are about 750 words per reference page and 26 pages of references: 19,600 words, or 34% of total length. This is an assessment, not a review, of the literature. There is for example no need for extensive lists of citations to support substantive points; the list can be replaced with structures like "(e.g. <most relevant reference>)". [J. Graham Cogley, Canada]	Accepted - the text has been shortened.
2086	2	0	0	0	0	4 My experience with AR5 is that it is much easier to move forwards to the final draft once you have the right number of words. It means that you know that if you want to put in something new you must take out something old, which is extremely helpful for deciding what you want to tell the world. Wordsmithing, e.g. the elimination of verbose constructions and sentences that are not doing any useful work, can achieve reductions of as much as maybe 15%, but more is needed. As an example, lists of observations from a long list of regions are not really helpful. The regions that are left out will feel neglected, those in the list will be dissatisfied at the lack of detail, and in general regional policymakers are unlikely to be satisfied by an assessment that is necessarily made at global scale. As another example, the Executive Summary occupies two pages and 11 paragraphs; they could usefully be shortened and merged into perhaps 7-8 paragraphs. [J. Graham Cogley, Canada]	Accepted - the text has been shortened.
2088	2	0	0	0	0	5 The CLAs and LAs could make a start on shortening by agreeing on section-specific word-equivalent counts, and especially on "allowed" numbers of references. There seem to be about 785 references, and I think a reasonable upper limit would be 250-300 for the whole chapter (8-10 of the 30 pages, at about 30 references per page). Fewer if possible. [J. Graham Cogley, Canada]	Accepted - the text has been shortened.
2258	2	0	0			Chapter 2 includes discussions on the Hindu-Kush and the changing precipitation patterns (as well as the uncertainty with these projections). This chapter—and perhaps also in Chapter 6 as part of the managing risks discussion—should highlight the importance of the Hindu-Kush as a water supply source. [Kristin Campbell, USA]	Accepted - information added in relevant places

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2260	2	0	0			Chapter 2 – are there any natural analogues for sulphates and solar radiation management? [Kristin Campbell, USA]	Taken into account - to the best of our knowledge, there is no natural analogue to sulphate and solar radiation management which would be specific and relevant to the high mountain cryosphere. The SOD contains a Box on Feedbacks, which may provide informations sought by the reviewer.
2384	2	0	0			Chapter 2 includes discussions on the Hindu-Kush and the changing precipitation patterns (as well as the uncertainty with these projections). This chapter—and perhaps also in Chapter 6 as part of the managing risks discussion—should highlight the importance of the Hindu-Kush as a water supply source. [Durwood Zaelke, USA]	Accepted - information added in relevant places
2386	2	0	0			Chapter 2 – are there any natural analogues for sulphates and solar radiation management? [Durwood Zaelke, USA]	Taken into account - to the best of our knowledge, there is no natural analogue to sulphate and solar radiation management which would be specific and relevant to the high mountain cryosphere. The SOD contains a Box on Feedbacks, which may provide informations sought by the reviewer.
6000	2	0	0			This comments are made in collaboration with Linda Bogerd and Tim van den Akker IMAU, UU [Roderik Van De Wal, Netherlands]	Noted
6774	2	0	0			Figure 2.1 lacks a good logic reference to Antarctica, this is a consistent problem in the chapter [APECS Group Review, Germany]	Rejected - this chapter does not include Antarctica (see Chapter 3)
6776	2	0	0			Services and such Figures and use of the term: Shoud state WHAT service [APECS Group Review, Germany]	Accepted - the text and figure have been revised
11498	2	0	0			"Even if blue carbon ecosystems could be restored to their 1990 extent (unlikely, because of the nature of much coastal development), globally, it cannot replace the need for the very rapid phase-out of fossil fuels," This sentence might indicate that ocean's blue carbon's pacity is limited to coastal development. It's true that non of the intervention could replace the phase out of fossil fuels. But such wording might also give priority to the fossil fuel solution than indicating climate change is worthy of all possible actions including protecting oceans. [Taehyun Park, Republic of Korea]	Rejected - this comment isn't on chapter 2
11500	2	0	0			The role of Hydropower is strongly discussed but apart from the economic viability due to decreasing water supplies, with it a destruction of forests and other ecosystems is not justifiable anymore. [Taehyun Park, Republic of Korea]	Rejected - this chapter is an assessment of current situation and does not evaluate ethical concerns of existing practices.
11502	2	0	0			The headline finding here includes an important message on limits to adaptation, but the language is too complex. [Taehyun Park, Republic of Korea]	Taken into account - it is unclear which line this refers to, but the Executive Summary statements have been revised substantially.
11748	2	0	0	0	0	Sufficient and adequate [Hanieh Zargarlellahi, Iran]	Noted
12754	2	0	0			My overall impression is that the chapter is composed and written very well. The language of the chapter is in good agreement with the other IPCC documents and fits in this series well. I have some issues concerning the state of knowledge on the global permafrost distribution in mountains. Here, uncertainties in the assessment of these areas should be expressed more clearly. Confidence on changes I can agree, but uncertainties on the degree/amount of changes are also high, with according implications on the consequences and adaptation possibilities. [Jan-Christoph Otto, Germany]	Accepted

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12882	2	0	0			Chapter 2 includes discussions on the Hindu-Kush and the changing precipitation patterns (as well as the uncertainty with these projections). This chapter—and perhaps also in Chapter 6 as part of the managing risks discussion—should highlight the importance of the Hindu-Kush as a water supply source. [Gabrielle Dreyfus, USA]	Accepted - information added in relevant places
12884	2	0	0			Chapter 2 – are there any natural analogues for sulphates and solar radiation management? [Gabrielle Dreyfus, USA]	Taken into account - to the best of our knowledge, there is no natural analogue to sulphate and solar radiation management which would be specific and relevant to the high mountain cryosphere. The SOD contains a Box on Feedbacks, which may provide informations sought by the reviewer.
13448	2	0	0			A clear line of sight is not always evident between the summary statements (especially confidence statements) and the detail in the text. One almost wishes to see in table format the sort of evidence presented in the literature, by topic, in an overview rather than just in narrated form. This would also clarify the different concepts this chapter addresses, see comment in section 2.3.3 for detail. [Debra Roberts and Durban Team, South Africa]	Accepted - confidence statements and the text checked carefully. The structure of the ES was significantly modified in order to better introduce the evidence.
13450	2	0	0			Many discipline-specific concepts are used and should be defined for an "educated non-specialist audience". There are many of these. Anything that cryosphere specialists know about, but let's say a general biologist doesn't: "active layer", "subsidence" (what happens and why), "lahar", "glacier lake", "headwall", "wet/dry snow pack" etc etc etc. Remember readers who live in the tropics and have never heard of these terms. A diagram showing these elements would be very helpful. Or a section on definitions with diagrams that specialists can skip. Many paragraphs start out with opening statements that are so vague they are nearly meaningless. Instead, opening sentences of paragraphs could be used to quickly define the element and terms that are being addressed in the paragraph. [Debra Roberts and Durban Team, South Africa]	Accepted - technical terms and better defining them was performed in tex text, to the largest extent possible given text size limitations.
13452	2	0	0			Using the active voice, and keeping verbs as verbs (instead of turning them into nouns) generally creates clarity and shortens the text. [Debra Roberts and Durban Team, South Africa]	Accepted - text was revised taking this suggestion into account.
14378	2	0	0			With my experience in cryosphere monitoring of Karakoram I have following specific information to share: Valleys are warming, resulting in rising snow line and rising trend in the winter flows from the area. [Danial Hashmi, Pakistan]	Taken into account - note however that the assessment is primarily performed on the basis of peer-reviewed literature.
14380	2	0	0			We have installed 20 automatic scientific grade weather stations in the elevation range of 3000-4700 masl (i.e. glacier melting zone) in Karakoram and Himalayas in 1995 to gauge the climatic behaviour and its impact on the glaciers of the Karakoram. Summer Temperatures from this weather network are showing falling trends in Western Karakorams . There is falling trend in summer flows as well that corroborates with the falling trend in summer temperatures. This also implies that Karakoram glaciers are not melting fast. Physically we don't see mass loss in the glacial ice at higher elevations. [Danial Hashmi, Pakistan]	Taken into account - note however that the assessment is primarily performed on the basis of peer-reviewed literature.

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14382	2	0	0			We have observed extremely low summer flows during 2000 -2009. [Danial Hashmi, Pakistan]	Taken into account - note however that the assessment is primarily performed on the basis of peer-reviewed literature.
14384	2	0	0			This year winter snowfall of Upper Indus Basin was almost 30% less with SCA on 1st May 2018 at 43% as compared to 63% last year, resultantly reduction in early summer flows by 46%. River flows have not improved as yet and drought like situation persists in the Indus River Basin. Indus Basin Irrigation System provides food and agro based industry of the country and its contribution to GDP of Pakistan is 19%, more that 40% of the population is directly associated with agriculture. [Danial Hashmi, Pakistan]	Taken into account - note however that the assessment is primarily performed on the basis of peer-reviewed literature.
14386	2	0	0			In my opinion it is the abnormal behaviour of summer temperatures that if failed to unlock waters from the glacial reservoir of Upper Indus Basin which is believed to be the largest ice mass out site of poles [Danial Hashmi, Pakistan]	Taken into account - note however that the assessment is primarily performed on the basis of peer-reviewed literature.
17046	2	0	0			For the next draft, I suggest moving all Boxes to the end. Within the text and being in the same layout they interrupt the flow of the reading. This has some weight as up to 5 sub-level headings are used and it is already difficult to follow the text flow. [Frank Paul, Switzerland]	Rejected - boxes are placed according to IPCC formatting guidelines.
17048	2	0	0			The fifth sub-level heading looks the same as the fourth. To improve clarity of all sctions, I suggest to use more distinguished differences for the different heading levels and clearly distinguish all 5 levels. [Frank Paul, Switzerland]	Rejected - header formatting is prescribed by IPCC
17050	2	0	0			I also suggest to shortly introduce the boxes. It is not always clear why they are there and why this topic is presented in more detail in a box. A short note in the main that Box 2.x is presenting further details on the respective topic might be sufficient to link the text to the box. [Frank Paul, Switzerland]	Accepted - boxes are introduced in the text
17052	2	0	0			The various sections of this Chapter present examples from different mountain regions. Whereas it is clear that not everything can be presented, it is often unclear why the presented examples have been selected. They appear largely arbitrary, unsystematic and biased towards Tibet and the Alps (plus maybe some tropical Andes). For example, it is not clear if for the other regions in Fig. 2.1 no information exists or if the authors of the report just cite what they are aware of. In avoidance of doubt, I would suggest clarifying the general approach for presenting only selected examples in section 2.1.1. [Frank Paul, Switzerland]	Accepted - the introduction now states that examples used are usually relevant to several different regions, and additionally an effort was made to have a broader geographic spread of examples throughout the chapter.
17054	2	0	0			In addition to comment 3 I suggest to present the selected regional examples in all sections in the same order, i.e. more systematically. This would also help avoiding the impression that examples are based on an arbitrary (and maybe biased selection) [Frank Paul, Switzerland]	Rejected - it would have been too unwieldy to enforce this order of geographic regions. More map figures are included to give a more systematic overview.
17056	2	0	0			In addition to comment 3 and as a suggestion to get the assessment more systematic, unbiased and clear, I would recommend to present the contents of several chapters in a tabular rather than plain text form (e.g. as in Tables 2.2 and 2.3 for permafrost. This mostly relates to the observations and scenario sections in section 2.2. [Frank Paul, Switzerland]	Accepted - more tables and figures are included

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17058	2	0	0			In addition to comment 3 and 5, I would add in such tables a line, listing all regions from Fig. 2.1 that are not covered before and writing that no information is available for these regions. This would help to get the message right, that presented examples are unbiased and present what it is available (which I assume is the case). [Frank Paul, Switzerland]	Accepted - regions for which information is not available are included with a statement indicating this.
17060	2	0	0			Similarly to comment 3 on the seemingly arbitrary selection of example regions, I am also unclear about the presented citations. Are they always complete or just some typical examples since AR5? In the latter case I would expect an 'e.g.' at the beginning of the reference list. Maybe it is worthwhile to shortly clarify the approach on how citations have been selected in section 2.1.1? [Frank Paul, Switzerland]	Taken into account - citations are often typical examples, and "e.g." is used more often in this draft. Note also that the number of citations has been cut due to space considerations.
17914	2	0	0			Congratulations for this much improved chapter! I enjoyed reading it and think it is informative and over large parts now more resembling an assessment than a review although some sections (as detailed) present rather case study based (or anecdotal) evidence and are a bit wordy. I appreciate the efforts to bring in more calibrated uncertainty language. However, I have some doubts concerning the use of it. If we follow the 2010 IPCC guidance paper on uncertainty (Mastrandrea et al 2010) which I think is still the reference, then likelihood language is for cases where issues can be quantified in terms of probability. Confidence statements can be used where qualitative assessments are possible. Throughout the chapter I have seen many likelihood statements where I had some doubts whether those can be really substantiated by quantified probability assessments. I suggest to thoroughly check all uncertainty / confidence / likelihood statements. [Christian Huggel, Switzerland]	Accepted - the confidence language is now more consistent with IPCC guidelines and there are fewer references to likelihood.
22882	2	0	0			The Chapter is well written, very interesting while bringing together numerous pertinent references. Some information seem to be missing (see PLACEHOLDER FOR SECOND ORDER DRAFT at several places in the text) enabling the understanding of the full concepts. [Romy Schlogel, UK]	Accepted - placeholders have been removed for this draft
22884	2	0	0			A summary table presenting the effect of changing climate parameters (with their corresponding agreement and evidence) on particular regions should be added. [Romy Schlogel, UK]	Accepted - tables were prepared for temperature, precipitation and snow cover changes in the regions covered. They are available as a supplement.
22886	2	0	0			Legends are often missing in figures enabling their understanding (e.g. 2.3-2.4). [Romy Schlogel, UK]	Accepted - figures have been improved
23506	2	0	0			Though the chapter is titled High Mountain Areas, it seems largely focused on continental high mountains, and does not take into account high mountain islands (not at high latitudes), which are also prone to, for example landslides, but as a result of extreme weather. Perhaps a clarification on the scope of the chapter and why tropical small mountainous islands are not included would be good. [Laura Lorenzoni, USA]	Rejected - the report concerns the response of cryosphere and oceans to climate change, hence only mountain areas that have cryosphere elements are considered in this chapter.
23636	2	0	0			uncertainty language and likelihood should be in italics [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - uncertainty language is in italics
23638	2	0	0			make sure that confidence language is consistenly used throughout chapter [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - the use of confidence languate is improved and acoording to IPCC guidelines

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23640	2	0	0			The structural changes to this chapter since the Internal Draft have greatly improved the logical flow of arguments, making it easier for the reader to follow the storyline of the Chapter. The first ca. two thirds of the chapter are well-developed, but could be shortened by reducing wordiness to ensure there is enough space to replace the placeholders that still exist, and to reduce the current overemphasis of the physical impacts which form a third of the Chapter, but only one bullet point in the Agreed Outline for the Chapter. There is still much room for improvement in the last third of the Chapter, especially in the Sections pertaining to Ecology / Biology / Agriculture. They currently read like a review or textbook rather than an assessment. The information in these sections should be more dense and less vague, and include future projections if possible. Please also ensure that any feedback provided from the previous, internal review is considered for these sections (and the Chapter in general). [Hans-Otto Poertner and WGII TSU, Germany]	Noted
23642	2	0	0			Many statements in the ES and the entire Chapter are currently very vague. Please avoid phrases such as "some regions", "many people", "large areas" but provide quantifications wherever possible. Please also ensure that all bullet points included in the Agreed Outline for this Chapter are covered by the Chapter text, and that the Chapter is more balanced - it currently overemphasises physical impacts compared to other points in the Outline. [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - the chapter is now less vague and less focused on physical impacts
23644	2	0	0			define all acronyms at first mention [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - text revised
24320	2	0	0			Your contributing authors are mostly from developing countries, you may wish to consider CAs from South America, the Himalaya region and Africa [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - we made efforts bring more Cas from developing countries, but not fully successful yet. Effort is still going on
24374	2	0	0			the climate feedback of methane release from thawing permafrost is not mentioned as indicated in the first bullet of the scoped outline [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - this item is covered in a Box on Feedbacks in SOD
24376	2	0	0			economic perspectives (eg costs impacts, avoided costs) should be included [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - some economic information added in 2,3.2 and 2.3.6, but very few literature is available on economic aspects of cryospheric changes. Effort is still going on to collect more information on economic aspects
24378	2	0	0			tropical mountain glaceirs eg glaciers in Africa, should be included, [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - they are included
24380	2	0	0			the consequences for coastal ecosystems and ocean circulation should be addressed (linking to other chapters) as indicated in the last scoped bullet point [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - link to ocean and coast are mentioned in 2.3.
24576	2	0	0			Hazard and Impacts sections are kept separate in the SPM and chapter. More integration is needed to emphasize the nature of the impacts and the policy relevance of the physical changes. [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - better integrated in the ES/SPM.
24622	2	0	0			Chapter is heavily front-loaded with physical climate science; opportunity for integration missed. The combination of physical changes and impacts on vulnerable systems for each sector dealt with would support integration, The section on water supply has in fact been quite successful to integrate physical changes with impacts and solutions. [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - we fully agree that more balance and integration are required between physical & social sciences. We are trying, but constrined by limited systematic study and qunatification of social and economic aspect of cryospheric changes. More research is required on this aspect. .

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24624	2	0	0			The treatment of biodiversity under climate change needs to be strengthenend and connected to the hazard in a differentiated way. Tipping points are mentioned but not quantified in relation to different climate futures. [Hans-Otto Poertner and WGII TSU, Germany]	accepted - linked to impacts of disturbance leading to more rapid vegetation change
24626	2	0	0			Hazard sections contain a lot of physical detail that may be too disconnected or redundant to the treatments of climate related changes earlier in the chapter. Some distribution of the climate science detail or its inclusion in OSM may support development of a coherent storyline for each sector. [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account - material moved and shortened
24628	2	0	0			The chapter lacks data figures and illustrative figures for ecosystem and biodiversity impacts. [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - an illustrative figure for ecosystem/biodiversity has been added, though we've chosen an approach that lists types of observations rather than a data figure.
24630	2	0	0			Chapter 2 should provide an assessment of quantifiable risk and how it can reduced by adaptation, building on the AR5 (e.g. risk bars or burning ember diagrams developed for specific sectors beyond the 5 Reasons for Concern, see AR5SYR). [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - added quantifiable risks and imapcts where information available
6430	2	1	0	83		The first order draft is in general of high quality, although many figures still need to be finalised. The table of contents is logical and the draft reads well. However there is a bit of a style break or mismatch between the first more physical part of the report (up to 2.3.4) and the more social-cultural part of the report. The physical part nicely summarises the state of the art by integrating findings of a large number of studies, whereas the latter part is more based on examples. It would be recommendable to match the styles, but that will likely happend in a second order draft. [Walter Immerzeel, Netherlands]	Accepted - the text has been improved.
6432	2	1	0	83		The report focuses very much on glaciers, snow and permafrost and how changes therein can potentially affect river runoff. However what I miss is an systematic assessment of the importance of the cryosphere in river runoff. In Asia for example glacier and snow runoff plays only a marginal role during the monsoon season when rains are the main runoff generating mechanism. In the western part of the Himalayas, the cryosphere plays a very crucial role. Various papers have focussed on this: Kaser, G., Großhauser, M., & Marzeion, B. (2010). Contribution potential of glaciers to water availability in different climate regimes. Proceedings of the National Academy of Sciences of the United States of America, 2010, 1–5. http://doi.org/10.1073/pnas.1008162107 / Immerzeel, W. W., Van Beek, L. P. H., & Bierkens, M. F. P. (2010). Climate change will affect the Asian water towers. Science, 328(5984), 1382–1385. http://doi.org/10.1126/science.1183188 / Lutz, A. F. F., Immerzeel, W. W. W., Shrestha, A. B. B., & Bierkens, M. F. P. F. P. (2014). Consistent increase in High Asia ' s runoff due to increasing glacier melt and precipitation. Nature Climate Change, 4(7), 1–6. http://doi.org/10.1038/NCLIMATE2237 [Walter Immerzeel, Netherlands]	Accepted - clarified in text

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6434	2	1	0	83		There are fundamental processes and feedbacks that will also be influenced by climate change, which could receive specific attention in the report. I have three specific recommendations: (i) understanding of precipitation patterns from valley scale to synoptic scale to global atmospheric circulation, (ii) the role of sublimation as a water loss in dry, high altitude environments and how it can be impacted by climate change, (iii) the role of debris covered glaciers and how they are impacted by climate change and modulate melt patterns. [Walter Immerzeel, Netherlands]	Accepted - within the strict size limits of the report, relevant processes are introduced when relevant, if this contributes to better assessing past and future changes, responses and adaptation.
6436	2	1	0	83		Previous work has shown that average water availability is likely to increase in the future as a result of in general more precipitation and glacier peak melt that is decades away. The challenge is how to deal with changes in seasonality and extremes and this message could be reflected in one of the key messages in the executive summary. [Walter Immerzeel, Netherlands]	Accepted - mentioned in text
6438	2	1	0	83		Climate change can also have positive impacts in mountains: more water being generated, an attenuation of the hdyrograph and a more constant water supply, longer growing seasons. It could be wortwhile to dedicate a box to the positive effects of climate change in mountain regions. [Walter Immerzeel, Netherlands]	Rejected - evidence on the topic is too limited or agreement is too low to warrant a dedicated box on positive impacts of CC in the high mountain (mediated through the cryosphere)
21126	2	1	0	55		THIS IS A FANTASTIC CHAPTER OVERALL. The graphics are terriffic, and the overall content and organization is outstanding. Please take comments only as enhancements. Not fundamental flaws. Authors to be commended! [Thomas Wagner, USA]	Noted
6318	2	1	1	83	9	The chapter is a great start overall - nice job! The inclusion of considerable material from the Andes and from the Tibetan Plateau and its surrounding mountains and icefields is a welcome addition, for example. General areas for improvement include evening out its overall geographic coverage and expanding the scope and representativeness of its literature citations. A particular area needing some improvement is the section on the water resource impacts of cryospheric (especially glacial) change, section 2.3.1. While its treatment of this topic is a reasonable start for a first-order draft, some crucial scientific content is missing, and in at least one case, the scientific content provided appears to be incorrect; it contains notable content gaps that appear to be the result of failing to consult the water resources literature, and coverage of western Canadian studies, for example, seems inadequate. Nevertheless, the overall framework is solid and, with some easily attainable improvements, will provide a great overview. [Sean Fleming, USA]	Taken into account - section is largely rewritten

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6320	2	1	1	83	9	A "big-picture" point that appears to be missing from this chapter is the fact that in some coastal regions, glacial runoff is so substantial that not only does it contribute to global sea level rise, but it's also a major general control on local to regional scale coastal oceanography, including both biological and physical dynamics, and climate changes therefore have a host of regional-scale near-shore coastal oceanographic implications as well. This is particlarly true in the Gulf of Alaska. Many studies have therefore been undertaken to quantify freshwater runoff to the GOA, with a strong emphasis on glacial runoff. Some great examples that should be cited here include: (a) Arendt et al., 2002, Rapid wastage of Alaska glaciers and their contribution to rising sea level, Science, 297, 382-386; (b) Neal et al., 2010, Contribution of glacier runoff to freshwater discharge into the Gulf of Alaska, Geophysical Research Letters, 37, doi:10.1029/2010GL042385; (c) Beamer et al., 2016, High-resolution modeling of coastal freshwater discharge and glacier mass balance in the Gulf of Alaska watershed, Water Resources Research, 52, 3888-3909; and (d) Hill et al., 2015, Spatial and temporal variability of freshwater discharge into the Gulf of Alaska, Journal of Geophysical Research, 120, 634-646. There has also been a major cross-disciplinary movement very recently to synthesize biology, hydrology, glaciology, and oceanography to holistically understand these linkages - see (and cite) O'Neel et al., 2015, Icefield-to-ocean linkages across the Northern Pacific Coastal Temperate Rainforest ecosystem, Bioscience, 65, 499-512. [Sean Fleming, USA]	Accepted - link to ocean and coast are mentioned. The big-picture will be given in Chapter 1.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
6330	2	1	1	83	9	A potentially very expensive impact of climate and cryospheric change may be loss of seasonal water supply forecast (WSF) skill. In the western US and elsewhere, a key piece of information for water management is the generation, typically starting in mid-winter, of forecasts of river runoff volume for the following spring and summer. This information is used for a wide variety of planning and management purposes related to flood control, agriculture, fisheries, and hydroelectric power generation, among other things. Even incremental improvements or losses in forecast skill can have monetary values of millions, or hundreds of millions, of dollars per year per basin. However, WSF skill here is derived mainly from measurement of the wintertime mountain snowpack. There are increasing concerns, therefore, that winter warming-driven loss of winter snowpack may therefore lead to WSF skill losses. This question is the sort of thing that has serious and specific real-world consequences and I suggest that it be identified somewhere in this chapter. See (and cite): (a) Pagano et al., 2004, Evaluation of official western US seasonal water supply outlooks, 1922-2002, Journal of Hydrometeorology, 5, 896-909; (b) Harrison and Bales, 2016, Skill assessment of water supply forecasts for western Sierra Nevada watersheds, Journal of Hydrologic Engineering, 21, 10.1061/(ASCE)HE.1943-5584.0001327; and (c) Brekke et al., 2011, Climate change impacts on water supply predictability, American Meteorological Society short course, “Hydrologic prediction and verification techniques with a focus on water supply,” 23 January 2011, Seattle, WA. [Sean Fleming, USA]	Accepted - this loss of predictability is mentioned in the report, where appropriate.
16478	2	1	1	56	37	Whole Chapter: Replace "altitude" (height above the ground) with "elevation" (level of the land surface relative to mean sea level) for most instances of the word in the text. [Patrick Gonzalez, USA]	Rejected - altitude and elevation are synonymous, but altitude is less ambiguous since it can also refer to the act of elevating or to angular distance above a horizontal plane (Cogley et al, 2011, Glossary of glacier mass balance and related terms)
17338	2	1	1	55	15	Just a general comment that the explanations of processes and impacts in this Chapter are excellent, very clear even to lay policy readers - kudos! [Pamela Pearson, USA]	Noted
21346	2	1	4	1	4	Golam Rasul is from Bangladesh, not Nepal [Philippus Wester, Nepal]	Rejected - country of current affiliation is reported in IPCC reports
21374	2	1	4	1	4	Very surprising to see that two of the leading scientists on cryosphere in high mountains are not part of the author team. Walter Immerzeel and Tobias Bolch should at least have been LAs, if not CLAs. In any case, will be good to involve them as CAs. [Philippus Wester, Nepal]	Noted - Immerzeel was invited to be a CA but had to decline due to other commitments
1254	2	1	12	1	12	Check spelling of "Kathrin Dicinson" [Ross Brown, Canada]	Taken into account - correct spelling is Katharine Dickinson
4114	2	1	12			Last name written incorrectly. Katherin 'Dicinson' must be 'Dickinson'. [Sylvia Sander, France]	Taken into account - correct spelling is Katharine Dickinson
11860	2	1	12			it should read "Dickinson" (New Zealand) instead of "Dicinsion" [Dirk Hoffmann, Germany]	Taken into account - correct spelling is Katharine Dickinson
21348	2	1	19	1	19	Aditi Mukherji is from India, not Nepal [Philippus Wester, Nepal]	Rejected - country of current affiliation is reported in IPCC reports
18308	2	1	34	1	51	the text in bold describing the boxes is confusing. Maybe using another color (e.g. blue/grey) for the boxes will work better. [Carmen Burghelea, Romania]	Rejected - style is according to IPCC, final report will have boxes clearly separated from the main text body
122	2	1	38	1	43	possibility and the role of vegetation cover and its relation with cryosephere should be mentioned [Mostafa Jafari, Iran]	Accepted - these relationships are mentioned in the text, when appropriate, taking account strong size length limitations.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
124	2	1	44	1	45	possibility and the role of vegetation cover and its relation with cryosephere should be mentioned [Mostafa Jafari, Iran]	Accepted - these relationships are mentioned in the text, when appropriate, taking account strong size length limitations.
1928	2	1	46	1	46	Either delete the question mark or put "Do" before "Glaciers". [J. Graham Cogley, Canada]	Noted - this box has been made into an FAQ and the text changed
19416	2	1	46	1	46	Box 2.4 title should be modified to either read: "How do glaciers, snow and permafrost affect runoff?" or, remove the question mark at the end of the title [Michelle A. North, South Africa]	Noted - this box has been made into an FAQ and the text changed
16446	2	2	3	2	4	IPCC (2013) Working Group I attributed temperature increases to anthropogenic emissions of greenhouse gases with robust evidence and attributed reductions in glaciers and snowpack to anthopogenic causes. This chapter should clearly state this attribition and its importance merits a statement at the beginning of the Executive Summary. Edit this sentence to say something like "...significant warming due to anthopogenic emissions of greenhouse gases..." [Patrick Gonzalez, USA]	Taken into account - text revised, however very few attribution studies specifically address the high mountain environment (they are included in the report).
16448	2	2	3	2	7	This paragraph mixes historical impacts and future projections. As in previous IPCC reports and other chapters in this report, separating historical impacts and future projections provides a more accurate summary of the scientific findings, since historical impacts are based on actual measurements while future projections come from modeling with higher uncertainties. Therefore, separate the text into one paragraph quantifying the historical changes and a different paragraph summarizing the future projections. [Patrick Gonzalez, USA]	Taken into account - executive summary statements rephrased
21034	2	2	3		11	Is there specific evidence that the snow line has changed? Is this the seasonal or the permanent? The evidence isn't decribed later. [Thomas Wagner, USA]	Taken into account - better linkages between executive summary and assessment text and better definition of the mean snowline in assessment body
16450	2	2	13	2	16	IPCC (2013) Working Group I attributed reductions in snowpack to anthopogenic causes. This importance of this attributiion merits inclusing in the text. Edit this sentence to say something like "Anthropogenic climate change has reduced snowpack..." [Patrick Gonzalez, USA]	Taken into account - text revised to better link snowpack decline in mountainous areas to atmospheric warming
16452	2	2	13	2	21	This paragraph mixes historical impacts and future projections. As in previous IPCC reports and other chapters in this report, separating historical impacts and future projections provides a more accurate summary of the scientific findings, since historical impacts are based on actual measurements while future projections come from modeling with higher uncertainties. Therefore, separate the text into one paragraph quantifying the historical changes and a different paragraph summarizing the future projections. [Patrick Gonzalez, USA]	Taken into account - executive summary statements rephrased
16454	2	2	23	2	24	IPCC (2013) Working Group I attributed reductions in snowpack to anthopogenic causes. This importance of this attributiion merits inclusing in the text. Edit this sentence to say something like "Anthropogenic climate change has caused glacier retreat..." [Patrick Gonzalez, USA]	Taken into account - executive summary statements rephrased

SROCC First Order Draft Expert Review Comments - Chapter 2							
Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
16456	2	2	23	2	27	This paragraph mixes historical impacts and future projections. As in previous IPCC reports and other chapters in this report, separating historical impacts and future projections provides a more accurate summary of the scientific findings, since historical impacts are based on actual measurements while future projections come from modeling with higher uncertainties. Therefore, separate the text into one paragraph quantifying the historical changes and a different paragraph summarizing the future projections. [Patrick Gonzalez, USA]	Taken into account - executive summary statements rephrased
21036	2	2	29		33	Is this accurately portrayed? Isn't the vast majority case that peak flow will occur later in the century? As it reads, it seems like "most" places are already seeing lower flow. [Thomas Wagner, USA]	Taken into account - text revised to cover observed and projected change in literature
12756	2	2	35			I think that the uncertainties in the quantification of the global permafrost distribution in mountain areas are extremely high. Therefore I have doubts in the combination of a detailed number in km² and the comment on high confidence. Yes, "high confidence" on "large permafrost areas in high mountains", but no to high confidence on the exact number of km² distribution. Please discuss this. That a number is missing here signifies the uncertainty I think. [Jan-Christoph Otto, Germany]	Accepted
21038	2	2	35		43	Isn't the majority of the permafrost temp data in the Arctic? And mostly unknown elsewhere? Also, it opens with warming air temp, I think, and then makes the jump to perm temps. Maybe just go to thaw, since that's pretty robust. [Thomas Wagner, USA]	Rejected - there is some data in mountains that shows warming exists where monitored. Inferring warming and thaw in locations not monitored is robust based on process understanding.
12724	2	2	37			erase "their" [Jan-Christoph Otto, Germany]	Accepted
6440	2	3	0	4		Previous work has shown that average water availability is likely to increase in the future as a result of in general more precipitation and glacier peak melt that is decades away. The challenge is how to deal with changes in seasonality and extremes and this message could be reflected in one of the key messages in the executive summary. [Walter Immerzeel, Netherlands]	Accepted - revised text better reflects these aspects
15548	2	3	0	4		Highlighting observed changes in Mountain cyrosphere since AR 5 is important -- especially in precipitation and permafrost where stability of the area can change with consequent impacts on local and downstream populations. [Melinda Kimble, USA]	Taken into account - note however that AR5 did not specifically address precipitation or permafrost in mountainous areas
18470	2	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]	Editorial – copyedit to be completed prior to publication
20458	2	3	0	4		I am surprised that there is nothing in the executive summary describing the potential changes of precipitation in mountainous areas. (described in Section 2.2.1.2) [Martin Ménégoz, France]	Taken into account - changes in precipitation are covered in ES (in the FOD, they were, but not in bold).
20604	2	3	0	55		In general the chapter is very nicely written however I feel that studies over Himalayas is missing. I would recommend to put more detail on this in the current report. [Pushp Raj Tiwari, UK]	Taken into account - adding text on ecosystem impacts in Himalayas
1654	2	3	1	4	53	Suggest more focus on the consequenses on society, biodiversity and ecosystem services in the executive summary, with examples (e.g drinking water). [Aurora Stenmark, Norway]	Taken into account - more informaion added
13016	2	3	1	4	51	The use of calibrated language doesn't seem very consistent in this executive summary. [Gerhard Krinner, France]	Accepted - the use of the confidence language was checked prior to submitting the SOD.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
21350	2	3	1	4	51	Overall comment: the Executive Summary is vague, much more concrete figures and numbers are needed. [Philippus Wester, Nepal]	Taken into account - ES revised
23646	2	3	1	4	51	The ES is lacking a statement on the ecological impacts. Please refine the assessment of Section 2.3.4, and include it in the ES. [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - text revised in biodiversity section and added to the ES
24324	2	3	1			This ES should include bullets on ecosystems and human system impacts and risks eg local and downstream effects on biodiversity, agriculture, urban, hydropower [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - ES is updated to include bullets on ecosystems and human systems
24754	2	3	1	3	6	This line incorporates past and future changes and assign the “very likely” and “robust evidence” wording to both concepts. Might the authors consider separating these ideas and giving them separate assessments of likelihood and agreement? [Elizabeth Weatherhead, USA]	Taken into account - the structure of the executive summary was modified so as to better address past and future changes separately
12770	2	3	3	3	11	Temperature trends do increase with height in the tropics and, to a certain extent, mid latitudes. But in polar regions, warming trends decrease with height. So the 'likely to exceed global temperatures' is probably technically right but hides some robust regional variations. [Collins Matthew, UK]	Accepted - regional differences are difficult to convey in the ES but efforts have been made in this direction.
13394	2	3	3	3	21	The first two paragraphs are confusing. Improve clarity by perhaps separating these into 2 or 3 paragraphs, each with a clear theme, eg temperature-snow-precipitation or high altitude - mid altitude - mid latitude, something like that. [Debra Roberts and Durban Team, South Africa]	Taken into account - the structure of the executive summary was modified so as to better address past and future changes separately
20454	2	3	3	3	4	I would specify to which period corresponds "currently" and "continue', by writting for example "underwent a significant warming over the XXth century, a signal following the global temperature trend that will continue over the XXIst century". [Martin Ménégoz, France]	Taken into account - the structure of the executive summary was modified so as to better address past and future changes separately
24756	2	3	3	4	51	Perhaps the authors would like to re-order these bullets to address past and future issues in that order/ [Elizabeth Weatherhead, USA]	Taken into account - the structure of the executive summary was modified so as to better address past and future changes separately
4444	2	3	4			The meaning of "along with global temperature trends" is unclear. Suggest rewording or removal. [Graham Mcdowell, Canada]	Accepted - the statements were edited to avoid this ambiguity.
17876	2	3	4	3	4	The meaning of “significant warming along with” is unclear. Does this mean that mountain T trends are similar to global trends? What does “significant” mean; if this is a detection statement, then it would be better to say so and provide traceability to a detection study. [Haroon Kheshgi, USA]	Accepted - the statements were edited to avoid this ambiguity.
3726	2	3	5	3	6	Altitude determines the amount of lapse rate. But at the same time it determines the amount of the trend. Therefore add "the amount of" in this sentence as "In many cases, the amount of temperature trends is dependent on the altitude and is likely to exceed global temperature increases at medium altitude levels". [Serhat Sensoy, Turkey]	Taken into account - the text was edited to avoid such ambiguity
6442	2	3	6			What is intermediate level? The link with the 0 degree isotherm is a bit strange. EDW happens over a large elevation range. [Walter Immerzeel, Netherlands]	Accepted - the statements were edited to address this issue
13396	2	3	6	3	6	Insert a full stop before 'Precipitation' [Debra Roberts and Durban Team, South Africa]	Editorial – copyedit to be completed prior to publication
6784	2	3	7	3	7	Add a point “.“ before Precipitation [APECS Group Review, Germany]	Editorial – copyedit to be completed prior to publication
15486	2	3	7	3	7	Insert a point after the closing parenthesis in: "medium agreement) Precipitation trends are..." [Hernan Sala, Argentina]	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
4020	2	3	9	3	11	"Other drivers such as the deposition and impact of light absorbing impurities play a significant role in the response of snow and ice to climate change, often leading to amplified responses." First, "impurities" encompass both anthropogenic (e.g. BC) and natural (dust) sources; that is not clear here, and the reader is likely to infer/assume that you are referring to anthropogenic possutants. Second, I think this is too strong a statement. There are sufficient studies for the Tibetan Plateau in particular and for the specific mountainous region of the Colorado Basin addressed in the Deems et al. (2013) study, but it is a reach to say that it is been shown that absorbing impurities play a *significant* role in snow- and glacial-cover trends in mountainous regions in general. It would be more accurate to say, e.g., that 'There is evidence that anthropogenic sources of light-absorbing impurities play a significant role in the response of snow and ice to climate change in some regions (e.g. parts of the Colorado River basin mountains and the Tibetan Plateau).' [Sarah Doherty, USA]	Taken into account - statements about the impact of LAP were revised in preparation for the SOD, to better align with the state of knowledge.
1256	2	3	10	3	10	The is somewhat overstated as the importance of LAP exhibits strong spatial variabiliy, LAP are observed to be declining, and LAP are not considered to be a major driver of cryosphere changes compared to warming (Namaziet al., 2015) "Overall, changes in BC concentrations in snow have much smaller impacts on the cryosphere than the net warming surface air temperatures during the second half of the 20th century." Namazi, M., K. von Salzen and J.N.S. Cole, 2015. Simulation of black carbon in snow and its climate impact in the Canadian Global Climate Model. Atmospheric Chemistry and Physics, 15:10887-10904. [Ross Brown, Canada]	Taken into account - statements about the impact of LAP were revised in preparation for the SOD, to better align with the state of knowledge.
12772	2	3	10	3	10	light absorbing impurities' seems a bit obscure. Do you mean aerosls? Most aerosols reduce incoming solar so not sure why they would have an amplifying effect. Perhaps this refers specifically to black carbon? [Collins Matthew, UK]	Taken into account - light absorbing impurities (LAP) are indeed mostly aerosols, and when they deposit on snow, irrespective of their composition at first order (dust, BC etc.) they absorb solar radiation more than pure snow and decrease snow albedo, which can increase the snow melt rate, and in turn can amplify the warming because of snow/albedo feedbacks. LAP can have a different role once deposited on snow, compared to their atmospheric behaviour. In detail, different LAP have different impacts on snow albedo. Text is edited to better capture this behaviour.
18310	2	3	10	3	10	"climate warming" will be more suitable instead of "climate change" [Carmen Burghelea, Romania]	Taken into account - climate change is more comprehensive than climate warming, although warming is the most visible sign of climate change in many cases.
4446	2	3	11			Should levels of agreement/evidence follow this sentence? [Graham Mcdowell, Canada]	Taken into account - the structure of the executive summary was modified and confidence language usage was carefully checked prior to submitting the SOD

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
20456	2	3	11			"… amplified response, whereas other aerosol species (e.g. sulfates) are know to regionally cool the climate. [Martin Ménégoz, France]	Taken into account - here statements refer to the role of light absorbing particles upon deposition on snow, not airborne. This is clarified in the SOD.
1258	2	3	13	3	16	his statement is correct for snow cover duration that is projected to decrease over most of the planet. However, the picture is more nuanced for SWE, particularly annual max SWE that is relatively insensitive to warming except in temperature mountain regions which are areas of greatest at-risk snow cover. I would modify this statement to make it clear it relates to the mean 0C region (i.e. promote the statement in parentheses). [Ross Brown, Canada]	Accepted - the statements were edited to better capture this fact.
6444	2	3	13	3	21	It could be mentioned that the uncertainty in snow conditions is driven by uncertainty in changes in total precipitation, but that shift in rain/snow threshold + increased melt is very likely. [Walter Immerzeel, Netherlands]	Accepted - the statements were edited to better capture this fact.
12556	2	3	13	3	16	the heading sentence of the snow section lacks a confidence estimate. [Thomas Vikhamar Schuler, Norway]	Taken into account - the structure of the executive summary was modified and confidence language usage was carefully checked prior to submitting the SOD
18312	2	3	13	3	13	after "snow depth", "snow cover" is also affected but it is not stated in text. [Carmen Burghelea, Romania]	Accepted - the text was clarified to avoid such ambiguity
12424	2	3	15	3	15	"altitudes" instead of "altitude" [Sven Kotlarski, Switzerland]	Editorial – copyedit to be completed prior to publication
12774	2	3	17	3	17	presumably there is some dependence on emission scenario here? [Collins Matthew, UK]	Accepted - more emphasis is now placed on the scenarios.
12776	2	3	23	3	27	I wonder if it is owrth having a short sentence on temperaure vs precip drivers of glacier change? [Collins Matthew, UK]	Taken into account - the structure of the executive summary was modified, climatic drivers of the cryospheric changes are discussed in the first ES statement.
13398	2	3	23	3	27	Is it possible to quantify the annual loss and projections for near and longterm scenarios? Hard facts of this nature are important in an Executive Summary. [Debra Roberts and Durban Team, South Africa]	Accepted - Numbers have been added in the ES.
17878	2	3	23	3	23	I could not find in 2.2.3 the basis for the statement "Since AR5, mountain glaciers have continued to decline in all glacierized regions". This statement implies data newer than the AR5 showing this a continued trend over the short period from 2011 or 2014 to present (a surprisingly short time period?), but I did not find support in the underlying text? [Haroon Kheshgi, USA]	Accepted - text was revised for clarity.
18314	2	3	23	3	23	"AR5" should read perhaps "IPCC-AR5" [Carmen Burghelea, Romania]	Rejected - we use AR5, following style in previous ARs
21458	2	3	23	3	27	Currently available data definitely allow for a more elaborate presentation of the past and future glacier changes addressing regional specifics and current understanding of the glacier response to the major CC-impact drives. The executive summary would greately benefit if the statement on glaciers would be less vague than that. [Oxana Savoskul, Sri Lanka]	Accepted - text was revised for clarity and providing more substantial statements.
24758	2	3	23	3	27	"…glacier mass loss rates in the early 21st century are unprecedented during the >70 year observational record." The term "unprecedented" seems a bit dramatic. Is the following equally true?: "the glacier mass loss rates in the past fifteen years are higher than they were in the prior 55 years?" If so, the second sounds a bit more scientific. For the authors' consideration. [Elizabeth Weatherhead, USA]	Taken into account - the structure of the executive summary and the text was modified and confidence language usage was carefully checked prior to submitting the SOD

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
188	2	3	24	3	27	Authors write "average mountain glacier mass loss rates in the early 21st century are unprecedented during the >70 year observational record". This statement may be misleading as palaeoclimatologists have reconstructed much longer glacier histories. These studied indicate that glacier length has fluctuated significantly in pre-industrial times, similar to the change of the past 150 years. This must be acknowledged in an open and transparent way otherwise it could be misunderstood as if authors try to conceal this. See e.g. Solomina et al. 2016 (doi: 10.1016/j.quascirev.2016.04.008) or Solomina et al. 2015 (doi: 10.1016/j.quascirev.2014.11.018). [Sebastian Luening, Portugal]	Taken into account - the structure of the executive summary and the text was modified to clarify the specific scope of this report on recent glacie cryospheric changes and it's impacts.
17880	2	3	25	3	25	It would be good to better define what is meant by "average" by specifying the spatial and temporal extent of the average. Is it gobal or regional, and over precisely what years (since early 21st is a limited time...does this mean 2000 to 2010?)? The underlying text does not seem to provide enough information to answer this question which must be a basis for defining "likely". [Haroon Kheshgi, USA]	Taken into account - the structure of the executive summary and the text was modified to clarify time intervals and spacial variability of glacier changes.
4448	2	3	26	3	27	Is the "Relative volume..." sentence helpful? Couldn't one equally say that areas with large glaciers will have the largest 'absolute' reductions in area and volume. If this is accurate, it may be worth reflecting on the utility of including such a statement in the ES. [Graham Mcdowell, Canada]	Accepted - text was revised for clarity and providing more substantial statements.
24326	2	3	26	3	26	Give examples of regions [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - text was revised, regional differences were described.
148	2	3	29	4	15	I think there is scope for mentioning conditions on active/dormant volcanoes specifically here, and emphasising this (more than at present) elewhere in the chapter. For example, in the section marked here, it could be emphasised that (1) As the amount fo snow and ice on volcanoes diminishes (as projected) the risk from lahars (perhaos the biggest hazard in mountain environments) and floods (caused by glacier or snow melt) diminishes. If/when volcanoes become glacier- and snow-free this risk effectively stops. (2) There is growing evidence to suggest that 'unloading' as glaciers melt might trigger volcanic activity and/or change the nature of eruptions. This might well be one of the most importnat consequences of glacier melt in High mountain Areas, [Iestyn Barr, UK]	Accepted - text was revised for mentioning conditions on volcanoes.
1932	2	3	29	3	29	Insert "since the culmination of the Little Ice Age" after "shrinkage". The statements are not meaningful unltil you assign a date to the maximum extent. [J. Graham Cogley, Canada]	Taken into account - the structure of the executive summary and the text was modified to clarify time intervals and spacial variability of glacier changes.
21418	2	3	29	3	35	the overall effect of those changes on the streamflow totals is however minor to negligible, whereas the changes in the seasonality of peak flows (slight increase of winter flows and stretching+lowering the peak runoffs in the melt season) will be the major consequence of the CC impact. This message should be articulated somewhere in the Executive summary [Oxana Savoskul, Sri Lanka]	Taken into account - the structure of the executive summary and the text was modified the statement about changes in ammount and timing of the river runoff was added.
24760	2	3	29	3	33	Very nicely written. [Elizabeth Weatherhead, USA]	Noted
6778	2	3	30	3	31	add "magnitude"...(High confindence), the magnitude, timing and duration of which.... [APECS Group Review, Germany]	Accepted - text revised
24328	2	3	31	3	31	Given examples of regions [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - text revised

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6780	2	3	32	3	33	Figure 2.5 does not show that the peak of runoff will be reach BY THE END OF THE CENTURY (in fact it shows that only in Sothern Andes and Alaska will be reached then) [APECS Group Review, Germany]	Accepted - text revised for better clarity.
21352	2	3	35	3	37	Very little is known about permafrost in high mountain areas, so the very high confidence assessment is misplaced, also considering that no figure is given for the area. The work by Gruber et al. on the Hindu Kush Himalaya give some indications of areas likely under permafrost, but not with high confidence. [Philippus Wester, Nepal]	Accepted
21450	2	3	35	3	35	Either the area and other spatial characteristic should appear in description of seasonal snow and glaciers or these characteristic are irrelevant in the description of the alpine permafrost too. [Oxana Savoskul, Sri Lanka]	Taken into account - the text was revised for better clarity, within strict text length constrains.
12778	2	3	37	3	38	It would be good to quantify this change of rate. [Collins Matthew, UK]	Rejected - the exact change rate is likely not to be representative as boreholes are few and contidions highly variable.
12780	2	3	40	3	41	I don't think you need the statement about coarse-scale models. [Collins Matthew, UK]	Rejected - it is important because otherwise, the reader might expect simulations of future scenarios to be derived from climate model simulation as is done in polar lowlands.
6786	2	3	41	3	43	Lack of uncertainty language for the sentence: Finer-scale simulations suitable for mountain environments (are likely/very likely to ??) indicate widespread warming and thaw of permafrost until the end of the century. [APECS Group Review, Germany]	Accepted
4012	2	3	42	3	42	"until the end of the century" implies that at the end of the century permafrost warming/thaw will stop, which I don't think is what you mean to convey~ [Sarah Doherty, USA]	Accepted
4450	2	3	42			As written, sentence gives the impression that permafrost degradation will only occur 'until the end of the century'. Perhaps reword so that the end of the century does not come across as a final point in time for permafrost degradation. Replacing 'until' with 'through' may help here. [Graham Mcdowell, Canada]	Accepted
3972	2	3	45	3	46	Sentence doesn't read correctly [Helene Hewitt, UK]	Accepted - text revised
6782	2	3	45	3	46	unclear "thaw of mountain permafrost decrease" [APECS Group Review, Germany]	Accepted - text revised
13400	2	3	45	3	46	Thaw of mountain permafrost decrease : reword [Debra Roberts and Durban Team, South Africa]	Accepted - text revised
15488	2	3	45	3	46	Please, revise wording in: "There is high confidence that current and projected retreat of mountain glaciers and thaw of mountain permafrost decrease and will continue to decrease the stability of mountain slopes". (The thaw of mountain permafrost decrease?) [Hernan Sala, Argentina]	Accepted - text revised
1260	2	3	46	3	46	Sentence does not make sense as written... It needs a comma after each "decrease" [Ross Brown, Canada]	Accepted - text revised
190	2	4	1	4	3	Similar lakes have formed during previous (natural) warm phases for which palaeoclimatic records do exist. In a Holocene context the formation of such lakes is not unprecedented. See e.g. Stansell et al. 2014 (doi: 10.1016/j.quascirev.2014.01.021) or Stansell et al. 2013 (doi: 10.1016/j.quascirev.2013.03.003). [Sebastian Luening, Portugal]	Accepted - text revised. We refer to historic tradition, and to disasters that ALSO could happen where such tradition is not available.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
4452	2	4	1	4	6	As written, this statement is very unclear. Perhaps re-write to something like: "There is high confidence (medium agreement) that climate change will alter high mountain landscape elements such as frozen slopes, glaciers, water bodies, implying related disasters where no historical record of previous events exists. For instance, there is high confidence (high agreement) that the increasing number of glacier lakes and decreasing slope stability will increase the number of landslide-generated impulse waves (tsunamis)." [Graham Mcdowell, Canada]	Accepted - text revised
6292	2	4	1	4	7	This passage would benefit from rewriting for improved readability. [Sean Fleming, USA]	Accepted - text revised
24762	2	4	1	4	3	“It is expected with high confidence…”. Remove passive voice and replace with scientific statement. Perhaps along the lines of “Observations and models indicate that climate change will reposition… (high confidence)…” [Elizabeth Weatherhead, USA]	Accepted - text revised
16458	2	4	2	4	2	Figure 2.1. For the "glacierised regions," it would be more accurate to trace polygons around the main mountain ranges rather than have large rectangles that include non-glacier areas. [Patrick Gonzalez, USA]	Taken into account - the rectangles are not just glaciated regions and the map legend has been revised accordingly.
16460	2	4	2	4	2	Figure 2.1. The geographic latitude-longitude format of the map does not accurately show surface areas, since the area of a pixel varies with latitude. Produce this map in an equal-area projection such as Robinson. [Patrick Gonzalez, USA]	Accepted - Map now uses Robinson projection
1262	2	4	3	4	3	Sentence does not make sense as written [Ross Brown, Canada]	Accepted - text revised
21420	2	4	5	5	5	Is it correct usage of the term (tsunami)? According to the context, the increased risks of debris and mud flows due to the loss of slope stability and destabilization of glacial deposits (front moraines especially) might be expected [Oxana Savoskul, Sri Lanka]	Accepted - text revised
12782	2	4	9	4	10	Strange application of uncertainty language here. [Collins Matthew, UK]	Taken into account - confidence language usage was carefully checked prior to submitting the SOD
16532	2	4	9	4	9	The beginning of the sentence is unclear and confusing [Luzi Bernhard, Switzerland]	Taken into account - text was edited and confidence language usage was carefully checked prior to submitting the SOD
18316	2	4	9	4	9	the statement "than not that" is not clear [Carmen Burghelea, Romania]	Taken into account - text was edited and confidence language usage was carefully checked prior to submitting the SOD
24764	2	4	9	4	13	Remove “It is more likely than not” because the “medium confidence” describes the likelihood and should probably be the only descriptor of likelihood. [Elizabeth Weatherhead, USA]	Taken into account - text was edited and confidence language usage was carefully checked prior to submitting the SOD
4460	2	4	17	4	30	These statements focus on low frequency, high magnitude events (e.g. flooding hazards), but changes in the high mountain cryosphere are also driving high frequency, low magnitude events (e.g. changes in water availability) that impact people in and beyond mountain areas. It would be good to expand the scope of climate-related impacts presented in these statements. [Graham Mcdowell, Canada]	Accepted - text revised to cover wider events
6446	2	4	17			Exposure to what? [Walter Immerzeel, Netherlands]	Accepted - text revised in a different way
17492	2	4	17	4	17	“Exposure” is introduced abruptly here and needs to better framed. Without that, the paragraph is not underdstandable. [Wolfgang Cramer, France]	Accepted - text revised in a different way
21040	2	4	17		22	Tourism is the main driver of change? Is this true outside of European ski resorts? Is it true in the Himalayas or South America? How about roads from India to China…trade…pop growth? [Thomas Wagner, USA]	Accepted - text revised to ensure a generalisation is not overstated (removed "tourism has been the main driver of this change" to avoid confusion).

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
21354	2	4	17	4	22	This paragraph needs more work. Tourism as main driver drops out of the sky and is unclear. Why is this a main driver? The sentence on cryosphere-related landslides and floods is inaccurate. Not many people live in high mountain areas, and impacts of these events tend to be quite limited and not reach far downstream. The use of "severe impacts" and "extending far beyond" is overblown and not backed by scientific evidence [Philippus Wester, Nepal]	Taken into account - text revised
24330	2	4	18	4	19	Give further detail, or the reader is left wondering why tourism has this effect? Is it because tourism is bringing large numbers or extending into cryosphere regions? [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - removed reference to tourism, this overstates a generalisation. See also comment ID 21040
4454	2	4	19			And population growth in mountains? See FAO (2015). Mapping the vulnerability of mountain peoples to food insecurity. R. Romeo, A. Vita, R. Testolin and T. Hofer. Rome, FAO: 68. [Graham Mcdowell, Canada]	Taken into account -text revised with other comments
6448	2	4	24	4	27	I suggest to remove the "compunding environmental stress". Is the impact increasing due to climate change or due to more people being exposed in the mountains? I am not sure if there is cinclusive evidence of an increase in mountain floods and landslides due to climate change. [Walter Immerzeel, Netherlands]	Accepted - text revised
11782	2	4	24	4	30	please mention usefulness of ecosystem-based approaches for risk reductions (floods/landslides…) and climate change adaptation in high mountain regions [Hilde Eggermont, Belgium]	Rejected - we do not have enough evidence in the chapter to highlight usefulness of EBA.
4456	2	4	25			Very important that 'social stresses' also be mentioned here explicitly. There is ample literature that highlights the importance social stressors in influencing sensitivity and vulnerability to climate-related changes, some of which is already cited in the HMA chapter. [Graham Mcdowell, Canada]	Accepted
17494	2	4	27	4	27	“Particularly for mountain regions…” a classical case of blindness of a research community that openly exposes its bias. Which empirical comparison has led you to conclude that this integration is a less important prerequisite for people else where? And would it matter? Please stick to stating the facts about the systems you are asked to assess and do not try to demonstrate their “uniqueness” when this is not part of the necessary assessment. [Wolfgang Cramer, France]	Accepted - text revised
4458	2	4	29			Perhaps change 'hydrological' to 'climate-related' [Graham Mcdowell, Canada]	Taken into account - text revised in a different way.
13402	2	4	30	4	30	Add "indigenous and local knowledge" here. [Debra Roberts and Durban Team, South Africa]	Taken into account - text revised in a different way with other comments
1656	2	4	32	4	34	The impacts on social-ecological systems are here described in neutral terms ('considerable impacts'). Please consider a more describing formulation of the impacts - are they positive/negative? Suggest mentioning expected considerable loss of biodiversity, cf. Ch. 2.3.4. [Aurora Stenmark, Norway]	Taken into account - text revised
6450	2	4	32	4	52	I find the last two points quite vaguely formulated such as "largely reflecting the diverse priorities, conditions and mechanisms available for their implementation and evaluation" and "Integrated (crosssectoral) governance approaches hold potential in promoting socio-economic sectors’ resilience and transformation". The last sentence "Recognition for multiple ways of knowing / indigenous and local knowledge promote resilience and adaptation in a changing climate and cryosphere environment" seems not connected to the prior part. [Walter Immerzeel, Netherlands]	Taken into account - text revised

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
17496	2	4	32	4	42	While attempting to generalize aspects of vulnerability and adaptation across the planet, you end up (as is often the case in the adaptation literature) saying nothing much at all to anyone outside the academic adaptation community. I suggest to completely drop this paragraph and replace it with three or four new ones that treat real-world aspects of adaptation, not as examples, but by citing the most important ones. [Wolfgang Cramer, France]	Taken into account - the text gives cross-ref to sections where case studies and exemples to these statements can be backed-up with evidence. Text has been revised to take note of diversity and differences. Given that this is Executive Summary text, text is unavoidably general.
21042	2	4	32		42	This seems really speculative. There didn't seem to be much in the report to support this. [Thomas Wagner, USA]	Accepted - text revised to reflect main report
1934	2	4	35	4	35	"remains". [J. Graham Cogley, Canada]	Accepted - text revised
6788	2	4	35	4	36	The following statement can be remove: “Impacts of cryosphere change on human society is already evident in many mountain regions”. Since it is already mentioned in the lines above that changes in the cryosphere are exerting considerable impacts in high mountain social- ecological systems, including many facets of biodiversity, and the ecosystem services that the cryosphere provides to humans. [APECS Group Review, Germany]	Accepted - text revised , previous sentence revised
1936	2	4	36	4	36	"are already". [J. Graham Cogley, Canada]	Accepted - text revised
4466	2	4	36	4	41	This statement could be revised based on soon-to-be available results in McDowell et al (in Review), which provides the most comprehensive and up to date synthesis of exiting adaptation action and research in mountain systems. See: McDowell, G., Huggel, C., Frey, H., Wang, F., Cramer, R., Ricciardi, V. (In Review) Adaptation action and research in glaciated mountain systems: Are they enough to meet the challenge of climate change? [Graham Mcdowell, Canada]	Taken into account - paper under review, will incorporate in the assessment once available after review process. Also, I would caution on the 'comprehensive' assertion, given that the systematic review is largely based on literure in English, and therefore geographically biased.
12784	2	4	38	4	38	Some examples of adaptation measures would be helpful here. [Collins Matthew, UK]	Taken into account - examples added
4462	2	4	39			What does 'collective' long-term effectiveness mean? Perhaps clarify or delete. [Graham Mcdowell, Canada]	Accepted - text revised
4468	2	4	44	4	45	Suggest rewording bolded text to: "There are limits to the adaptability of individuals and socio-economic sectors exposed to climate-related changes in mountain regions." Note: that ‘individuals’ has been added, in addition to rewording. [Graham Mcdowell, Canada]	Accepted - text revised in a different way with other comments
17498	2	4	44	4	51	Just as in the previous paragraph: While attempting to generalize aspects of adaptation across the planet, you end up saying nothing much at all to anyone outside the academic adaptation community. These are all commonplace truisms that also work for much of the rest of the planet – no need for a SROCC to say this. I suggest to completely drop this paragraph and replace it with three or four new ones that treat real-world aspects of adaptation, not as examples, but by citing the most important ones. [Wolfgang Cramer, France]	Accepted - text revised.
19070	2	4	44			This should be linked to and supplemented by information on loss and damage in high mountain areas [Carl-Friedrich Schleussner, Germany]	Accepted - text revised. Loss and damage discussed elsewhere in chapter and in CCB on resilience/risk BEN? The answer was in the comment field

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
4470	2	4	46	4	50	There is a shift in this statement from adaptation (previous statements) to resilience and transformation. These are all valid framings, but conceptual consistency across statements about human experinces of and responses to climate change would be helpful. [Graham Mcdowell, Canada]	Accepted - added 'vulnerability' to address the contextual conditions that are amplified by impacts, and stating the difference there with respct to resilience. A separate statement may be needed to account for transformation(s), subjecvt to additional text in main chapter text.
21356	2	4	48	4	51	Language is unclear, these two sentences do not say much. For an Exec Sum they need more work, and need to be more precise. [Philippus Wester, Nepal]	Accepted - text revised
1938	2	4	50	4	51	Incoherent sentence. "Recognition of … promotes". Delete the slash. But I still do not know what "multiple ways of knowing … knowledge" might mean. [J. Graham Cogley, Canada]	Accepted - text revised
4472	2	4	50			Recognition and 'integration' of multiple knowledge sources. 'Integration' is key to emphasize here. [Graham Mcdowell, Canada]	Accepted - text revised in a different way with other comments
13404	2	4	50	4	51	This seems to have been inappropriately placed and the linkage to preceeding issue addressed in this paragraph is not clear. Recommend that the point on the recognition of multiple ways of knowing be added to the sentence on line 30 page 4. [Debra Roberts and Durban Team, South Africa]	Accepted - subject to additional text revision for sentence ending with line 30 (page 4).
21046	2	5	0	7		Figure 2.1 is amazing piece of work, but there is nothing in the text that communicates the differences between the Mtn cryosphere in different regions in terms of both characteristics, change, relationships to be people etc. I wonder if a page is needed on how Himalayas are diff than Europe than Alaska than South America. Might set the stage better for later discussons. Maybe just frame this by discussing Fig 2.1 more. [Thomas Wagner, USA]	Rejected - this report is an assessment of changes rather than a description of mountainous areas in different regions. Some of the differences are covered in the subsequent text.
2692	2	5	3	5	48	Much more attentions and specific notes are necessary for small areas of high mountains with perrenial snow and possible small glaciers in mid latitude, e.g., in Japan, Taiwan, and Indonesia, mostly owing to its preciousness in biodiversity and the imminent threats to their sustainability. These mountains are now sinking into warming air. It is the scattered front line of the cryosphere crisis. [Kentaro Hayashi, Japan]	Taken into account - such areas are addressed when relevant, and when literature is available.
150	2	5	5	5	24	I think the geopolital implications of a shrinking mountain cryosphere could be mentioned explicitly. For example, the political consequences of reduced snow and glacial ice in NW India (a region maentioned later in the chapter), where meltwater feeds intio the Indus and onward to Pakistan. These are surely areas for potential dispute/confilt in the future. [Iestyn Barr, UK]	Taken into account --geopolitical implications discussed in section 2.3.1.4 Water governance and response measures
16104	2	5	5	5	34	suggest to express the defination of High Mountain Areas more logically. Now the chapter is using "mountain regions" , "mountains", "high mountain areas", and "mountain areas". The usage of these four terms are confusing. We suggest to move Lines 26-34 to Line 5, before "Mountain regions…" and delete Lines 5-7 "Mountain regions… gradients". [Jing Gao, China]	Taken into account - however, this paragraph has been deleted.
16806	2	5	5	5	5	"institutional remoteness" is not a clear term. It may not be good to combine with spatial remoteness [Arun Shrestha, Nepal]	Rejected - we have cited literature that uses this term in this context.

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17062	2	5	5	40	40	I would be clearer about the meaning of 'polar regions'. This term is used likewise for the polar environment in high mountain regions (see third pole) and thus not useful to distinguish them. Fig. 2.1 is also indicating that a simple value of geographic latitude is also not applicable. I thus suggest to explicitly list the mountain regions that are not considered in this section (Canadian and Russian Arctic, Svalbard, peripheral Glaciers on Greenland and sub-Antarctic Islands). [Frank Paul, Switzerland]	Accepted - polar regions vs high mountain areas defined in figure 2.1
17064	2	5	5	40	40	Further to comment 8, I suggest adding why the above mountain regions are excluded here although many of the aspects discussed in Ch. 2 for the other mountain regions do also apply here, in particular when considering the possible much higher temperature increase. As these regions are not covered in the same depth in the other Chapters of the report, the reasoning for excluding them here - despite the fact that the largest impacts are expected for these regions - must be extremely convincing. [Frank Paul, Switzerland]	Rejected - for chapter 2. These regions come under chapter 3 that will expand on these areas for the next draft of the report.
21044	2	5	6			"Which" should be "That" [Thomas Wagner, USA]	Accepted - text revised.
16106	2	5	7	5	8	suggest to delete "mountains often feature" and "and" in Line 8. [Jing Gao, China]	Rejected - sentence is focused on cryospheric components often being related to high elevation.
12426	2	5	12	5	24	As this paragraph is supposed to outline the relevance of the cryosphere, I'd suggest to add one or two sentences on cryosphere-atmosphere feedbacks, i.e. the ability of changing cryospheric features to modify at least local/regional climates. [Sven Kotlarski, Switzerland]	Taken in to account - text revised in a different way with other comments.
6790	2	5	15	5	17	Include citation: Viviroli, D., H. H. Dürr, B. Messerli, M. Meybeck, and R. Weingartner (2007), Mountains of the world, water towers for humanity: Typology, mapping, and global significance, Water Resour. Res., 43(7), doi:10.1029/2006WR005653. [APECS Group Review, Germany]	Accepted - reference added
19418	2	5	15	5	15	Populations - should be plural [Michelle A. North, South Africa]	Rejected - population is more appropriate in this context
20460	2	5	15			"…water resources in response to declining snow cover and glacier mass, and in potential changes of precipitation regimes" [Martin Ménégoz, France]	Noted - this part has been deleted
19420	2	5	17	5	17	Alter to read: "downstream populations, for agricultural and domestic water use, and…" [Michelle A. North, South Africa]	Accepted - text revised.
3470	2	5	21	5	21	I would include snow avalanches here as well: “rock/ice/snow avalanches” [Deborah Verfaillie, Spain]	Accepted - text revised.
2694	2	5	22	5	22	It is questionable that the mass from mountain glaciers is a significant contributor to current sea-level rise. There are two aspects in my question. One is that the volume of mass provided by mountain glaciers seem not large in the global scale in comparison with the mass from ice sheets in the two polar regions. The other is that the mass lost from the mountain glaciers contain sediments providing rocks and sands to downstream areas, which is partly effective to increase the land volume coping with the sea-level rise (though we should also consider its negative aspects). [Kentaro Hayashi, Japan]	Rejected - abundant literature has established the large role of mountan glaciers in sea-level rise (e.g. IPCC 2013).
15490	2	5	22	5	22	Check where is written "Section 4.X". Does this section really exist? [Hernan Sala, Argentina]	Accepted - reference has been corrected

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21358	2	5	23	5	24	how many millions of people will be impacted by changes in mountain cryosphere? As melting glaciers tend to increase stream and river flows far into the 21st century and very few people live in high mountains, So direct impacts globally may only be on around 20 to 40 million people. The chapter team needs to verify this and make a scientifically based estimate of how many people will be directly impacted. [Philippus Wester, Nepal]	Rejected - outside the scope of the chapter, Coming up exact number is difficult, so far there is no such global assessment
152	2	5	31	5	34	Given the definition of 'high mountain regions' adopted here, volcanoes are presumably a (if not 'the') key componenet. At present it seems like the chapter skips very quickly past volcanoes (i.e., the only section to even mention volcanoes is pg. 39, lines 46-54). [Iestyn Barr, UK]	Rejected - report is focused on changes in crysophere due to climate change, and volcanoes are mentioned only when relevant
3928	2	5	31	5	34	Mountain definition (2017) is very vague and not backed by scientific references. Please consider definition and scope with some scientific references, suggested literatures: (1) Michel Meybeck, Pamela Green, and Charles Vörösmarty, A New Typology for Mountains and Other Relief Classes; Mountain Research and Development Vol 21 No 1 Feb 2001: 34–45. (2) Kapos V, Rhind J, Edwards M, Price MF. 2000. Developing a map of the world's mountain forest. In: Price MF and Butts N, editors. Forest in Sustainable Mountain Development: A State of Knowledge Report for 2000. Wallingford, UK: Commonwealth Agricultural Bureau (CAB) International. [Anil Mishra, France]	Noted - text was deemed superfluous and whole paragraph is deleted.
4474	2	5	31	5	34	The definition of high mountain regions as "mountain areas where seasonal or perennial cryosphere is present and poses a potential and serious risk to society related to water scarcity and disaster resilience" seems too limiting for this report. The 'and poses a potential and serious risk to society' places significant limits of the geographical scope of what counts as a high mountain region. Some of the works cited in this report is conducted in areas where the high mountain cryosphere does not pose a potential and serious risk to society but ecological impacts are significant, for example. The definition adopted suggests that such work is out of scope for this report? Perhaps the Kapos or Korner definition would make more sense? [Graham Mcdowell, Canada]	Noted - text was deemed superfluous and whole paragraph is deleted.
12428	2	5	31	5	34	This definition actually excludes certain mountain regions. I think it would help to refer here to the scope of the entire SROCC report to betetr motivate a definition based on cryospheric features. [Sven Kotlarski, Switzerland]	Noted - text was deemed superfluous and whole paragraph is deleted.
6792	2	5	36	5	38	In the chapter, Tibet is shown as an example of mountain area, when it is a vast plateau including mountains along its margins. In some cases, maybe it should be reviewed to make clear that we refer to the mountains. [APECS Group Review, Germany]	Taken into account - text revised for clarify mountain area / regions in Tibet when required
6794	2	5	36	5	38	Suggestion to make the text shorter and easier to read: Thus, in this chapter high mountains are considered as those mountain regions where glaciers, snow or permafrost are prominent features of the landscape, without a strict and quantitative demarcation, but with a focus on distinct regions. [APECS Group Review, Germany]	Accepted - text reivsed
24620	2	5	36			Formulation needs to be more specific with respect to inclusion or not of polar mountains. [Hans-Otto Poertner and WGII TSU, Germany]	Noted - figure 1 is used to define area of interest.
11862	2	5	39			"socio-ecological" also appears as "social-ecological" and "socioecological" in different places (e.g. page 17, lines 34 and 36) [Dirk Hoffmann, Germany]	Accepted - term is now consistent throughout the chapter.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
4476	2	5	45	5	46	'non-cryospheric drivers are not considered here' Perhaps this could be re-worded in less definite terms? The report actually does mentions other drivers of exposure and vulnerability, and doing so is consistent with what the broader literature tells us about lived experiences of climate change (i.e. that they cannot be decoupled from specific socio-ecological contexts). [Graham Mcdowell, Canada]	Accepted - taken into account by rephrasing 'non-cryospheric drivers', as per our SROCC scope, without discounting those external factots and processes that are relevant for adaptation.
5926	2	5	45	5	48	We understand that because of the focus of this report, the other physical developments (i.e.: physical developments not related to the cryosphere) are not considered. However, maybe it is better to change the title of the chapter to: development in the cryosphere in the high mountain areas. Especially because of the third chapter, which is only focussed on the cryosphere area or outline this better at the start [Roderik Van De Wal, Netherlands]	Rejected - the titles of the chapters are prescribed and can not be changed.
13406	2	6	0			"Figure 2.1: This is a very interesting and information-packed figure. 1. Currently each bar graph is displayed with its own Y-axis. This wastes space, means regions have to be displayed in two rows, and prevents comparisons between regions. Recommend displaying graphs on common Y-axis so axis labels appear once only. This allows all regions to be displayed alongside each other in a single row, and makes comparison easy, showing clearly how ice occurs at different altitudes by region. Axis titles ""Elevation (m)"" and ""Normalized area"" can be included once and do not need to appear in legend. 2. Also recommend placing area circles directly above the graphs, rather than scattered on the map, to associate the total area clearly with each graph. The circles should not fade into white, so that even the smallest area circles would still be visible, and show the degree to which regions differ from each other with regard to total cryosphere area." 3. bars and circles: change colour range on permafrost to fade into something other than white (eg green or brown for ice-free land) as the colour fades to invisible in some graphs. Same for circle plots. In Alaska you can't see how big the circle is. Also, on bars, let it fade the other way, with purple near the glacier axis, and the 'thawed' end pointing left." Legend: 1. Check colour orange in legend matches colour in map 2. The Elevation(m) scale is not required if the same elevation scale is used throughout in the figure, and axis is labelled once. X-axis can be labelled in diagram too, and label should read 'proportion of total mountain area per altitude bin' for instance, to match text. 3. the circles should represent total mountain area represented on graphs (to give a scale to what 'total area' means in the graph charts. Perhaps they do, but this is not quite clear.	Accepted - figure has been revised

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13408	2	6	0			Figure 2.1: Looking very carefully at the content of the figure, and trying to read information off it. Take Iceland for example. The map, area graph and bar chart suggest that: - The area circle suggests that the maximum extent of glacier/permafrost is 10 000km2 or less. Correct? - The Central Europe area circle is smaller, even though the blue areas ('glaciers') on the map look larger (particularly taking into account that this is not an equal area projection). Please explain? Or else, what do the blue areas on the map represent compared with the area circles and bar charts? How do they relate to each other? One would assume that the cyan bars and cyan map areas represent the same thing (ie glaciers)? - The text says "Histograms show glacier and permafrost area for each elevation bin in fraction of total 9 glacier area" . In Iceland bin width= 200m - Reading off the Iceland bar chart: for example, around 25% of areas between 1600-1800m are glacier (permanent ice cover?). What is the rest? Since there is no permafrost? Bare rock? Around 90% of areas between 800-1000m are (temporary) permafrost, right? What is the rest? Never-frozen land? Was that not excluded? Glacier? But the glacier side is about 50%, so how can you have 50% of that elevation being glacier and at the same time 90% being some form of permafrost? This is confusing. [Debra Roberts and Durban Team, South Africa]	Taken into account - this aspect of the figure is changed, now.
3472	2	6	1	6	11	Figure 2.1: Glacierised regions (in white in the legend) don't appear in the figure [Deborah Verfaillie, Spain]	Taken into account - renamed to 'high-mountain regions'
3474	2	6	1	6	11	Figure 2.1: The current representation of permafrost and glacier area using circles does not seem optimal, as for some regions the information is barely visible (for example, New Zealand or Iceland). I don't see any information for Central Europe? [Deborah Verfaillie, Spain]	Taken into account - better representation in new figure.
3476	2	6	1	6	11	Figure 2.1: Glaciers and permafrost are addressed in this figure, but not the third feature of high mountain areas, namely snow. Shouldn't there be some information about snow cover as well in this figure? [Deborah Verfaillie, Spain]	Taken into ccount - snow metric included into figure.
6452	2	6	1	6	2	It would be nice to add a human dimension to the bar plots, e.g. the number of people per elevation band? Also now the figure contains information about glaciers and permafrost but if snow cover could also be covered that would be more complete. For example the % of snow cover per elevation band + seasonal variation as error bar? [Walter Immerzeel, Netherlands]	Rejected - the global data sets for disaggregated population density known to the authors, such as GPW or GRUMP, do not have sufficient quality in remote mountain areas to allow statistics per elevation band. For example, there would still be inhabitants in a 7000m-high area around Mount Everest.
11078	2	6	1	6	2	Figure 2 it is a well-done resume figure to represent the distribution of glaciers and mountain permafrost around the world. It would be more useful (and visually) to a comparison between different zones if the elevation scale it is same in all boxes. [Lucas Ruiz, Argentina]	Accepted

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12430	2	6	1	6	1	Two suggestions to improve this figure: (1) It might be helpful to use the same y-axis scale for all regions to have a better comparability among them. (2) The purple circle markers indicating permafrost and glacier areas are somehow hard to understand, at least it takes some time to understand them. To imporve on this, I'd suggest to slightly modify the legend for these markers. The medium-sized and the small inner circle are currently placed at the right hand side edge of the big circle. In the figure, the glacier circle however appears in the very center of the permafrost circle. I'd suggest to place the medium and the small circle in the legend also in the center of the big circle (I hope my explanations are understandable) [Sven Kotlarski, Switzerland]	Accepted
15508	2	6	1	6	2	Figure 2.1 is a very confusing figure. The vertical axes of the distribution of glaciers, and glacierised regions should not vary by continent. Also, the designation of permafrost glaciers just adds confusion to the map. The numbers associated with the purple circles would be much more informative. [Daniel Feldman, USA]	Taken into account - new figure is improved in this regard.
16108	2	6	1	6	2	If you use "high mountain areas" defination you have proposed in chapter 2, Fig 2.1 is not appropriate. [Jing Gao, China]	Taken into account - caption clarifies how and why the boxes on our map differ from the definition we give in the text.
16808	2	6	1	6	11	The term "Central Asia" is misleading. South Asia occupies larger area so I suggest changing it to "South and Central Asia". The circle diagram combining permafrost and glacier areas is not very clear. [Arun Shrestha, Nepal]	Taken into account - "High Mountain Asia"
17916	2	6	1	6	2	Figure 2.1: a very informative figure which brings glaciers and permafrost together which is still rarely made. Unclear to me is the meaning of the circles. Do they represent only permafrost? From the legend one would think both permafrost and glaciers. [Christian Huggel, Switzerland]	Taken into account - circles abandoned in new version.
18772	2	6	1	6	11	the permafrost indication is not clear enogh [Petra Seibert, Austria]	Taken into account - summary values shown now more clearly, permafrost cannot be shown on map for mountain areas as patterns are to fine for the scale of the figure.
22888	2	6	1		4	The map doesn't represent clearly all the targeted areas. I'd suggest enlarging the current map and adding a map of the Arctic area using another projection. [Romy Schlogel, UK]	Rejected - this chapter is only about high mountain regions outside the polar regions. Polar regions are dealt with in chapter 3.
12726	2	6	2			I find the circles hard to grasp: glacier area difficult to read and very small, the relation between size of circles and shading/transition between continous and discontinous is not clear. I don't understand the comment "Permafrost area bracket a minimum and maximum estimate". [Jan-Christoph Otto, Germany]	Taken into account - circles abandoned in new version, expression with 'bracket' removed.
12844	2	6	2	6	2	In the inner caption of Fig. 2.1: change "glacierised" by "glacierized" [Antoine Rabatel, France]	Rejected - british spelling used.
16534	2	6	2	6	2	Fig 2.1: The color selection for permafrost events is misleading or not intuitive. Suggestion: cont inuous permafrost in blue and sporadic permafrost in violet [Luzi Bernhard, Switzerland]	Taken into account - new color scheme now, although we have reason not to distinguish continuous/sporadic
16536	2	6	2	6	2	Fig 2.1: adding an asterix to 'Low Latitude' makes it clear from the outset that there is a side note with the statement [Luzi Bernhard, Switzerland]	Taken into account - figure changed
1264	2	6	4	6	4	The bulls-eyes are not very instructive (are more of a distraction). [Ross Brown, Canada]	Taken into account - circles abandoned in new version.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
19154	2	6	4			The proportional circles in figure 2.1 are not easy to understand. I would suggest dividing the circle in two halfs, one for permafrost and the other for glacier area. Colour scale could be maintained in the part for permafrost (continuous v to sporadic) while the glacier side could show only area. [Goncalo Vieira, Portugal]	Taken into account - circles abandoned in new version.
21456	2	6	4	6	4	The use of circles is somewhat misleading. The relation between glacier-covered and permafrost area are not aesy to derive from the circles. May be these have to be shown as pie charts? Besides, the accuracies of glacier-covered area measurements and permafrost area estimates are very different, therefore bringing both figures into one circle may confuse the reader. [Oxana Savoskul, Sri Lanka]	Taken into account - circles abandoned in new version.
12558	2	6	8	6	9	the caption to Fig 2.1 is unclear about what is shown by the histograms, i.e. how were the glacier/ PF areas normalized? The caption states "total glacier area" but this seems unlikely since individual bins reach 1 in several cases. Presumably the total area of the respective bin has been used as the norm. [Thomas Vikhamar Schuler, Norway]	Taken into account - now clarified in new version.
24332	2	6	9	6	9	Add a sentence: Note elevation scales differ among histograms [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account - now equal scale
16490	2	6	14	6	24	Some quantitative assessments of the degree of impacts on society, ecosystems, etc. would be beneficial here. These qualitative remarks leave one wondering which impacts of change are likely to be the most significant. [Baylor Fox-Kemper, USA]	Noted - text has deleted and impacts on sectors are highlighted in Excecutive Summary
17500	2	6	14			You have made the choice to uncritically adopt the ecosystem service terminology – exact at a point in time where the ecosystem service research community increasingly questions the usefulness of this concept. I would propose that two things are needed to justify the present text: a) present the essentials of the framework here, or somewhere else in SROCC, obviously with a clear reference to IPBES, and b) take notice of the debate triggered by Diaz et al in a recent SCIENCE paper (https://doi.org/10.1126/science.aap8826). Without this, the text will pose problems for some people. [Wolfgang Cramer, France]	Taken into account - figure has been changed and text revised
24334	2	6	17	6	17	Add reference for ecosystem service framework as IPBES has an alternative framework [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account - figure has been changed and text revised
6454	2	6	18	6	18	Avoid using etc. [Walter Immerzeel, Netherlands]	Accepted - text has been revised.
3478	2	6	19	7	4	In Figure 2.2, the information provided by the cryosphere is contained in the “cultural” services, but in the main text (page 6, line 19-20), this is indicated in the “provisioning” services. [Deborah Verfaillie, Spain]	Taken into account - this text has been substantially revised
24336	2	6	19	6	19	Scientific and cultural information??? [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account - figure and text have been revised
154	2	6	20	6	21	Could also mention that the cryosphere has a 'regulating effect' on climate, via increased albedo. This could also be mentioned under 'REGULATING' in Figure 2.2. [Iestyn Barr, UK]	Taken into account - however this paragraph was removed
1940	2	6	23	6	24	Comma needed after "cryosphere", and "services" after "recreational". [J. Graham Cogley, Canada]	Taken into account - text has been revised
20462	2	6	23			The cultural, economic, religious, and spiritual services..." [Martin Ménégoz, France]	Taken into account - text has been revised

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
344	2	7	0	8		A bit weak description of snow observations, box 2.1, vocabulary not very suitable for general public [López Moreno Juan Ignacio, Spain]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.
346	2	7	0	8		Length and number of references for glaciers in box 2.1 disproportionated compared to snow, better to harmonize [López Moreno Juan Ignacio, Spain]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.
348	2	7	0	8		Not mentioned that old paintings and photographies are a good information for study glaciers in historical times [López Moreno Juan Ignacio, Spain]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.
6456	2	7	0	7		The part on snow pobservations is very generic. I suggets to add some specific examples: acoustic sensors, gamma ray sensors, snow pillows, new satellites (sentinel, landsat 8, etc.) [Walter Immerzeel, Netherlands]	Taken into account - however this box was removed, and some material on observation methods was transferred to Chapter 1.
13410	2	7	0			Figure 2.2: This diagram implies that glaciers are associated only with provisioning and regulating, permafrost only with supporting and cultural, etc. Is this really true? If not, then this diagram is misleading. A simple box-type flow-chart may be better. Or perhaps cross-tabulate cryosphere elements with services, and check all those that apply (eg glacier ticks all four, permafrost ticks… which?). What about water? Lakes, streams ? Climate change is increasing temperature of those in cryosphere which affects biodiversity. Also, reading curved vertical text is not ideal. Dark blue area too dark, black text will be invisible. All solid colours should be paler. [Debra Roberts and Durban Team, South Africa]	Accepted - figure has been changed.
5928	2	7	1	7	4	The figure is clear, it is always nice to have an overview presented in a figure. The middle part is however not very clear to us: is permafrost only related to supporting and cultural for example? Is this how this figure must be interpreted? [Roderik Van De Wal, Netherlands]	Accepted - figure has been changed.
15502	2	7	1	7	4	Considering that the inclusion of "Mining" as an environmental service is highly arguable, I ask to exclude it from the Figure 2.2. (in the Provisioning category). [Hernan Sala, Argentina]	Accepted - mining is excluded from the figure.
18318	2	7	1	7	1	Inside the Fig. 2.2, the regulating services should read: "Water availability and conservation" instead of "water conservation" [Carmen Burghelea, Romania]	Taken into account - text has been revised
18774	2	7	1	7	4	This scheme should be thoroghly reviewed and better expained.Hydrower is missing. Tourism belongs to support, not culture. Maybe the whole Culture sector should go there, it is a bit odd here. Migration routes not a first-order topic nowadays. [Petra Seibert, Austria]	Taken into account - figure and text have been substantially revised
19422	2	7	1	7	1	The darkest colour used in the figure is too dark to permit easy-reading of the black text inside, I would recommend chosing a lighter colour. [Michelle A. North, South Africa]	Accepted - colour of figure has been revised.
24338	2	7	3	7	4	Add reference for ecosystem service framework as IPBES has an alternative framework [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account - figure has been changed and text revised

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
20936	2	7	9			How do we observe the MOUNTAIN cryosphere [Christophe Cudennec, France]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.
21452	2	7	9	7	9	The section requires a bit more attention, particularly regarding the methods of large-scale regional and global assessments and their uncertainties and accuracy. The gaps between scarce monitoring in-situ and remote-sencing can be bridged by various reanalyses and modeling approaches. The large data bases, such as WGI and subsequent glacier inventories are not mentioned as the primary data source. ICIMOD extended efforts in inventoring glaciers and conducting snow surveys in the HKH region could have been addressed as well. [Oxana Savoskul, Sri Lanka]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.
156	2	7	11	7	12	Sentencce needs re-wording [Iestyn Barr, UK]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.
1942	2	7	11	7	11	"stems from". [J. Graham Cogley, Canada]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.
3752	2	7	11	7	12	sentence not clear, please rephrase [Carlo Carmagnola, France]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.
12560	2	7	11			…stems from a range… (remove ", and ") [Thomas Vikhamar Schuler, Norway]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.
19424	2	7	11	7	11	Alter sentence to read: "…glaciers and ice sheets stems from a variety of ground-based…" [Michelle A. North, South Africa]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.
23648	2	7	11	7	12	Please revise this sentence. [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.
1266	2	7	14	7	14	The snow measurement section is very thin cf glaciers and contains virtually no references to recent papers and no mention of new technologies. The SWIPA 2017 report (Brown et al 2017a, Chapter 3) contains an updated review of snow measurement methods and technologies. [Ross Brown, Canada]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.
1308	2	7	14	7	32	This section on "Observation of snow" seems a bit short and little referenced, especially compared to the Glacier section just after. [Etienne Berthier, France]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
6326	2	7	14	7	32	This section on how snow is observed seems a little lackluster. Some additional information could be provided re: how in situ measurements are taken, for example. In addition, this passage omits some of the really exciting work being done on improving snow observations and products - some recent examples that come immediately to mind and which should be cited here include (a) Painter et al., 2016, The Airborne Snow Observatory: fusion of scanning lidar, imaging spectrometer, and physically-based modelling for mapping snow water equivalent and snow albedo, Remote Sensing of the Environment, 184, 139-152; and (b) Snauffer et al., 2018, Improving gridded snow water equivalent products in British Columbia, Canada: multi-source data fusion by neural network models, The Crysophere, 12, 891-905. While some of these new technologies (e.g., (a) above) may not be immediately relevant to long-term climate change studies, they point the way forward in crysopheric data collection and as such deserve a mention here. Others (e.g., (b) above) improve the longer-term record, therefore improving our ability to detect and attribute historically observed crysopheric changes under climate change and are, therefore, immediately relevant to the task at hand in this report. [Sean Fleming, USA]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.
16538	2	7	14	7	33	In the "box 2.1: How do we observe the cryosphere?" I generally miss more detailed information regarding 1) the role of terrestrial snow cover (p.e. Vavrus, S 2007: The role of terrestrial snow cover in the climate system. Climate Dynamics, 29/1), and 2) the understanding/estimation of the snow liquid water content/dielectric properties of dry and wet snow. Monitoring the snow water equivalent (SWE) is critical to effective management of water resources in many parts of the world that depends on the mountain snowpack for water storage (Bradford et al. 2009: Complex dielectric permittivity measurements from ground penetrating data to estimate snow liquid water content in the pendicular region. Water Resources Research, 45/W08403; Denoth, A 1980: The pendular-funicular liquid transition in snow. Journal of Glaciology, 25/91; Frolov and Macheret 1999: On dielectric properties of dry and wet snow. Hydrological Processes, 13/12-13) [Luzi Bernhard, Switzerland]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.
21048	2	7	14		26	MODIS, Landsat snow cover maps should be considered. Airborned techniques? [Thomas Wagner, USA]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.
158	2	7	16	7	18	In-situ measurments of snow density seem to be overlooked here. [Iestyn Barr, UK]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.
1268	2	7	16	7	16	Note that in situ observing networks tend to have a low elevation bias in mountain regions with the exception of dedicated networks such as SNOTEL that are designed for real-time monitoring of mountain snowpack. [Ross Brown, Canada]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
21422	2	7	20	7	25	In view of the scarcity of the long-term in-situ monitoring of snow cover depth and extent, the global climatologies based on reanalisys and simulated terrestrial water budgets gain in importance as the principal tool for the large-scale assessments of the changes in seasonal snow extent and water storage properties in high mountains (e.g. Global land precipitation and temperature data archive for 1900-2014, maintained by Willmott and Matsuura & National Center for Atmospheric Research Staff "The Climate Data Guide: Global (land) precipitation and temperature: Source https://climatedataguide.ucar.edu/climate-data/global-land-precipitation-and-temperature-willmott-matsuura-university-delaware.) [Oxana Savoskul, Sri Lanka]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.
6796	2	7	22	7	22	In Box 2.1 The sentence would be easier to read if we change it to: Passive microwave data are mostly unsuitable [APECS Group Review, Germany]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.
13098	2	7	27	83	28	"Due to the dependency on temperature and precipitation there are a multiplicity of variables and indicators describing seasonal snow state and variations. Hence, there is no..." [Christoph Marty, Switzerland]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.
1270	2	7	28	7	28	Re "no universal indicator", this is a red herring. Start/end dates, the max accumulation (SWE or depth) and date of max accumulation are the essential variables describing seasonal snow cover and these are the ones most often used in studies. [Ross Brown, Canada]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.
19426	2	7	28	7	28	Remove the comma after "literature" [Michelle A. North, South Africa]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.
16498	2	7	31	7	32	"can be used to infer" is too strong, it suggests that a model-based estimate is equivalent to a direct measurement. I suggest replacing "infer" with "produce an estimate of". [Ken Takahashi, Peru]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.
192	2	7	34	8	38	Some key palaeoclimatic reconstruction techniques have been left out here and need to be mentioned. Palaeoclimatic glacier history is routinely being reconstructed using age dating of moraines as well as of vegetation (trees, moss...) that has been overrun by the glacier (e.g. Kaplan et al. 2016, doi: 10.1016/j.quascirev.2016.03.014). This allows to map upslope and downslope shifts of the glacier fronts. One key finding is that most glaciers globally have reached their maximum extent for the past 10,000 years during the Little Ice Age, an extreme natural cold phase that is not representative for the pre-industrial climate of the past millennia, but is more an extreme of the bandwidth of natural variability. Furthermore, there are palaeoclimate reconstruction techniques for changes in high-altitude lake ice cover which should be mentioned here (e.g. von Gunten et al. 2009, doi: 10.1177/0959683609336573). [Sebastian Luening, Portugal]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
12562	2	7	36	8	2	It appears unbalanced to describe recent remote sensing evolution in detail but restrict in situ observations to the most basic long term methods. The way how in situ observations are collected has considerably developed with the widespread use of automatically recording systems, e.g. automatic weather stations and ground penetrating radar. This has contributed a.o. to enhanced understanding of mass balance processes and better spatial representation of their meteorological drivers. [Thomas Vikhamar Schuler, Norway]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.
16110	2	7	36	8	2	There is no reference in the paragraph of in-situ glacier observations. Here we suggest to add a refence of "Yao et al., 2012" in the end of Line2. REF: Yao, T., et al., 2012: Different glacier status with atmospheric circulations in Tibetan Plateau and surroundings. Nature Climate Change, 2 (9), 663-667, doi:10.1038/nclimate1580. [Jing Gao, China]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.
21424	2	7	37	7	37	The principal tool for the assessment of the changes in glacier spatial distribution, length, area and volumes over the past five-six decades are the global glacier inventories. The World Glacier Inventory (WGI, WGMS-NSIDC 2009; Cogley 2009, 2011) of the first generation was based on the global glacier surveys conducted in 1960-1970s. WGI covers almost all the high mountain areas with a few exceptions. The follow-up regional (ICIMOD, 2007: Mool et al. 2001a, 2001b; Mool and Bajracharya 2003; Mool et al. 2005; Bhagat et al. 2004; Sah et al. 2005; Lizong et al. 2005) and world glacier inventories (Randolph Glacier Inventory v6.0, RGI Consortium, 2017) are based on the surveys conducted in 2000s. The cross-comparisons of the large data sets from glacier inventories of different age generations are used (or may be used) world-wide for the most accurate up to date assessments of the large-scale glacier changes over the period of approximately 50 years, in some instances for the tracing of the decade-to-decade changes (e.g. Bajracharya and Shrestha 2011, ICIMOD, 2011; IWMI, 2014; Savoskul, Smakhtin2013a.) References: Cogley, J.G. 2009. A more complete version of the World Glacier Inventory. Annals of Glaciology 50(53): 32-38. Cogley, J.G.; Kargel, S.; Kaser, G.; van der Veen, C.J. 2010. Tracking the source of glacier misinformation. Science 327: 522. IWMI, 2014: http://waterdata.iwmi.org/Applications/Glacier_Snow_Asia/; Savoskul, O. S.; Smakhtin, V. 2013a Glacier systems and seasonal snow cover in six major Asian river basins: water storage properties under changing climate. IWMI Research Report, 149, 61 pp [Oxana Savoskul, Sri Lanka]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.
6460	2	8	0	8		Now the box contains information about glacier, snow and permafrost measurements. It could be worth considering to add also precipitation (snow fall) measurements in mountains which is currently one of the largest unknowns. [Walter Immerzeel, Netherlands]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.
12728	2	8	1			In-situ observation have the longest records in central europe, with first measurements starting in the late 19th century. [Jan-Christoph Otto, Germany]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
12730	2	8	1			Increased glacier melt combined with thick supraglacial debris cover as well as intensivied disintegration of the ice front causes severe problems in recording the frontal position of the glacier. This makes a continuation of length change records difficult especially for small glaciers. [Jan-Christoph Otto, Germany]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.
16492	2	8	2	8	2	What fraction or how many have been observed in situ, i.e., provide a list of references. [Baylor Fox-Kemper, USA]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.
1944	2	8	4	8	4	"open up large areas for analysis of" (?) Or perhaps "make possible large-area analyses of"? [J. Graham Cogley, Canada]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.
6800	2	8	4			Photogrammetry citation: very biased and selective citations, incomplete [APECS Group Review, Germany]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.
6458	2	8	8	8	10	Our group has been pioneering with UAVs on debris covered glaciers, which has led to important insights and some studies could be cited here. Immerzeel, W. W., Kraaijenbrink, P. D. A., Shea, J. M., Shrestha, A. B., Pellicciotti, F., Bierkens, M. F. P., & de Jong, S. M. (2014). High-resolution monitoring of Himalayan glacier dynamics using unmanned aerial vehicles. Remote Sensing of Environment, 150, 93–103. http://doi.org/10.1016/j.rse.2014.04.025 Kraaijenbrink, P., Meijer, S. W. S. W., Shea, J. M. J. M., Pellicciotti, F., De Jong, S. M., Immerzeel, W. W. W. W., … Immerzeel, W. W. W. W. (2016). Seasonal surface velocities of a Himalayan glacier derived by automated correlation of unmanned aerial vehicle imagery. Annals of Glaciology, 57(71), 103–113. http://doi.org/10.3189/2016AoG71A072 Kraaijenbrink, P. D. A. D. A., Shea, J. M. M., Pellicciotti, F., De Jong, S. M., Immerzeel, W. W. W., Jong, S. M. D., & Immerzeel, W. W. W. (2016). Object-based analysis of unmanned aerial vehicle imagery to map and characterise surface features on a debris-covered glacier. Remote Sensing of Environment, 186, 581–595. http://doi.org/10.1016/j.rse.2016.09.013 Kraaijenbrink, P. D. A., Shea, J. M., Litt, M., Steiner, J. F., Treichler, D., Koch, I., & Immerzeel, W. W. (2018). Mapping Surface Temperatures on Debris-Covered Glaciers with Unmanned Aerial Vehicles. Frontiers in Earth Science, 6(64), 1–19. http://doi.org/10.3389/feart.2018.00064 [Walter Immerzeel, Netherlands]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.
16810	2	8	8	8	8	Suggest changing "Cameras" to "sensors" [Arun Shrestha, Nepal]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.
17066	2	8	8	5	5	Maybe add Korsgaard et al (2016)? [doi: 10.1038/sdata.2016.32] [Frank Paul, Switzerland]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
17068	2	8	8	12	12	Assuming that this sentence refers to the Landset MSS sensor (?), I suggest writing 1970s instead of 1960s [Frank Paul, Switzerland]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.
17070	2	8	8	14	17	I suggest adding at the end of this statement one or two citations, e.g. Belward and Skøjen 2015 (10.1016/j.isprsjprs.2014.03.009) or Pope et al. 2016 (10.3390/rs6076183). [Frank Paul, Switzerland]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.
17072	2	8	8	19	19	Instead of ALOS Prism I would list here ASTER DEMs as they have lately been used for DEM differencing in various regions (see citation Brun et al. in L22) [Frank Paul, Switzerland]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.
17076	2	8	8	25	25	continues to provide': is GRACE still accurately working? [Frank Paul, Switzerland]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.
17078	2	8	8	28	28	There is quite a jump from GRACE measurements to the knowledge of indigenous people. I miss the inclusion of recent studies using mapping of trimlines for a reconstruction of Little Ice Age maximum extents or the use of historic topographic maps to add detail from the LIA to the satellite era (numerous examples in the literature). Going further back in time, there is also written and pictorial evidence (e.g. paintings) from glacier fluctuations during the LIA (Zumbühl, Nussbaumer, etc.). These reconstructions have been used to calibrate and/or validate numerical glacier models that are used to provide information on future glacier extent, volume, run-off etc. In the framework of the later description of climate change impacts on glaciers I think this is worth adding. [Frank Paul, Switzerland]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.
17080	2	8	9	40	19	I find this entire section on Permafrost confusing by structure and contents. Specific statements are repeated several times (in slightly different ways) and the most general information (P9, L15: permafrost is a sub-surface thermal phenomenon) comes at the end. I suggest a complete rewriting of this part, starting with a proper introduction of the terminology (permafrost, ZAA, active layer thickness) before the observations are described (in some good order). [Frank Paul, Switzerland]	Taken into account - reduced repetition and restructured

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
12846	2	8	12	8	27	In the glacier section of Box 2.1 "How do we observe the cryosphere", the paragraph regarding satellite observation clearly miss of references for the methods developped to quantify the annual-to-seasonnal glacier surface mass balance or surface displacements or changes in surface state (l. 15-17). Some references can be: Rabatel, A., P. Sirguey, V. Drolon, P. Maisongrande, Y. Arnaud, E. Berthier, L. Davaze, J.-P. Dedieu, M. Dumont. 2017. Annual and seasonal glacier wide surface mass balance quantified from changes in glacier surface state: a review on existing methods using optical satellite imagery. Remote Sensing, 9 (5), 507. doi: 10.3390/rs9050507 Berthier, E., Vadon, H., Baratoux, D., Arnaud, Y., Vincent, C., Feigl, K.L., Rémy, F., Legrésy, B. (2005). Surface motion of mountain glaciers derived from satellite optical imagery. Remote Sens. Environ., 95:1, 14-28. doi: 10.1016/j.rse.2004.11.005 Dehecq, A., Gourmelen, N., Trouvé, E. (2015). Deriving large-scale glacier velocities from a complete satellite archive: Application to the Pamir–Karakoram–Himalaya. Remote Sens. Environ., 162, 55-66. doi: 10.1016/j.rse.2015.01.031 [Antoine Rabatel, France]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.
13018	2	8	12	8	13	"uncorrected RCM results can propagate llarge uncertainties into impact simulations": why "uncertainties"? Rather: errors, or biases? [Gerhard Krinner, France]	Taken into account - this sentence was rephrased for the SOD.
21050	2	8	12		27	GLOVIS Landsat for glacier velocity. Aren't there papers on moraine mapping? And also sedimentary records? [Thomas Wagner, USA]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.
16812	2	8	14	8	14	Vaughan, 2013 is not the best reference for what has been mentioned in lines 12 to 14. This is basically IPCC Chapter. Better to cite original references. [Arun Shrestha, Nepal]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.
15510	2	8	15	8	17	The phrase that starts with "was followed by" is vague and it is unclear where specifically these 10-30 m data are coming from. [Daniel Feldman, USA]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.
6798	2	8	17	8	22	In Box 2.1. The sentence would be easier to read, if we change the word stem for arise like: Improved satellite measurements of changes in glacier elevation and volume arise from differencing new regional (airborne) and global …. [APECS Group Review, Germany]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.

SROCC First Order Draft Expert Review Comments - Chapter 2							
Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
11080	2	8	22	8	24	Although not always present, there is inherent uncertainty in geodetic mass balance assessment related with a difference of the seasons when the geodetic surveys were conducted (e.i. winter/summer). Indeed sometimes the seasonal variations could “obscure” the longer-term signal. Most of the time, seasonality correction are based on direct surface mass balance measurement. Since geodetic surveys are more and more used to assess the mass balance of vast regions, where direct mass balance measurements are scare or not available, uncertainties related to seasonality correction could even larger than snow/ice density uncertainties (e.g. Gardelle et al., 2013; Ruiz et al., 2017). [Lucas Ruiz, Argentina]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.
11082	2	8	22	8	24	Although not always present, there is inherent uncertainty in geodetic mass balance assessment related with a difference of the seasons when the geodetic surveys were conducted (e.i. winter/summer). Indeed sometimes the seasonal variations could “obscure” the longer-term signal. Most of the time, seasonality correction are based on direct surface mass balance measurement. Since geodetic surveys are more and more used to assess the mass balance of vast regions, where direct mass balance measurements are scare or not available, uncertainties related to seasonality correction could even larger than snow/ice density uncertainties (e.g. Gardelle et al., 2013; Ruiz et al., 2017). Gardelle, J., Berthier, E., Arnaud, Y. and Kääb, A.: Region-wide glacier mass balances over the Pamir-Karakoram-Himalaya during 1999–2011, The Cryosphere, 7, 1263–1286, doi:10.5194/tc-7-1263-2013, 2013. Ruiz, L., Berthier, E., Viale, M., Pitte, P. and Masiokas, M. H.: Recent geodetic mass balance of Monte Tronador glaciers, northern Patagonian Andes, The Cryosphere, 11(1), 619–634, doi:10.5194/tc-11-619-2017, 2017. [Lucas Ruiz, Argentina]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.
15512	2	8	24	8	27	Be specific about resolution, and indicate prospects for future satellite gravitometric observations. Readers should be aware of GRACE-FO, its advanced capabilities, and what that would mean for the science. [Daniel Feldman, USA]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.
16112	2	8	24	8	38	suggest to add ", lake expansion (Lei et al., 2013; Zhang et al., 2015)" before "and increased risk of GLOFs" in Line 38. REFs: Lei, Y., T. Yao, B. W. Bird, K. Yang, J. Zhai, and Y. Sheng (2013), Coherent lake growth on the central Tibetan Plateau since the 1970s: characterization and attribution, J Hydrol, 483(0), 61−67, doi: 10.1016/j.jhydrol.2013.01.003. Zhang, G., T. Yao, H. Xie, W. Wang, and W. Yang (2015), An inventory of glacial lakes in the Third Pole region and their changes in response to global warming, Global Planet Change, 131, 148−157, doi: 10.1016/j.gloplacha.2015.05.013. [Jing Gao, China]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.
21428	2	8	28	17	56	The recollection of "localized observations of indigenous and local communities" in the context of this report appears out of place in view of the availability of modern survey technologies capable of tracking the 3D glacier changes with an accuracy of 2-5 cm. [Oxana Savoskul, Sri Lanka]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
3930	2	8	29	8	30	Suggested line to add- Indigenous and local knowledge are important and provide important feedback but need to be cross-validated with the scientific findings. [Anil Mishra, France]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions.
11084	2	8	29	8	38	There is a vital source of information to know the former state of glaciers related to older documents (reports, old photos, paintings) that must be included in this paragraphs. [Lucas Ruiz, Argentina]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.
18776	2	8	29	8	31	not only glacier retreat, also advances, see famous events in Oetztal, Austra [Petra Seibert, Austria]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.
1946	2	8	37	8	37	Please clarify. Why does glacier retreat not lead to increased streamflow (at least initially - see my comment at P3 L29)? [J. Graham Cogley, Canada]	Taken into account - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions.
4478	2	8	37			Suggest changing 'decreased' to 'changing' [Graham Mcdowell, Canada]	Noted - however, box was removed due to space restrictions
5930	2	8	40	9	19	Earlier in the box it is mentioned: modern digital aerial photogrammetry and laser scanning are also used for permafrost measurements. However, in this permafrost paragraph nothing is mentioned about this technique. Is it still in development? [Roderik Van De Wal, Netherlands]	Accepted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1, but this specific comment is not relevant anymore.
11086	2	8	42	9	19	From a High Mountains perspective, mountain permafrost is commonly inferred from or by the presence of rock glaciers or creeping of permafrost phenomena. Although an indirect indicator of the existence of permafrost, this kind of evidence is widely used in the literature and is a valid way to assess the presence of permafrost in mountain areas. (Haeberli, 1985; Haeberli and Gruber, 2009). Haeberli, W.: Creep of Muntain Permafrost: Internal Structure and Flow of Alpine Rock Glaciers, Mitteilungen der Versuchsanstalt für Wasserbau, Hydrologie und Glaziologie, ETH Zürich, 77, Zürich, Switzerland., 1985. Haeberli, W. and Gruber, S.: Global Warming and Mountain Permafrost, in Permafrost Soils, pp. 205–218, Springer, Berlin, Heidelberg., 2009. [Lucas Ruiz, Argentina]	Rejected - this chapter is focused on change in permafrost and details of inferring the presence locally are excluded. Creeping peramfrost is included in terms of changes in velocity.
22890	2	8	42	19	9	The relashionship with unstable rock glaciers with associated reference should be introduced here. [Romy Schlogel, UK]	Rejected - this chapter is focused on change in permafrost and details of inferring the presence locally are excluded. Creeping peramfrost is included in terms of changes in velocity.
19156	2	8	49			A new and important global synthesis is currently submitted and under review in a major international journal and may be published still in 2018 and may be considered for inclusion here (Biskaborn et al.) [Goncalo Vieira, Portugal]	Rejected - included elsewhere, not best reference in this section
22786	2	8	51	8	56	The first part of this paragraph needs to be clearly references, e.g. in respect to valye 15 meters depth for ZAA etc. [Lena Rubensdotter, Norway]	Noted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.
21360	2	9	1	9	4	difficult to understand sentence, what is being said here? [Philippus Wester, Nepal]	Noted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.
22788	2	9	1	9	3	The sentence starting with "Consequently, low.." is not clearly written and must be refrased for a easier understanding of non-expert readers. Would be good also with example, and should also be referenced. [Lena Rubensdotter, Norway]	Noted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.
1948	2	9	3	9	3	"in ground". [J. Graham Cogley, Canada]	Noted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
15514	2	9	7	9	9	This is far too vague. Language is needed to describe these techniques. Also, there have been discussions about surface deformation monitoring from satellites. These should be mentioned. [Daniel Feldman, USA]	Rejected - see paragraph directly afterwards
22790	2	9	8	9	8	The "different techniques".. "some of which" must at least to some deegree be named and / or references - the present wording begs confusion and does not really transfer any real meaning. [Lena Rubensdotter, Norway]	Rejected - this is included in the Brown et al. 2000 reference, we need to be mindful of space.
17082	2	9	9	29	29	This Box 2.2 is describing some details about the performance of RCMs in mountain regions, but I found nothing about how a changing cryosphere in mountains is 'simulated' (better: modelled). But instead of changing the title of the box, I would like to see also the cryospheric models that are used to determine the future evolution of glaciers (e.g. Huss, Marzeion) shortly explained. [Frank Paul, Switzerland]	Noted - unfortunately we had to remove the box "Simulating Changing Climate and Cryosphere in Mountains" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.
17084	2	9	9	29	29	The Box 2.2 seems to have a bias towards the Alps and RCMs. Where are the other models (e.g. WRF) that are used to get the climate in steep mountain topography properly modelled or those investigating other regions (e.g. Collier et al. 2013; doi:10.5194/tc-7-779-2013)? [Frank Paul, Switzerland]	Noted - unfortunately we had to remove the box "Simulating Changing Climate and Cryosphere in Mountains" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.
19158	2	9	11			Consider including GNSS monitoring, which is still today a widely used technique to monitor permafrost deformation and subsidence worldwide. [Goncalo Vieira, Portugal]	Noted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.
3832	2	9	18	9	19	I would suggest to add the reference: X. Bodin et al. (2018). Multi-Annual Kinematics of an Active Rock Glacier Quantified from Very High-Resolution DEMs: An Application-Case in the French Alps. Remote Sens.,10, 547; doi:10.3390/rs10040547. [Emmanuel Thibert, France]	Noted - we had to remove the box "How do we observe the cryosphere?" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.
15520	2	9	24	10	22	Need strong recommendations about joint efforts using modeling and observations to target key uncertainties. How should these communities best join forces? Recommendations by Viviroli et al., 2011 (doi:10.5194/hess-15-471-2011); Rasmussen et al., 2012 (doi:10.1175/BAMS-D-11-00052.1); Henn et al., 2016a,b (doi:10.1016/j.jhydrol.2016.08.009, doi:10.1002/2015WR018564); Henn et al., 2018 (10.1016/j.jhydrol.2017.03.008) Bales et al., 2006 (doi:10.1029/2005WR004387); Lundquist et al., 2015 (doi:10.1175/JHM-D-15-0019.1); Clark et al., 2015a,b (doi:10.1002/2015WR017198, doi:10.1002/2015WR017200) are all relevant!!! [Daniel Feldman, USA]	Accepted - unfortunately we had to remove the box "Simulating Changing Climate and Cryosphere in Mountains" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.
16814	2	9	24	10	22	This box places high importnace to dynamic downscaling, which is a valid point. However statistical downscaling also has merits, particularly for impact modelling as this method can provide a large number of scenarios. Impact assessment should consider a range of possibilities. I suggest adding more on statistical downscaling methods. For example following paper provides a good example of benefits of Statistical downscaling method: Lutz, A. F., ter Maat, H. W., Biemans, H., Shrestha, A. B., Wester, P., & Immerzeel, W. W. (2016). Selecting representative climate models for climate change impact studies: an advanced envelope-based selection approach. International Journal of Climatology, 36, 3988–4005. [Arun Shrestha, Nepal]	Accepted - unfortunately we had to remove the box "Simulating Changing Climate and Cryosphere in Mountains" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
21362	2	9	24	10	22	Box 2.2 is good, but misses the work by Immerzell, Lutz and Kraaijenbrink. Their work on the HKH needs to be brought into the analysis [Philippus Wester, Nepal]	Accepted - unfortunately we had to remove the box "Simulating Changing Climate and Cryosphere in Mountains" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.
16462	2	9	27	10	24	Section 2.2. Changes in the Mountain Cryosphere would more effectively start with robust evidence of historical changes from measurements, rather than a box on modeling. [Patrick Gonzalez, USA]	Rejected - the location of box in the FOD does not reflect the location and style of the boxes in the final report.
1272	2	9	29	9	29	I think it would be more logical to present this material from a process modelling perspective rather than starting with GCMs as "entities". This would also avoid the disjointed material on reanalyses that is added at the end of the para. [Ross Brown, Canada]	Accepted - the description of the reanalyses should be located close to the GCMs. However, unfortunately we had to remove the box due to space restriction. Some summarizing material has been moved to Chapter 1 where GCM and reanalyses are both covered.
1406	2	9	29	9	29	The information in this box does not relate to the (changing) Cryosphere. I would suggest removing the term 'and Cryosphere' [Harry Zekollari, Switzerland]	Accepted - unfortunately we had to remove the box "Simulating Changing Climate and Cryosphere in Mountains" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.
3974	2	9	29	10	22	Box 2.2 would benefit from editing. The description of atmospheric reanalyses would be better moved to near the start of the text around line p9, line 33. The text on bias adjustment should be moved up in the third paragraph to p10, line 3. There is a lot of use of sentences starting 'These...' which could be eliminated. [Helene Hewitt, UK]	Accepted - the description of the reanalyses should be located close to the GCMs. However, unfortunately we had to remove the box due to space restriction. Some summarizing material has been moved to Chapter 1 where GCM and reanalyses are both covered.
6294	2	9	31	10	22	This section would benefit from bewing rewritten for improved clarity and logical flow. The content is generally fine and the choice of topics covered is defintiely good, but it feels like the passage meanders through these various topics in a hapzard way. It spends most of its length devoted to RCMs, which implies that RCMs are the dominant tool for GCM downscaling, which is questionable if not wrong outright. Statistical downscaling makes a brief appearance, in the middle of a paragraph about something else. Reanalysis products make an appearance as well, but it's not clear how they tie into the rest of the material in this section. There also seem to be discrepancies between the two paragraphs in the passage - for example, lines 31-33 on page 9 appears to contradict lines 48-49 on page 9. [Sean Fleming, USA]	Accepted - unfortunately we had to remove the box "Simulating Changing Climate and Cryosphere in Mountains" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.
11864	2	9	31			Abbreviation used here for "Global climate model", whereas more appropriate would be "General circulation model" (as is done elsewhere in the text); see page 20, line 1) [Dirk Hoffmann, Germany]	Accepted - unfortunately we had to remove the box "Simulating Changing Climate and Cryosphere in Mountains" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.
21364	2	9	31	9	31	GCMs are generally defined as General Circulation Models, not as Global Climate Models. WG Co-Chairs to decide and give guidance on this. [Philippus Wester, Nepal]	Accepted - unfortunately we had to remove the box "Simulating Changing Climate and Cryosphere in Mountains" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
1596	2	9	32	9	43	In this paragraph, the term “resolution” is often used with reference to grid spacing. Although the use of the word “resolution” with such connotation is widespread in literature, please consider to change it to “grid spacing” as in the context of model parameterizations (implicitly discussed in this paragraph) the distinction between grid spacing and resolution (i.e. how many gird points are needed to resolve a given phenomenon) is of primary importance. [Maria Vittoria Guarino, UK]	Accepted - unfortunately we had to remove the box "Simulating Changing Climate and Cryosphere in Mountains" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.
14428	2	9	32	9	32	Why is 70 km used for a GCM resolution lower bound--because that is the majority of studies? There are GCMs at higher resolution (50 and 25 km -- GFDL and MiROC). These have been used to explore cryosphere change with long term forcings in Kapnick et al. 2014 (presently referenced) and Kapnick and Delworth (2013): Controls of Global Snow Under a Changed Climate. Journal of Climate, 26 (15), 5537-5562. [Sarah Kapnick, USA]	Accepted - unfortunately we had to remove the box "Simulating Changing Climate and Cryosphere in Mountains" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.
16114	2	9	33	9	33	suggest to add a reference of Gao et al., (2011) before "Eyring et al., 2016;". The paper of Gao et al. (2011) is the first peer-reviewed paper compared performances of different GCMs simulations in the Tibetan Plateau and should be cited here. REF: Gao, J., V. Masson-Delmotte, T. Yao, L. Tian, C. Risi, and G. Hoffmann (2011), Precipitation Water Stable Isotopes in the South Tibetan Plateau: Observations and Modeling, Journal of Climate, 24(13), 3161-3178, doi:Doi 10.1175/2010jcli3736.1. [Jing Gao, China]	Accepted - unfortunately we had to remove the box "Simulating Changing Climate and Cryosphere in Mountains" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.
16116	2	9	35	9	35	suggest to add a reference of "Yao et al., 2013" before "Gao et al., 2015". REF: Yao, T. D., et al. (2013), A REVIEW OF CLIMATIC CONTROLS ON delta O-18 IN PRECIPITATION OVER THE TIBETAN PLATEAU: OBSERVATIONS AND SIMULATIONS, Reviews of Geophysics, 51(4), doi:ARTN 2012RG000427.10.1002/rog.20023. [Jing Gao, China]	Accepted - unfortunately we had to remove the box "Simulating Changing Climate and Cryosphere in Mountains" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.
5932	2	9	36	9	46	While this part provides interesting information, it is maybe not so relevant. 10-50 km hydrostatic approximations are too coarse (this can shortly be mentioned), but resolutions of a few km are feasible (line 39-40), so we don't think the explanation of the model which are too coarse is relevant for this box [Roderik Van De Wal, Netherlands]	Accepted - unfortunately we had to remove the box "Simulating Changing Climate and Cryosphere in Mountains" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.
12432	2	9	36	9	36	I'd suggest to replace "representing atmospheric dynamics" by "representing meso-scale atmospheric dynamics" or by "representing regional-scale atmospheric dynamics". Large-scale dynamics are also represented (or at least are assumed to be represented) by the driving GCMs. [Sven Kotlarski, Switzerland]	Accepted - unfortunately we had to remove the box "Simulating Changing Climate and Cryosphere in Mountains" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.
16500	2	9	36	9	37	Says "Most RCMs use a hydrostatic approximation, without explicitly representing convection in the atmosphere, and typically simulate continental-scale domains at 10–50 km resolution". The first part is not correct: one of the most popular RCMs used today is the WRF model, which has non-hydrostatic dynamics that enables it to be used in cloud-resolving simulations. However, this requires very high horizontal resolution, which is uncommon in climate simulations. Thus, a correct statement would be: "Most RCMs cannot explicitly represent convection in the atmosphere due to their relatively low horizontal resolution, typically simulating continental-scale domains at 10–50 km resolution" [Ken Takahashi, Peru]	Accepted - unfortunately we had to remove the box "Simulating Changing Climate and Cryosphere in Mountains" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
20464	2	9	36			"...when producing finer-resolution output. However, dynamical downscaling cannot catch potential feedbacks from regional to larger scales." [Martin Ménégoz, France]	Accepted - unfortunately we had to remove the box "Simulating Changing Climate and Cryosphere in Mountains" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.
1602	2	9	38	9	43	In the paragraph, the vertical grid spacing is not mentioned at all. However, the vertical grid spacing is as important as the horizontal one in order to resolve the particle vertical motion. While the use of a finer horizontal scale invalidates the use of the hydrostatic approximation, without the right number of model vertical levels vertical motions cannot be resolved and represented in numerical models. [Maria Vittoria Guarino, UK]	Accepted - unfortunately we had to remove the box "Simulating Changing Climate and Cryosphere in Mountains" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.
6462	2	9	38	9	40	Although it is feasible to run non-hydrostatic models at a few km resolution, it is unfeaible currently to do long term climate simulations for large areas at this resolution. [Walter Immerzeel, Netherlands]	Accepted - unfortunately we had to remove the box "Simulating Changing Climate and Cryosphere in Mountains" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.
18778	2	9	38	9	43	Note that few km is still not enough, see works in Switzerland (SM model at 1 km), various papers by by G Zaengl, or I. Schicker, P. Seibert, 2009, Simulation of the meteorological conditions during a winter smog episode in the Inn Valley, https://doi.org/10.1007/s00703-008-0346-z [Petra Seibert, Austria]	Accepted - unfortunately we had to remove the box "Simulating Changing Climate and Cryosphere in Mountains" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.
1598	2	9	39	9	39	Please specify you refer to the horizontal grid spacing. [Maria Vittoria Guarino, UK]	Accepted - unfortunately we had to remove the box "Simulating Changing Climate and Cryosphere in Mountains" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.
1600	2	9	39	9	39	“can only be capture at a spatial resolution finer than 5 km” – maybe add that this is the case because with a horizontal grid spacing ≤ 5 km we start to resolve the actual mountains and, thus, the interactions between atmospheric flows and orography. [Maria Vittoria Guarino, UK]	Accepted - unfortunately we had to remove the box "Simulating Changing Climate and Cryosphere in Mountains" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.
16502	2	9	40	9	40	"resolving vertical motion and key processes like convection" [Ken Takahashi, Peru]	Accepted - unfortunately we had to remove the box "Simulating Changing Climate and Cryosphere in Mountains" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.
16506	2	9	41	9	44	To better reflect the findings of Vuille et al (2015) related to the role of natural variability, I propose the following phrasing: "For instance, temperatures at low levels on the western slope of the Andes are strongly influenced by sea surface temperature and recent decadal-scale coastal cooling at low levels has resulted in an elevation-dependence of the warming." [Ken Takahashi, Peru]	Accepted - unfortunately we had to remove the box "Simulating Changing Climate and Cryosphere in Mountains" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.
14430	2	9	43	9	43	New sentence after "(Rummukainen et al., 2015)." However, due to computational constraints of high resolution RCMs, simulations cannot be performed over multiple decades or centuries to fully capture climate variability and extremes. [Sarah Kapnick, USA]	Accepted - unfortunately we had to remove the box "Simulating Changing Climate and Cryosphere in Mountains" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.
12436	2	9	46	9	46	You might think about adding an additional sentence here on the existing and upcoming regional reanalyses that provide a much higher resolution (e.g. Bollmeyer et al. 2015 (QJRMS, https://doi.org/10.1002/qj.2486). [Sven Kotlarski, Switzerland]	Accepted - unfortunately we had to remove the box "Simulating Changing Climate and Cryosphere in Mountains" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.

SROCC First Order Draft Expert Review Comments - Chapter 2							
Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
5934	2	9	48	9	55	This paragraph is well explained and very clear written: It is 8 sentences, while it provides a physical understanding and a clear explanation for the bias [Roderik Van De Wal, Netherlands]	Noted - unfortunately we had to remove the box "Simulating Changing Climate and Cryosphere in Mountains" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.
6464	2	9	48	10	22	I suggest to add a paragraph about the scale mismatch between impact models (distributed hydrological models, glacier models, snow models) and the resolution of RCMs. This is a very difficult issue and statistical downscaling is probably the only way to go with its own limitations. [Walter Immerzeel, Netherlands]	Accepted - unfortunately we had to remove the box "Simulating Changing Climate and Cryosphere in Mountains" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.
12434	2	9	48	9	49	I'd suggest to add Kotlarski et al. 2010 (Climate Dynamics, DOI 10.1007/s00382-009-0685-6) in the list of references (or at least to replace Kotlarski et al. 2014 by Kotlarski et al. 2010). To my knowledge this paper still presents the so far only exisiting online integration of a glacier parameterisation into the physcis of a regional climate model. This setup allows for the assessment of cryospheric changes (here: glacier changes) in the direct RCM output. [Sven Kotlarski, Switzerland]	Accepted - unfortunately we had to remove the box "Simulating Changing Climate and Cryosphere in Mountains" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.
6424	2	9	51	9	52	Considering length, latitude and elevation ,The range of simulation quality can be enhanced [Leila Rashidian, Iran]	Accepted - unfortunately we had to remove the box "Simulating Changing Climate and Cryosphere in Mountains" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.
20466	2	9	51			"RCMs generally offer detailed schemes to simulate the snow cover, to take into account the snow cover properties (e.g. Ménégoz et al., 2014). However, in mountains, RCMS often exhibit…". Ref: Ménégoz, M., Gallée, H., and Jacobi, H. W., 2013b: Precipitation and snow cover in the Himalaya : from reanalysis to regional climate simulations, Hydrol. Earth Syst. Sci., 17, 3921-3936, doi:10.5194/hess-17-3921-2013. [Martin Ménégoz, France]	Accepted - unfortunately we had to remove the box "Simulating Changing Climate and Cryosphere in Mountains" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.
3976	2	9	52	9	54	It seems contradictory to state that the cold bias affects the quality of simulated snow cover fields and then subsequently to attribute a possible cause of the cold bias to persistent snow cover [Helene Hewitt, UK]	Accepted - unfortunately we had to remove the box "Simulating Changing Climate and Cryosphere in Mountains" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.
16504	2	9	52	9	52	Include Junquas et al (2018) in the citation in relation to wet biases in the Andes: "(e.g., Frei et al., 2018; Junquas et al., 2018)" Reference: C. Junquas, K. Takahashi, T. Condom, J.-C. Espinoza, S. Chavez, J.-E. Sicart, T. Lebel, 2018: Understanding the influence of orography on the precipitation diurnal cycle and the associated atmospheric processes in the central Andes, Climate Dynamics, 50, 11–12, 3995–4017, doi:10.1007/s00382-017-3858-8 [Ken Takahashi, Peru]	Accepted - unfortunately we had to remove the box "Simulating Changing Climate and Cryosphere in Mountains" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.
18780	2	9	53	9	53	Note that RCM also suffer from approximations made in the numerical schemes, see work of Zaengl. Also npt only biases. [Petra Seibert, Austria]	Accepted - unfortunately we had to remove the box "Simulating Changing Climate and Cryosphere in Mountains" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
6466	2	10	0	10		In the drivers of change part there could be a specific paragraph on the energy balance, e.g. changes in incoming shortwave and cloud cover, albedo feedbacks because of snow, changes in and outgoing longwave and the role of turbulent fluxes. In the end it is the EB that drives melt. [Walter Immerzeel, Netherlands]	Accepted - unfortunately we had to remove the box "Simulating Changing Climate and Cryosphere in Mountains" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.
13100	2	10	2			References are missing here, since references have also been used for the direct RCM output. Possible references are: www.the-cryosphere.net/8/1673/2014/ or doi.org/10.5194/tc-11-517-2017 [Christoph Marty, Switzerland]	Accepted - unfortunately we had to remove the box "Simulating Changing Climate and Cryosphere in Mountains" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.
18784	2	10	3	10	22	the whole section is written more from hydrological point of view, should contain more meteorology, esp mountain-related issues to be discussed in more detail. It is not true that stat. downscaling is suitable for precipitation. Rather suited fo temperature. See eg Maraun, D. (2016). Bias correcting climate change simulations-a critical review. Current Climate Change Reports, 2(4), 211-220. [Petra Seibert, Austria]	Accepted - unfortunately we had to remove the box "Simulating Changing Climate and Cryosphere in Mountains" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.
6804	2	10	10			This is a motherhood statement "Statistical downscaling is particularly well suited for precipitation" [APECS Group Review, Germany]	Accepted - unfortunately we had to remove the box "Simulating Changing Climate and Cryosphere in Mountains" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.
6806	2	10	10			It's a fact that little machine learning is used in those methods, which makes it inferior, for years that is. [APECS Group Review, Germany]	Accepted - unfortunately we had to remove the box "Simulating Changing Climate and Cryosphere in Mountains" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.
12438	2	10	10	10	10	I'd suggest to include Rajczak et al. 2016 (Int J Clim, DOI: 10.1002/joc.4417) in this list of references. They present a two-step quantile mapping implementation tailored to data-poor mountain environments. [Sven Kotlarski, Switzerland]	Accepted - unfortunately we had to remove the box "Simulating Changing Climate and Cryosphere in Mountains" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.
17086	2	10	10	29	29	As mentioned above, I would suggest organizing section 2.2.1.1 in tabular form and maybe with a map. The (seemingly) arbitrary selection of a few example regions and values feels incomplete and is are difficult to grasp and compare in text form. [Frank Paul, Switzerland]	Accepted - much of the content of Sections 2.2.1 and 2.2.2 are now presented in Tabular form
1950	2	10	11	10	11	"for removing the added vaule" (?). [J. Graham Cogley, Canada]	Accepted - unfortunately we had to remove the box "Simulating Changing Climate and Cryosphere in Mountains" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.
15516	2	10	11	10	12	Change "Though bias correction has been criticized to remove the added values of RCMs compared to GCMs" to ""Though bias correction has been criticized for destroying the additional information derived from RCMs over GCMs [Daniel Feldman, USA]	Noted - thank you for the suggestion. Unfortunately we had to remove the box "Simulating Changing Climate and Cryosphere in Mountains" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.
18782	2	10	13	10	13	errors rather than uncertainties [Petra Seibert, Austria]	Accepted - unfortunately we had to remove the box "Simulating Changing Climate and Cryosphere in Mountains" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
15518	2	10	14	10	14	Change "model cascade" to either "model chain" or "model hierarchy" [Daniel Feldman, USA]	Accepted - unfortunately we had to remove the box "Simulating Changing Climate and Cryosphere in Mountains" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.
20468	2	10	14			"… model cascade linking GCMs and impact models. (Lafaysse et al., 2014)." Ref: Lafaysse, M., Hingray, B., Mezghani, A., Gailhard, J., & Terray, L. (2014). Internal variability and model uncertainty components in future hydrometeorological projections: The Alpine Durance basin. Water Resources Research, 50(4), 3317-3341. [Martin Ménégoz, France]	Accepted - unfortunately we had to remove the box "Simulating Changing Climate and Cryosphere in Mountains" completely due to space restrictions. Some few summarizing lines have been moved to Chapter 1.
15550	2	10	27	11	44	Concise summary of atmospheric warming trends is important. Conclusions that it is impacting terrestrial glaciers and dependent communities relevant to planners. [Melinda Kimble, USA]	Noted
16818	2	10	27	27	22	This is a comment related to the whole section. Hindu Kush Himalayan Monitoring and Assessment Programme is preparing a comprehensive assessment of the Hindu Kush Himalaya region. Springer will be publishing it and it is in the final process. This assessment will be relevant for the discussion on Climate, cryosphere and water. I suggest as a placeholded include the following. Material will be provided soon: Wester, P., Mishra, A., Mukherji, A., & Shrestha, A. B. (Eds.). (2018). The Hindu Kush Himalaya Assessment. Mountains, Climate Change, Sustainability and People. Kathmandu: Springer Open Krishnan, R., Shrestha, A., & Ren, G. Unravelling climate change in the Hindu Kush Himalaya: Rapid warming in the mountains and increasing extremes. In P. Wester, A. Mishra, A. Mukherji & A. B. Shrestha (Eds.), The Hindu Kush Himalaya Assessment. Mountains, Climate Change, Sustainability and People: Springer. Bolch, T., Shea, J., & Liu, S. Status and Change of the HKH Cryosphere. In P. Wester, A. Mishra, A. Mukherji & A. B. Shrestha (Eds.), The Hindu Kush Himalaya Assessment. Mountains, Climate Change, Sustainability and People: Springer. Scott, C., Zhang, F., & Mukherji, A. Water Security: Availability, Use, and Governance. In P. Wester, A. Mishra, A. Mukherji & A. B. Shrestha (Eds.), The Hindu Kush Himalaya Assessment. Mountains, Climate Change, Sustainability and People: Springer. [Arun Shrestha, Nepal]	Taken into account - the recently released HIMAP chapters were taken into account while preparing the SOD
194	2	10	31	10	55	This description of past temperature changes misses the pre-industrial context which is key for robust attribution analysis Pre-industrial warm phases have occurred in the High Mountain areas, often associated with rapid warming. Why are the Medieval Climate Anomaly, Roman Warm Period and Holocene Thermal Maximum not mentioned here? For the Andes see e.g. Neukom et al. 2011 (doi: 10.1007/s00382-010-0793-3) and Jomelli et al. 2009 (doi: 10.1016/j.palaeo.2008.10.033). [Sebastian Luening, Portugal]	Taken into account - due to size constraints and the need to provide policy-relevant information across WP1 and WP2, emphasis is placed on the 20th and 21st century in Chapter 2 on High Mountains. Longer time scales are considered in broader-scope IPCC reports, such as AR5 WG1 and WR6 WG1 currently in preparation.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
5936	2	10	31	10	55	Major: In paragraph 2.2.1 and 2.2.2, there are no statistical/ agreement terms (in italic) in the observation sections, however there are in paragraph 2.2.3 and in 2.2.4. Also, no attribution paragraph is provided for 2.2.1 , 2.2.2, while there is an attribution paragraph included in 2.2.3 and 2.2.4. This is not consistent, and it makes it difficult for the reader to interpret the chapter as a whole thing. Also, we think that 2.2.3 and 2.2.4 are very well written, maybe it is better to adjust 2.2.1 and 2.2.2 to the same structure as 2.2.3 and 2.2.4 [Roderik Van De Wal, Netherlands]	Taken into account - the structure of sections 2.2.1 and 2.2.2 were modified for SOD, with increased homogeneity with sections 2.2.3 and 2.2.4. Some material was placed in Tables, with positive impact on section flow.
18320	2	10	31	10	51	The Observations section 2.2.1.1.1 would be more appealing when presenting seasonal variations in temperature (e.g. increase in temperature during winter/spring or summer heat waves). [Carmen Burghelea, Romania]	Taken into account - long term trends are the main focus of this report addressing climate change and the high mountain cryosphere.
1952	2	10	32	10	32	"mountain". [J. Graham Cogley, Canada]	Editorial – copyedit to be completed prior to publication
16118	2	10	32	10	32	suggest to add "below 5000 m a.s.l." after " in mid-latitudes". [Jing Gao, China]	Taken into account - text largely modified and some content placed in tabular form.
16816	2	10	32	10	47	This paragraph breifly discussed EDW, although it is discussed in detail later. While discussing EDW I think a reference to following work which is a good overveiw of this phenomenon and current understanding should not be missed: Mountain Research Initiative EDW Working Group. (2015). Elevation-dependent warming in mountain regions of the world. Nature Clim. Change, 5(5), 424-430. [Arun Shrestha, Nepal]	Taken into account - the reference from Pepin et al. (2015) was quoted in FOD and will remain quoted in SOD.
17502	2	10	32	10	55	Clearly, this presentation of recent trends will need a lot more work. It is not clear to me whether SR15 will contain the information you hope to rely on, I would rather hope that, for most major high mountain areas of the world, clear and comparable numbers could be given in tables or illustrations. [Wolfgang Cramer, France]	Taken into account - some of the material was recast in tabular form for SOD.
19434	2	10	32	10	40	Move the sentence: "Warming has been detected in most mountainous regions of the world, often with an elevation dependent trend (Pepin et al., 2015)." to just after the first sentence in the paragraph, and refer to Box 2.3 at the end of this sentence. [Michelle A. North, South Africa]	Taken into account - text was revised for better clarity.
21366	2	10	32	10	47	EDW is crucial, and this paragraph is important. Suggest to also reference the recent work on the HKH, both from the climate change chapter in HIMAP (will be shared with TSU shortly), and the articles by Arun Bhakta Shrestha and co-authors published in Advances in Climate Change Research in 2017. These need to be referenced here, and HKH EDW trends given sufficient attention. [Philippus Wester, Nepal]	Taken into account - articles from the Advances in Climate Change Research 2017 special issue on climate change in the Hindu Kush Himalaya were considered as part of the assessment process.
19428	2	10	33	10	33	Please provide the full terms / explanation for the units "metres above sea level" at the first use, since although this may be a common term in the disciplines contained in this chapter, it isn't common to everyone. [Michelle A. North, South Africa]	Taken into account
19430	2	10	33	10	34	Please move "on the Tibetan Plateau" earlier in the sentence to read: "...mean warming rate for stations on the Tibetan Plateau above 2000, 3000 and 4000 m above sea level (m a.s.l.) was..." [Michelle A. North, South Africa]	Taken into account - this material was recast in tabular form.
19432	2	10	34	10	34	Delete "indicating warming with an elevation-dependent trend (Box 2.3)." [Michelle A. North, South Africa]	Taken into account - text was revised for better clarity.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
1310	2	10	36	10	38	I did not read Beniston et al. but I just want to point that this seems to be in disagreement wit the conclusion of Gilbert & Vincent in their 2013 GRL paper where warming was inferred from englacial temperature at the summit of Mont Blanc. Maybe C. Vincent, as contributing author, can help solve this paradox? "A mean warming rate of 0.14 C/decade between 1900 and 2004 was found. This is similar to the observed regional low altitude trend in the northwestern Alps, suggesting that air temperature trends are not altitude dependent. " [Etienne Berthier, France]	Taken into account
3838	2	10	37	10	38	Beniston et al., 2018 do not show any temperature elevation dependency for Alps. Differently, Zeng, et al., 2015 show no dependency for Europe. (Zeng, et al., 2015, GRL, 42(11), 4563-4572). [Franco Salerno, Italy]	Accepted - Beniston et al. (2018) was wrongly referenced here. Text was revised for SOD.
6802	2	10	37	10	37	Add key references to support the warmer trend at highter elevations. [APECS Group Review, Germany]	Taken into account
12440	2	10	38	10	38	This sentence is too strong in my opinion, observational evidence for an elevation dependent warming in the Alps is much more subtle. There are strong seasonal dependencies, and a large influence of natural climate variability. These issues are discussed in the following two publications that I'd strongly sugegst to cite here: (1) Ceppi et al. 2012 (Int J Clim, DOI: 10.1002/joc.2260) (2) Begert and Frei, 2018 (Int J Clim, DOI: 10.1002/joc.5460). On the other hand, the cited reference of Beniston et al. 2018 is not appropriate in my opinion. I could not find any reference to elevation-dependent warming in this work. [Sven Kotlarski, Switzerland]	Accepted - Beniston et al. (2018) was wrongly referenced here. Text was revised for SOD.
19436	2	10	38	10	38	Move "also" in front of "exhibiting", to read: " Alps have undergone significant warming, also exhibiting an altitude..." [Michelle A. North, South Africa]	Taken into account - text was revised for better clarity.
15522	2	10	41	10	41	Please consider adding the following language: The sparsity and quality-control of the observations, in particular, have led to a debate about the magnitude of EDW (Oyler et al, 2015, doi:10.1002/2014GL062803). [Daniel Feldman, USA]	Taken into account - this addition was considered for inclusion in the EDW Box.
19438	2	10	41	10	44	Alter sentence to read: "For instance, in the Andes, temperatures at low levels on the western slopes are strongly influenced by sea surface temperature, and coastal cooling at low levels has caused elevation-dependent warming at higher elevations in the early 21st century (Vulle et al, 2015)" [Michelle A. North, South Africa]	Taken into account - some of the material was recast in tabular form for SOD.
19440	2	10	41	10	44	Delete the "and" between Alaska and Canada so that it reads: "(e.g., Alaska, northern Canada, and Fennoscandia)" [Michelle A. North, South Africa]	Taken into account - some of the material was recast in tabular form for SOD.
3840	2	10	42	10	44	It is not correct to speak about temperature evelation-dependence for Andes. The only observable phenomenon is the cooling effect along the costs. [Franco Salerno, Italy]	Taken into account - text was revised to better reflect the state of knowledge.
15492	2	10	42	10	43	Please, revise the wording of "... and coastal cooling at low levels has caused elevation-dependent warming at higher elevations in the early 21st century in the Andes". Because, it does not seem to be clear if the elevation-dependent warming is a consequence of the cooling at low levels. At a first glance, coastal cooling at low levels do not necessarily must be linked with the elevation-dependent warming. In fact, they might be independent phenomena, isn't it? [Hernan Sala, Argentina]	Taken into account - text was revised to better reflect the state of knowledge.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
13412	2	10	46	10	46	This is not the same time period used as recent period in chapter 1. There has to be consistency. [Debra Roberts and Durban Team, South Africa]	Taken into account - although the literature is very inconsistent in terms of time periods used.
16464	2	10	52	10	53	IPCC (2013) Working Group I attributed temperature increases to anthropogenic emissions of greenhouse gases with robust evidence. Edit this sentence to say something like "...significant warming due to anthopogenic emissions of greenhouse gases..." [Patrick Gonzalez, USA]	Taken into account - attribution of atmospheric warming in mountain areas is treated in the SOD.
21368	2	10	52	10	55	The assessment that it is "likely" that high mountains are showing an amplified response to climage change with a faster rate of warming is on the weak side. It should be "very likely" to "virtually certain". Not sure where the medium evidence, medium agreement is coming from for this statement, as EDW appears evident in all mountain ranges, and is well established. Expert judgement on this could be stronger. [Philippus Wester, Nepal]	Taken into account - some high mountain do not show such strong evidence for EDW (Andes, European Alps etc.) and the report reflects this diversity.
11088	2	10	53	10	55	Although I agree with the statement (and the level of evidence and agreement), it must be taken into account that is not supported by the preceding paragraphs of section 2.2.1. It would be better in term of the concern of this assessment may have for policymakers that at least one sentence related with the BOX 2.2 and the increase of air temperature change with elevation be included in the preceding paragraph to support this summary sentence. [Lucas Ruiz, Argentina]	Taken into account - text was modified and better link to the Elevation Dependent Warming was implemented
13020	2	11	1	11	1	Scenarions or projections? Seem to be talking about projections [Gerhard Krinner, France]	Accepted. The term "projections" was used for SOD where relevant.
17504	2	11	1	11	44	Likewise, this text seems to look for generalities and thereby provides less information than it could. The reader will be less interested in general trends across all mountain areas, for which some could be seen as examples (with a bias of course to well-studied mountains). Instead, what one expects here is a treatment of one major area after the other, along with an indication of uncertainty. [Wolfgang Cramer, France]	Taken into account - some of the material was recast in tabular form for SOD, partly in order to address this concern.
10674	2	11	2	11	23	The paragraph combines scenarios from 4 and 5 ARs.This is very confusing. Please use better the more recent Assessment Report. Contries' National Communications to UN FCCC contain the relevant information. [Oxana Lipka, Russian Federation]	Taken into account - in many regions, there is hardly any literature based on CMIP5-based projections, hence the need to use CMIP3-based evidence too, which is not necessarily obsolete.
16466	2	11	2	11	3	Since this section describes future projections, it should use the conditional voice and identify the emissions scenario of the projections. It should not use the definitive verb "will". Delete "will" and edit the text to say something like, "Under RCP8.5...temperatures would be ..." [Patrick Gonzalez, USA]	Accepted - text was revised accordingly.
19444	2	11	2	11	23	Try to be consistent with the methods used to indicate warming versus cooling: in the beginning of the pargraph +-signs are used to indicate warming, (e.g., "between +1.2'C in spring and +1.6'C in summer and winter..."), whereas later in the paragraph there are no symbols (e.g., "and 2'C to 6'C by the late-21st century..."). [Michelle A. North, South Africa]	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
21370	2	11	2	11	23	More attention to the HKH needs to be given in this paragraph, as this mountain range is the most populous in the world (240 million inhabitants in the mountains and hills). More references to the HIMAP chapter on climate change needed here, as well as the spin-off articles in Advances in Climate Change Research (ACCR). Sanjay et al. 2017 is referenced, but there are 7 or 8 more articles in the ACCR special issue on the HKH that warrant attention. [Philippus Wester, Nepal]	Taken into account - HIMAP chapters brought to the attention of the author team were considered during the preparation of the SOD.
19442	2	11	6	11	6	Check whether the statement: "annual rate of 0.25'C warming per decade..." is correct. [Michelle A. North, South Africa]	Noted - text was revised to address this typo.
3480	2	11	8	11	9	References of recent studies using EURO-CORDEX and investigating future temperature changes (although this is not the main focus of those studies) could include: - Giorgi et al., 2016. Enhanced summer convective rainfall at Alpine high elevations in response to climate warming, Nature Geoscience, 9, pages 584–589. - Hanzer et al., 2018. Projected cryospheric and hydrological impacts of 21st century climate change in the Ötztal Alps (Austria) simulated using a physically based approach, Hydrol. Earth Syst. Sci., 22, 1593–1614,https://doi.org/10.5194/hess-22-1593-2018. - Verfaillie et al., 2018. Multi-component ensembles of future meteorological and natural snow conditions for 1500 m altitude in the Chartreuse mountain range, Northern French Alps, The Cryosphere, 12, 1249-1271, https://doi.org/10.5194/tc-12-1249-2018. [Deborah Verfaillie, Spain]	Taken into account - material considered for the preparation of SOD.
11866	2	11	10	11	15	There seems to be a contradiction with the values for temperature rise given for the tropical Andes: The value given by Vuille et al. 2018 is very much the same as the standard value given for global aveerage warming - whereas warmin in high mountains is expected to be between 1.5 and 2 times that value (as rightly stated on the preceding page 10, line 54). In addition, the value given for the Bolivian Andes (which belong to the tropical Andes) is very much higher than the value from Vuille et. al. I would strongly suggest to check this part again also with other researchers. [Dirk Hoffmann, Germany]	Taken into account - text revised to better reflect the current state of kowledge.
12848	2	11	10	11	15	Other studies presented temperature projections for the 21st century in the Tropical Andes according to different RCP and climate models, that can be added into the references: Réveillet, M., C. Vincent, D. Six, A. Rabatel. 2017. Which empirical model is best suited to simulating glacier mass balances? Journal of Glaciology, 63 (237), 39-54. doi: 10.1017/jog.2016.110 Rabatel, A., J.L. Ceballos, N. Micheletti, E. Jordan, M. Braitmeier, J. Gonzalez, N. Mölg, M. Ménégoz, C. Huggel, M. Zemp. 2018. Toward an imminent extinction of Colombian glaciers? Geografiska Annaler: Series A, Physical Geography, 100(1), 75-95. doi: 10.1080/04353676.2017.1383015 [Antoine Rabatel, France]	Taken into account - material considered for the preparation of SOD.
16468	2	11	10	11	10	Delete "expected" replace with "projected" [Patrick Gonzalez, USA]	Accepted
17088	2	11	11	56	56	What is a 'retreating snow line'? Should this be the ' increasing elevation of a snpwline'? [Frank Paul, Switzerland]	Taken into account - text revised for better clarity.
1954	2	11	22	11	22	Delete "overall". [J. Graham Cogley, Canada]	Accepted
5938	2	11	25	11	25	High agreement: in italics? Or, if used as normal term, it is maybe better to rephrase it [Roderik Van De Wal, Netherlands]	Taken into account - text was revised to better use the confidence language.

SROCC First Order Draft Expert Review Comments - Chapter 2							
Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
6468	2	11	25	11	37	The EDW is also confirmed for all RCPs in the futrue for high mountain Asia: Kraaijenbrink, P. D. A., Bierkens, M. F. P., Lutz, A. F., & Immerzeel, W. W. (2017). Impact of a 1.5 °C global temperature rise on Asia's glaciers. Nature, 549(7671), 257–260. http://doi.org/10.1038/nature23878 [Walter Immerzeel, Netherlands]	Taken into account - material considered for the preparation of SOD.
13022	2	11	25	11	25	The high agreement of the projections is somewhat in contradiction with the low confidence in the observed EDW trends. Could the physical understanding of the projected EDW increase confidence in the observed changes that should have simiar causes? [Gerhard Krinner, France]	Accepted - text revised to better reflect the current state of kowledge.
15494	2	11	31	11	31	Please, check the text: "...using the an ensemble of RCMs driven". [Hernan Sala, Argentina]	Editorial – copyedit to be completed prior to publication
16540	2	11	31	11	31	delete 'the': "...in the European Alps using the an ensemble... [Luzi Bernhard, Switzerland]	Editorial – copyedit to be completed prior to publication
22892	2	11	31	11	31	Remove "the" [Romy Schlogel, UK]	Editorial – copyedit to be completed prior to publication
18786	2	11	32	11	32	Inversions are also very relevant in Alpine valleys [Petra Seibert, Austria]	Taken into account - text revised to better reflect the current state of kowledge.
6808	2	11	37	11	37	Specify 'air' or 'ground' temperatures [APECS Group Review, Germany]	Rejected - this section is about air temperature, hence specifying it here additionnally would be redundant.
12442	2	11	37	11	37	You might add a sentence here on the fact that the study by Winter et al. 2017 (Clim Dyn, DOI 10.1007/s00382-016-3130-7) suggests problems of the current climat emodel generation to properly represent the snow-albedo-feedback and, hence, elevation-dependent warmign signals driven by snow (albedo) changes. This puts some of the results mentioned just before into perspective. [Sven Kotlarski, Switzerland]	Taken into account - material considered for the preparation of SOD.
1274	2	11	41	11	41	"uphill" is redundant [Ross Brown, Canada]	Accepted

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
16820	2	11	49	12	34	This section on EDW lack some critical references. Here I list some Mountain Research Initiative EDW Working Group. (2015). Elevation-dependent warming in mountain regions of the world. Nature Clim. Change, 5(5), 424-430. Shrestha, A. B., Wake, C. P., Mayewski, P. A., & Dibb, J. E. (1999). Maximum temperature trends in the Himalaya and its vicinity: An analysis based on temperature records from Nepal for the period 1971-94. Journal of Climate, 12, 2775-2787. homogenized surface stations and reanalysis data. Global and Planetary Change, 71, 124-133. You, Q. L., Min, J., & Kang, S. (2016). Rapid warming in the Tibetan Plateau from observations and CMIP5 models in recent decades. International Journal of Climatology, 36, 2660-2670. Some studies did not find EW. It is also imortant to mention this: You, Q. L., Kang, S. C., Pepin, N., & Yan, Y. P. (2008b). Relationship between trends in temperature extremes and elevation in the eastern and central Tibetan Plateau, 1961-2005. Geophysical Research Letters, 35(4), L04704. doi:10.1029/2007GL032669 Ding, Y.H., & Zhang, L. (2008). Intercomparison of the time for climate abrupt change between the Tibetan Plateau and other regions in China. Chinese Journal of Atmospheric Sciences, 32(4), 794-805. [Arun Shrestha, Nepal]	Taken into account for SOD, also accounting for the fact that this report is an assessment with very tight and strict size limit.
15526	2	11	51	12	34	This section is, in general, quite unsatisfactory, since it presents a number of qualitative statements. The report needs to notify the reader that the relative importance of these mechanisms is yet to be determined. Furthermore, the report needs to make recommendations about the investigations needed to elucidate the importance of these mechanisms. [Daniel Feldman, USA]	Taken into account - the body of the report is not meant to include recommendations (this is an assessment), but there is a section of knowledge gaps which could serve this purpose.
17506	2	11	54			You do not really expect your readers to grasp the idea of negative warming, do you? For me, that would be cooling. [Wolfgang Cramer, France]	Noted
15524	2	11	55	11	57	The sentence that begins with "The change is not necessarily linear" has language that is far too qualitative and needs to be quantified. [Daniel Feldman, USA]	Taken into account - text revised for better clarity
22792	2	11	55	11	55	The statements in the sentence ending "often the case" needs reference or else better explanation. [Lena Rubensdotter, Norway]	Taken into account - text revised for better clarity
17508	2	12	1			It would be huge discovery if any physical processes did NOT operate similarly on different latitudes – you have to be more specific to avoid this interpretation. A first step could be to replace “processes” with “mechanisms”, a better solution would be to mention those mechanisms by their name. [Wolfgang Cramer, France]	Noted

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
1956	2	12	5	12	5	"lowers the lapse rate" will confuse readers. Here it means "will lead to a gentler vertical temperature gradient". In other words, the writer is assuming that the lapse rate is a positive quantity and is trying to tell readers that iatent heating will move it closer to zero, not further away. The lapse rate (T1-T0)/(z1-z0), with z1 higher than z0, is in fact negative. It would be better to avoid using the notion of the lapse rate altogether and to state the facts in plain language. [J. Graham Cogley, Canada]	Accepted - text revised for better clarity.
1796	2	12	8	12	12	This is true of black carbon (citation to Flanner et al., 2007 would also be appropriate), but Kaspari et al (2014) showed radiative forcing by dust particles to exceed that of BC in the Solu-Khumbu (Nepal) because although mineral dusts are less potent albedo-reducers than BC they accumulate in higher concentrations. Kaspari et al., (2011) also found BC concentrations to have increased recently by analysing an ice core extracted from Mt Everest. In the Colorado Basin (USA) radiative forcing due to dust particles was found to have greater influence on snow melt than changes in air temperature (Painter et al., 2017). There is also recent appreciation of radiative forcing by biological particles accelerating snow melt by up to 20% in mountainous Alaska (Ganey et al., 2017; Dial et al., 2018) and found to be observable from satellite remote sensing data (Painter et al., 2001; Takeuchi et al., 2006) in Alaska and the High Sierra (California, USA). Painter, T. H., Duval, B., and Thimas, W. H.: Detection and quantification of snow algae with an airborne imaging spectrometer, Appl. Environ. Microbiol., 67, 5267–5272, https://doi.org/10.1128/AEM.67.11.5267-5272.2001, 2001. Ganey, G.Q., Loso, M.G., Burgess, A.B, Dial, R. (2017) The role of microbes in snowmelt and radiative forcing on an Alaskan icefield. Nature Geoscience, 10(10): 754-9, doi:10.1038/ngeo3027 Dial R., Ganey, G.Q., Skiles, S.M. 2018. What colour should glacir algae be? An ecological role for red carbon in the cryosphere. FEMS Microbiology Ecology, 93 (fiy007), doi: 10.1093/femsec/fiy007 Kaspari, S., Painter, T. H., Gysel, M., Skiles, S. M., and Schwikowski, M.: Seasonal and elevational variations of black carbon and dust in snow and ice in the Solu-Khumbu, Nepal and estimated radiative forcings, Atmos. Chem. Phys., 14, 8089–8103, https://doi.org/10.5194/acp-14-8089-2014, 2014 Kaspari, S., M. Schwikowski, M. Gysel, M. G. Flanner, S. Kang, S. Hou, and P. A. Mayewski (2011), Recent increases in balck carbon concentrations from a Mt. Everest ice core spanning 1860-2000 AD, Geophysical Research Letters, 38, doi: 10.1029/2010GL046096. Painter, T. H., Skiles, S. M., Deems, J. S., Brandt, W. T., & Dozier, J. (2018). Variation in	Taken into account - material considered for the preparation of SOD (not only with respect to elevation dependant warming, but also feedbacks and attribution of changes in snow cover to light absorbing particles)

SROCC First Order Draft Expert Review Comments - Chapter 2							
Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
4022	2	12	10	12	12	The references cited here are a bit odd. Flanner et al. (2007, JGR) and Flanner et al. (2009, ACP) shoud be cited in addition to or instead of Lawence and Lelieveld (2010). Also, the study of Lau et al. is not a valid reference to support this statement. The Lau et al paper is largely about the effect of absorbing aerosol aloft, in the atmosphere, and how this affects air flows and air temperatures -- i.e. the "Elevated Heat Pump" effect. (Note that the existence of the EHP effect has been disputed in other studies). [Sarah Doherty, USA]	Taken into account - material considered for the preparation of SOD.
15496	2	12	10	12	10	Delete the space between the closing parenthesis and the point in: "al., 2015) . Aerosol deposition". [Hernan Sala, Argentina]	Editorial – copyedit to be completed prior to publication
21088	2	12	11	12	12	Consider insert Iceland (Kylling et al., 2018; 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]	Taken into account - material considered for the preparation of SOD, not only in the feedback section but also for attribution of snow cover changes
17090	2	12	12	39	39	See comment 21 on section 2.2.1.1. This also applies to section 2.2.1.2. [Frank Paul, Switzerland]	Taken into account - however reviewer comment numbers are not available to IPCC authors when compiled, it is not entirely sure that the comment was properly identified.
20470	2	12	12			"…particularly pronounced on the Tibetan Plateau (Lau et al., 2010)." -> Many studies overestimated the forcing of aerosol deposition in the Tibetan Plateau, because teh snow cover is not so extended in this very dry area. Ménégoz et al., 2018 showed that this forcing is active only over a limited fraction of the Tibetan Plateau, along the Himalaya. [Martin Ménégoz, France]	Taken into account - material considered for the preparation of SOD.
1276	2	12	14	12	14	So what is the link between the low-elevation bias and EDW? There needs to be some linking text e.g. "One of the issues for measuring EDW is the strong bias…" [Ross Brown, Canada]	Taken into account - text revised for better clarify.
3482	2	12	14	12	18	This paragraph should be introduced better, otherwise we don't really understand the link with the previous paragraph (i.e., problems/uncertainties associated to the detection/analysis of elevation-dependent warming). [Deborah Verfaillie, Spain]	Taken into account - text revised for better clarify.
3932	2	12	14	12	26	The two paragraph (line 14-18 and line 20-26) which descirbes EDW should move before the line starting from 1 and the paragraph describing physical process (line 1-12) should move below after those paragraphs. [Anil Mishra, France]	Taken into account - text revised for better clarify.
17510	2	12	14	12	18	This paragraph comes in a slightly odd place and requires more context. In its present state, some decision makers will at this point conclude that we really do not know enough and that it is not worth to continue reading. [Wolfgang Cramer, France]	Taken into account - text revised for better clarify.
13024	2	12	15	12	15	Would be useful here to know what the land surface fraction < 3000 m is [Gerhard Krinner, France]	Accepted - this paragraph was changed extensively, the comment is no longer relevant here.
2668	2	12	20	12	26	The TreeLine Upslop's role in global warming needs to be presented with values. [Mohammad Javad Zareian, Iran]	Taken into account - however, this aspect is rather covered in the feedbacks box, as quantitatively as possible within the scope of such a global-wide report

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
12444	2	12	24	12	24	Id suggest to cite Scherrer et al. 2012 (Theoretical and Applied Climatology, doi:10.1007/s00704-012-0712-0) after "location". For the case of the Alps they exactly show this dependency on the season and location (around a retreating snowline). [Sven Kotlarski, Switzerland]	Taken into account - material considered for the preparation of SOD.
20472	2	12	24			"The snow albedo feedback also dominates model experiments (...), although its elevation depends on season and location (Palazzi et al., 2018)". Ref: Palazzi, E., Mortarini, L., Terzago, S. and von Hardenberg, J., 2018. Elevation-dependent warming in global climate model simulations at high spatial resolution. Climate Dynamics, pp.1-18. [Martin Ménégoz, France]	Taken into account - material considered for the preparation of SOD.
1278	2	12	28	12	28	The snow-albedo feedback [contribution to EDW] is reduced... [Ross Brown, Canada]	Taken into account - text revised for better clarity
13026	2	12	29	12	32	It might be useful to explain this mechanism in a bit more detail (modified lapse rate) [Gerhard Krinner, France]	Taken into account - text revised for better clarity, within the bounds of strict size limits
196	2	12	41	13	21	Need to state that precipitation was subject to significant natural variation also in pre-industrial time during the past millennia. Otherwise readers might get the wrong impression that the precipitation changes of the past 100 years are unprecedented in the Holocene or even late Holocene context (see e.g. Ljungqvist et al. 2016, doi: doi:10.1038/nature17418; Lüning et al. 2018, doi: 10.1016/j.palaeo.2018.01.025). Ignoring climatic and precipitation changes in pre-Little-Ice-Age times is climatically shortsighted and leads to questions about the robustness of this chapter. [Sebastian Luening, Portugal]	Taken into account - the report has a more limited time scope, and builds on AR5 which had an extensive paleo-component. Internal variability is mentioned when relevant, which is the case for precipitation in mountain regions.
17512	2	12	41	13	21	As mentioned above for temperature, this presentation of recent trends will need a lot more work. I hope that, for most major high mountain areas of the world, clear and comparable numbers could be given in tables or illustrations. [Wolfgang Cramer, France]	Accepted - tables were prepared to better reflect the state of knowledge, but the figures are difficult to compare, in view of the current lack of international framework for dealing with such changes at the global scale within the scientific community.
18322	2	12	41	13	21	The Observation section 2.2.1.2.1 about rain and snow precipitation would be more interesting if presenting extreme events (e.g. number of storm days or snow days). [Carmen Burghelea, Romania]	Taken into account - extreme events are mentioned when literature supports such statements.
18788	2	12	41	13	6	The problem of accurate measurement of precipitation under strong wind conditions, frequent at high sites, and worse for snow, should be addredded. See eg Frei, C., Christensen, J. H., D&#xfffd;qu&#xfffd;, M., Jacob, D., Jones, R. G., & Vidale, P. L. (2003). Daily precipitation statistics in regional climate models: Evaluation and intercomparison for the European Alps. Journal of Geophysical Research: Atmospheres, 108(D3). [Petra Seibert, Austria]	Accepted - measurement issues are explicitly mentioned in the SOD.
6296	2	12	42	13	18	Discussion of precipitation patterns appears limited to the Tibetan Plateau and continental Europe, mainly the Alps. What about the rest of the world? [Sean Fleming, USA]	Accepted - the text was extensively modified, with the inclusion of a table containing regional evidence.
20474	2	12	44	12	45	Masson and Frei observe an increase of precipitation in the Alps over the XXth century. Ref: Masson, D., & Frei, C. (2016). Long-term variations and trends of mesoscale precipitation in the Alps: recalculation and update for 1901–2008. International Journal of Climatology, 36(1), 492-500. [Martin Ménégoz, France]	Taken into account - material used for the preparation of the SOD
1312	2	12	46	12	46	what about precipitation trends in the southern Andes? No reference in mind but there must be some studies. [Etienne Berthier, France]	Noted - more extensive searchs were performed to include more evidence from the southern Andes, which are now presented in the form of a table.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
16120	2	13	1	13	1	suggest to add a reference of Yao et al. (2012) before "Molg et al., 2014". REF: Yao, T., et al., 2012: Different glacier status with atmospheric circulations in Tibetan Plateau and surroundings. Nature Climate Change, 2 (9), 663-667, doi:10.1038/nclimate1580. [Jing Gao, China]	Noted - respective text had to be removed
3842	2	13	2	13	3	Decreasing trends have been observed for Himalayas even by Yao et al., 2012 (Nat. Clim. Change, 2, 663–667, doi:10.1038/nclimate1580, 2012) [Franco Salerno, Italy]	Taken into account - material used for the preparation of the SOD
16122	2	13	3	13	3	suggest to add two refences of Yang et al. (2013) and Yu et al. (2013) before "Salerno et al., 2015". REFs: Yang W*, Yao TD, Guo XF, Zhu ML, Li SH, Kattel DB. Mass balance of a maritime glacier on the southeast Tibetan Plateau and its climatic sensitivity. Journal of Geophysical Research-Atmospheres, 2013, doi:10.1002/jgrd.50760. Yu, W., et al., 2013: Different region climate regimes and topography affect the changes in area and mass balance of glaciers on the north and south slopes of the same glacierized massif (the West Nyainqentanglha Range, Tibetan Plateau). Journal of Hydrology, 495, 64–73. [Jing Gao, China]	Taken into account - material used for the preparation of the SOD
1958	2	13	5	13	5	"intense precipitation". [J. Graham Cogley, Canada]	Editorial – copyedit to be completed prior to publication
19446	2	13	5	13	5	Precipitation should be singular [Michelle A. North, South Africa]	Editorial – copyedit to be completed prior to publication
1280	2	13	8	13	8	"The solid fraction of total precipitation is closely…" There is a lot of loose terminology in this chapter concerning snowfall and solid precipitation. [Ross Brown, Canada]	Accepted - text was revised to ensure consistency. However, both "snowfall" and "solid precipitation" are employed, the former being more understandable for non-specialists.
18790	2	13	8	13	10	This statement is almost universally valid, not just in the few regions mentioned. [Petra Seibert, Austria]	Accepted -
1282	2	13	10	13	10	"… ratio of snowfall to precipitation days" is imprecise. Should be spelled out e.g. "A decrease in the ratio of the number of days with snowfall to the total number of days with precipitation has been…" [Ross Brown, Canada]	Accepted - the text was extensively modified, with the inclusion of a table containing regional evidence.
18324	2	13	10	13	10	in addition to Lopez-Moreno, 2005, another important reference for the Pyrenees area is Zaharescu et al., 2016 that observed an increase in temperature associated to a reduction in snow cover and snow events (Zaharescu, D.G., P.S. Hooda, C.I. Burghelea, V. Polyakov and A. Palanca-Soler, 2016: Climate change enhances the mobilisation of naturally occurring metals in high altitude environments. Science of the Total Environment, 560-561, 73-81). [Carmen Burghelea, Romania]	Taken into account - material considered for the preparation of the SOD
18792	2	13	11	13	13	similar to previous [Petra Seibert, Austria]	Accepted - the text was extensively modified, with the inclusion of a table containing regional evidence.
13102	2	13	12	13	13	Wrong reference: Replace with doi.org/10.1029/2011GL046976 [Christoph Marty, Switzerland]	Taken into account - material considered for the preparation of the SOD
22474	2	13	12	13	13	Replace Serquet and Rebetez 2011 by :Serquet et al. 2010 [Martine Rebetez, Switzerland]	Taken into account - material considered for the preparation of the SOD
1960	2	13	13	13	13	Presumably this garbled sentence means "There was a large increase in the proportion of winter precipitation falling as rain … between 1866 and 2006 …". Please clarify. [J. Graham Cogley, Canada]	Accepted - text was revised for better clarity.

SROCC First Order Draft Expert Review Comments - Chapter 2							
Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
17092	2	13	13	23	23	This section has a focus on the response of snow cover to (in a statistical average) increasing temeperatures. What about exptreme events that can bring massive snow fall during a short period also in a (on average) warmer climate (e.g. Nordstau in the Alps with a cyclone over the Gulf of Genova (Vb weather type))? Such events can cause massive problems (avalanches, flooding) and should thus at least be mentioned. I am aware that models do not show them but this does not mean that they do not exist. [Frank Paul, Switzerland]	Taken into account - extremes are dealt with, to the extent of text length limitations and availability of evidence.
19448	2	13	13	13	14	Do you mean an increasing proportion of winter precpitation is rain instead of snow during this time period, rather than a large proportion? [Michelle A. North, South Africa]	Accepted - text was revised for better clarity.
22480	2	13	13	13	13	Add after the bracket : and where the months with the most negative trends were altitude dependant (Serquet et al. 2013) [Martine Rebetez, Switzerland]	Taken into account - material considered for the prepation of the SOD
22894	2	13	16	16	13	"Tien Shan" instead of Tienshan [Romy Schlogel, UK]	Accepted - the text was extensively modified, with the inclusion of a table containing regional evidence.
3834	2	13	17	13	17	I would suggest to add a point on snow precipitation at very high elevation derived from glaier winter mass balance measurements: “At very high elevation in the Alps (above the mean rain/snow transition altitude), only weak changes in solid precipitation are observed from glacier winter mass balance observations over the last 6 decades (Thibert et al., 2013).” Thibert, E., N. Eckert, and C. Vincent (2013). Climatic drivers of seasonal glacier mass balances: an analysis of 6 decades at Glacier de Sarennes (French Alps). The Cryosphere, 7, 47-66, doi:10.5194/tc-7-47-2013. [Emmanuel Thibert, France]	Taken into account - material considered for the prepation of the SOD
6470	2	13	18	13	19	I think the statement that "It is likely that insignificant trends are shown" is strange [Walter Immerzeel, Netherlands]	Accepted - text was revised for better clarity.
12732	2	13	18			positive/upward trend or negative trend? At other locations you are specific, here not. Please be consistent. [Jan-Christoph Otto, Germany]	Accepted - text was revised for better clarity.
5940	2	13	23	14	11	This paragraph contains interesting information. However, it is hard to remember when it is written like this. Maybe it is nice to provide the information of the scenario's in a figure (like paragraph 2.2.3 and 2.2.4), or in a table [Roderik Van De Wal, Netherlands]	Accepted - the text was extensively modified, with the inclusion of a table containing regional evidence.
17514	2	13	23	14	11	Again, the generalities (which are limited anyway, as is clearly shown) are less interesting than the specifics for the major regions. [Wolfgang Cramer, France]	Accepted - the text was extensively modified, with the inclusion of a table containing regional evidence.
3484	2	13	24	13	37	Are there no projections of precipitation in the European Alps (e.g., in references given in comment nº6 above)? Even if the trend is not significant and interannual variability is very high, this is still an information worth giving here. [Deborah Verfaillie, Spain]	Taken into account - Additional material was assessed in the preparation of the SOD
23650	2	13	24	13	27	Please provide citations for these projections [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - the text was extensively modified, with the inclusion of a table containing regional evidence.
22896	2	13	25	27	13	What about Central Asia and the rest of the Himalayas? [Romy Schlogel, UK]	Accepted - the text was extensively modified, with the inclusion of a table containing regional evidence.
1284	2	13	26	13	26	typo missinng word "... others [are] expected..." [Ross Brown, Canada]	Editorial – copyedit to be completed prior to publication
22794	2	13	27	13	29	Needs reference [Lena Rubensdotter, Norway]	Accepted - the text was extensively modified, with the inclusion of a table containing regional evidence.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
11090	2	13	29	13	29	Where it says “Andes” it must say “Tropical Andes.” The scope of the analysis of Vuille et al. (2018) it is restricted to the sector of the Andes, know of the Tropical Andes, which has a different climate setting that others regions of the Andes, like the Southern Andes, or its subdivision (Dry and Wet Andes). Due to the different climatic setting, not all the statement or the assessment from one region must be valid for the rest of the Andes. [Lucas Ruiz, Argentina]	Accepted - the text was extensively modified, with the inclusion of a table containing regional evidence.
17918	2	13	29	13	31	This statement is too general. In some regions of the Andes decreasing precipitation has been observed and projected (e.g. central Andes, southern Peru, Neukom et al. ERL 2016). [Christian Huggel, Switzerland]	Accepted - the text was extensively modified, with the inclusion of a table containing regional evidence.
1286	2	13	39	13	40	Terminology is unclear. Suggestion: "The decrease in solid precipitation frequency and fractional contribution to total precipiitation experienced in many mountain areas of the globe over the last century is projected to continue in the future. [Ross Brown, Canada]	Accepted - text was revised for better clarity.
18794	2	13	39	13	41	The argument is not properly presented, main point is warming. [Petra Seibert, Austria]	Accepted - text was revised for better clarity.
11092	2	13	44	13	51	It would be easy for the non-specialist reader if there were a sentence explaining which are the equivalences and differences between RCP’s and scenarios (e.g., A1B, and so far.). They are used through the text, and it is not accessible for the non-specialist to get it if there are the same or not. [Lucas Ruiz, Argentina]	Taken into account - this belongs to the framing chapter (Chapter 1)
22898	2	13	46	47	13	It is not clear at which lower-lying areas correspond. Add some precision considering the Alps case if pertinent. [Romy Schlogel, UK]	Accepted - the text was extensively modified, with the inclusion of a table containing regional evidence.
19450	2	13	47	13	47	What is meant by: "will be enhanced for heavy snowfall events"? [Michelle A. North, South Africa]	Accepted - text was revised for better clarity.
1962	2	13	51	13	51	Unbalanced right parenthesis. [J. Graham Cogley, Canada]	Editorial – copyedit to be completed prior to publication
15504	2	13	51	13	51	There is an orphan closing parenthesis in "A2)." [Hernan Sala, Argentina]	Editorial – copyedit to be completed prior to publication
1964	2	13	52	13	52	Delete "overall". [J. Graham Cogley, Canada]	Accepted - text was revised for better clarity.
14434	2	13	52	13	52	remove "the" as the models in these studies are different: "behavior overall simulated by models over the entire Northern Hemisphere" [Sarah Kapnick, USA]	Accepted - text was revised for better clarity.
14432	2	13	53	13	54	Change to: "O'Gorman 2014; Kapnick and Delworth 2013), 2014), indicating that snowfall may increase only in regions with very cold temperatures such as high mountains and polar regions, otherwise it is expected to decrease.----The O'Gorman paper omits data from high mountains due to the coarseness of CMIP5 models and snowfall does not thermodynamically scale with temperature in the same way as it does at lower elevations. Kapnick and Delworth 2013 deal with the high mountains and poles. [Sarah Kapnick, USA]	Taken into account - material considered for the preparation of the SOD
21052	2	14	4		8	What is the evidence for decrease of solid precip? I think there is only evidence of earlier melt onset. [Thomas Wagner, USA]	Accepted - text was revised for better clarity.
18796	2	14	5	14	5	very likely or virtually certain? [Petra Seibert, Austria]	Taken into account - the use of the confidence language was further checked prior to SOD submission.
1288	2	14	6	14	6	change "(snow)" to "(snowfall)" to be consistent across chapter [Ross Brown, Canada]	Accepted - text was revised for better clarity.
18798	2	14	7	14	8	more than 'medium' [Petra Seibert, Austria]	Taken into account - the use of the confidence language was further checked prior to SOD submission.
1290	2	14	9	14	9	change "snow preciptiation" to "solid precipitation" to be consistent with WMO terminology [Ross Brown, Canada]	Accepted - text was revised for better clarity.
13104	2	14	10			"Due to the paucity of measuerments and of studies…." [Christoph Marty, Switzerland]	Accepted - text was revised for better clarity and better reflecting the state of knowledge and available evidence

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
18800	2	14	10	14	10	not clear what 'nost detailed modelling tools' are; probaby not the most limiting factor [Petra Seibert, Austria]	Accepted - text was revised for better clarity and better reflecting the state of knowledge and available evidence
2696	2	14	13	14	13	2.2.1.1' should be '2.2.1.3'. [Kentaro Hayashi, Japan]	Accepted
3486	2	14	13	14	13	The section numbering here is wrong (should be 2.2.1.3 instead of 2.2.1.1). [Deborah Verfaillie, Spain]	Accepted
6810	2	14	13	14	13	Subsection number 2.2.1.1 should be 2.2.1.3 [APECS Group Review, Germany]	Accepted
22900	2	14	13	13	14	Numerotation problem, replace by 2.2.1.3? [Romy Schlogel, UK]	Accepted
2302	2	14	22	14	27	Elaborate on the fact that air pollution control policies reduce aerosols that have a cooling effect on the climate, and committed warming may be as high as 2.4ºC with aerosols providing such substantial cooling that we have only observed 1ºC of that warming. At the same time, these aerosols must be reduced in order to protect human health and other co-benefits from reducing air pollution, which includes reducing black carbon (and its warming abilities) in the process. (Ramanathan V. & Feng Y. (2008) On avoiding dangerous anthropogenic interference with the climate system: Formidable challenges ahead, PROC. NAT'L. ACAD. SCI. 105(38):14245–14250; Lamarque J.-F., et al. (2011) Global and regional evolution of short-lived radiatively-active gases and aerosols in the Representative Concentration Pathways, CLIMATIC CHANGE 109:191–212; Ramanathan V. & Feng Y. (2008) On avoiding dangerous anthropogenic interference with the climate system: Formidable challenges ahead, PROC. NAT'L. ACAD. SCI. 105(38):14245–14250; Ramanathan V. & Xu Y. (2010) The Copenhagen Accord for limiting global warming: Criteria, constraints, and available avenues, PROC. NAT'L. ACAD. SCI. 107(18):8055–8062; Westervelt D. M., et al. (2015) Radiative forcing and climate response to projected 21st century aerosol decreases, ATMOS. CHEM. PHYS. 15:12681–12703; van Vuuren D. P., et al. (2011) RCP2.6: Exploring the Possibility to Keep Global mean Temperature Increase Below 2ºC, CLIMATIC CHANGE 109:95–116.) [Kristin Campbell, USA]	Rejected - this section ("Atmospheric Drivers of Changes in the Mountain Cryosphere") does not assess the effects of aerosols on climate.

SROCC First Order Draft Expert Review Comments - Chapter 2							
Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
2428	2	14	22	14	27	Elaborate on the fact that air pollution control policies reduce aerosols that have a cooling effect on the climate, and committed warming may be as high as 2.4ºC with aerosols providing such substantial cooling that we have only observed 1ºC of that warming. At the same time, these aerosols must be reduced in order to protect human health and other co-benefits from reducing air pollution, which includes reducing black carbon (and its warming abilities) in the process. (Ramanathan V. & Feng Y. (2008) On avoiding dangerous anthropogenic interference with the climate system: Formidable challenges ahead, PROC. NAT'L. ACAD. SCI. 105(38):14245–14250; Lamarque J.-F., et al. (2011) Global and regional evolution of short-lived radiatively-active gases and aerosols in the Representative Concentration Pathways, CLIMATIC CHANGE 109:191–212; Ramanathan V. & Feng Y. (2008) On avoiding dangerous anthropogenic interference with the climate system: Formidable challenges ahead, PROC. NAT'L. ACAD. SCI. 105(38):14245–14250; Ramanathan V. & Xu Y. (2010) The Copenhagen Accord for limiting global warming: Criteria, constraints, and available avenues, PROC. NAT'L. ACAD. SCI. 107(18):8055–8062; Westervelt D. M., et al. (2015) Radiative forcing and climate response to projected 21st century aerosol decreases, ATMOS. CHEM. PHYS. 15:12681–12703; van Vuuren D. P., et al. (2011) RCP2.6: Exploring the Possibility to Keep Global mean Temperature Increase Below 2ºC, CLIMATIC CHANGE 109:95–116.) [Durwood Zaelke, USA]	Rejected - this section ("Atmospheric Drivers of Changes in the Mountain Cryosphere") does not assess the effects of aerosols on climate.
12926	2	14	22	14	27	Elaborate on the fact that air pollution control policies reduce aerosols that have a cooling effect on the climate, and committed warming may be as high as 2.4ºC with aerosols providing such substantial cooling that we have only observed 1ºC of that warming. At the same time, these aerosols must be reduced in order to protect human health and other co-benefits from reducing air pollution, which includes reducing black carbon (and its warming abilities) in the process. (Ramanathan V. & Feng Y. (2008) On avoiding dangerous anthropogenic interference with the climate system: Formidable challenges ahead, PROC. NAT'L. ACAD. SCI. 105(38):14245–14250; Lamarque J.-F., et al. (2011) Global and regional evolution of short-lived radiatively-active gases and aerosols in the Representative Concentration Pathways, CLIMATIC CHANGE 109:191–212; Ramanathan V. & Feng Y. (2008) On avoiding dangerous anthropogenic interference with the climate system: Formidable challenges ahead, PROC. NAT'L. ACAD. SCI. 105(38):14245–14250; Ramanathan V. & Xu Y. (2010) The Copenhagen Accord for limiting global warming: Criteria, constraints, and available avenues, PROC. NAT'L. ACAD. SCI. 107(18):8055–8062; Westervelt D. M., et al. (2015) Radiative forcing and climate response to projected 21st century aerosol decreases, ATMOS. CHEM. PHYS. 15:12681–12703; van Vuuren D. P., et al. (2011) RCP2.6: Exploring the Possibility to Keep Global mean Temperature Increase Below 2ºC, CLIMATIC CHANGE 109:95–116.) [Gabrielle Dreyfus, USA]	Rejected - this section ("Atmospheric Drivers of Changes in the Mountain Cryosphere") does not assess the effects of aerosols on climate.

SROCC First Order Draft Expert Review Comments - Chapter 2							
Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
19452	2	14	24	14	26	The line "shown to be particularly sensitive in pristine regions" appears to contradict the following sentence which states that only minor effects were detected at high elevations in the Alps… Please check whether these sentences are conveying the intended meaning. [Michelle A. North, South Africa]	Taken into account - clarified formulation.
11868	2	14	29	14	37	The information given on "wind" is very little. As there probably is very little information available, it might be good to highlight that changes in wind (velocity, etc.) are probably ocurring (a number of empirical evidence of higher wind speeds and wind related damages exist for example for the Bolivian highlands), but data availability is very much limited [Dirk Hoffmann, Germany]	Noted
12850	2	14	29	14	30	Wind has also a major impact on surface energy balance (turbulent fluxes) of the snow pack and glacier surface mass balance. This deserves to be mentioned, all the more than recent studies showed that the poor representation of wind (intensity and direction) into the models can seriously impact the future simulation of snow and ice melt. You can refer to: Litt, M., Sicart, J.-E., Six, D., Wagnon, P., and Helgason, W. D.: Surface-layer turbulence, energy balance and links to atmospheric circulations over a mountain glacier in the French Alps, The Cryosphere, 11, 971–987, https://doi.org/10.5194/tc-11-971-2017, 2017 Réveillet, M., D. Six, C. Vincent, A. Rabatel, M. Dumont, M. Lafaysse, S. Morin, V. Vionnet, M. Litt. 2018. Relative performance of empirical and physical models in assessing seasonal and annual glacier surface mass balance of Saint Sorlin glacier (French Alps). The Cryosphere, 12, 1367-1386. doi: 10.5194/tc-12-1367-2018 [Antoine Rabatel, France]	Taken into account - influence on mass balance included, but no reference as this is textbook type insight rather than assessment of change.
6426	2	14	30	14	31	In addition to wind speed, wind direction is also best to be investigated. [Leila Rashidian, Iran]	Taken into account - only mentioned briefly due to limited space.
19454	2	14	34	14	34	Delete the ", and" before "in all seasons". [Michelle A. North, South Africa]	Accepted
1292	2	14	39	14	39	An important point to make in this section is that in areas with perennial snow and ice, LAP accumulate over successive melt seasons providing a cumulative contribution to albedo reduction that is decoupled from annual deposition. [Ross Brown, Canada]	Accepted - this is true LAIs can accumulated in the surface of a glacier during melt (glacier includes perennial snow and ice) with one or two magnitudes higher than these in fresh snow (quite few references discussed about the point).
12446	2	14	41	14	42	I'm not sure if this statement is fully valid. I'd say the influence of GHGs on LW radiation and, hence, on the radiation balance of cryospheric surfaces is a more or less direct effect. [Sven Kotlarski, Switzerland]	Accepted - this point is redundant. We go to LAIs directly.
21090	2	14	41	14	47	There are aerosol sources inside the cryosphere. I would suggest to include a sentence here. Glacier areas are surrounded by active dust sources producing at least 100 Tgy-1 of dust aerosol (Bullard et al., 2016). 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. [Pavla Dagsson Waldhauserova, Iceland]	Taken into account - this section was extensively modified for SOD
1966	2	14	42	14	42	"particularly when they are absorbent". [J. Graham Cogley, Canada]	Taken into account - this section was extensively modified for SOD

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
1798	2	14	49			There is also emerging evidence that biological light absorbing particles, specifically green and red-coloured snow algae of the genera Chlamydomonas, Chlainomonas and Chloromonas can alter the albedo of snow and accelerate melt rates in mountainous regions (Takeuchi, 2001; Painter et al., 2001; Takeuchi et al., 2004, 2006; Ganey et al., 2017; Dial et al., 2018). Incorporation of snow algal growth into regional melt models has not yet been achieved but an early candidate parameterization has recently been published (Cook et al., 2017). On mountain glaciers, biological melt acceleration has also been well documented, resulting either from algae growing on the ice surface or the presence of biological aggregates known as 'cryoconite'. The albedo lowering effects of these biological particles are difficult to disentangle due to existing in admixtures with non-biological particles and having complex life-cycles that are not yet well-known. Nevertheless, there is a substantial and growing literature documenting biological acceleration of glacier melt in geographically diverse mountainous regions (Kohshima et al., 1992; Takeuchi et al., 2002; Takeuchi et al., 2001; Takeuchi et al., 2001b; Thomas and Duval, 1995). Kohshima S, Seko K, Yoshimura Y (1992) Biotic acceleration of glacier melting in Yala Glacier, Langtang region, Nepal Himalaya. IAHS Publication 218 (Symposium at Kathmandu 1992 – Snow and Glacier, Hydrology): 309 – 316 Takeuchi, N. 2002. Surface albedo and characteristics of cryoconite (biogenic surface dust) on an Alaska glacier, Gulkana Glacier in the Alaska Range. Bull. Glaciol. Res., 19, 63–70. Takeuchi, N., S. Kohshima, T. Shiraiwa and K. Kubota. 2001b. Characteristics of cryoconite (surface dust on glaciers) and surface albedo of a Patagonian glacier, Tyndall Glacier, Southern Patagonia Icefield. Bull. Glaciol. Res., 18, 65–69. Takeuchi, N., S. Kohshima and K. Seko. 2001c. Structure, formation, and darkening process of albedo-reducing material (cryoconite) on a Himalayan glacier: a granular algal mat growing on the glacier. Arct. Antarct. Alp. Res., 33 (2), 115–122. Thomas, W.H. and B. Duval. 1995. Sierra Nevada, California, U.S.A., snow algae: snow	Taken into account - this section was extensively modified for SOD
2304	2	14	49	15	6	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 - Greenland Ice Sheet is presented in Chapter 3.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
2430	2	14	49	15	6	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]	Rejected - Greenland Ice Sheet is presented in Chapter 3.
12928	2	14	49	15	6	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]	Rejected - Greenland Ice Sheet is presented in Chapter 3.
21054	2	14	49		57	I thought it was more straightforward; and especially for low elevations in the himalayas…more soot more melt. [Thomas Wagner, USA]	Taken into account
1968	2	14	50	14	50	"demonstrate". [J. Graham Cogley, Canada]	Changed.
16124	2	14	52	14	52	suggest to add a reference of Xu et al. (2009) before "Ginot et al., 2014". REF: Baiqing Xu, Junji Cao, James Hansen, Tandong Yao, Daniel R. Joswiak, et al., 2009. Black soot and the survival of Tibetan glaciers, PNAS, 106(52): 22114-22118 [Jing Gao, China]	Taken into account
4974	2	14	54	14	57	To assess the role of deposition of light absorbing impurities (LAI): The LAI effects on water holding capacity and density are currently missing -> SUGGEST TO ADD: The knowledge on the role of impurities in decreasing the liquid-water retention capacity of melting snow, and density effects of melting surface snow, is very limited (Meinander et al. 2014, Skiles & Painter 2017)(low agreement, low evidence). [Outi Meinander, Finland]	Taken into account - material was considered for the preparation of SOD
4976	2	14	54	14	57	citation: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.: Brief communication: Light-absorbing impurities can reduce the density of melting snow, The Cryosphere, 8, 991-995, https://doi.org/10.5194/tc-8-991-2014, 2014. [Outi Meinander, Finland]	Taken into account - material was considered for the preparation of SOD
4978	2	14	54	14	57	citation: Skiles SMK & Painter T, Daily evolution in dust and black carbon content, snow grain size, and snow albedo during snowmelt, Rocky Mountains, Colorado, J. Glaciol., 63, 237, 118-132, doi:10.1017/jog.2016.125, 2017. [Outi Meinander, Finland]	Taken into account - material was considered for the preparation of SOD
4980	2	14	54	14	57	To assess the role of deposition of light absorbing impurities (LAI): The information on insulation versus melt effects due to volcanic ash is currently missing - > SUGGEST TO ADD: The melt versus insulation effect of volcanic ash and dust deposited on snow and ice is limited (Dragosics et al. 2016, Möller et al. 2016)(medium agreement, medium evidence). The insulation effect has been found to start at impurity thicknesses of 5.5 - 24 mm, while melt is effective at thin impuritiy layers, most often 1-3 mm (Table 1 of Dragosics et al. 2016). [Outi Meinander, Finland]	Taken into account - material was considered for the preparation of SOD. However, given the strong size limitations only concise statements could be employed.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
4982	2	14	54	14	57	citation: Dragosics M, Meinander O., Jónsdóttír T.,Dürig T., De Leeuw G., Pálsson F., Dagsson-Waldhauserová P., Thorsteinsson T. Insulation effects of Icelandic dust and volcanic ash on snow and ice. Arabian Journal of Geosciences, Topical Collection on DUST, 9, 126, 2016. [Outi Meinander, Finland]	Taken into account - material was considered for the preparation of SOD
4984	2	14	54	14	57	citation: Möller, R., Möller, M., Kukla, P. A., and Schneider, C.: Impact of supraglacial deposits of tephra from Grimsvötn volcano, Iceland, on glacier ablation, J. Glaciol., 62, 933–943, doi:10.1017/jog.2016.82, 2016. [Outi Meinander, Finland]	Taken into account - material was considered for the preparation of SOD
12230	2	14	54	15	1	The limited ability of numerical models to account for effects arising from LAI cannot be reduced to the limitations in the current knowledge on flushing efficiencies. To my opinion, this is only a small part of the problem and certainly not the most significant. I would propose something like : « Furthermore, the limited knowledge of LAI sources and emissions, the discrepancies between LAI deposition fluxes simulated by atmospheric models and measured in the field (Menegoz et al., ACP, 2014), the incomplete or absent representation of the interactions between LAI and snow metamorphism (Tuzet et al., 2017) along with the uncertainties in the knowledge on LAI composition and optical properties (Ginot et al., TC, 2014), on their mixing state with respect to snow microstructure (Flanner et al., 2012) and on flushing efficiencies (Doherty et al., 2013), limit the ability of numerical models to account for effects arising from light-absorbing impurities (Quian et al., 2015). » [Marie Dumont, France]	Taken into account - this section was extensively modified for SOD

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
4018	2	15	1	15	6	I think it is a stretch to say that in "most mountainous regions… snow and ice darkening is a critical component of cryospheric changes, with signficant impacts on snow and ice radiative forcig, signficantly contributing to interannual variability and long term trends of snow and ice conditions." First, as in my earlier comment about the summary bullet on this topic, distinction needs to be made about anthropogenic sources of snow/ice darkening and natural sources of snow/ice darkening. In many regions -- e.g. on glaciers and in the Tibetan Pleateau more genearally, there are signficant natural sources of dust and while these darken snow they are not necessarly anthropogenic or exhibiting trends. Second, I don't think we are yet at the point where we know this is a significant factor in most mountainous regions. A number of studies (Xu et al. and the Zhang et al studies cited) do show signficant impacts in the Tibetan Plateau region and one modeling study (Schmale et al. 2017) showed a significant impact in central Asia. The Deems et al (2013) study shows that anthropogenic dust is accelerating snow melt in a very specific region in the Colorado River Basin -- but not the western Rockies genearally. Gabbi et al (2015) addresses the impact of Sahara dust and BC for two sites in the Swiss Alps only. The Kaspari et al (2015) paper looked at the influence of a very anomalous wildfire event in the Washington State Olympic mountains so really can not be generalized. Yasunari et al. (2015) is a model study of the impacts of anthropogenic black carbon more generally in the northwest US, but does not address mountain snowpack specfically and is a single study. The Painter et al. study was about the contribution of BC deposition on snow to the end of the Little Ice Age -- not contributions to recent trends in snow/glacier melt. As such, I would moderate this statement. [Sarah Doherty, USA]	Taken into account - this section was extensively modified for SOD
1800	2	15	2	15	2	not only deposition of aerosols but also in situ modification, scavenging and - in the case of biological cells – growth. [Joseph Cook, UK]	Taken into account - this section was extensively modified for SOD
1970	2	15	2	15	2	Increasing evidence that darkening is a "critical" component contradicts the "low agreement" of P14 L53. [J. Graham Cogley, Canada]	Taken into account - this section was extensively modified for SOD
21092	2	15	4	15	6	Please consider to include case study from Iceland on Snow-Dust Storm from Dagsson-Waldhauserova et al. (2015). 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]	Taken into account for preparation of SOD.
4986	2	15	6	15	6	To assess the role of deposition of light absorbing impurities (LAI): SUGGEST TO ADD: In cryospheric changes related to deposited light absorbing impurities, the wavelength dependent directonal and diurnal changes in snow and ice reflectance and albedo can be soot and dust particle type specific (e.g., Peltoniemi et al. 2015) (medium agreement, medium evidence). [Outi Meinander, Finland]	Taken into account - material was considered for the preparation of SOD. However, given the strong size limitations only concise statements could be employed.

SROCC First Order Draft Expert Review Comments - Chapter 2							
Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
4988	2	15	6	15	6	citation: 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., and de Leeuw, G.: Soot on Snow experiment: bidirectional reflectance factor measurements of contaminated snow, The Cryosphere, 9, 2323-2337, https://doi.org/10.5194/tc-9-2323-2015, 2015. [Outi Meinander, Finland]	Taken into account - material was considered for the preparation of SOD.
13414	2	15	8	15	9	How come it is 'likely' that impurities played a 'significant' role? Given the 'limited evidence' cited ? [Debra Roberts and Durban Team, South Africa]	Taken into account - this section was extensively modified for SOD
21094	2	15	8	15	14	There are different types of dust and each has different effects on albedo, including clumping mechanism effects on albedo. For example Icelandic volcanic dust reduces albedo similarly as black carbon. I suggest to specify here dust to 1. volcanic dust*, 2. crustal dust and 3. High Latitude dust**. 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). 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. and 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. *volcanic dust is defined in Dagsson-Waldhauserova et al., 2015 (comment above) **High Latitude dust is defined in Bullard et al., 2016 (second comment). [Pavla Dagsson Waldhauserova, Iceland]	Taken into account - material was considered for the preparation of SOD. However, given the strong size limitations only concise statements could be employed.
5942	2	15	10	15	10	If we interpret it correctly, this is a summary of section 2.2.1.4. The short summary is nice to have, but it mentions a few regions explicitly, while they aren't before in paragraph 2.2.1.4. Why are those regions especially mentioned in the summary? [Roderik Van De Wal, Netherlands]	Taken into account - this section was extensively modified for SOD
21096	2	15	10	15	10	Please consider insert Iceland here. [Pavla Dagsson Waldhauserova, Iceland]	Accepted - Iceland is fully in the scope of Chapter 2.
17094	2	15	15	11	11	snow-albedo feedback: What about Sahara dust events? Such depositions can create extreme melt rates of snow at high elevations [Frank Paul, Switzerland]	Accepted. Dust deposition is addressed in the attribution section for snow and glacier changes.
17096	2	15	15	16	16	I would add here somewhere that an early snow cover can be very good for glaciers but very bad for permafrost. [Frank Paul, Switzerland]	Accepted. Impacts of snow on permafrost are outlined in the introduction to the snow section, and referred to as well in the snow and permafrsot sections, where relevant.
3490	2	15	16	17	23	Are there no figures or tables to display for snow, like there are for glaciers and permafrost? [Deborah Verfaillie, Spain]	Taken into account - figures for snow have been developed.
3492	2	15	16	17	23	Is there no “Attribution” section for snow, like there are for glaciers and permafrost? [Deborah Verfaillie, Spain]	Taken into account - text revised for better clarity and inclusion of an attribution section.

SROCC First Order Draft Expert Review Comments - Chapter 2							
Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
17920	2	15	16	24	33	The sections on snow, glaciers and permafrost and lake/river ice are consistently structured which I think helps reading and understanding them but the sub-section on attribution is missing in the snow section. Why is this? I think it is important to have these attribution sections and snow should not be an exception. There are attribution statements/assessments on snow in the AR5 (both WGI and WGII) which can form a starting point. Attribution to anthropogenic climate change is only considered for glaciers. I'm awre of the relative lack of literature on attribution of changes in cryo elements to anthropogenic CC but this does not necessarily prevent from an expert assessment. Furthermore, for the glaciers I wondered whether some regional specification of attribution should be made? Marzeion et al 2014 provide this (but maybe it would be too much detail for this section?) [Christian Huggel, Switzerland]	Taken into account - text revised for better clarity and inclusion of an attribution section.
21056	2	15	16		55	Less falling snow or earlier melting? I know it's hard to do, then say we don't know clearly. Also, regionality might be discussed. I feel like it needs to be explained that climate change is meaning more snow in a few places, and earlier melting in most places. [Thomas Wagner, USA]	Accepted - text revised to better introduce processes responsible for inception/development of the snow cover, and ablation processes, the impact of climate change thereon.
18802	2	15	18	15	18	sect 2.2.2 should be called 'Snow cover' [Petra Seibert, Austria]	Accepted
6814	2	15	19	15	20	I would include the idea that snow also plays a major role in "soil thermal regime", which is also crucial for several other issues: permafrost/seasonal frost, vegetation growing cycle, etc. [APECS Group Review, Germany]	Accepted
1294	2	15	23	15	23	change "snow preciptiation" to "solid precipitation" to be consistent with WMO terminology [Ross Brown, Canada]	Accepted - however, because solid and liquid precipitation is not necessarily a standard terminology in the target audience of this report, the terms snowfall and rainfall were kept along with the first occurrences of the terms solid and liquid precipitation, in sections 2.2.1 and sections 2.2.2
22796	2	15	26	15	26	I think the important process of meltwater percolation and refreezing within the snowpack should be mentioned here also (as well as changes in microstructure etc.. [Lena Rubensdotter, Norway]	Accepted
18804	2	15	27	15	28	remove 'and exposed', numerous instead of 'multiple' [Petra Seibert, Austria]	Accepted
19456	2	15	27	15	28	Delete "and exposed" and "interest and" so that the sentence reads: "identified to be particularly sensitive to climate change, generating concern from multiple stakeholders…" [Michelle A. North, South Africa]	Accepted
6812	2	15	28	15	28	For completeness, can add that snow cover (depth, melting, duration) also affects ground temperatures. [APECS Group Review, Germany]	Accepted - text revised accordingly.
20476	2	15	34			MODIS is available from 2000. AVHRR is available from 1966; see Estilow, T. W., Young, A. H., and Robinson, D. A.: A long-term Northern Hemisphere snow cover extent data record for climate studies and monitoring, Earth Syst. Sci. Data, 7, 137-142, https://doi.org/10.5194/essd-7-137-2015, 2015. [Martin Ménégoz, France]	Taken into account - note however that there are relatively few studies spanning more than 2 decades of satellite observations to address changes in snow cover in the mountainous areas, which make them generally fall short of describing relevant climate-related trends, because of the high interannual variability and too short observation window.

SROCC First Order Draft Expert Review Comments - Chapter 2							
Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
6298	2	15	43	15	54	This passage seems to understimate the research that has been completed on changes in snow cover in western Canada. A large number of studies have been completed by scientists at Environment and Climate Change Canada and the Pacific Climate Impacts Consortium, for example. And for the western US, there has been a huge amount of work; I might suggest extending the references beyond the work of Mote et al. (2018), and a good starting point for that might be the landmark detection & attribution study by Barnett et al., 2008, Human-induced changes in the hydrology of the western United States, Science, 319, 1080-1083. [Sean Fleming, USA]	Taken into account - further studies were used for the assessment of snow in North America.
1972	2	15	46	15	46	"21st". Same at P16 L22. [J. Graham Cogley, Canada]	Editorial – copyedit to be completed prior to publication
15498	2	15	46	15	46	Along this chapter, the XX century is referenced in different ways, for instance: "20st" (?), "20th" and "20th" (with "th" as superscript). In order to keep consistency along this chapter (and in the whole Report), I suggest to check and unify them, whenever is correct or possible. [Hernan Sala, Argentina]	Editorial – copyedit to be completed prior to publication
23652	2	15	46	15	46	"20st": is this 20th century or 21st century? Please clarify and revise [Hans-Otto Poertner and WGII TSU, Germany]	Editorial – copyedit to be completed prior to publication
1974	2	15	47	15	47	Change "hampers" to "reduces". [J. Graham Cogley, Canada]	Accepted
13416	2	15	47	15	48	"interannual variability is high and the trend is not statistically significant" - awkward wording. [Debra Roberts and Durban Team, South Africa]	Taken into account - text revised for better clarity.
17516	2	15	48	15	54	“Literature addressing analysis of snow cover trends for Canadian Rocky Mountains and Alaska is limited and often not specific to mountain environments.” I wonder if this sentence and also the rest of the paragraph are not overly cautious. First if there are trends from the Rocky Mountains and Alaska, then much of this would relate to mountains, wouldn’t it, even if not explicitly stated? And second, do you need to focus ONLY on the uncertainty? Is there nothing that can be concluded? [Wolfgang Cramer, France]	Taken into account - expanded assessment of NW America was performed for the SOD
3836	2	15	51	15	51	"I would extend the results to the European Alps: Since the early 1980’s, snow melt above 3000 m starts on average 2 weeks earlier in spring and melt has also intensified with melt rates risen by 15% (Thibert et al., 2013)." Thibert, E., N. Eckert, and C. Vincent (2013). Climatic drivers of seasonal glacier mass balances: an analysis of 6 decades at Glacier de Sarennes (French Alps). The Cryosphere, 7, 47-66, doi:10.5194/tc-7-47-2013. [Emmanuel Thibert, France]	Taken into account - this material has been incorporated in the assessment for Europe.
1976	2	16	1	16	1	"exhibits … but has declned". [J. Graham Cogley, Canada]	Editorial – copyedit to be completed prior to publication
11094	2	16	2	16	3	It would be better regarding the assessment approach that better picture of what publications say about what is going on with snow in New Zealand and Japan. [Lucas Ruiz, Argentina]	Taken into account - expanded assessment of Japan and New Zealand was performed for the SOD
13418	2	16	2	16	2	Change '20st' to '20th' or confirm that this was not supposed to be '21st' [Debra Roberts and Durban Team, South Africa]	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
14080	2	16	5	16	18	Including the change report for tropical mountanieous region will add the value of the chapter. Tropical glaciers can provide climatic information through changes in ice area through time and from ice core records contained within them. The glaciers near Puncak Jaya in Papua, Indonesia are the last remaining glaciers in the tropical West Pacific (see Thompson et al. 2017) [Siswanto Siswanto, Indonesia]	Taken into account - glacier changes for all 11 mountain regions discussed in the this chanpter are presented in Fig. 2.3. Due to space limitations we concentrate on regional averages for observed and projected glacier changes.
18806	2	16	5	16	17	For trends in Alpine snowcover, don't miss Klein, G., Vitasse, Y., Rixen, C., Marty, C., & Rebetez, M. (2016). Shorter snow cover duration since 1970 in the Swiss Alps due to earlier snowmelt more than to later snow onset. Climatic Change, 139(3-4), 637-649. [Petra Seibert, Austria]	Taken into account for the assessment for Europe
1978	2	16	8	16	8	"momotonic and is superimposed" (otherwise the sentence says that it is NOT superimposed). [J. Graham Cogley, Canada]	Accepted - text revised for better clarity.
19458	2	16	8	16	8	Add an "in" in front of superimposed, to read: "The trend is not monotonous and is superimposed on significant…" [Michelle A. North, South Africa]	Accepted - text revised for better clarity.
17518	2	16	9			“snow depth data exhibited a strong shift” - first of all, it’s not the data, it’s the snow depth itself, or perhaps the observations (“data” could come from models too). But more importantly, if there was a “shift” then why do you give no indication of that shift’s direction? The entire rest of the paragraph can be read backwards and forewards, it does not seem to be willing to give away the information of what actually shifted where and how. [Wolfgang Cramer, France]	Accepted - text revised for better clarity.
19460	2	16	9	16	9	"…snow depth data exhibited a strong shift…" - in which direction? [Michelle A. North, South Africa]	Accepted - text revised for better clarity.
22482	2	16	10	16	10	Add : At all elevations in the Swiss Alps the decrease in snow cover was twice faster in spring compared to autumn, the snow season started on average 12 days later and ended 26 days earlier in 2015 compared to 1970 (Klein et al., 2016). [Martine Rebetez, Switzerland]	Taken into account for the assessment for Europe
23656	2	16	13	16	16	Please revise this sentence. [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - text revised for better clarity.
1980	2	16	14	16	14	"shows". [J. Graham Cogley, Canada]	Editorial – copyedit to be completed prior to publication
3754	2	16	14	16	14	the reference should be put in parentheses [Carlo Carmagnola, France]	Editorial – copyedit to be completed prior to publication
19462	2	16	14	16	14	Correct the style of the citation Husler et al (2014) and move to the end of the sentence [Michelle A. North, South Africa]	Editorial – copyedit to be completed prior to publication
5946	2	16	19	16	26	High altitude areas have a low data-density this information can be deduced from this paragraph, and from the box before which said that only less than 1% is above a certain attitude), and it is likely that there is a insignificant trend, either positive or negative. This sounds as if we do not know (yet) what happens above a certain attitude. If there is not much data, the trend is insignificant and even the sign isn't known, isn't is better to leave this part out of the report? [Roderik Van De Wal, Netherlands]	Taken into account - text revised for better clarity on the significant of the trends depending on elevation.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
12572	2	16	19	16	23	whereas snow depth and SWE in Norway have been reduced at low elevation, at higher elevation increases in these variables have been observed. Cf the following studies: Skaugen, Bache Stranden and Saloranta, 2012; Trends in snow water equivalent in Norway (1931–2009); Hydrology Research Aug 2012, 43 (4) 489-499; DOI: 10.2166/nh.2012.109 AND Dyrrdal, Saloranta, Skaugen, Bache Stranden 2013; Changes in snow depth in Norway during the period 1961–2010; Hydrology Research Feb 2013, 44 (1) 169-179; DOI: 10.2166/nh.2012.064 [Thomas Vikhamar Schuler, Norway]	Taken into account - further material used for the assessment for Scandinavia
17520	2	16	20	16	21	Why so complicated. The change of the indicators themselves cannot really be uncertain at all – I guess what you are trying to say is that the change in snow characteristics has this degree of uncertainty. [Wolfgang Cramer, France]	Accepted - text shortened and revised for better clarity.
18808	2	16	20	16	20	maybe 'virtually certain'? [Petra Seibert, Austria]	Taken into account
24976	2	16	20	16	26	Do not mix uncertainty terms, use likelihood or confidence [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account - text revised for better use of confidence language.
19464	2	16	21	16	21	Change "been reduced" to "declined" to read: "have declined since the beginning…" [Michelle A. North, South Africa]	Accepted
15500	2	16	22	16	22	Along this chapter, the XX century is referenced in different ways, for instance: "20st" (?), "20th" and "20th" (with "th" as superscript). In order to keep consistency along this chapter (and in the whole Report), I suggest to check and unify them, whenever is correct or possible. [Hernan Sala, Argentina]	Editorial – copyedit to be completed prior to publication
20482	2	16	22	16	22	Check whether you mean 20th or 21st century, please. [Michelle A. North, South Africa]	Taken into account - text revised to address this typo.
23654	2	16	22	16	22	"20st": is this 20th century or 21st century? Please clarify and revise [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account - text revised to address this typo.
17522	2	16	23	16	23	If not before then here at the latest, it becomes clear that “insufficiently long in-situ observationb” makes sense only when some criteria for “sufficiently long” have been given. Currently, chapter 1 has only a very weak paragraph on this underlying problem of detection and attribution – the statement here, and actually many others, demonstrate clearly that significant work on these terms is needed for the report. [Wolfgang Cramer, France]	Accepted - text shortened and revised for better clarity.
19466	2	16	24	16	24	Please move "currently" before "provides" to read: "which currently provides insufficient…" [Michelle A. North, South Africa]	Accepted - text revised for better clarity.
11870	2	16	30	16	33	It might be good to introduce a sentence on the limited relevance of snow cover in the tropical Andes. In the tropical Andes, there is no relevant seasonal snow cover, which means the situation is not comparable to higher or lower latitudes. [Dirk Hoffmann, Germany]	Taken into account - text revised to better reflect the situation of snow cover in the tropical Andes
19468	2	16	30	16	30	Move "specifically" to either before "describes", or to the end of the sentence. [Michelle A. North, South Africa]	Accepted - text revised for better clarity.
21372	2	16	30	16	33	For snow conditions in the HKH see the HIMAP Cryosphere chapter. Needs to be expanded and referenced here. [Philippus Wester, Nepal]	Taken into account - HIMAP relevant chapters considered for the assessment.
1296	2	16	39	16	39	Change "Snow projections…" to "Projected changes in snow cover…" [Ross Brown, Canada]	Accepted
1982	2	16	45	16	45	Delete "areas". Same at P16 L48. [J. Graham Cogley, Canada]	Accepted

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
17524	2	16	45	16	45	Here and in many other places, authors need to recognize that “downscaled CMIP3 GCM projections” is jargon which, first, has insufficient specifics to be useful, and, second, is not helpful at all for policy makers. Instead of this sloppy language, the expected trends should be described in clear terms, and the origin of the statement be made clear alongside the uncertainty assessment. [Wolfgang Cramer, France]	Accepted - text revised for better clarity.
12448	2	16	51	16	51	I'm not sure if there has been a publication date deadline for reference sin this report. If not, the recent work of di Luca et al., 2018 (Clim Dyn, DOI 10.1007/s00382-017-3946-9) could be cited here as well. They assess the future evolution of Australian snowpack based on RCM output. [Sven Kotlarski, Switzerland]	Taken into account for SOD
10676	2	16	53	16	53	Caucasus is totally missed in the assesment of European Mountains. Please add [Oxana Lipka, Russian Federation]	Taken into account - literature is scarce for past and future trends of snow cover in Caucasus.
12450	2	16	54	16	54	"downwards trend of seasonal snow" [Sven Kotlarski, Switzerland]	Editorial – copyedit to be completed prior to publication
19470	2	16	54	16	54	Which is correct, the fact that all models indicate the trends, or that the models generally indicate the trends? Please choose which is suitable and delete the other. [Michelle A. North, South Africa]	Taken into account - text revised for better clarity.
22798	2	16	54	16	54	The sentence on this line is wrongly worded, does not conway meaning, some words missing? [Lena Rubensdotter, Norway]	Taken into account - text revised for better clarity.
12452	2	16	56	16	56	This sentence sound rather odd: The first part says that GCMs are used, the bracket says that RCMs are used. Needs to be formulated in a clearer way. Also, the bracket shoudl be changed to "(using EURO-CORDEX RCMs)". [Sven Kotlarski, Switzerland]	Taken into account - text revised for better clarity.
350	2	17	0	17		When mentioned the likely dissapeareance of some glaciers in impacts it might be mentioned that we lose environmental archives that will not be possible to be studied in the future [López Moreno Juan Ignacio, Spain]	Taken into account - text was revised and this sentence was removed.
19472	2	17	3	17	3	Delete "the" and replace with "an" to read: "For example, at an altitude of…" [Michelle A. North, South Africa]	Taken into account - text revised for better clarity.
3488	2	17	8	17	9	This sentence could benefit from some references. [Deborah Verfaillie, Spain]	Taken into account - text revised for better clarity and better referencing.
3756	2	17	9	17	10	sentence not clear, please rephrase [Carlo Carmagnola, France]	Taken into account - text revised for better clarity and better referencing.
22902	2	17	9	10	17	What do the authors mean by "in high resolution" in this context? [Romy Schlogel, UK]	Taken into account - text revised for better clarity.
1984	2	17	10	17	10	What is a "high resolution location"? [J. Graham Cogley, Canada]	Taken into account - text revised for better clarity.
3280	2	17	12	17	23	Perhaps may be useful to note here that those predicted changes in altitude may be also driven by changes in the SST of the closest marine areas where convection processes occur. In my experience, examples of this occured in the coastal mountains from NW Iberia during the Mid and Late Holocene: e.g. Muñoz Sobrino et al. (2005) Boreas 34(3): 381-400; Muñoz Sobrino et al. (2009) Plant Ecology 203, 317–340, and may be also currently affecting some moist-dependant ecosystems worldwide at mid-latitudes (e.g. Reimer et al. (2015) PLos One 10(4): e0125177. [Castor Muñoz Sobrino, Spain]	Taken into account - note however that the chapter builds on AR5 assessment, where extensive assessment of paleoclimate evidence was assessed. Due to space limitation and the joint IPCC WG1/WG2 nature of this report, emphasis is placed on past decades and the 21st century.
18810	2	17	15	17	15	maybe 'virtually certain'?, also say 'snow cover' [Petra Seibert, Austria]	Taken into account

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
17098	2	17	17	15	15	undergo significant reduction': This might be correct by the physical response, but contrasting observations exist. For example, temperature in the Alps has increased by about 2 degrees over ths past 150 years but there is no trend in precipitation (at lower elevations) or winter mass balance over the past 50 years (e.g. Vernagtferner). Things might not be that simple and I would suggest to confront the theoretical model output with what is observed. [Frank Paul, Switzerland]	Taken into account - in other parts of the report. Indeed, this review comment points to past changes of precipitation, or glacier (winter) mass balance, which are outside the scope of the statements made here on future changes of snow cover
17100	2	17	17	28	29	"outside the Greenland and Antarctic ice sheets": In this condensed form the statement might be misleading (i.e. the two ice sheets are included in the total for glaciers). I suggest writing: " roughly 30% of the total global glacier area (that does not include the two ice sheets of Greenland and Antarctica)." [Frank Paul, Switzerland]	Accepted - text revised
17102	2	17	17	42	42	Maybe use the in the meantime widely used term 'High Mountain Asia' instead of 'High Asian Mountains' (cf. P25, L52)? [Frank Paul, Switzerland]	Accepted - text revised
18812	2	17	19	17	23	include discussion of role of inversions [Petra Seibert, Austria]	Taken into account - text revised within size contraints.
1986	2	17	20	17	20	"is mostly due". [J. Graham Cogley, Canada]	Editorial – copyedit to be completed prior to publication
22800	2	17	23	17	23	Here should perhaps also be mentioned co-variance and dependence with dominating wind direction for snow depth and also microstructure of snow pack. [Lena Rubensdotter, Norway]	Taken into account - text revised within size contraints.
11096	2	17	25			It would be significant regarding analyzing the response of mountain glaciers and their different kinds if this section assessment what is going on the icefields around the world. In the way it is presented here, it is not possible to detect or assess that there are large icefields in different regions outside Antartica and Greenland are shrinking faster than mountain and valley glacier for positive feedbacks between ice thinning and increase of calving rate (e.g., Arendt et al., 2002; Berthier et al., 2010; Foresta et al., 2018; Schaefer et al., 2015; Willis et al., 2012). Arendt, A. A., Echelmeyer, K. A., Harrison, W. D., Lingle, C. S. and Valentine, V. B.: Rapid wastage of Alaska glaciers and their contribution to rising sea level, Science, 297(5580), 382–386, 2002. Berthier, E., Schiefer, E., Clarke, G. K. C., Menounos, B. and Rémy, F.: Contribution of Alaskan glaciers to sea-level rise derived from satellite imagery, Nat. Geosci., 3(2), 92–95, doi:10.1038/ngeo737, 2010. Foresta, L., Gourmelen, N., Weissgerber, F., Nienow, P., Williams, J. J., Shepherd, A., Drinkwater, M. R. and Plummer, S.: Heterogeneous and rapid ice loss over the Patagonian Ice Fields revealed by CryoSat-2 swath radar altimetry, Remote Sens. Environ., 211, 441–455, doi:10.1016/j.rse.2018.03.041, 2018. Schaefer, M., Machguth, H., Falvey, M., Casassa, G. and Rignot, E.: Quantifying mass balance processes on the Southern Patagonia Icefield, The Cryosphere, 9(1), 25–35, doi:10.5194/tc-9-25-2015, 2015. Willis, M. J., Melkonian, A. K., Pritchard, M. E. and Rivera, A.: Ice loss from the Southern Patagonian Ice Field, South America, between 2000 and 2012, Geophys. Res. Lett., 39(L17501), 1–6, doi:10.1029/2012GL053136, 2012. [Lucas Ruiz, Argentina]	Taken into account - text revised. Please note that reaction of the glaciers in polar regions (outside ice sheets) is covered in Ch 3 and partly in Ch4 whith some information about calving. The importance of the ice fields in Southern Andes and Alaska is well illustrated by figure 2.3.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
16822	2	17	25	17	37	Following work provides best overview of glacier in Hindu Kush Himalaya region. It should not be missed. Bajracharya, S. R., Maharjan, S. B., Shrestha, F., Guo, W., Liu, S., Immerzeel, W., et al. (2015). The glaciers of the Hindu Kush Himalayas: current status and observed changes from the 1980s to 2010. International Journal of Water Resources Development, 1-13. some important points that chan be used from this work are: Number of glaciers 54,252 Total area of glaciers 60,054 km2 Estimated ice reserves of 6127 km3 Variable rate of change in glacier area [Arun Shrestha, Nepal]	Noted - this work was included into evaluatation of existing literature on glacier changes
21058	2	17	27		37	It makes it seem like all glaciers are created equal,in terms of size, change and downstream implications of their loss. Somehow the variability needs to be communicated. [Thomas Wagner, USA]	Rejected - the report is focused on global and regional glacier mass changes. The regional differences are discussed in the text. The discussion of the behaviour of individual glaciers is out of the scope of this report.
3934	2	17	29	17	30	Please check the figure in the following line, there are mountains higher than 8000 meters (Himalayas). ..'These glaciers span an altitude range from sea-level to >7000 m a.s.l. and occupy diverse climatic regions'. [Anil Mishra, France]	Accepted - 7000 replaced by 8000 m
13420	2	17	34	17	37	Actual examples of these effects should be provided. [Debra Roberts and Durban Team, South Africa]	Accepted - text slightly revised; but actual examples of glacier change impacts are discussed further in chapter
6816	2	17	35	17	35	rivers [APECS Group Review, Germany]	Accepted - typo corrected
18326	2	17	35	17	35	"rives" should read "rivers" [Carmen Burghelea, Romania]	Accepted - typo corrected
198	2	17	39	19	16	Glaciers underwent significant changes also in pre-industrial times which needs to be acknowledged here. This represents important context information that should not be concealed to the readers. See e.g. Solomina et al. 2016 (doi: 10.1016/j.quascirev.2016.04.008) or Solomina et al. 2015 (doi: 10.1016/j.quascirev.2014.11.018). [Sebastian Luening, Portugal]	Rejected - paleoglaciation is outside the scope of the chapter 2. This chapter is focused on recent and projected changes of the cryospheric components and intended to provide a wide-ranging assessment of impacts and risks associated with cryosphere changes in high mountain areas. Due to lack of space we follow the accepted outline of the report. The information about past climate and glacier changes in preindustrial time has been covereed in previous IPCC reports and new literature will be assessed in AR6 report. The suggested reference about the glacier changes in Holocene is in full support of the attribution of the recent glacier recession to antropogenic climate change. It also shows that glaciers in most of the mountain regions of the Northern Hemisphere were smaller in erly/mid Holocene and attributed past glacier variations to natural climate forcings.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
6300	2	17	39	18	16	Section 2.2.3.1 could do a better job of citing the literature and representing observed glacier changes across the world. Two examples from western Canada and Alaska, just off the top of my head, are Schiefer et al., Recent volume loss of British Columbia glaciers, Canada, Geophysical Research Letters, 34, doi: 0.1029/2007GL030780; and Arendt et al., Changes of glaciers and climate in northwestern North America during the late twentieth century, Journal of Climate, 22, 4117-4134. [Sean Fleming, USA]	Taken into account - regional changes included from new global-scale publications. Citing all regional/local glacier change papers is not possible due to space limitations
21060	2	17	39	19	16	Not mentioning GRACE data? Or GLOVIS? [Thomas Wagner, USA]	Taken into account - GRACE data from literature included in text/figure
534	2	17	41	17	42	it could be useful to add one or two references in order to show the potential of satellites method, for instance: Berthier,E., C. Vincent, E. Magnússon, Á. Þ. Gunnlaugsson, P. Pitte, E. Le Meur, M. Masiokas, L. Ruiz, F. Pálsson, J.M.C. Belart, and P. Wagnon. 2014 Glacier topography and elevation changes from Pléiades sub-meter stereo images. The Cryosphere. 8, 2275–2291, doi:10.5194/tc-8-2275-2014. [Christian Vincent, France]	Rejected - due to space constraints
542	2	17	41	18	5	in Introduction, it is written that glaciers respond to imbalances in their mass budget by adjusting their volume, size and shape...It means that the glacier-wide mass balance is affected by the dynamic response of the glaciers and is not directly related to the climate conditions. I believe that the best indicator of climate change is the point mass balance . Consequently, iIt seems to me that the section 2,2,3,1 should point out the studies related to point mass change changes in different areas of the world for instance in the Alps: Huss M. , L. Dhulst, A. Bauder (2015), New long-term mass-balance series for the Swiss Alps . J. of Glaciol., Vol. 61, No. 227, 2015 doi: 10.3189/2015JoG15J015 which show the longest series of moint winter amd summer since 1920 or Vincent C., A. Fischer, C. Mayer, A. Bauder, S. P. Galos, M. Funk, E. Thibert, D. Six, L. Braun, M. Huss. 2017. Common climatic signal from glaciers in the European Alps over the last 50 years. Geophys. Res. Lett., 44, doi:10.1002/ 2016GL072094.,which reveals remarkable regional consistencies over the European Alps and indicates a clear and regionally consistent acceleration of mass loss over recent decades over the entire European Alps. This acceleration obtained directly from point mass balance is more pronounced than the mass loss obtained from glacier-wide mass balance because a part of glacier-wide mass balance is due to geometric adjustment [Christian Vincent, France]	Rejected - due to space constraints. We agree with the concept but it is a difficult one to explain.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
1314	2	17	41	17	49	Not sure how much room the authors have but I think they should mention that the Karakoram/Pamir/Kunlun anomaly can be tracked back to the 1970s. The most comprehensive paper is probably: Zhou, Y., Li, Z., Li, J., Zhao, R. and Ding, X.: Glacier mass balance in the Qinghai–Tibet Plateau and its surroundings from the mid-1970s to 2000 based on Hexagon KH-9 and SRTM DEMs, Remote Sensing of Environment, 210, 96–112, doi:10.1016/j.rse.2018.03.020, 2018. Another paper is Bolch, T., Pieczonka, T., Mukherjee, K. and Shea, J.: Brief communication: Glaciers in the Hunza catchment (Karakoram) have been nearly in balance since the 1970s, The Cryosphere, 11(1), 531–539, doi:10.5194/tc-11-531-2017, 2017. [Etienne Berthier, France]	Taken into account - text revised.
15552	2	17	41	18	12	Discussion of glacial decline underscores limits of available time series; ILK becomes reinforcing. High confidence measure is important. [Melinda Kimble, USA]	Rejected - All subsections here start with describing the observed changes, then projections and then the attribution
16470	2	17	41	17	41	The section should start with an important detection and attribution analysis of glacier mass loss, with text like "Anthropogenic temperature increases caused 64 ± 24% of global glacier mass loss from 1991 to 2010, with significant contributions to glacier loss in parts of Asia, Europe, New Zealand, North America, and South America (Marzeion et al. 2014)." Marzeion, B., J.G. Cogley, K. Richter, and D. Parkes. 2014. Attribution of global glacier mass loss to anthropogenic and natural causes. Science 345: 919-921. [Patrick Gonzalez, USA]	Noted
200	2	17	47	17	49	Authors write: "For Columbia Glacier, Alaska, the minimum extent is unprecedented in the last 900 years (Carlson et al., 2017)". This is a valid statement, yet, the description is incomplete. It implies that glaciers have experienced a similar phase of retreat and shrinkage some 900-1000 years ago. This is the well-known warm phase of the Medieval Climate Anomaly (MCA). There are many papers that have documented glacier retreat in Alaska and elsewhere in the world during the MCA. Why is the reader not informed about this here? The obvious question that needs to be briefly touched upon is: What has climatically driven the MCA glacier retreat phase? Without this knowledge and discussion it is impossible to carry out a balanced attribution study of modern glacier retreat, because it cannot be excluded that the mechanism that led to MCA glacier shortening might still play a significant role today. By not discussing "the elephant in the room" there will be lots of questions about the concept and objectives of this chapter and in fact the report. [Sebastian Luening, Portugal]	Taken into account - text revised. Columbia glacier example has been removed. Section focuses on recent changes
12564	2	17	47			Columbia glacier is a tidewater glacier, the retreat of which is governed by other processes than the surface mass balance. Is it a good example here? (other than that it is probably the most spectacular glacier retreat). [Thomas Vikhamar Schuler, Norway]	Taken into account - text revised. Columbia glacier example has been removed.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
21426	2	17	51	17	51	The main argument in favor of using single-glacier records for the regional assessment of mass loss of large glacier systems is the good correlation of the long-term variations of the specific mass-balance of the glaciers scattered hundreds and thousands of kilometers apart (Meier and Dyurgerov, 2002; Meier et al. 2003; Dyurgerov and Meyer 2005; Dyurgerov 2010). However, careful consideration of the mass-balance records suggests that the cumulative mass-balance curves have much weaker correlation (Fountain et al. 2009). [Oxana Savoskul, Sri Lanka]	Accepted - new regional-scale mass balance assessment included that are based on newly compiled large number of glacier observations
13422	2	17	56	18	1	Do you mean 'simplify'? [Debra Roberts and Durban Team, South Africa]	Noted - comment unclear to authors
6818	2	18	10	18	11	It's better to adopt same subregion names as those shown in Figures 2.1 and 2.4. E.g., "High Mountain Asia" (Table 2.1) can change to "Central Asia" (Figures 2.1 and 2.4), or vice versa. [APECS Group Review, Germany]	Accepted - region names are homogenized across figures and text
16508	2	18	10	18	10	The criterium for the ordering of the regions in Table 2.1 is unclear. I propose sorting them according to Area. [Ken Takahashi, Peru]	Rejected - table 2.1 was removed
17104	2	18	18	2	2	were generally short lived': Sseveral studies (using DEMs from Hexagon) indicate that the balanced mass budgets for the Karakoram/Pamir region persist at least since the 1970s (e.g. Bolch et al. 2017 => doi: 10.5194/tc-11-531-2017). Also glacier surges have been observed in this region since the 19th century (e.g. Copland et al. 2011 => doi: 10.1657/1938-4246-43.4.503, Bhambri et al. 2017 => doi:10.1038/s41598-017-15473-8). So I would not write that this anomaly is 'short-lived'. [Frank Paul, Switzerland]	Accepted - text revised.
17106	2	18	18	8	8	Table 2.1: I would add a filed 'Source' (e.g. geodetic, altimetry, GRACE, extrapolated field data) for the mass change data [Frank Paul, Switzerland]	Rejected - table 2.1 was removed
6822	2	19	0			Figure 2.4 lacks Antarctica [APECS Group Review, Germany]	Rejected - this chapter is only about high mountain regions outside the polar regions. Polar regions are dealt with in chapter 3.
16542	2	19	1	19	5	adding the legend and/or explanations in the captions regarding the colors and symbols [Luzi Bernhard, Switzerland]	Taken into account - figure was redrawn and updated
12734	2	19	3			Explain what blue line, black bar, red cross, green and orange line represents. [Jan-Christoph Otto, Germany]	Taken into account - figure was redrawn and updated
18332	2	19	3	19	5	Fig. 2.3 caption needs to be explanatory. The legend is missing. [Carmen Burghelea, Romania]	Taken into account - figure was redrawn and updated
18334	2	19	3	19	3	"budgets of 11"? Or "budgets of 19" as shown in the Figure 2.3 [Carmen Burghelea, Romania]	Taken into account - figure was redrawn and updated
22802	2	19	3	19	5	This figure is meaningless for any reader without adequate legend for all features of the different graphs (but I assume this will come) [Lena Rubensdotter, Norway]	Taken into account - figure was redrawn and updated

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
1316	2	19	8	19	11	The periods over which the glacier velocity trends are observed could be clearer and I think the long term velocity measurements in the European Alps could be emphasized a bit more to show that the recent (since the ~1990s) decline in glacier velocity followed a period of acceleration (when mass balances were positive) Span, N. and Kuhn, M.: Simulating annual glacier flow with a linear reservoir model, Journal of Geophysical Research-Atmospheres, 108(D10), 2003. and Vincent, C., Soruco, A., Six, D. and Le Meur, E.: Glacier thickening and decay analysis from 50 years of glaciological observations performed on Glacier d'Argentière, Mont Blanc area, France, Annals of Glaciology, 50(50), 73–79, doi:10.3189/172756409787769500, 2009. [Etienne Berthier, France]	Rejected - outside the scope of the chapter. SROCC report is an assessment based on literature published after AR5 report. Another issue is that these papers focused on individual glaciers and certain morphological patterns which explain mb, thickness and velocity changes. This is of course relevant but too specific given the word limitations for the whole section. Due to space limits the whole section on glacier velocity changes was removed. The report focus primaraly on policy relevant issues.
11098	2	19	8	19	11	I do not agree about the confidence assessment (medium confidence) that glaciers in Patagonian have decrease, especially for some of them where has been measured the highest retreating rate around the world (Rivera et al., 2012). Opposite to Alaska or Central Asia most of Patagonian glaciers and especially those from the Southern Patagonian Icefield (SPI) are debris free (De Angelis et al., 2007). Although, Heid and Kääb (2012) indicate a decrease on the velocity of 10 outlet glaciers of the SPI for the period 1986-1987 to 2001-2002, their data set only cover a small part (less than ten points for each glacier; table 5 in Heid and Kääb (2012)) of 10 outlet glaciers (SPIhave more than 43 outlet glaciers; Aniya et al., 1996). More detail and exhaustive evidence exist that show the picture is more complex (Mouginot and Rignot, 2015; Sakakibara et al., 2013; Sakakibara and Sugiyama, 2014), with some glaciers showings fluctuation, others decrease and other increasing their surface velocity along the last 20-30 years. Especially does who have increase their surface velocity (e.g.HPS12, Upsala or Jorge Montt) shown extraordinary large retreats which were not directly controlled by a climate or related to a warming trend but instead driven by glacier dynamics. As Sakakibara and Sugiyama (2014) state, such dynamically controlled rapid recession of several calving glaciers plays a key role in the recent volume decrease of the SPI. Due to the important of these glaciers to the volume change of the Icefield, Willis et al.(2012) state that the volume change of Upsala alone represent de 15% of the total volume lost by SPI between 2000 and 2012. I think this assessment of confidence must be reviewed and more clear assessment about the importance of the dynamic response of calving glacier in Patagonia and anywhere else must be done. Aniya, M., Sato, H., Naruse, R., Skvarca, P. and Casassa, G.: The use of satellite and airborne imagery to inventory outlet glaciers of the Southern Patagonia Icefield, South America, Photogramm. Eng. Remote Sens., 62(12), 1361–1369, 1996. De Angelis, H., Rau, F. and Skvarca, P.: Snow zonation on Hielo Patagonico Sur, Southern Patagonia, derived from Landsat 5 TM data, Glob. Planet. Change, 59, 149–158, 2007. Mouginot, J. and Rignot, E.: Ice motion of the Patagonian Icefields of South America: 1984–2014, Geophys. Res. Lett., 42(5), 2014GL062661, doi:10.1002/2014GL062661, 2015. Rivera, A., Corripio, J., Bravo, C. and Cisternas, S.: Glaciar Jorge Montt (Chilean Patagonia) dynamics derived from photos obtained by fixed cameras and satellite image feature tracking, Ann. Glaciol., 53(60), 147–155, doi:10.3189/2012AoG60A152, 2012. Sakakibara, D. and Sugiyama, S.: Ice-front variations and speed changes of calving	Accepted - text revised.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
12736	2	19	11			"sub-surface temperature" At glacier bed? [Jan-Christoph Otto, Germany]	Taking into account - sub-surface means below the surface (not necessarily at the bed). Changed to englacial to avoid confusion.
536	2	19	15	19	16	About the impact about the unstability of hanging glaciers in the future, it could be useful to add a reference, for instance: Gilbert, A., C. Vincent, O. Gagliardini, J. Krug and E. Berthier (2015) Assessment of thermal change in cold avalanching glaciers in relation to climate warming, Geophys. Res. Lett., 42, doi:10.1002/ 2015GL064838 or Faillettaz, J., Funk, M., and Vincent, C. (2015). Avalanching glacier instabilities: Review on processes and early warning perspectives, Reviews of Geophysics, doi 10.1002/2014RG000466 [Christian Vincent, France]	Rejected - we refer to the section where this topic is dealt with and which has relevant references.
12738	2	19	15			"Change in temperature regime" ADD: Of the glacier and the sub-surface [Jan-Christoph Otto, Germany]	Taken into account - Changed to glacier temperatures
3828	2	19	16	19	16	Cite here on line 16 the paper: Faillettaz, J., M. Funk and C. Vincent, 2015: Avalanching glacier instabilities: Review on processes and early warning perspectives. Reviews of Geophysics, 53 (2), 203-224, doi:10.1002/2014rg000466. [Emmanuel Thibert, France]	Rejected - we refer to the section where this topic is dealt with and which has relevant references.
12852	2	19	18	20	22	The section 2.2.3.2 about future scenario of glacier changes needs to state about the major uncertainty in the future projections related to the very high uncertainty related to glacier volume and glacier thickness distribution. This uncertainty is mentioned in the recent review papers by Beniston et al. (2018) and Vuillet et al. (2018) (both already quoted in the references). This uncertainty is most of the time not fully presented/discussed in the papers presenting global scale simulations of glacier changes in the future. This is a pity has the consequences in terms of impacts related to glacier shrinkage are serious. Therefore, from my point of view, it is mandatory to mention in such a special report that work has to be done (is being done) to better quantify the glaciers volume and ice thickness distribution. [Antoine Rabatel, France]	Rejected - detailed analysis of uncertainties is beyond the scope of this report. Ice thickness is only one of many uncertainties in these projections which are discussed in the original papers
6820	2	19	21	19	21	Maybe "changing climate conditions" would descrbe better the changing scenario [APECS Group Review, Germany]	Rejected - here we refer to *current* climate no matter if it is currently changing or not.
16472	2	19	22	19	23	Edit this to make it conditional on the scenarios, something like "Model simulations indicate that, under RCP[insert proper RCP identifiers here], mountain glaciers are very likely to lose substantial mass by the end of the century." [Patrick Gonzalez, USA]	Accepted - text revised
11100	2	20	10	20	11	The sentence " A loss of 36±7% was estimated for a global temperature rise of 1.5°C" is un-connect with the preceding or later sentence and it is not clear if this number is for the High Mountain of Asia or another region. [Lucas Ruiz, Argentina]	Taken into account - text revised (sentence was removed)

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
6302	2	20	11	20	14	The fantastic work of Clarke et al., 2015 is summarized in this passage. That's a great study, and I'm glad it's cited and summarized here. Unfortunately, it did apparently make one mistake, which is repeated here on lines 13-14: that peak runoff from western Canada's glaciers (actually, the Clarke et al. paper's runoff results focused on the Columbia Basin) will occur in 2020-2040. In fact, there is a signficant body of literature, based on both historical datasets and climate model projections, that indicates that glacial river flows in the Canadian headwaters of the Columbia Basin have been in the declining stage for decades and will continue to decline. While it is a magnificent piece of glaciological research, the authors of the Clarke et al. (2015) study were not strongly familiar with, and it would appear they did not check their river runoff projections against, outcomes in the water resource science and engineering literature. The solution is easy - the phrase, "corresponding to peak input of meltwater to rivers", should be deleted. [Sean Fleming, USA]	Accepted - text revised.
17108	2	20	20	18	19	very small mountain glaciers': I suggest writing 'small glaciers' instead. Most of these might be cirques rather than mountain glaciers and 0.5 km2 is small but maybe not very small. [Frank Paul, Switzerland]	Accepted - text revised.
12740	2	20	21			"shading or avalanching" and debris cover [Jan-Christoph Otto, Germany]	Rejected - sentence was deleted
17334	2	20	24	20	29	Use of this kind of graphic, showing decrease in mass balance rather than contribution to SLR, is excellent and far more easily grasped by policy makers -- continue. [Pamela Pearson, USA]	Noted
17336	2	20	24	20	29	These graphs are based on RCP4.5. At some point in this Chapter however, it is highly important to show the split in projections for these regional glacier systems based on different emissions scenarios. And, it migt be better to show this split here rather than simply using RCP4.5 as a proxy, as for some of these glacier systems RCP2.6 has the potential for significantly more preservation of mass, per Marzeion 2012 and 2018 among other publications. [Pamela Pearson, USA]	Taken into account - figure redrawn with RCP2.6 and 8.5
22904	2	20	25	25	20	The reference models and their differences need to be defined in a legend. [Romy Schlogel, UK]	Taken into account - figure redrawn with RCP2.6 and 8.5
4014	2	20	26	20	26	Figure 2.4: I assume these are fractional volume changes relative to present-day? Say in the caption. [Sarah Doherty, USA]	Taken into account - figure redrawn and updated
15528	2	20	26	20	30	What is being plotted in Figure 2.4? Relative change? All y-axis values start at 1. [Daniel Feldman, USA]	Taken into account - figure redrawn and updated
16494	2	20	26	20	28	Please define color scheme of four thick lines in caption. [Baylor Fox-Kemper, USA]	Taken into account - figure redrawn and updated
18330	2	20	28	20	29	what do the different colors of the thick lines in the Fig. 2.4 represent? [Carmen Burghelea, Romania]	Taken into account - figure redrawn and updated
11102	2	21	2	21	2	It is essential to discuss the calving rate and the connection between thinning and retreat/acceleration for calving glaciers. [Lucas Ruiz, Argentina]	Taken into account - text revised. Calving processes are also covered in Ch.3
1410	2	21	4	21	30	Quite some overlap with sections from chapter 3 (3.2.2.4) and chapter 4 (4.2.2.6.1): make sure this is consistent and consider ommiting one of these and refer to similar sections in other chapters [Harry Zekollari, Switzerland]	Taken into account - overlap with other chapters has been removed

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
202	2	21	5	21	6	Authors suggest "Statistical analyses confirm that natural climate variability can be excluded as cause (Roe et al., 2017)." But is this really so? The standard strategy to distinguish between natural and anthropogenic drivers of glacier retreat is to 1) study the pre-industrial natural glacier variability of the past millennia and identify climatic drivers. Once these drivers are identified, they have to be considered as candidates also for recent glacier retreat, in addition to anthropogenic drivers which have now been added in the past 150 years. Notably, Roe et al. 2017 have not followed this workflow because their analysis only starts in the Little Ice Age at 1600 AD. They should have included prominent glacier retreat phases associated with the Medieval Climate Anomaly, Roman Warm Period, Holocene Thermal Maximum etc. Their attribution analysis has to be therefore considered as incomplete and the quantitative contribution of natural climate variability to recent glacier changes can be hardly constrained. More research is needed which the IPCC Special Report needs to acknowledge. [Sebastian Luening, Portugal]	Accepted - sentence deleted
6304	2	21	5	21	6	This passage asserts that "statistical analyses confirm that natural climate variabilty can be excluded as cause (Roe et al., 2017)" of global mountain glacier recession over the last 100 years. This assertion may well be true, but the work of Roe et al. (2017) didn't appear to prove it - it seems that Roe et al. (2017) only demonstrated that long-term shifts in glacier terminus position were due to climate, rather than short-term meteorological forcing transformed into low-frequency terminus position change by slow glacial dynamics. My understanding is that their method could not differentiate between global anthropogenic climate change versus natural long-term climate changes, most notably for northern hemisphere glaciers, recession following the end of the Little Ice Age. Also, there may be a number of other studies that should be cited here either in addition to or instead of Roe et al., (2017) - see article at http://glacierhub.org/2017/02/21/research-confirms-significance-climate-change-glacier-retreat/. So, overall, it seems the passage would benefit from some more precise language and more representative literature citations. [Sean Fleming, USA]	Accepted - sentence deleted
17526	2	21	5			“warming” or “climate change”? This statement sounds as if any anthropogenic changes in snow fall were not a significant contribution to mountain glacier recession? I have no knowledge of this, but I would want to know whether “warming” is used as a synonym to “climate change” or really as “warming”. [Wolfgang Cramer, France]	Rejected - climate change can refer to a multitude of climate variables, here we mean atmospheric warming
4016	2	21	6	21	8	This sentence needs rewording. Global modeling can't "find" things; it can be used to find things. [Sarah Doherty, USA]	Taken into account - text revised.
1412	2	21	8	21	8	The reference here should not be the Marzeion et al. (2015) study, but rather Marzeion et al. (2014, Science, doi: 10.1126/science.1254702) [Harry Zekollari, Switzerland]	Accepted - text revised

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
17528	2	21	12	21	13	I find it odd to say that mass balance was considered to be influenced by ENSO. Clearly, the glacier knows nothing about ENSO but is subjected to, what, changing snowfall (?), warming (?) or other meteorological quantities. I think it would be good to make this clear. And once one speaks about this, it would be great to learn in which way high or low ENSO affect those glaciers. [Wolfgang Cramer, France]	Accepted - sentence deleted
538	2	21	13	21	14	as it is written, it seems that the cause of european alpine glaciers decrease is different from the "global atmospheric warming" mentioned at the line 5. In the contrary, the increasing long-wave irradiance and latent heat due to enhanced humidity could be related to this global warming. [Christian Vincent, France]	Rejected - we say 'exacerbated' and don't claim that other causes don't play a role
3830	2	21	13	21	15	The sentence “Glacier mass loss over the last seven decades in the European Alps was exacerbated by increasing long-wave irradiance and latent heat due to enhanced humidity (Thibert et al., 2018).” would better fit in the first paragraph of this section as these forcings are directly related to global warming. [Emmanuel Thibert, France]	Accepted - sentence moved
12854	2	21	13	21	13	For such a statement "relationship between ENSO and tropical glacier surface mass balance", please refer to the original works and remove currently quoted reference (Veettil et al., 2017). Such references can be: Francou, B., Ramirez, E., Caceres, B., and Mendoza, J. (2000). Glacier evolution in the tropical Andes during the last decades of the 20th century: Chacaltaya, Bolivia and Antizana, Ecuador, Ambio, 29, 416–422. Vuille, M., Francou, B., Wagnon, P., Juen, I., Kaser, G., Mark, B.G., and Bradley, R.S. (2008). Climate change and tropical Andean glaciers: Past, present and future, Earth-Sci. Rev., 89, 79–96, doi:10.1016/j.earscirev.2008.04.002 Rabatel, A., B. Francou, A. Soruco, J. Gomez, B. Caceres, J.L. Ceballos, R. Basantes, M. Vuille, J.E. Sicart, C. Huggel, M. Scheel, Y. Lejeune, Y. Arnaud, M. Collet, T. Condom, G. Consoli, V. Favier, V. Jomelli, R. Galarraga, P. Ginot, L. Maisincho, M. Ménégoz, J. Mendoza, E. Ramirez, P. Ribstein, W. Suarez, M. Villacis, P. Wagnon. 2013. Current state of glaciers in the tropical Andes: a multi-century perspective on glacier evolution and climate change. The Cryosphere, 7, 81-102. doi: 10.5194/tc-7-81-2013 [Antoine Rabatel, France]	Accepted - however sentence was removed due to space limits.
1414	2	21	15	21	17	Reference to support this statement? [Harry Zekollari, Switzerland]	Accepted - reference added
10678	2	21	15	21	15	Central Asia (capital) [Oxana Lipka, Russian Federation]	Rejected - term removed entirely
19474	2	21	15	21	17	Please cite relevent literature to sustantiate this statement. [Michelle A. North, South Africa]	Rejected - term removed entirely
22906	2	21	15	15	21	Remove "in Central Asia" [Romy Schlogel, UK]	Accepted
6824	2	21	17	21	17	Key references are missing regardign chagnes in the Tien Shan. [APECS Group Review, Germany]	Accepted - reference added
160	2	21	19	21	30	Glacier advances have also been obserevd in response to volcanic activity (Barr et al., 2018 - already cited in chpter), and due to the supraglacial deposition of minin waste (Evans et al., 2016 - already cited in chpter). [Iestyn Barr, UK]	Taken into account - text revised.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
1408	2	21	19	21	30	For the Karakoram anomaly: there are also some recent studies suggesting a role of irrigation on climate, which in turn affects the glaciers: check and potentially include the study by Kok et al. (2018, GRL, doi: 10.1002/2017GL076158) [Harry Zekollari, Switzerland]	Accepted - reference added
6472	2	21	19	21	30	There have been two recent studies which have made relevant discoveries about the potential drivers of the karakoram anomaly and they could be cited here: Forsythe, N., Fowler, H. J., Li, X.-F., Blenkinsop, S., & Pritchard, D. (2017). Karakoram temperature and glacial melt driven by regional atmospheric circulation variability. Nature Climate Change, 7(August). http://doi.org/10.1038/nclimate3361 / de Kok, R. J., Tuinenburg, O. A., Bonekamp, P. N. J., & Immerzeel, W. W. (2018). Irrigation as a potential driver for anomalous glacier behaviour in High Mountain Asia. Geophysical Research Letters, 1–8. http://doi.org/10.1002/2017GL076158 [Walter Immerzeel, Netherlands]	Accepted - reference added
21062	2	21	19	30		This seems to come out of the blue. I get it, you need to cover surging, but explain why. [Thomas Wagner, USA]	Accepted - text reworded
22804	2	21	19	21	20	The data referenced here from Andreassen relates only to Norwegian glaciers, of which most are more or less maritime; It should not be frased as describing "Scandinavian" glacier advances. If done, then specified to "maritime Scandinavian", Or else give reference for more general Scandinavian data including from the more continental Swedish glaciers.. [Lena Rubensdotter, Norway]	Accepted - reworded
17110	2	21	21	25	25	In the meantime the term is not only used for advancing glaciers but also for the balanced to slightly positive mass balances and the a different trend in climate. [Frank Paul, Switzerland]	Accepted - reworded
19476	2	21	21	21	22	Either write out "Thirty-six" or start the sentence with "In Alaska," [Michelle A. North, South Africa]	Accepted - reworded
20478	2	21	21			"… changes in atmospheric circulation. Some glaciers in Southern Hemisphere have also reduced drastically over the last decades because of dyring trend related to changes of atmospheric circulation (Favier et al., 2016)." Ref: Favier, V., Verfaillie, D., Berthier, E., Ménégoz, M., Jomelli, V., Kay, J.E., Ducret, L., Malbéteau, Y., Brunstein, D., Gallée, H., Park, Y.H., Rinterknecht, V., 2016: Atmospheric drying as the main driver of dramatic glacier wastage in the southern Indian Ocean, Scientific Reports 6, 32396 (2016), doi:10.1038/srep32396. [Martin Ménégoz, France]	Rejected - outside the scope of the chapter. Polar regions are covered by Ch.3
19478	2	21	22	21	22	"…periods of significant retreat and advance" - should be singular, not plural [Michelle A. North, South Africa]	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
16824	2	21	25	21	30	Karakorum anomaly canno be associated with glacier surge. It is actual mass increase. While discussing the reasion for Karakorum anomaly there have been different reasoning presented. Some recent work need to be presented. Forsythe, N., Fowler, H. J., Li, X.-F., Blenkinsop, S., & Pritchard, D. (2017). Karakoram temperature and glacial melt driven by regional atmospheric circulation variability. Nature Clim. Change, advance online publication. attributes this to atmospheric circulation Kok Remco, J., Tuinenburg Obbe, A., Bonekamp Pleun, N. J., & Immerzeel Walter, W. (2018). Irrigation as a Potential Driver for Anomalous Glacier Behavior in High Mountain Asia (Vol. 45, pp. 2047-2054). attributes Karakorum anomaly to increased irrigation in the surrounding, particularly in the Tarim Basin [Arun Shrestha, Nepal]	Taken into account - text revised.
540	2	21	27	21	29	the following reference should be added: F. Brun, E. Berthier, P.Wagnon, Andreas Kääb3 and Désirée Treichler. A spatially resolved estimate of High Mountain Asia glacier mass balances from 2000 to 2016. ature Geoscience. 2018. DOI: 10.1038/NGEO2999 . This study provides one of the best overview of the himalayan glaciers changes over the last 2 decades. [Christian Vincent, France]	Accepted - added
3936	2	21	32	22	41	The section does not cover permafrost information from the Andes region. Following literature may be relevant to this section: 1) Future climate warming and changes to mountain permafrost in the Bolivian, Andes Sally Rangecroft, Andrew J. Suggitt, Karen Anderson1 Stephan Harrison, Climatic Change (2016) 137:231–243, DOI 10.1007/s10584-016-1655-8 2) Permafrost distribution modelling in the semi-arid Chilean Andes Guillermo, F. Azócar , Alexander Brenning , and Xavier Bodin, The Cryosphere, 11, 877–890, 2017, www.the-cryosphere.net/11/877/2017/ doi:10.5194/tc-11-877-2017 3) Recent climate warming and the Varas rock glacier activity, Cordillera Oriental, Central Andes of Argentina, Mateo AMartini, Jorge AStrelin, EliseoFlores, Ricardo AAstini, and Michael RKaplan GeoResJ, Volume 14, December 2017, Pages 67-7, https://doi.org/10.1016/j.grj.2017.08.002 [Anil Mishra, France]	Taken into account - 1) included publication, 2) Included in restructured introductory paragraph that shows regional diversity of models
15554	2	21	32	23	7	Permafrost discussion needs highlighting as it impacts stability of areas as well as contributes to GHG emissions. [Melinda Kimble, USA]	Accepted - included now, there is also a short separate section on GHG
24340	2	21	35	21	35	Mentioned? What did it say about these? [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - reformulated.
12758	2	21	38	21	44	Please include more comments on the uncertainties in the quantification of permafrost distrubtion in mountain areas. In the Executive summary you want to include a number, but here the number is left out. Be consistent here. I think a number here is a very borad approximation with large uncertainties. [Jan-Christoph Otto, Germany]	Taken into account -not too many details can be given though as this section focuses on changes. The data used for determining total area a=discusses uncertainty.
18814	2	21	38	21	38	existence os permafrost is CERTAIN! [Petra Seibert, Austria]	Taken into account - rephrased and restructured

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
6752	2	21	41	21	41	Please consider to add a refence to pan-Arctic high resolution modelling paper: Aalto, J., Karjalainen, O., Hjort, J. & M. Luoto (2018). Statistical forecasting of current and future circum-Arctic ground temperatures and active layer thickness. Geophysical Research Letters 45, 4889–4898. [Jan Hjort, Finland]	Rejected - the suggested publication adds little insight into mountain areas.
6826	2	21	41	21	41	Can add this new paper to the reference list on spatial modeling of permafrost extent: Zou, D., Zhao, L., Sheng, Y., Chen, J., Hu, G., Wu, T., Wu, J., Xie, C., Wu, X., Pang, Q., Wang, W., Du, E., Li, W., Liu, G., Li, J., Qin, Y., Qiao, Y., Wang, Z., Shi, J., and Cheng, G.: A new map of permafrost distribution on the Tibetan Plateau, The Cryosphere, 11, 2527-2542, https://doi.org/10.5194/tc-11-2527-2017, 2017. [APECS Group Review, Germany]	Accepted
22908	2	21	44	44	21	Which type of change to permafrost are you refering to? Degradation? [Romy Schlogel, UK]	Accepted - replaced with more meaningful formulation
24342	2	21	44	21	44	Cannot be high confidence with limited evidence [Hans-Otto Poertner and WGII TSU, Germany]	Acceoted - rephrased
18328	2	21	49	21	50	it is not clear what "colder and warmer permafrost" represent [Carmen Burghelea, Romania]	Accepted - clarified in text
22806	2	21	51	21	51	First part of this section needs references. Especially the part "consistent with observations in polar areas" must be given with a reference! [Lena Rubensdotter, Norway]	Taken into account - first part has references in table, second part is referenced, now.
22808	2	21	52	21	52	Is there no more recent ref. than 2003 and -04? [Lena Rubensdotter, Norway]	Rejcted - no suitable newer reference exist.
3494	2	21	53	21	53	Shouldn't it be "Together with the evidence in Table 2.2"? [Deborah Verfaillie, Spain]	Accepted
6828	2	21	53	21	53	Table 2.1 should be Table 2.2 [APECS Group Review, Germany]	Accepted
22810	2	21	53	21	53	Wording; Together with the evidence <of glacial changes> in Table… Needs clarifying [Lena Rubensdotter, Norway]	Accepted - clarification added.
6830	2	21	54	21	54	Can specify the period (~2005-2015). [APECS Group Review, Germany]	Taken into account - years added
19160	2	22	1	22	12	Consider adding a sentence indicating that the number of monitored rockglaciers for velocity is still very scarce at the global scale and possibly the monitored rockglaciers are those showing more significant changes, rather than na unbiased sample. [Goncalo Vieira, Portugal]	Accepted
19480	2	22	2	22	2	"…such AS…" [Michelle A. North, South Africa]	Accepted
19482	2	22	3	22	3	What is a "rock glacier"? [Michelle A. North, South Africa]	Accepted - explanation added.
19484	2	22	4	22	4	Change to "revealed…" [Michelle A. North, South Africa]	Accepted
19486	2	22	5	22	5	Please delete "in line with rising temperatures indicating gradual ice loss" [Michelle A. North, South Africa]	Taken into account - reformulated to "likely indicating gradual ground-ice loss" as the relevance of liquid water needs explanation.
1988	2	22	6	22	6	"decimetres per year". [J. Graham Cogley, Canada]	Accepted

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
6836	2	22	6	22	7	I would also say that some rock glaciers are showing also higher vertical than horizontal displacement rates, showing evidence of the degradation of the permafrost/frozen mass beneath the debris cover. A nice example exists in Sierra Nevada (Spain), where vertical ates are four times higher than planar movement as a result of the permafrost+buried ice degradation. In addition, adding reference to other mountain areas could also include a broader geographical perspective to the text. Reference: Gómez-Ortiz, A.; Oliva, M.; Salvador-Franch, F.; Salvà-Catarineu, M.; Palacios, D.; Sanjosé, J.J.; Tanarro, L.; Galindo-Zaldívar, J. & Sanz de Galdeano, C. (2014). Degradation of buried ice and permafrost in the Veleta cirque (Sierra Nevada, Spain) from 2006-2013. Solid Earth, 5, 979-993. [APECS Group Review, Germany]	Noted - there is limited space to discuss this
19488	2	22	6	22	6	Units: decimeters per what? Per year, day, century? [Michelle A. North, South Africa]	Accepted
6832	2	22	10	22	10	Can add this paper to the reference list: Schoeneich, P., Bodin, X., Echelard, T., Kaufmann, V., Kellerer-Pirklbauer, A., Krysiecki, J. M., & Lieb, G. K. (2015). Velocity changes of rock glaciers and induced hazards. In Engineering Geology for Society and Territory-Volume 1 (pp. 223-227). Springer, Cham. [APECS Group Review, Germany]	Rejected - the number of rock-glacier papers is too large to include every one. Some
22812	2	22	12	22	12	There seems to be a lack of data from North and south america in the section ending here - is this really so? [Lena Rubensdotter, Norway]	Taken into account -in part this is true and also, the regional balance hadnow be improved.
16474	2	22	14	22	27	The subsection on attribution (currently 2.2.4.3) is an important part of the section and it is tied to observations. So, the subsection on scenarios, which deals with future projections, should be moved after the subsection on attribution. [Patrick Gonzalez, USA]	Accepted
17530	2	22	16			end of WHICH century? The entire sentence is indeed very sloppy language. [Wolfgang Cramer, France]	Accepted
24768	2	22	16	22	17	Perhaps rewrite this sentence to make more readable to the non-specialist. [Elizabeth Weatherhead, USA]	Accepted
19490	2	22	17	22	17	Explain what is meant by a "RCP2.6/8.5 bracket" [Michelle A. North, South Africa]	Accepted
17112	2	22	22	6	6	Faster flow of rock glaciers: I suggest adding a sentence how the faster flow is related to increasing temperatures to get the link to climate change and make clear that - in strong contrast to glaciers - rock glaciers tend to advance under increasing temperatures. This important difference is often not understood. [Frank Paul, Switzerland]	Accepted
17114	2	22	22	29	29	I suggest adding here that there could be - at least for some time - a negative feedback between increasing temperatures, later snow fall and cooling of permafrost. Early snowfall (under lower temperatures) has a chance to warm permafrost considerably (as we know from the Alps). This makes attribution of trends in permafrost much more difficult than for glaciers or snow. [Frank Paul, Switzerland]	Taken into account -partially included in text, now. The amount of explanation that can be given here is limited by available pages.
19492	2	22	24	22	24	Change to read: "decades to centuries…" [Michelle A. North, South Africa]	Accepted

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17532	2	22	26	22	27	Even if this sounds reasonable, the extrapolation is not supported by the Magnin paper which is exclusively about the Mont Blanc massif, and does not generalize to “Peaks in the European Alps”. [Wolfgang Cramer, France]	Taken into account -Sentence reworded for clarity. This paper concerns some of the highest peaks of th Alps, which have (in global context) rather uniform climate.
19494	2	22	26	22	26	Change "can" to "may", to read: "Peaks in the European Alps may lose permafrost…" [Michelle A. North, South Africa]	Accepted
22910	2	22	26	26	22	You are not using the same scale of confidence here. Is it likely? [Romy Schlogel, UK]	Rejected -citation of individual study
21064	2	22	31		41	I think Cui has published specificallyt on this (landslides after thaw)? Might be: https://link.springer.com/article/10.1007/s11629-017-4392-1 [Thomas Wagner, USA]	Rejected - comment does not fit this line. The suggested paper ("The formation of the Wulipo landslide and the resulting debris flow in Dujiangyan City, China") does not contribute to the later section on thaw and hazards.
24770	2	22	31	22	32	“There is high confidence…”. This is a nice sentence and nice introduction to the subject. [Elizabeth Weatherhead, USA]	Noted
17534	2	22	37	22	38	In this brevity, the description of the feedback mechanisms is not very convincing. Can more detail be provided? [Wolfgang Cramer, France]	Rejected - the reader will have to follow the references, otherwise we gradually flood the assessment with textbook-style content.
6834	2	22	47	23	6	Many cited papers in Tables 2.2 and 2.3 (Noetzli et al., 2018, Pogliotti et al. 2015, Isaksen et al. 2011, Christiansen et al. 2010, Liu et al., 2015, and Åkerman and Johansson 2008) are missing from the reference list. Magnin et al. 2015 should be Magnin et al. 2017? [APECS Group Review, Germany]	Accepted
6840	2	23	0			Table 2.3 Lin Luo and Lin 2016 I assume it should be Lin et al. 2016 [APECS Group Review, Germany]	Accepted
19496	2	23	3	23	6	In Table 2.3, please explain why some of the elevations and ALTs are italicized [Michelle A. North, South Africa]	Taken into account - italics removed.
22814	2	23	3	23	3	Is there no later refs for Scandinavian mpuntains in Table 2.3.+ [Lena Rubensdotter, Norway]	Noted (no, there are not)
6838	2	23	5	23	6	Last row, first column: add (Tien Shan) next to 3500 [APECS Group Review, Germany]	Accepted
1990	2	23	6	23	6	Explain the italicized column entries. [J. Graham Cogley, Canada]	Accepted
6324	2	23	8	24	33	I don't see anything in here about changes in ice-jam flooding, which is one of the dominant river flooding mechanisms in northern and cold-regions rivers. Is there any information on historical or projected future changes in the severity, frequency, or extent of ice-jam flooding under climate change? If there is, it should be briefly mentioned here; if there isn't, the need for work on the subject should be identified here. [Sean Fleming, USA]	Accepted - text on river ice jams has been added
13028	2	23	8	23	8	Unclear whether this refers to lake and river ice only in high mountain areas [Gerhard Krinner, France]	Accepted - it has been added that the statement refers to mountainous regions
204	2	23	10	24	8	There are several studies from the High Mountain areas that have documented significant pre-industrial changes in lake ice duration, e.g. Martel-Cea et al. (2016), doi: 10.1016/j.palaeo.2016.08.003. Why are these pre-industrial changes not mentioned? Some readers might suspect that authors want to make the recent changes look more dramatic by concealing that similar changes have taken place before. It would be good to avoid this by being more transparent with regards to recent vs. pre-industrial climate change of the past millennia. [Sebastian Luening, Portugal]	Taken into account - the comment is relevant but since this subchapter only deals with observed ice cover changes during the past few years, a comparison with reconstructed pre-industrial values is not relevant for this chapter
3938	2	23	12	24	33	The section doesn't discuss Glacial lake outburst flood (GLOF). [Anil Mishra, France]	Taken into account - discussed in section 2.3.3.1.3

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
16826	2	23	12	24	8	This sections should also talk about glacial lakes. Change in glacial lake is an important phenomenon in the Hindu Kush Himalaya. Following publication provides the most up to date overview of glacial lake in HKH: Maharjan, S.B., Mool, P.K., Lizong, W., Xiao, G., Shrestha, F., Shrestha, R.B., Khanal, N.R., Bajracharya, S.R., Joshi, S., Shai, S., Baral, P. (2018). The status of glacial lakes in the Hindu Kush Himalaya. ICIMOD Research Report 2018/1. Kathmandu: ICIMOD Highlights of the publication: Number of glacial lakes > 0.003 km2 area - 25,614 Total area of those glacial lakes - 1,444 km2 [Arun Shrestha, Nepal]	Accepted - we added the reference in the first sentence where it is described how ice cover dynamics are monitored
22816	2	23	12	23	12	Last word in line should be "aerial", not air. [Lena Rubensdotter, Norway]	Editorial - accepted
24772	2	23	12	23	13	This is another nice sentence and great introduction to the paragraph. These simple, clear sentences, together with the tables (e.g. Table 2.2 and 2.3) are a great combination. [Elizabeth Weatherhead, USA]	Noted
17536	2	23	14	23	17	IPCC assessments of detected and attributed change need to involve critical assessment of the underlying literature. It is not clear what general lesson from the paper by Sharma et al, about a Japanese lake and a Swedish river, can be drawn. Clearly, the message cannot be that 500 years of global warming response have been detected in Japan. One may also wonder about the the usefulness of the Swedish case, using temperatures from 700km away and claiming no local human impact. And even if these findings were valid, what do they actually mean in the context of this assessment: that lake ice is sensitive to temperature? [Wolfgang Cramer, France]	Accepted - we agree that the two longest time series give no real evidence on general changes. We removed them now.
22818	2	23	16	23	16	Better worded; "demonstrating a trend in later ice freeze" [Lena Rubensdotter, Norway]	Editorial - accepted
22820	2	23	17	23	17	"start of industrial Revolution" should be given with a approximate year [Lena Rubensdotter, Norway]	Accepted - this comment is no longer relevant since we removed the description
1992	2	23	18	23	18	What does "ice phenology" mean? [J. Graham Cogley, Canada]	Taken into account - ice phenology is a common term but was now replaced by ice cover on-set, off-set and duration
19498	2	23	20	23	20	Move the ", for example" to before "it has" [Michelle A. North, South Africa]	Editorial - accepted
22822	2	23	21	23	21	wording; should be "..in another region between 2001 and 2010" [Lena Rubensdotter, Norway]	Editorial - accepted
16126	2	23	22	23	22	sugest to add "of ice cover" after "The high variability". [Jing Gao, China]	Editorial - accepted
22824	2	23	22	23	22	Wording; should be; The high variability in <lake ice in> mountainous [Lena Rubensdotter, Norway]	Editorial - accepted
16128	2	23	23	23	24	Suggest to add "lake water surface temperature (Zhang et al., 2014)" in the end of Line 23. REF: Zhang, G., T. Yao, H. Xie, J. Qin, Q. Ye, Y. Dai, and R. Guo (2014), Estimating surface temperature changes of lakes in the Tibetan Plateau using MODIS LST data, Journal of Geophysical Research: Atmospheres, 119(14), 8552−8567, doi: 10.1002/2014JD021615 [Jing Gao, China]	Accepted - the sentence was restructured and the reference added
17538	2	24	2	24	6	I do not see how the Sharma paper, with its two very odd cases, would support the high confidence in this statement. [Wolfgang Cramer, France]	Accepted - the entire paragraph was rewritten and Sharma was no longer cited in combination with high confidence

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
19500	2	24	2	24	4	Modify the sentence to read: "Despite high spatial and temporal variability in lake and river ice phenology, freeze and thaw/breakup dates for 865 lakes and rivers in the Northern hemisphere show that, in mountainous regions and over shorter time periods, there is robust evidence and high confidence in a general shift..." [Michelle A. North, South Africa]	Taken into account - we rewrote the entire paragraph so that the sentence has changed
22826	2	24	5	24	5	"over the past years".. What does that referr to? 5?10?20 years? [Lena Rubensdotter, Norway]	Accepted - we now always clarify which exact time periods we are refering to
24774	2	24	6	24	8	“This global trend in ice phenology…”. Please state the years over which the confirmation takes place for both the Du et al. result and the O’Reilly et al. result. [Elizabeth Weatherhead, USA]	Accepted - we now always clarify which exact time periods we are referring to
5944	2	24	10	24	22	Major: This paragraph provides a clear overview and really has some concrete information and numbers. However, nothing has been stated about the uncertainty or agreement, and there is only one scenario which has been worked out [Roderik Van De Wal, Netherlands]	Taken into account - the paragraph has substantially been rewritten, uncertainty has been added and one new submitted study has been added. Other secenarios which would be valid for the mountainous region are not available
16476	2	24	10	24	22	The subsection on attribution is an important part of the section and it is tied to observations. So, the subsection on scenarios, which deals with future projections, should be moved after the subsection on attribution. [Patrick Gonzalez, USA]	Accepted - the paragraph was moved according to the suggestion
24776	2	24	12	24	12	Consider changing “three future scenarios for ice cover” to “three future aspects of ice cover dynamics” –assuming I understand what the authors mean. Also consider changing “have been inferred” to “have been identified” [Elizabeth Weatherhead, USA]	Editorial - accepted
24778	2	24	12	24	22	Please consider adding a level of confidence/agreement to these results. [Elizabeth Weatherhead, USA]	Accepted - the uncertainty was added
6842	2	24	15	24	15	and thinner ice cover [APECS Group Review, Germany]	Rejected - ice thickness depends on many additional factors not mentioned in the paragraph. If we add "thinner ice cover" then we would need to change the uncertainty level and we would need to give many more explanations
19502	2	24	16	24	16	Delete "along", to read: "variability in ice cover dynamics will increase with increasing air temperature..." [Michelle A. North, South Africa]	Editorial - accepted
22828	2	24	18	24	18	before last word "ice-covered" should be specified; "seasonally" [Lena Rubensdotter, Norway]	Accepted - we added seasonally although the term dimictic already indicated that the systems are seasonally ice covered; dimictic and monomictic were however now replaced
18816	2	24	19	24	22	the Tm/Ta ratio appears to not be scientifically proper (not OK with Kelvin, questionable for Celsius, theory??) [Petra Seibert, Austria]	Taken into account - it seems that the ratio caused confusion, it was therefore removed and replaced, in particular since it would need far more explanation
22830	2	24	19	24	22	The sentence on these lines is not clearly worded and should be expanded and clarified [Lena Rubensdotter, Norway]	Taken into account - the senteces were rewritten to make it easier to follow
24766	2	24	19	24	22	“impacts on lives and livelihoods, often extending far beyond the directly affected region and persisting for several years.” What persists? Impacts? How can an impact extend beyond the directly affected region—I’m sure it can, but as written it seems unclear. [Elizabeth Weatherhead, USA]	Taken into acount - the sentence was entirely rewritten. However, we did not add something on impacts as this was not the prupose of the subchapter
19504	2	24	20	24	22	Please explain what is meant by Tm and Ta, annd why we should be concerned with their ratio, or rewrite into general terms [Michelle A. North, South Africa]	Accepted - the term needs far more explanation and was consequently removed
1994	2	24	21	24	21	"comparatively", or "relatively". [J. Graham Cogley, Canada]	Taken into account - the sentence was rewritten and comparatively is no longer included

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
206	2	24	24	24	33	Attribution of lake ice changes would only be possible by comparing to previous natural warm phases and potential drivers of lake ice changes during those times. Description incomplete. [Sebastian Luening, Portugal]	Accepted - the paragraph was moved to the observations to make clear that it is based on past observations
19506	2	24	26	24	33	Confidence language? [Michelle A. North, South Africa]	Accepted - the confidence levels were added
19508	2	24	27	24	27	Replace "while" with "however, " [Michelle A. North, South Africa]	Accepted - the word was replaced
19510	2	24	28	24	28	Delete "a very" before high precision [Michelle A. North, South Africa]	Accepted - the word was deleted
24780	2	24	29	24	29	Consider changing “and river ice also follows” to “and river ice vary with the QBO…” One phenomena following the other implies more causality than I believe is known. They co-vary, but perhaps with a lag. [Elizabeth Weatherhead, USA]	Accepted - we replaced follows with co-vary
24782	2	24	37	24	54	Very nicely written. [Elizabeth Weatherhead, USA]	Noted
12454	2	24	46	24	46	Regional feedbacks have also been identified for the European Alps by (1) Scherrer et al. 2012 (Theoretical and Applied Climatology, doi:10.1007/s00704-012-0712-0) , (2) Winter et al. 2017 (Clim Dyn, DOI 10.1007/s00382-016-3130-7) and (3) Kotlarski et al. 2010 (Climate Dynamics, DOI 10.1007/s00382-009-0685-6) . For the Rocky Mountains: Minder et al. 2018 (J Clim, DOI: 10.1175/JCLI-D-17-0321.1). [Sven Kotlarski, Switzerland]	Taken into account - material was used for the preparation of the SOD
20480	2	24	48			"… at the global scale." -> there si an exception in the Himalayan region, where snow cover changes have been suspected to affect the monsoon circulation (Wu et al., 2016). Ref: Wu, Z., Zhang, P., Chen, H. and Li, Y., 2016. Can the Tibetan Plateau snow cover influence the interannual variations of Eurasian heat wave frequency?. Climate dynamics, 46(11-12), pp.3405-3417. [Martin Ménégoz, France]	Taken into account - material was used for the preparation of the SOD
4480	2	24	51			Add 'some' before 'measures', as this sentence is only referencing to a sub-set of adaptation efforts. [Graham Mcdowell, Canada]	Taken into account - the text was revised for better clarity, within strict text length constrains.
4482	2	24	53			Suggest changing 'this burden' to 'attendant consequences' [Graham Mcdowell, Canada]	Taken into account - the text was revised for better clarity, within strict text length constrains.
6474	2	25	0	26		The response of runoff to climate change is complicated. To illustrate it a conceptual figure could be added showing the annual hydrograph and the effect of warming (higher and longer glacier melt period, earlier snow melt, lower average runoff due to higher ET, quicker runoff due to less glacier area) and precipitation changes (more/less, more extremes, less snow and more rain). [Walter Immerzeel, Netherlands]	Accepted - FAQ2.1 and schematics are added
6858	2	25	0			Lacks citation in the Box [APECS Group Review, Germany]	Taken into account - the box has been eliminated. A similar question is now part of the FAQ. Question has been reformulated.
21070	2	25	0	27		Is the science on reduced runoff really that robust? I'm not doubting that it WILL be a problem, but this seems really thin. I wonder if it would be stronger to state, "It's already beginning, here are examples…but still localized." Also, how much does mountain water affect the recharge of the major aquifers in California and Northern India noted to be drawing down from GRACE data? [Thomas Wagner, USA]	Accepted - the text has been revised.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
3940	2	25	1	25	11	Please discuss water demand in regions downstream of the glaciers. Some example available from paper: 'Glacial melt content of water use in the tropical Andes' by Wouter Buytaert, Simon Moulds, Luis Moulds, Luis Acosta, Bert De Bievre, Carlos Olmos, Marcos Villacis, Carolina Tovar and Koen M J Verbist, Environmental Research Letters, 12 (2017), 114014 [Anil Mishra, France]	Accepted - key impacts include consequences of runoff for human systems are more highlighted.
4484	2	25	1			This title is unclear. Suggest revising. [Graham Mcdowell, Canada]	Accepted - title is revised
11876	2	25	1	54	10	While the impacts of cryoshpere changes on livelihoods are mentioned in this chapter, there is no discussion or mention of the impacts of these changes on mountain culture/culture(s) of mountain people. To give an example: Where climate change effects water availability in high Andean wetlands, possibility for livestock herding are reduced, which in consequence has impacts on mountain communities/people, potentially leading to a loss of a specific mountain culture. [Dirk Hoffmann, Germany]	Accepted - changes in runoff is connected to implication to human activity including livelihoods in latter subsections.
24322	2	25	1			Such of section 2.3 is poorly developed and reads as a review rather than an assessment of climate change risks. There is little treatment of downstream implications for agriculture or urban areas. [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - the text has been revised with more assessment language. Implication to downstream is highlighted.
24796	2	25	1	25	3	Is it appropriate to add an example from South Africa? [Elizabeth Weatherhead, USA]	Rejected - not enough literture
6306	2	25	3	28	6	This is a good start on summarizing the implications of climate change-induced glacier recession on water resources. Unfortunately, it seems to be told from a glaciologist's perspective, whereas to be relevant, accurate, and generally serve its purpose, this section should instead (or additionally) be told from the perspective of a water resource scientist, engineer, or manager. The passage contains an excess of details in some in respects, while other important ideas are left completely untouched, and it appears there may be some scientific errors in the passage. Several key areas for improvement are outlined in subsequent comments. [Sean Fleming, USA]	Accepted - key impacts and implication to human activity is revised

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
6308	2	25	3	28	6	This section would benefit from better geographical coverage. There's little on Alaska and almost nothing on western Canada, for example, yet this is one of the most heavily glaciated areas in the world; it spans both martime and continental, surging and non-surging, tidewater and non-tidewater, and pre- and post-peak water glaciers; and some of the most advanced studies of climate and glacier change impacts on river flows and river and estuarine ecosystems have been conducted here. Key examples from western Canada include (a) Jost et al., 2012, Quantifying the contribution of glacier runoff to streamflow in the upper Columbia River Basin, Canada, Hydrology and Earth System Sciences, 16, 849-860; (b) Stahl and Moore, 2006, Influence of watershed glacial cover on summer streamflow in British Columbia, Canada, Water Resources Research, 42, doi:10.1029/2006WR005022; (c) Stahl et al., Coupled modelling of glacier and streamflow response to future climate scenarios, Water Resources Research, 44, doi:10.1029/2007WR005956; (d) Fleming and Clarke, 2003, Glacial control of water resource and related environmental responses to climatic warming, Canadian Water Resources Journal/Revue canadienne des ressources hydriques, 28, 69-86; (e) Fleming and Dahlke, 2014, Modulation of linear and nonlinear hydrclimatic dynamics by mountain glaciers in Canada and Norway: results from information-theoretic polynomial selection (see also erratum to this article), Canadian Water Resources Journal/Revue canadienne des ressources hydriques, 39, 324-341; and (f) Dery et al., 2012, A century of hydrological variability and trends in the Fraser River Basin, Environmental Research Letters, 7, doi:10.1088/1748-9326/7/2/024019. Each of these papers helped delineate river runoff responses to climate and glacier change in western Canada and was also a "first" in terms of methodology or fundamental scientific discovery. I think it's appropriate that these papers, and their content, should be recognized here. [Sean Fleming, USA]	Taken into account - regions consider are given in supplementary table.
6310	2	25	3	28	6	The passage appears to miss a basic point about glacier recession and water resources. Downstream, glacier melt is typically a small proportion of a river's annual flow volume, so the problem posed by the loss of glacial runoff isn't really about runoff volumes - it's about when those decreases occur. Glacial melt contributions to flow tend to occur at times of year when other runoff sources - snowmelt and rainfall - are at a minimum. Glacial recession therefore removes water from a river at the time of year that water users and ecosystems can least afford it. That should be spelled out here, citing two review & synthesis articles: (a) Moore et al., 2009, Glacier change in western North America: influences on hydrology, geomorphic hazards and water quality, Hydrological Processes, 23, 42-61; and (b) O'Neel et al., 2015, Icefield-to-ocean linkages across the Northern Pacific Coastal Temperate Rainforest ecosystem, Bioscience, 65, 499-512. [Sean Fleming, USA]	Accepted - more explanation is given to explain effect of glacier recession to downhill in FAQ.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
6312	2	25	3	28	6	To adequately serve its purpose as an IPCC summary of the impacts of climate change on water resources viz-a-vis mountain glaciers, the passage must recognize and explain that, from the viewpoint of a water resource scientist/manager/engineer, the key point about mountain glaciers is that a glacier is an extra component of the basin water balance which is missing in non-glacial watersheds, and that fact deeply affects the way that river flows respond to climate variability and change. Any given region will contain a mixture of glacial and non-glacial rivers, and these will respond very differently to both short-term climate fluctuations and long-term climate change. Indeed one river may experience increasing flow and an adjacent river may experience decreasing flow (under the same climate changes) if one watershed has a glacier and the other doesn't. The first study to conclusively prove this crucial fact (using observational data from several glacial rivers and comparing trends against a control population of non-glacial rivers in the same area) was Fleming and Clarke, 2003, Glacial control of water resource and related environmental responses to climatic warming, Canadian Water Resources Journal/Revue canadienne des ressources hydriques, 28, 69-86. Similar effects were subsequently identified by, for example, Li et al., 2010, Observed changes in streamflow at the headwaters of the Urumqi River, eastern Tianshan, central Asia, Hydrological Processes, 24, 217-224; and Dahlke et al., 2012, Contrasting trends in floods for two sub-arctic catchments in northern Sweden - does glacier presence matter? Hydrology and Earth System Sciences, 16, 2123-2141. The most recent and sophisticated work on this subject is Fleming and Dahlke, 2014, Modulation of linear and nonlinear hydrclimatic dynamics by mountain glaciers in Canada and Norway: results from information-theoretic polynomial selection (see also erratum to this article), Canadian Water Resources Journal/Revue canadienne des ressources hydriques, 39, 324-341. This content & the associated literature citations need to be added to the section. [Sean Fleming, USA]	Accepted - key impacts include consequences of runoff for human systems are more highlighted.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
6314	2	25	3	28	6	Another important aspect of climate change in glacial rivers is that glacier recession changes not only long-term runoff volumes and seasonal flow timing, but it also affects the way that streamflows respond to shorter-term climatic forcing. It is well-demonstrated that the presence or absence of a glacier in a river's upstream drainage area changes the impacts that processes like ENSO and the PDO have on downstream water resources. As glaciers recede and eventually play a smaller role in the basin water balance under climate change, therefore, the streamflow responses to ENSO and PDO will change, and potentially grow more homogeneous across a given region: see (and cite) Fleming et al., 2016, Seasonal flows of international British Columbia-Alaska rivers: the nonlinear influence of ocean-atmosphere circulation patterns, Advances in Water Resources, 87, 42-55. It's also well-known that glaciers provide a moderating influence on the streamflow impacts of year-to-year variations in climate. As a result, loss of glacial mass and area under climate change may increase hydrologic variability; see (and cite) Dery et al., 2012, A century of hydrological variability and trends in the Fraser River Basin, Environmental Research Letters, 7, doi:10.1088/1748-9326/7/2/024019. [Sean Fleming, USA]	Accepted - short-term runoff changes associated with glacier recession is schematically explained
20938	2	25	3	34	20	I think it would be more logical to have sections inthe following order: River runoff / Water quality which are processes and characteristics underlying the water supply - then Hydropower / Agriculture and irrigation / Driking water / Governance which are types of use [Christophe Cudennec, France]	Accepted - section structure have been reorganized
17540	2	25	5	15	5	I do not agree that freshwater from mountains is an ecosystem service. Ecosystem services are provided by ecosystems, and it is clearly the case that mountain ecosystems may contribute to the storage or regulation of freshwater. But in the way the sentence is given here one gets the idea that any water running from a glacier into a stream, even if unaffected by any ecosystem, would be an "ecosystem service". [Wolfgang Cramer, France]	Accepted - the ecosystem service here is key impacts in the new structure.
24784	2	25	5	25	5	Consider changing “service” to “role.” [Elizabeth Weatherhead, USA]	Accepted - the ecosystem service here is key impacts in the new structure.
6844	2	25	8	25	9	The presence of seasonally frozen ground, where the shallow subsurface freezes and thaws annually without permafrost below, also exerts a control on runoff and should be included in this list. [APECS Group Review, Germany]	Accepted - covered in text
1298	2	25	9	25	9	Glaciers also play an major role in water temperature which is important for aquatic systems esepcially fish like salmon and trout (e.g. Hari et al. 2014; Fellman et al., 2014; Pletterbauer et al. 2018). Hari, R.E., Livingstone, D.M., Siber, R., Burkhardt-Holm, P. and Guettinger, H., 2006. Consequences of climatic change for water temperature and brown trout populations in Alpine rivers and streams. Global Change Biology, 12(1), pp.10-26. Fellman, J.B., Nagorski, S., Pyare, S., Vermilyea, A.W., Scott, D. and Hood, E., 2014. Stream temperature response to variable glacier coverage in coastal watersheds of Southeast Alaska. Hydrological Processes, 28(4), pp.2062-2073. Pletterbauer, F., Melcher, A. and Graf, W., 2018. Climate Change Impacts in Riverine Ecosystems. In Riverine Ecosystem Management (pp. 203-223). Springer, Cham. [Ross Brown, Canada]	Accepted - water temperature is added

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6854	2	25	9	25	11	Include citation: Li, Hong., Xu .Yu. Chong., Beldring, S., Tallasken, Z. M., Jain.S.K (2016), Water resource under climate change in Himalayn basins, Water Resource Management, 30, 843-859. DOI:10.2007/S11269-015-1194-5 [APECS Group Review, Germany]	Taken into account - the reference is used in the assessment
4486	2	25	11			Could also cite work by Bury and McDowell for more recent emperical assessments supporting this sentence, e.g. McDowell, G., et al. (2013). "Climate-related hydrological change and human vulnerability in remote mountain regions: a case study from Khumbu, Nepal." Regional Environmental Change 13(2): 299-310. ; Bury, J., et al. (2013). "New geographies of water and climate change in Peru: Coupled natural and social transformations in the Santa River watershed." Annals of the Association of American Geographers 103(2): 363-374. [Graham Mcdowell, Canada]	Taken into account - the references are used in the assessment
6856	2	25	11	25	11	Important questions about regional water security need to be addressed in context of climate change - It can also be added in the paragraph at the end. [APECS Group Review, Germany]	Accepted - key impacts include consequences of runoff for human systems are highlighted.
1996	2	25	16	25	16	"How Do Glaciers ...". [J. Graham Cogley, Canada]	Taken into account - the box has been eliminated. A similar question is now part of the FAQ. Question has been reformulated.
3496	2	25	16	25	39	There are no references for the whole Box 2.4, maybe some should be indicated? [Deborah Verfaillie, Spain]	Taken into account - the box has been eliminated. A similar question is now part of the FAQ. Question has been reformulated.
19512	2	25	16	25	16	As mentioned previously, change the title of the box so that is it a question [Michelle A. North, South Africa]	Taken into account - the box has been eliminated. A similar question is now part of the FAQ. Question has been reformulated.
21430	2	25	16	25	16	The key message to stress out in this section is an underlying notion that neither glaciers nor seasonal snow are the sources of streamflow as such. Both glaciers and snow act solely as natural water storage agents, which delay the input from precipitation to streamflow by time lags of different duration (from weekly/monthly scales to years//decades//centuries). Thus it is their role as seasonal and intra-annual redistributors of atmospheric precipitation is changing under CC impact. The scenarios of the glacier runoff changes due to glacier decline may be then considered along these lines. Changes in glacier runoff do not necessarily mean the overall decrease of total stream flow, but rather the changes of high and low flow seasonality. [Oxana Savoskul, Sri Lanka]	Taken into account - the box has been eliminated. A similar question is now part of the FAQ. Question has been reformulated.
21432	2	25	16	25	16	It has been shown recently, that seasonal snow contribution to streamflow in high mountains is equal to or significantly higher than that of glacier runoff (Savoskul, Smakhtin, 2013b), varying in the range between the first few percent (southern basins of High Asia) to more than 50% (High Asia north from HKH region). The role of seasonal snow as the source of meltwater contribution to runoff increases from tropics to high latitude areas (high confidence). Reference: Savoskul, O.S., Smakhtin, V. 2013: Glacier systems and seasonal snow cover in six major Asian river basins: Hydrological role under changing climate. IWMI Research Report 150, 45 pp. IWMI Research Report, 150 [Oxana Savoskul, Sri Lanka]	Accepted - seasonal snowmelt is included
23658	2	25	16			This heading does not form a complete sentence [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account - the box has been eliminated. A similar question is now part of the FAQ. Question has been reformulated.

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24344	2	25	16			Can you add more context of the consequences of runoff for human systems [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - the box has been eliminated. Key impacts include consequences of runoff for human systems are highlighted in 2.3.
21434	2	25	18	25	18	The basin-scale effects of glaciers mass loss on the changes of total runoffs for the entire HKH region have been evaluated by Savoskul and Smakhtin (2013 b). The overall contribution by the negative glacier mass-balance to the mean annual flow is normally within a range of <1% to 5-7% in the large and densely populated river basins of Indus, Ganges, Brahmaputra, Amu Darya and Syr Darya. [Oxana Savoskul, Sri Lanka]	Rejected - comment not supported by peer-reviewed published literature
24786	2	25	18	25	39	This section would be much improved with references. [Elizabeth Weatherhead, USA]	Taken into account - the box has been eliminated. A similar question is now part of the FAQ. Question has been reformulated.
4488	2	25	20	25	22	What about hydrological dynamics in ranges in the tropics/sub-tropics? This would be good to mention, too. [Graham Mcdowell, Canada]	Taken into account - the box has been eliminated. A similar question is now part of the FAQ. Question has been reformulated.
19514	2	25	20	25	24	Please rewrite this sentence completely and cite [Michelle A. North, South Africa]	Taken into account - the box has been eliminated. A similar question is now part of the FAQ. Question has been reformulated.
19516	2	25	24	25	24	Replace "dampen" with "reduce" interannual streamflow.. [Michelle A. North, South Africa]	Taken into account - the box has been eliminated. A similar question is now part of the FAQ. Question has been reformulated.
19518	2	25	25	25	25	Variation should be singular [Michelle A. North, South Africa]	Accepted
19520	2	25	26	25	26	"In contrast with snow cover…", not "to" [Michelle A. North, South Africa]	Taken into account - the box has been eliminated. A similar question is now part of the FAQ. Question has been reformulated.
1998	2	25	30	25	30	Presumably "glacier" should be deleted. [J. Graham Cogley, Canada]	Taken into account - the box has been eliminated. A similar question is now part of the FAQ. Question has been reformulated.
4490	2	25	30			Delete 'glacier' [Graham Mcdowell, Canada]	Taken into account - the box has been eliminated. A similar question is now part of the FAQ. Question has been reformulated.
6322	2	25	30	33	33	This "peak runoff" concept is great, but no solid references are provided for it in the report. There are two key papers that should be referenced here: (a) Jansson et al., 2003, The concept of glacier storage: a review, Journal of Hydrology, 282, 116-129; and (b) Moore et al., 2009, Glacier change in western North America: influences on hydrology, geomorphic hazards and water quality, Hydrological Processes, 23, 42-61. [Sean Fleming, USA]	Taken into account - the box has been eliminated. A similar question is now part of the FAQ. Question has been reformulated.
6848	2	25	30	25	31	The phrase 'glacier annual snowmelt runoff' is confusing. Do you mean, 'annual snowmelt runoff from glaciated catchments' or 'annual snowmelt runoff on glaciers'? [APECS Group Review, Germany]	Taken into account - the box has been eliminated. A similar question is now part of the FAQ. Question has been reformulated.
12744	2	25	30			erase "glacier" [Jan-Christoph Otto, Germany]	Taken into account - the box has been eliminated. A similar question is now part of the FAQ. Question has been reformulated.
12856	2	25	30	25	30	"glacier annual" needs probably to be removed here. [Antoine Rabatel, France]	Taken into account - the box has been eliminated. A similar question is now part of the FAQ. Question has been reformulated.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
16544	2	25	30	25	31	This statement is false. It is true that the runoff peak will arrive earlier in the year, but not that the glacier annual snowmelt runoff will decrease. Before this decline occurs, we expect an increase in the European high mountains up to the middle of the current century (CH-2014-Impacts, 2014). Reason: The increase in temperature causes more glacier melt, which will lead to an increased runoff. In the second half until 2100, however, the amount of glacier melt will be significantly below the current one; there will only be a fraction of mass left. (CH2014-Impacts 2014: Toward Quantitative Scenarios of Climate Change Impacts in Switzerland, published by OCCR, FOEN, MeteoSwiss, C2SM, Agroscope, and ProClim, Bern, Switzerland, 136 pp) [Luzi Bernhard, Switzerland]	Taken into account - the box has been eliminated. A similar question is now part of the FAQ. Question has been reformulated.
16828	2	25	30	25	33	Temperature and precipitation change does not happen in isolation. It is also important to discuss the combined effect ot temperature change and precipitation change. [Arun Shrestha, Nepal]	Taken into account - the box has been eliminated. A similar question is now part of the FAQ. Question has been reformulated.
19522	2	25	30	25	30	Change sentence to read: "In case of continuous atmostpheric warming, annual glacier snowmelt runoff…" [Michelle A. North, South Africa]	Taken into account - the box has been eliminated. A similar question is now part of the FAQ. Question has been reformulated.
19524	2	25	31	25	31	Change to read: "In contrast, glacier runoff is expected to increase initially in response…" [Michelle A. North, South Africa]	Taken into account - the box has been eliminated. A similar question is now part of the FAQ. Question has been reformulated.
22832	2	25	31	25	31	the sentence starting "In contrast" is presumably relating to inter-yearly variations (as opposed to the previous sentence), but this is not clearly written.. [Lena Rubensdotter, Norway]	Taken into account - the box has been eliminated. A similar question is now part of the FAQ. Question has been reformulated.
19526	2	25	33	25	33	Replace "wastes away" with "disappears" [Michelle A. North, South Africa]	Taken into account - the box has been eliminated. A similar question is now part of the FAQ. Question has been reformulated.
6846	2	25	35	25	36	For clarity, should be changed to 'Permafrost and seasonally frozen ground affect runoff…' [APECS Group Review, Germany]	Rejected - scope of report does not include seasonally frozen ground.
6850	2	25	35	25	36	Permafrost is thought to be an aquitard, not an impermeable layer. For clarity, this sentence could be changed to (with suggestions in bold): 'Permafrost affects runoff by acting as a semi-impermeable hydrological barrier that inhibits groundwater recharge and reduces soil water storage and movement'. Evans, S. G., S. Ge, and S. Liang (2015), Analysis of groundwater flow in mountainous, headwater catchments with permafrost, Water Resour. Res., 51, 9127–9140, doi:10.1002/2014WR016259. [APECS Group Review, Germany]	Taken into account - the box has been eliminated. Still, a formulation like "hydrological barrier, strongly limiting percolation" will be used elsewhere in a attempt to be more true to the meaning of aquitard and also to avoid using the technical term, which would need explanation. Thank you.
6852	2	25	36	25	39	This sentence should be modified since it is expected that river discharge will increase with permafrost degradation due to increasing transmissivity of the subsurface. A suggestion with changes in bold: '…but also indirectly through increases in groundwater discharge to streams via increases in subsurface pathways to the river system…' Walvoord, M. A., and B. L. Kurylyk (2016), Hydrologic impacts of thawing permafrost—A review, Vadose Zo. J., 15(6), doi:10.2136/vzj2016.01.0010. [APECS Group Review, Germany]	Taken into account - the box has been eliminated. A similar question is now part of the FAQ. Question has been reformulated.
19528	2	25	39	25	39	Add a comma after deeper [Michelle A. North, South Africa]	Taken into account - the box has been eliminated. A similar question is now part of the FAQ. Question has been reformulated.

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17922	2	25	44	28	6	I suggest to add material/a discussion on the difference between different RCPs on future runoff and peak water. This would be highly policy relevant. [Christian Huggel, Switzerland]	Noted - given huge regional differences as well as broad uncertainties in lower emission scenario, we plot the case of the highest emission scenario (RCP8.5) in Figure 2.5 for better readability. It is difficult to summarize changes in different level of RCPs but more information will be provided in supplementary table and Chapter 4 - sea level rise.
18818	2	25	44	25	44	I think river runoff should go into the previous section, not under ecosystem services etc [Petra Seibert, Austria]	Rejected - previous subsection is physical/direct change in cryosphere. I agree that runoff change is kind of physical change, but we put here to connect further impacts due to the change (hydropower, agriculture and drinking water) .
3282	2	25	46	25	57	Increase in runoff might be at least partially compensated by larger forest extensions, with both the tree -line and the timber-line moving uphill in many mountians. [Castor Muñoz Sobrino, Spain]	Noted - terrestrial ecosystems are mentioned and linked to related subsection.
20484	2	25	46	25	46	Change sentence to read: "Since AR5, a large number of studies have emerged that assess past and future changes..." [Michelle A. North, South Africa]	Accepted - text revised
24788	2	25	46	25	47	Consider opening with “In the past decade, a large number of studies.” Writers of this document may think in terms of AR5, but readers think in terms of the past few years or the past few decades. [Elizabeth Weatherhead, USA]	Rejected - the report will explain recent development of research after AR5.
24792	2	25	49	26	15	Very nice couple of paragraphs: rich, concise and readable. [Elizabeth Weatherhead, USA]	Noted
4492	2	25	54			Comment about contribution of 'snow' to increased streamflow is inconsistent with statement on line 30 (same page). Perhaps more nuance regarding the spatial and temporal dimensions of meltwater generation form snow is needed? [Graham Mcdowell, Canada]	Taken into account - comprehensive description of snow melt contribution is added.
4494	2	25	57			Regarding use of 'sustainability', perhaps use alternative, less loaded word. [Graham Mcdowell, Canada]	Accepted - text revised
6860	2	26	0			There is a generic use of MODELs, but all really dffer and show and say different things and with certain error estimate [APECS Group Review, Germany]	Taken into account - uncertainty in models are discussed
22834	2	26	2	26	3	Is there no more recent references for this report? [Lena Rubensdotter, Norway]	Taken into account - more new litereturea are added
24794	2	26	2	26	3	Can you finish the last sentence with “water shortages due to....” ? [Elizabeth Weatherhead, USA]	Accepted - text revised
17542	2	26	3	26	3	"...are ALSO experiencing..." - this indicates the problem with the paragraph which is a mix of detected changes from different places and leaves the reader with no clear picture of what happens. The entire assessment could be more structured and make it more clear to understand that both increases and reductions in runoff can be due to climate change. Actually, this comment is valid also for the following paragraphs which need a lot more in terms of a logical structure. [Wolfgang Cramer, France]	Accepted - text revised
22836	2	26	5	26	5	6th word in line should be; support [Lena Rubensdotter, Norway]	Accepted - text revised
24798	2	26	5	26	15	Nicely written paragraph, particularly the last sentence. [Elizabeth Weatherhead, USA]	Noted

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12858	2	26	6	26	7	This sentence is erroneous. Indeed, in Soruco et al. (2015) study, there is no simulation (only data are analyzed), and also because the precipitation is assumed to be constant. Please consider revising the sentence in the following way: "In Bolivia, quantified glacier runoff shows no trend over the 1963-2006 period as increasing ice melt rates compensated from decreasing glacier surface area (Soruco et al., 2015). [Antoine Rabatel, France]	Taken into account - the original sentence is deleted due to limitation in text length
3284	2	26	14	26	15	In my opinion, it also depends on the tree cover in the basin (e.g. Muñoz Sobrino et al. 2012. Boreas, 41: 578–601). [Castor Muñoz Sobrino, Spain]	Noted - terrestrial ecosystems are mentioned and linked related subsection.
2000	2	26	15	26	15	"change". [J. Graham Cogley, Canada]	Accepted - text revised
19530	2	26	23	26	25	Rewrite the sentence [Michelle A. North, South Africa]	Accepted - text revised
12860	2	26	27	26	29	This statement regarding the peak water (already or close to be passed in many catchments) needs to be minimized. Indeed, as mentioned in my comment #5, this strongly depends on the simulated glacier volume and glacier ice thickness distribution which are both highly uncertain. [Antoine Rabatel, France]	Accepted - text revised
16830	2	26	27	26	39	Again a combined effect of temperature and precipitation change on cryosphere and resulting change in the water has to be looked at. The level of impact also dependes on how much different componentes (glacier, snow, groundwater, precipitation, etc.) contribute to the flow. There will be a strong spatial diffrences, particularly in the headwater, where melt component wil dominating and in the plans where groundwater and precipitation will be dominating. Lutz et al, 2014 nicely higlights this. [Arun Shrestha, Nepal]	Accepted - text revised
21436	2	26	27	26	39	In High Asia, recent large-scale estimates of meltwater contribution to runoff (Savoskul, Smakhtin, 2013b; IWMI, 2014) indicate that glaciers contribute from 2-5% to 20-25% to total streamflow, whereas seasonal snow contribution makes between 2-10% up to 50-70%. In the period from 1960's towards 2000's the meltwater contribution to runoff in High Asia decreased by 2 to 10%. However, this change did not significantly impact the runoff totals, due to the increased input from liquid precipitation to stream flow over cold periods of the year. [Oxana Savoskul, Sri Lanka]	Accepted - text revised
24346	2	26	27	26	28	Do not mix uncertainty language [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account - text revised
24348	2	26	35	26	36	Some regions? Give examples [Hans-Otto Poertner and WGII TSU, Germany]	Noted - text revised to clarify regions
3844	2	26	37	26	38	Even Soncini et al., 2016 shown that contribution of ice melt to total runoff will almost remain quite stable until 2050 (Soncini et al., 2016 http://dx.doi.org/10.1016/j.scitotenv.2016.05.138) [Franco Salerno, Italy]	Noted - the sentence is revised
22838	2	26	38	26	38	wording;"will" should perhaps be changed to " is estimated to" or similair.. [Lena Rubensdotter, Norway]	Accepted - text revised
6862	2	26	56			difficult to combine or to infer on that way [APECS Group Review, Germany]	Noted - text revised
6476	2	27	0	27		Although the figure with peak glacier water is great, it would also be recommendable to place it in the context of the importance of melt water. What is the relative contribution of glacier melt in overall runoff? [Walter Immerzeel, Netherlands]	Noted - contriution to total runoff is noticed
6866	2	27	0			Fig 2.5 red dots are not stand-alone, needs to be self-explantory instead [APECS Group Review, Germany]	Accepted - caption and figure is updated

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
6328	2	27	1	27	8	Figure 2.5 appears to contain some mistakes. The figure is intriguing to look at and might be worth including here, but it requires improvement before it can be published in an IPCC report. I like really the idea, preliminarily attempted in this figure, to superimpose outcomes from macroscale glacier modeling work with local case studies. The problem with this figure, though, seems to be the same general problem with Section 2.3.1 as a whole: there is little to no apparent uptake of work from the water resource science and engineering literature. How do these results compare against detailed river-by-river hydrology studies, which collectively span both emprical analyses of historical data, and watershed model-based projections of future changes, across many basins? For Western Canada, certainly, the results presented in this figure look wrong. It is a well-established fact that glacially derived river flows in most watersheds in the southern part of western Canada (including the headwaters to the Columbia River Basin) have been declining for decades, that is, they are post-peak flow. That contrasts sharply with the modeling results presented in the figure, and which appear to reflect glaciological rather than hydrological studies, at both the macroscale (bars on the figure) and local scale (dots) (though the content of this figure does seem to agree with detailed hydrological studies in the northern part of western Canada, where glacial river flows have been rising, consistent with pre-peak flow conditions). Certainly, several key studies are missing from the "case studies" shown in the figure. (There are also problems with the panel for Alaska, which apparently claims that only one case study has ever been completed there.) As a start, the authors need to correct this figure by including case study information for western Canada from the actual water resources literature. Six key papers for this figure include the following: (a) Moore et al., 2009, Glacier change in western North America: influences on hydrology, geomorphic hazards and water quality, Hydrological Processes, 23, 42-61; (b) Fleming and Clarke, 2003, Glacial control of water resource and related environmental responses to climatic warming, Canadian Water Resources Journal/Revue canadienne des ressources hydriques, 28, 69-86; (c) Fleming and Dahlke, 2014, Modulation of linear and nonlinear hydrclimatic dynamics by mountain glaciers in Canada and Norway: results from information-theoretic polynomial selection (see also erratum to this article), Canadian Water Resources Journal/Revue canadienne des ressources hydriques, 39, 324-341; (d) Jost et al., 2012, Quantifying the contribution of glacier runoff to streamflow in the upper Columbia River Basin, Canada, Hydrology and Earth System Sciences, 16, 849-860; (e) Stahl and Moore, 2006, Influence of watershed glacial cover on summer streamflow in British Columbia, Canada, Water Resources Research, 42, doi:10.1029/2006WR005022; (f) Stahl et al.,	Noted - the physical change is connected to implication to human and ecosystem
16496	2	27	1	27	10	Cyan typeface in legend is very difficult to see. Alter colors to darken this color. Alternatively, as legend is indentical in all subpanels consider adding a larger, easier to read legend that covers all subpanels. [Baylor Fox-Kemper, USA]	Accepted - figure revised
17924	2	27	1	27	8	Figure 2.5: a very good figure but I think the colors of the bars and their relation to the size classes needs clarification in the caption. Furhthermore, is there good confidence that for NZ all is concentrated in one 10year bin? How it the North Asia region defined? [Christian Huggel, Switzerland]	Accepted - figure revised
19532	2	27	1	17	8	Figure 2.5. Add explanation of the colours and what the km^2 is referring to [Michelle A. North, South Africa]	Accepted - figure revised

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
6864	2	27	11	27	13	Changes to total runoff will also be a function of changes in aquifer recharge. For example, in a glaciated alpine catchment in Alaska, half of annual headwater streamflow was lost to aquifer recharge (Liljedahl, et al. 2016). Liljedahl, A. K., A. Gadeke, S. O'Neel, T. A. Gatesman, and T. A. Douglas (2016), Glacierized headwater streams as aquifer recharge corridors, subarctic Alaska, Geophys. Res. Lett., 6876–6885, doi:10.1002/2017GL073834. [APECS Group Review, Germany]	Rejected - due to limitation in length this section focus impact of cryospheric change on water supply and associated direct impact on nature and humanity.
2002	2	27	12	27	12	"in the Shigar river in the Karakoram". [J. Graham Cogley, Canada]	Noted - sentence revised
19534	2	27	12	27	14	Modify sentence to read: "For example, in Karakoram in Pakistan, the contribution of glacier melt to the Shigar river has passed its peak flow, but the loss of ice has been compensated for by an increase in precipitation ()." [Michelle A. North, South Africa]	Noted - sentence revised
19536	2	27	16	27	17	Modify sentence to read: "Regions where glacier melt forms a high proportion of total runoff will be most affected as glaciers shrink." [Michelle A. North, South Africa]	Accepted - text revised
21438	2	27	16	27	22	The uncertainty of the projected changes of precipitation in High Asia under GCM-based scenarios are of the same order as the overall negative glacier mass-balance contribution to runoff totals, therefore in the monsoon-influenced High Asia, the future water availability will be affected by changes in precipitation much more significantly than by the changes in glacier total runoff due to glacier mass-loss. [Oxana Savoskul, Sri Lanka]	Noted - uncertainty in GCM projections is noted
22840	2	27	17	27	17	grammer; catchments cannot "project" anything, choose other wording. [Lena Rubensdotter, Norway]	Accepted - text revised
19538	2	27	18	27	18	"...presently project decreased runoff (). In the tropical Andes, accelerated..." [Michelle A. North, South Africa]	Accepted - text revised
2004	2	27	21	27	21	Delete "that". [J. Graham Cogley, Canada]	Accepted - text revised
19540	2	27	21	27	22	Rewrite the sentence [Michelle A. North, South Africa]	Accepted - text revised
6868	2	28	1	28	6	Additional citation for 'earlier peaks in runoff are...projected in many mountain regions': Huntington, J. L., and R. G. Niswonger (2012), Role of surface-water and groundwater interactions on projected summertime streamflow in snow dominated regions: An integrated modeling approach, Water Resour. Res., 48(11), 1–20, doi:10.1029/2012WR012319. Evans, S. G., S. Ge, C. I. Voss, and N. P. Molotch (2018), The Role of Frozen Soil in Groundwater Discharge Predictions for Warming Alpine Watersheds, Water Resour. Res., (2013), 1127–1145, doi:10.1002/2017WR021623. [APECS Group Review, Germany]	Accepted - text revised
5082	2	28	8	28	8	clarify : The changing of water streams in oceans and seas regarding to climate change and its effect on Hydropower. [Essam Hassan Mohamed Ahmed, USA]	Rejected - not enough literture
24802	2	28	8	29	25	A very important aspect of hydropower is that it can serve as a perfect complement to other sources of renewable energy because it can be quickly dispatched if, for instance, the sun stops shining or the wind stops blowing. Might the authors like to add this concept? At the very least, emphasizing the carbon free aspect of hydropower may be important. [Elizabeth Weatherhead, USA]	Rejected - out of scope of this chapter

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
6878	2	28	10	29	25	Overall, Section 2.3.1.2 could be reduced in length to increase reader comprehension. It seems to have a deeper level of detail than Section 2.3.1.1. [APECS Group Review, Germany]	Accepted - text revised.
6882	2	28	10	28	11	Include citation: Wagner,T., Theme, M., Schuppel, A., Gobiet, A., Stigler, H., and Birk, S (2016), Impacts of climate chnge on stream flow hydropower generation in the alpine region, Environ Earth Sci 76(4). DOI: 10.1007/512665-016-6318-6 [APECS Group Review, Germany]	Accepted - citation added
19542	2	28	10	28	10	Delete: ", as a result of cryosphere change, "; any cause of altered river runoff will affect hydropower [Michelle A. North, South Africa]	Accepted - text revised.
19544	2	28	11	28	14	Delete "There is a close association between hydropower and mountainous regions, giving", and modify the sentence to read: "Since the amount of power that can be generated is directly proportional to the difference in height between the inlet and outlet (), hydropower installations are typically in mountainous areas." [Michelle A. North, South Africa]	Accepted - text revised.
24800	2	28	11	28	14	This sentence needs to be re-written (and possibly broken into two sentences?) [Elizabeth Weatherhead, USA]	Accepted - text revised.
2006	2	28	12	28	12	"given that" [J. Graham Cogley, Canada]	Taken into account - text revised in a different way.
6884	2	28	14	28	16	Include citation: Wagner,T., Theme, M., Schuppel, A., Gobiet, A., Stigler, H., and Birk, S (2016), Impacts of climate chnge on stream flow hydropower generation in the alpine region, Environ Earth Sci 76(4). DOI: 10.1007/512665-016-6318-6 [APECS Group Review, Germany]	Accepted - citation added
19546	2	28	15	28	16	Modify to read: "…changes in the cryospheric components can directly affect hydropower production." [Michelle A. North, South Africa]	Accepted - text revised.
5960	2	28	16	28	20	Intuitively we think that hydropower is directly related to the amount of water and elevation of the centre of mass of the body of water, as only gravitational energy of the water is turned into electrical energy (through m*g*h). So you would expect an almost linear effect of river runoff and available hydropower. Maybe it is nice to provide a short explanation to elaborate what makes it complicated? [Roderik Van De Wal, Netherlands]	Rejected - don't have space for textbook explanations of material
6886	2	28	16	28	16	Include citation: Hamududu, B., and Killingtveit, A (2012), Assessing climate change impacts on global hydropower, Energies 2012 (5), 305-322. DOI: 10.3390/en5020305 [APECS Group Review, Germany]	Rejected - article refers to neither crysophere nor mountains
19548	2	28	16	28	17	Modify to read: "…electricity generation globally but contributes sometimes close to 100% in many mountainous countries." [Michelle A. North, South Africa]	Accepted - text revised.
19550	2	28	16	28	17	Provide a citation for the sentence [Michelle A. North, South Africa]	Accepted - citation added
6890	2	28	17			Hydropower 100%: that is for electricity, but often other cooking energy is fuel wood or dung etc. needs to be clear [APECS Group Review, Germany]	Rejected - sentence explicitly states electricity generation
5948	2	28	18	28	20	It is stated that different studies predict, but only one study has been mentioned (and because it is still under review, I can also not check whether more studies are mentioned in this paper) [Roderik Van De Wal, Netherlands]	Noted - the sentence has deleted due to space
19552	2	28	18	18	17	"…can vary substantially across regions…" [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
22340	2	28	25	28	30	The same holds true for the Himalayan region, where a large and increasing number of glacier-fed rivrers are dammed for hydropower generation (see Nüsser 2014: Large dams in Asia. published by Springer). [Marcus Nüsser, Germany]	Noted - the sentence has deleted due to space
17116	2	28	28	6	6	I suggest adding in this section that a remaining glacier cover in summer also dampens the impact of extreme precipitation events on flooding, in particular for heavy thunderstorms in mountains. [Frank Paul, Switzerland]	Rejected - require literature
12746	2	28	30			consider citing Farinotti et al. 2016 here as well: Farinotti, D., Pistocchi, A., Huss, M. From dwindling ice to headwater lakes: Could dams replace glaciers in the European Alps? (2016) Environmental Research Letters, 11 (5), art. no. 054022, . Cited 7 times. https://www.scopus.com/inward/record.uri?eid=2-s2.0-84994684028&doi=10.1088%2f1748-9326%2f11%2f5%2f054022&partnerID=40&md5=b12a2001f25fea592d8293552f938c88 [Jan-Christoph Otto, Germany]	Noted - the sentence has deleted due to space
6870	2	28	32	28	34	Instead of 'a decrease in total annual runoff' expected changes to runoff should be framed using same language that was used on Page 26 Line 28 and Page 42 Line 36 (i.e. shifts in the timing of 'peak water'). [APECS Group Review, Germany]	Accepted - text revised with consistency in runoff change
19554	2	28	35	28	35	Delete "runoff" after glacier melt [Michelle A. North, South Africa]	Accepted - text revised.
19556	2	28	36	28	38	Modify to read: "Although increasing flows in the Upper Rhone Basin may favour higher production in ice-fed reservoirs in the short term, the longer term..." [Michelle A. North, South Africa]	Accepted - text revised.
6872	2	28	40	28	45	This paragraph would be more appropriate towards the start of this section. [APECS Group Review, Germany]	Rejected - paragraph has been deleted due to space.
24804	2	28	40	28	45	This paragraph needs some slight rewording. These are two challenges, not two responses. Should be easy to fix. [Elizabeth Weatherhead, USA]	Rejected - paragraph has been deleted due to space.
19558	2	28	41	28	43	Modify to read: "The first includes responses necessary to accommodate long-term changes in runoff caused by changes in the cryospheric reservoir () and in the seasonality of snowmelt." [Michelle A. North, South Africa]	Rejected - paragraph has been deleted due to space.
10680	2	28	43	28	45	Please add, that in spite of reservoires are usually considered as a flood prevention measure, their capacity is limited. Acceleration of extremal precipitation in mountainous regions togeter with more active glacier meiting lead to overflow of reservoirs and risk of dams' brake. It is ecpecially dangerous at old HPs, which heed to be reconstructed, but developing countries usually have not enough money. Look for example 7th National Communication to UN FCCC - Kazakhstan [Oxana Lipka, Russian Federation]	Rejected - paragraph has been deleted due to space.
19560	2	28	43	28	43	Modify to read: "The other category includes responses to extreme events such as floods and droughts." [Michelle A. North, South Africa]	Rejected - paragraph has been deleted due to space.
3286	2	28	44	28	45	Again the tree cover (and also the occudence of well-preserved wetlands) may have a role preventing/cushioning sudden floods. [Castor Muñoz Sobrino, Spain]	Rejected - paragraph has been deleted due to space.
6880	2	28	44	28	44	Glacier floods is not clear to me. This could be relates to glacial-derived floods of GLOFs events o even also to periglacial processes (destabilizing rock glaciers, debris flows, etc). [APECS Group Review, Germany]	Rejected - paragraph has been deleted due to space.

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6888	2	28	44	28	45	Floods and especially glacier floods can cause a sudden increase in sediment input to a reservoir that may threaten the longevity of the reservoir or reduce its water carrying capacity - sentence can be reframed like this. [APECS Group Review, Germany]	Rejected - paragraph has been deleted due to space.
19562	2	28	47	28	47	Modify to read: "...hydropower reservoirs can also be used to buffer the effects of changes in the cryosphere." [Michelle A. North, South Africa]	Taken into account - text revised in a different way.
19564	2	28	48	28	49	Modify to read: "As water is available for use downstream of the hydropower facility, the reservoir can be used as a supply of fresh water for drinking and irrigation." [Michelle A. North, South Africa]	Accepted - text revised.
1416	2	28	53	28	57	Recent efforts to incorporate glacier changes in hydrological models are becoming more sophisticated. Here, it would be good to mention the recent study by Seibert et al. (2018, HESS, doi: 10.5194/hess-22-2211-2018) [Harry Zekollari, Switzerland]	Noted - due to limitation in length, uncertainty in modeling is discussed
5950	2	28	53	28	54	We cannot find this statement back in the mentioned paragraph [Roderik Van De Wal, Netherlands]	Accepted - text revised.
6874	2	28	53	28	54	This sentence that points to Section 2.3.1.1 is not supported by Section 2.3.1.1. Please revise. [APECS Group Review, Germany]	Accepted - text revised.
19566	2	28	53	28	53	Modify to read: "Many hydrological models do not incorporate glacier changes at all, or only incorporate them very simplistically." [Michelle A. North, South Africa]	Accepted - text revised.
6876	2	28	54	28	57	The language and syntax of this sentence makes it unclear, please revise. [APECS Group Review, Germany]	Accepted - text revised.
24806	2	28	54	28	57	This sentence needs a re-write, possibly breaking the sentence into two sentences. [Elizabeth Weatherhead, USA]	Accepted - text revised.
19568	2	28	56	28	57	Start a new sentence after the reference (Condom et al 2012), so that the mitigation constraints stand alone. [Michelle A. North, South Africa]	Accepted - text revised.
12568	2	29	1	29	6	is there a reference available to support the statement? My impression is that expansion in OECD countriesis limited by difficulties to find political consent rather than by exhaust of the potential. [Thomas Vikhamar Schuler, Norway]	Noted - paragraph deleted due to space constraints
17544	2	29	2	29	6	Leaving aside the unclear definition of "mature", I notice that the entire paragraph comes without references and comes with a rather vague conclusion. Can this be substantiated? [Wolfgang Cramer, France]	Noted - paragraph deleted due to space constraints
22842	2	29	2	29	4	This sentence is not well written. Needs to more clear what "technical potential" is. [Lena Rubensdotter, Norway]	Noted - paragraph deleted due to space constraints
3942	2	29	4	29	4	Future expansion of Hydropower in 'Africa' is missing. [Anil Mishra, France]	Noted - paragraph deleted due to space constraints
6900	2	29	4	29	6	Hence, for a successful mitigation, the problems associated with data generation, access and incorporation into operational procedures need to be addressed. - sentence can be reframed like this [APECS Group Review, Germany]	Noted - paragraph deleted due to space constraints
19570	2	29	4	29	4	What about Africa? Please provide a citation for this statement [Michelle A. North, South Africa]	Noted - paragraph deleted due to space constraints
4496	2	29	5			Change 'mitigation' to 'adaptation' - Mitigation has a different use in an IPCC context than (I believe) is intended here. [Graham Mcdowell, Canada]	Noted - paragraph deleted due to space constraints
24808	2	29	5	29	6	"incorporate of knowledge" is unclear in this context, although I am sure the authors have something specific in mind; I don't know what that is. [Elizabeth Weatherhead, USA]	Noted - paragraph deleted due to space constraints
6892	2	29	8	29	25	This paragraph could be reduced in length to increase clarity. [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
17546	2	29	8	29	25	It is good to see that the discussion of adaptation is integrated into the risk assessment, but the text should be more critical and more concise. For example, an IPCC assessment does not need to say that "This begins by outlining key uncertain factors that may affect a project. Potential vulnerabilities that a project incurs if one or a combination of these factors falls into problematic ranges are then identified." This sounds too much like a beginner's text book in technical adaptation. [Wolfgang Cramer, France]	Accepted - text revised.
21066	2	29	8		25	This paragraph needs context. The point is really that they're aware of, not that they are currently impacted. And if they are already impacted by it we should be specific and cite that as evidence elsewhere. [Thomas Wagner, USA]	Accepted - text revised.
24810	2	29	8	29	11	Great writing, clear concepts well expressed. [Elizabeth Weatherhead, USA]	Noted
22844	2	29	12	29	12	What does "generation losses" mean? [Lena Rubensdotter, Norway]	Taken into account - this text has been rewritten and the term deleted.
2008	2	29	21	29	21	Delete "potential", or change "incurs" to "may incur". [J. Graham Cogley, Canada]	Accepted - text revised.
24812	2	29	21	29	25	Too much detail without adding much to the report? [Elizabeth Weatherhead, USA]	Accepted - text revised.
6902	2	29	22	29	23	A box to explaining "climate stress test" in brief and how it is calculated should be included. [APECS Group Review, Germany]	Taken into account - this part of the text has been deleted
6904	2	29	23			Climate stress test needs a citation [APECS Group Review, Germany]	Taken into account - this part of the text has been deleted
11872	2	29	24			I would strongly advocate against the use of "climate changes" in the plural form. In the context of the UNFCCC, we talk about "climate change" as a singular phenomenon (see Art.1). Better here would be "climatic changes". See also P. 38, line 20 [Dirk Hoffmann, Germany]	Accepted - text revised
6898	2	29	29	30	11	The technical language of Section 2.3.1.3 will likely make it inaccessible to policy makers and should be revised accordingly. [APECS Group Review, Germany]	Accepted - the section has been revised and more accessible
21442	2	29	29	29	33	Water quality in the high mountains is affected in first hand by non-soluble erratic material (silt to boulder fractions) present in gacier runoff in high concentrations. The notion of contamination of high mountain runoff by soluble components such as heavy metals is a bit misleading, since the major source of runoff in the mountains is atmospheric precipitation and associated typical contaminants. Hence it is unclear whether the contamination mentioned in this paragraph is just occasional or typical for all the high mountain areas. [Oxana Savoskul, Sri Lanka]	Taken into account - but is In other sections
24816	2	29	29	29	32	Perhaps mention the Arctic Monitoring Assessment Program's work on water quality? [Elizabeth Weatherhead, USA]	Rejected - due to age of document
2010	2	29	30	29	34	Delete "SRP", "DIN" and "DON" - acronyms not re-used. [J. Graham Cogley, Canada]	Accepted - text revised
19572	2	29	30	29	30	The acronym SRP is not used again, please omit [Michelle A. North, South Africa]	Accepted - text revised
24814	2	29	30	29	30	SRP is introduced as an acronym and then hardly used. Perhaps drop the acronym for clarity? [Elizabeth Weatherhead, USA]	Accepted - text revised
19574	2	29	32	29	32	Write phosphorus out in full (phosphorus-flux) [Michelle A. North, South Africa]	Accepted - text revised.
19576	2	29	33	29	34	Please remove all acronyms not used again (including DIN, DON) [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
19578	2	29	33	29	33	Add a comma after "In contrast" [Michelle A. North, South Africa]	Accepted - text revised.
18336	2	29	35	29	35	comma missing after "However" [Carmen Burghelea, Romania]	Accepted - text revised.
19580	2	29	35	29	36	Use "its" instead of repeating DOC again, so that it reads: "As DOC increases with more glacial melt, its bioavailability will change because DOC derived from glacier runoff…" [Michelle A. North, South Africa]	Accepted -text revised
18338	2	29	36	29	36	"will change" can be replaced with "will decrease" [Carmen Burghelea, Romania]	Accepted -text revised
19582	2	29	38	29	38	Please explain the unit Tg.yr^-1, as it is not commonly used in general sciences [Michelle A. North, South Africa]	Taken into account - think it is a common unit Terra grams but has been spelt out
19584	2	29	40	29	42	Delete this sentence [Michelle A. North, South Africa]	Accepted - text revised
18340	2	29	44	29	46	Another good reference for trace metals would be Zaharescu et al., 2016 (Zaharescu, D.G., P.S. Hooda, C.I. Burghelea, V. Polyakov and A. Palanca-Soler, 2016: Climate change enhances the mobilisation of naturally occurring metals in high altitude environments. Science of the Total Environment, 560-561, 73-81) that showed the important role of climate change on geogenic trace metal mobilization in sediments of high altitude lakes. [Carmen Burghelea, Romania]	Taken into consideration - this reference added
19586	2	29	45	29	46	Delete acronyms and alter to read: "... associated with legacy pollutants like persistent organic pollutants, polycyclic aromatic hydrocarbons and heavy metals ()." [Michelle A. North, South Africa]	Accepted -text revised
2012	2	29	46	29	48	Delete "POPs" (re-used once), "PAHs" (not re-used) and "PCBs" (not re-used and not even defined, so spell out once). [J. Graham Cogley, Canada]	Accepted -text revised
19588	2	29	47	29	47	Write POPs out in full [Michelle A. North, South Africa]	Accepted -text revised
3848	2	29	48	29	49	Guzzella et al., 2016 found that in southern Central Himalaya, the long-range atmospheric transport (LRAT) mechanism its primary role in the transfer of POPs and PAHs to high-elevated regions, while the increased melting of glaciers, due to global warming, and the was suggested to be a secondary source of pollution. (http://dx.doi.org/10.1016/j.scitotenv.2015.11.118) [Franco Salerno, Italy]	Rejected - secondary source of contaminants so not included
6894	2	29	48	29	48	Need to define PCB acronym (technical language) [APECS Group Review, Germany]	Taken into consideration - spelt out in full
19590	2	29	48	29	48	PCBs has not yet been defined - remove acronym and write out term in full. [Michelle A. North, South Africa]	Accepted -text revised
22846	2	29	54	29	54	Needs to be stated if its is naturally geologically occuring mercury or some anthropogenical pollution secondary released .. [Lena Rubensdotter, Norway]	Accepted - clarified
6896	2	29	56	29	56	Need to define geogenic and Hg (technical language) [APECS Group Review, Germany]	Accepted - spelt out in full
6916	2	30	2			lacks a period before Howver [APECS Group Review, Germany]	Accepted -text revised
3846	2	30	5	30	7	On the matter Colombo et al., 2018 publish an exaustive review. (https://doi.org/10.1016/j.gloplacha.2017.11.017) [Franco Salerno, Italy]	Accepted - included this reference
6906	2	30	9	30	9	Need to define bioflocculation (technical language) [APECS Group Review, Germany]	Taken into consideration - added to glossary
6908	2	30	13	30	57	While well written, the first part of Section 2.3.1.3.1 lacks the citation frequency of other sections (for example, Section 2.3.3.1.1), potentially creating uncertainty. Please add additional citations to this text. [APECS Group Review, Germany]	Noted - additional references provided by CA Graham McDowell and others have been added. The literature on human response remains sparser than for physical processes.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
12456	2	30	13	33	22	It seems to me that the numbering is wrong for some of these Sections. I guess it should read 2.3.1.4 Agriculture and irrigation, 2.3.1.5 Drinkign water supply, 2.3.1.6 Water Governance and Response Measures. Also note that, in general, some headings use capitalized words, some not (e.g. "Agriculture and irrigation" versus "Observed and Projected Changes"). [Sven Kotlarski, Switzerland]	Accepted - capitalization changed to follow SROCC Style Guide.
22912	2	30	13	57	30	Some information about the location where changing practices of agriculture and irrigation are happening and expect to happen are missing in this section. [Romy Schlogel, UK]	Accepted - e,f should read 30, 57. locations and references added.
24818	2	30	13	30	57	This entire section needs more references, particularly in the first two paragraphs and the last two paragraphs. [Elizabeth Weatherhead, USA]	Accepted - references have been added
5952	2	30	14	30	19	Major: The first part of paragraph 2.3.1.3.1 give some clear statements, which is in our opinion a good thing. However, should statements like this not be backed up with references? [Roderik Van De Wal, Netherlands]	Accepted - locations and references added.
21376	2	30	14	30	19	References are urgently needed for this paragraph. The paragraph as currently phrased is neither verifiable nor traceable. Which areas have already observed reductions in irrigation water, and which areas are projected to do so in the future? [Philippus Wester, Nepal]	Accepted - locations and references added.
2014	2	30	17	30	17	"leads". [J. Graham Cogley, Canada]	Accepted - text revised
6918	2	30	17			Some areas' is a weak statement, needs details and citations [APECS Group Review, Germany]	Accepted - locations added
24350	2	30	17	30	17	Which areas? Give examples [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - locations added
24352	2	30	19	30	19	many other? Give examples [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - text revised
4498	2	30	22			What is the evidence that larger scale assessments are 'more systematic'? Local scale assessments involving local populations can also be 'systematic'. Perhaps support this claim, or remove it. [Graham Mcdowell, Canada]	Accepted - specified/added references
4500	2	30	22	30	24	Citations supporting these sentences would be helpful. [Graham Mcdowell, Canada]	Accepted - references added
19592	2	30	24	30	24	Delete "more" so that it reads: "...more localized and focused on rivers..." [Michelle A. North, South Africa]	Accepted - text revised
6910	2	30	27	30	27	soil stability [APECS Group Review, Germany]	Accepted
11874	2	30	28	30	29	The half sentence "which were previously less erodible" can be erased. [Dirk Hoffmann, Germany]	Accepted
126	2	30	30	30	32	Change in hydrological regimes also contributes to changes in the land cover, land use and land use change, which may cause forest ecosustem change and resulted affect its role in protecting soil and storing water, with potential cascading effects on downstream areas. [Mostafa Jafari, Iran]	Accepted - original wording is clear on land use change.
19594	2	30	31	30	31	Delet ethe second "land", so that it reads: "...land cover and use..." [Michelle A. North, South Africa]	Noted
6912	2	30	32	30	32	By contrast, higher sediment input from glacier runoff may favour agriculture productivity [APECS Group Review, Germany]	Rejected - not supported by peer-reviewed literature
22914	2	30	38	39		Some information are missing in relation to the intensity of the events mentioning and their location all over the world while it is not a general statement. [Romy Schlogel, UK]	Accepted - text revised to indicate Alps
24354	2	30	38	30	38	new crops? Give examples [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - references have been added

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
6914	2	30	39	30	42	The substance does not seems relevant as market forces and political pressures are common to all types of ecosystems or environments and are not unique to the mountain environments only. Hence it should be excluded [APECS Group Review, Germany]	Accepted - text revised
4502	2	30	40			Research by McDowell or Bury could be cited along with Porter et al 2014, e.g. McDowell, G., et al. (2013). "Climate-related hydrological change and human vulnerability in remote mountain regions: a case study from Khumbu, Nepal." Regional Environmental Change 13(2): 299-310. ; Bury, J., et al. (2013). "New geographies of water and climate change in Peru: Coupled natural and social transformations in the Santa River watershed." Annals of the Association of American Geographers 103(2): 363-374. [Graham Mcdowell, Canada]	Accepted - McDowell, Bury refs added elsewhere
4504	2	30	44	30	57	The first formal systematic review of adaptation in mountain regions was conducted by McDowell et al 2014, and soon-to-be available results in McDowell et al (in Review) will provide a comprehensive and up to date synthesis of exiting adaptation action and research in mountain systems. These documents can underpin and update claims in this section. See: McDowell, G., Huggel, C., Frey, H., Wang, F., Cramer, R., Ricciardi, V. (In Review) Adaptation action and research in glaciated mountain systems: Are they enough to meet the challenge of climate change? ; McDowell, G., et al. (2014). "Adaptation to climate change in glaciated mountain regions." Climatic Change 126(1-2): 77-91. [Graham Mcdowell, Canada]	Accepted - McDowell, Bury refs added elsewhere
21378	2	30	44	30	50	Red Flag: this paragraph is highly problematic. Its statements are not referenced, and factually incorrect. References to the large body of work by ICIMOD on adapation would be needed here, as well as the HIMAP chapter on adaptation, which provides a large-scale review and synthesis study for teh HKH region. [Philippus Wester, Nepal]	Accepted - references from ICIMOD added at several point in chapters
19596	2	30	46	30	46	Delete "also" and "other", so that it reads: "Large-scale review and synthesis studies, based on complementary data..." [Michelle A. North, South Africa]	Accepted - text revised
21380	2	30	52	30	57	same comment as above. References are needed here, and the assessment is far too negative. A lot of work on adaptation in mountain agriculture has been published, and should be referenced here. [Philippus Wester, Nepal]	Accepted - references from ICIMOD added at several point in chapter
2016	2	30	56	30	56	"has led". Why "outmigration" and not "emigration"? [J. Graham Cogley, Canada]	Rejected - outmigration is a standard term. Retained
5954	2	31	1	31	42	While this box provides some nice background information: we do not see the additional value of this box directly , there is a lot of space used to give examples, and we feel that it is disproportional with regard to the space used to describe physical processes [Roderik Van De Wal, Netherlands]	Rejected - we revised text, by deleting many examples or reviews of literature, to make space to explain physical process more in detail. Now the revised text has less examples and the box can provides leaders to see examples.
17926	2	31	1	31	40	Some of the text in this box is poorly based on literature, even though references are given. E.g. line 12, the evidence for this statement cannot be found in the papers referenced. Or line 28, I'm not aware of evidence that artificial ice reservoirs enable cultivation where it otherwise would not be possible. There is no clear assessment of the effect of such structures, e.g. the volume of ice of the reservoirs in relation to river runoff. There is a new paper (accepted) which is informative, Nüsser et al., Regional Env Change 2018. Finally, the last sentence of the bos (lines 33-34) is odd and very weak, poorly founded in evidence. [Christian Huggel, Switzerland]	Taken into account - more literature added

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
22332	2	31	5	31	34	Box 2.5: The information in the box should consider the paper by Nüsser et al. 2018: Socio-hydrology of 'artificial glaciers' in Ladakh, India: assessing adaptive strategies in a changing cryosphere. Regional Environmental Change doi:10.1007/s10113-018-1372-0 [Marcus Nüsser, Germany]	Taken into account - litterature added
24820	2	31	5	31	34	There is too much information on stupas and too little on frozen ponds and ice barriers. Can there be a bit more balance? [Elizabeth Weatherhead, USA]	Taken into account - text revised
11690	2	31	8	31	34	I do understand the interest of the three interventions (ice stupa, frozen ponds and snow barriers) for places where there is water shortage in spring – summer. But, is it really the case for areas impacted by glacier retreat, were precisely glacial shrinkage provides water that can be used directly for irrigation? [Jacques Mourey, France]	Taken into account - text revised with other comments
11692	2	31	8	31	34	If available, it would be interesting to provide more information about the effectiveness of such innovations. For what surface of fields one ice stupa provides water? On average, for how many people one ice stupa is enough? Etc. [Jacques Mourey, France]	Taken into account - text revised
19598	2	31	9	31	9	Indian states, plural [Michelle A. North, South Africa]	Accepted - text revised
4506	2	31	11			Reduced' should be changed to 'Increased' [Graham Mcdowell, Canada]	Accepted - text revised as Reduced snow and glacier melt water
2018	2	31	22	31	23	"melt". "flow". "barrier". [J. Graham Cogley, Canada]	Accepted - text revised as Reduced snow and glacier melt water
19600	2	31	22	31	22	Modify: "...'artificial glaciers', which melt in the spring and flow to fields..." (melt and flow without an 's') [Michelle A. North, South Africa]	Accepted - text revised
4508	2	31	28			Otherwise uncultivated' gives the impression that these responses are general agricultural innovations, not adaptations to climate change. Perhaps clarify the link to climate-related changes, as is done in lines 11-12 (same page). [Graham Mcdowell, Canada]	Accepted - text revised
11104	2	31	28	31	28	The ice that forms the stupa is not glacier ice it is just frozen water. Please see both definitions in Cogley et al., (2011). Cogley, J. R., Hock, R., Rasmussen, L.A., Arendt, A.A., Bauder, A., Braithwaite, R.J., Jansson, P., Kaser, G., Möller, M., Nicholson, L. and Zemp, M.: Glossary of Glacier Mass Balance and Related Terms, UNESCO-IHP, Paris. [online] Available from: http://unesdoc.unesco.org/images/0019/001925/192525E.pdf (Accessed 1 February 2015), 2011. [Lucas Ruiz, Argentina]	Taken into account - now called ice reservoirs'
17118	2	31	31	11	11	As mentioned in the report, shrinking glaciers only results in reduced meltwater after peak flow. I am not sure if this is already the case here. Morevover, glacier retreat (i.e. change in length) has in general very little impact on the amount of meltwater. Ths requires a substantial reduction in glacier volume. [Frank Paul, Switzerland]	Accepted - text revised
17120	2	31	31	34	34	glacier retreat: see comment before: retreating glaciers have a very limited impact on water shortages (that is for a long time over-compensated by additional meltwater from higher elevations). [Frank Paul, Switzerland]	Accepted - text revised
17122	2	31	31	38	38	Glacier ice stupa': I hope you can simply write 'ice stupa'. I am aware that locally the misleading terminology has been used, but I hope it must not be repeated in this report. It is ice but certainly not glacier ice (i.e. composed of compressed snow). [Frank Paul, Switzerland]	Accepted - text revised, now call icer reservoir

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
6926	2	32	0			Re. adaptations, for years there is a push and implementation of DRY RICE varieties; should be mentioned as a major [APECS Group Review, Germany]	Rejected - not supported by the peer-reviewed published literature
6928	2	32	0			Asian and world crop [APECS Group Review, Germany]	Rejected - text already refers to Asian and world crops
15556	2	32	1	32	53	Is there some way to clarify how/why adaptation changes were made? Are communities involved in planning responses? Is information sufficient to develop a strategic response for at least a generation? [Melinda Kimble, USA]	Accepted - text revised
21382	2	32	1	32	41	More can be cited and referenced here on the work in the HKH [Philippus Wester, Nepal]	Accepted - new references added
4510	2	32	2			What is the assessment protocol for evaluating the state of adaptation (e.g. how was the literature collated and coded, and how were the six points identified)? The reminder of the page reads like a traditional literature review, not a systematic review of the available literature. [Graham Mcdowell, Canada]	Rejected - beyond the mandate of the report to include a discussion of selection and coding of literature.
4516	2	32	4	32	53	All of this should be checked against and augmented by the soon-to-be available results in McDowell et al (In Review) which provides a comprehensive and up to date systematic review of exiting adaptation action and research in mountain systems. See: McDowell, G., Huggel, C., Frey, H., Wang, F., Cramer, R., Ricciardi, V. (In Review) Adaptation action and research in glaciated mountain systems: Are they enough to meet the challenge of climate change? The supplementary materials for McDowell et al (In Review) provide a reference list for all articles that engage with adaptation in mountain systems, which may be a helpful resource when revising this and other adaptation focused sections. [Graham Mcdowell, Canada]	Accepted - McDowell et al reviewed, papers added.
19602	2	32	5	32	5	Modify: "...greenhouses have been adopted in Ecuador..." [Michelle A. North, South Africa]	Accepted - text revised
19604	2	32	7	32	8	Modify to read: "Box 2.5 describes innovative irrigation practices in India." [Michelle A. North, South Africa]	Accepted - text revised
19606	2	32	9	32	9	There is something missing at the end of this sentence [Michelle A. North, South Africa]	Accepted - text revised
2020	2	32	12	32	12	Delete "overall". [J. Graham Cogley, Canada]	Accepted - text revised
19608	2	32	12	32	12	Modify to read: "...which are more profitable overall..." [Michelle A. North, South Africa]	Accepted - text revised
19610	2	32	20	32	20	Crop production should be singular (not crops) [Michelle A. North, South Africa]	Accepted - text revised
19612	2	32	26	32	27	Delete "the" before "two tribes" [Michelle A. North, South Africa]	Accepted - text revised
17124	2	32	32	4	53	As the measures reported here are equally applicable in non-mountain regions with irrigation water shortages, I am not fully convinced that this level of detail for agricultural practices is required here. It seems to be off-topic of this report and I suggest reducing it to a couple of citations or reference to another report. [Frank Paul, Switzerland]	Rejected - mountain cryosphere is scope of this chapter
17126	2	32	32	55	55	climate warming': Is there a chance to avoid this term (e.g. using global warming instead)? As climate is more than temperature, it is difficult to warm the climat;. 'threatend by increasing temperatures' should also work. [Frank Paul, Switzerland]	Accepted - text revised
6920	2	32	38	32	38	Delete point before reference [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
22334	2	32	38	32	39	Insert "Pakistan" and "Parveen et al. 2015". The text should read : ... from India (Dame and Mankelow, 2010; Clouse, 2016), Pakistan (Parveen et al., 2015; Nüsser and Schmidt, 2017), and Peru (Postigo, 2014). [Marcus Nüsser, Germany]	Accepted - text revised
4512	2	32	39			If a Nepal example providing evidence of multiple adaptation activates is helpful in supporting this point, McDowell 2013 et al could be cited. See: McDowell, G., et al. (2013). "Climate-related hydrological change and human vulnerability in remote mountain regions: a case study from Khumbu, Nepal." Regional Environmental Change 13(2): 299-310. [Graham Mcdowell, Canada]	Accepted - text revised
24822	2	32	43	32	43	Consider replacing “such practices” with “adaptive practices.” [Elizabeth Weatherhead, USA]	Accepted - text revised
4514	2	32	47			Suggest changing 'few undertake' to 'few are able to undertake' to highlight the importance of barriers to adaptation, not a lack of initiative and agency, as is currently implicit. [Graham Mcdowell, Canada]	Accepted - text revised
6922	2	32	47	32	49	In addition, lack of minimum support price for the climate sensitive crops or environment/water friendly crops also prohibits farmers to take initiatives for adaptation activities. Citation: Kumar, S (2015),Status of ground water in punjab – a temporal analysis. Discovery Agriculture 3(10), 1-5. [APECS Group Review, Germany]	Rejected - text contains reference to finance
24824	2	32	47	32	47	Consider replacing “Barriers include..” with “Barriers to adaptation include…” [Elizabeth Weatherhead, USA]	Accepted - text revised
6924	2	32	49	32	50	The impact of increasing temperature on agricultural production has been assessed by the Indian Network for Climate Change Assessment (2010). For instance; Apple production in the Himachal Pradesh has decreased between 1982 & 2005 as the increase in maximum temperature has led to reduction in total chilling hours in the region. A decline of more than 91 units per year in last 23 years has taken place. [APECS Group Review, Germany]	Rejected - non-cryosphere mountain processes are outside the scope of the chapter
21068	2	32	55	56		That's coastal elevations, not high mountain. Make sure to state that. [Thomas Wagner, USA]	Accepted - text revised
24826	2	33	1	33	1	Consider replacing “Ice layers in the snow lead to …” with “Ice layers in the snow formed by melting and refreezing of snow or by freezing rain lead to..” [Elizabeth Weatherhead, USA]	Accepted - text revised
6946	2	33	2			state as an example, many more of those exist [APECS Group Review, Germany]	Rejected - reviewer does not indicate what "many more of these" refers to
15558	2	33	4	33	16	Given extensive research on Bogota, Colombia, shouldn't it be incorporated into this discussion of water availability and quality? [Melinda Kimble, USA]	Rejected - not supported by the peer-reviewed published literature
21072	2	33	5		10	With regards to the last comment, this section says up front it's little studied. This pararaphs is profoundly important and I feel like this should frame the water section up front. But nothing about supplying water to INDIA AND CHINA? [Thomas Wagner, USA]	Accepted - text revised
11878	2	33	6	33	7	La Paz is not the national capital of Bolivia (this is Sucre); La Paz is "only" the seat of government, which sometimes causes confusion. [Dirk Hoffmann, Germany]	Accepted - text revised

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
11880	2	33	8	33	10	The data given for the dry season (even though technically probably very much correct) is misleading, as there is almost no precipitation during the dry season. In consequence, a high percentage of a very low total is negligeable for future water scarcity in the city of La Paz. - where future loss of glacier contribution in the dry season will probably matter is on local biodiversity (and associated livelihoods); but not for water supply to the city. [Dirk Hoffmann, Germany]	Rejected - cited reference does not contain the technical issue which the reviewer suggests
6930	2	33	10	33	10	Should change 'It shows' to 'These studies show'. [APECS Group Review, Germany]	Accepted - text revised
24828	2	33	10	33	10	“It shows the vulnerability..” Replace “It” with something more descriptive. [Elizabeth Weatherhead, USA]	Accepted - text revised
6944	2	33	12	33	12	some high volcanoes in the Andes have also permafrost and theefore the runoff may be also influenced by thawing permafrost [APECS Group Review, Germany]	Rejected - not supported by the peer-reviewed published literature
24830	2	33	12	33	16	The references appear at the very end of the paragraph but seem to belong when actual results are first quoted (earlier in the paragraph). [Elizabeth Weatherhead, USA]	Accepted - text revised
2022	2	33	13	33	13	"flows". [J. Graham Cogley, Canada]	Accepted - text revised
17928	2	33	18	33	20	Can we say that Delhi partly relies on glacier melt water. I'm not sufficiently familiar with the water service system of Delhi (or Islamabad) but for instance Ganges river has relatively low glacier melt contributions and he Ganges plain also depends much on groundwater retrieval. [Christian Huggel, Switzerland]	Rejected - Yamuna river is a major source of water for Delhiit, which receives glacier melt water
21444	2	33	18	33	19	It is a highly disputable statement, since the streamflow of the large rivers in the monsoon regions depends mainly on liquid precipitation. In Ganges basin the contribution from the meltwater resources is low (around 5%) (IWMI, 2014). In Indus basin, it is laround 40-45%, however the reduction of glaciers and seasonal snow affects mainly the seasonal distribution of flow by increasing runoff during cold part of the year and stretching and lowering the spring-summer peak flow. [Oxana Savoskul, Sri Lanka]	Taken into account - the sentence was deleted.
2024	2	33	19	33	20	"on the banks of". "meltwater". "of the cryosphere". "water shortages". [J. Graham Cogley, Canada]	The sentence was deleted
19614	2	33	20	33	20	Should be "risk to water supply", not "of" [Michelle A. North, South Africa]	Taken into account - text revised
4518	2	33	21			Perhaps include a numberd list of key adaptaion responses here, as was doen on p 32? [Graham Mcdowell, Canada]	Taken into account - examples in transboundary policies are given, but due to limitation in space and evidence, individual adaptation response except for transboundary cooperation is given in separate subsections.
4522	2	33	21			Perhaps include a numbered list of key adaptation responses here, as was done on p 32? Data from McDowell et al (In Review) can be provided to support this effort (contact lead author). See: McDowell, G., Huggel, C., Frey, H., Wang, F., Cramer, R., Ricciardi, V. (In Review) Adaptation action and research in glaciated mountain systems: Are they enough to meet the challenge of climate change? [Graham Mcdowell, Canada]	Taken into account - examples in transboundary policies are given, but due to limitation in space and evidence, individual adaptation response except for transboundary cooperation is given in separate subsections.
5084	2	33	21	33	21	To add: 2.3.1.3.3: Brackish water , Irrigation, industrial and house hold waste water [Essam Hassan Mohamed Ahmed, USA]	Rejected - not enough peer-reviewed publications. Key impacts and vulnerabilities directly related to change in cryosphere are discussed.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
1610	2	33	24	33	35	Another key recent reference is Quincey et al. 2018, which provides a link for readers to consider these implications in high mountain Asia https://onlinelibrary.wiley.com/doi/full/10.1002/wat2.1258 . I agree that the issues are outside of the scope of this chapter, but it would be important to flag in a report like this that many of these social, cultural and economic inter-linkages driving water accessibility are also not well understood at all. Line 32 also does not make sense as written [Brown Lee, UK]	Taken into account - reference added
6934	2	33	24	33	27	This sentence should be broken apart into two sentences to increase reader clarity. [APECS Group Review, Germany]	Taken into account - sentence revised
6942	2	33	24	34	3	Run on and compound sentences found throughout Section 2.3.1.4 should be broken up to increase reader comprehension. [APECS Group Review, Germany]	Taken into account with other comments
21384	2	33	24	33	35	The HIMAP water chapter needs to be referenced here, and its content reflected. [Philippus Wester, Nepal]	Taken into account - due to limitation in space, however, only selected papers are cited in main text.
19616	2	33	25	33	25	Check the section 2.2.3. being referred to here, since this section refers to Glaciers and doesn't appear to fit where it is being cited [Michelle A. North, South Africa]	Accepted - text revised
6932	2	33	26	33	26	Add 'to' in '...that are important to local...'. [APECS Group Review, Germany]	Accepted - text revised
6936	2	33	29	33	29	Remove comma between mitigation and rests. [APECS Group Review, Germany]	Taken into account - The sentence was deleted
19618	2	33	30	33	33	Alter to read: "Despite its importance, a comprehensive assessment of the complex interlinkages between socio-economic and cultural aspects important and relevant for water governance, falls outside the scope of this chapter." [Michelle A. North, South Africa]	Taken into account - The sentence was deleted
2026	2	33	32	33	32	Delete ", these". [J. Graham Cogley, Canada]	Taken into account - The sentence was deleted
6938	2	33	32	33	32	Change to '...relevant for water governance falls outside...' [APECS Group Review, Germany]	Taken into account - The sentence was deleted
17128	2	33	33	20	20	As mentioned above, there is only an impact after peak water, before there is an increase in run-off. As far as I know, peak water for the Himalaya with ist huge and often debris-covered glaciers is expected to occur only at the end of the 21st century. So this should not be an issue for the time to come for this region. [Frank Paul, Switzerland]	Accepted - the sentence was deleted
16832	2	33	45	33	45	Following two prublication are highly relevant for this discussion Molden, D. J., Vaidya, R. A., Shrestha, A. B., Rasul, G., & Shrestha, M. S. (2013). Water infrastructure for the Hindu Kush Himalayas. International Journal of Water Resources Development, 30(1), 60-77. Shrestha, A. B., Wahid, S. M., Vaidya, R. A., Shrestha, M., & Molden, D. J. (2013). Regional water cooperation in the Hindu Kush Himalaya. In J. Griffiths & R. Lambert (Eds.), Free Flow: Reaching Water Security Through Cooperation (pp. 65-69). Paris: UNESCO and Tudor Rose. [Arun Shrestha, Nepal]	Taken into account - due to limitation in space, however, only selected papers are cited in main text.
6940	2	33	48	33	48	Remove ', such as' [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
15622	2	33	51	33	52	The Bangladesh Delta Plan 2100 is introduced without cited any reference. Either of the following references can be cited- 1) "BanDuDeltas: Bangladesh Delta Plan 2100 Formulation Project: Inception Report, BDP 2100, Consultant Team BanDuDeltas, 2014." 2) "GoB, 2014. Bangladesh Delta Plan 2100 Formulation Project, Inception Report. Planning Commission, Government of Bangladesh (GoB), Dhaka." [Akm Saiful Islam, Bangladesh]	Taken into account - The sentence was deleted
24832	2	33	51	33	56	Consider addressing the writing style: “For example, the upcoming Bangladesh…For example, in Nepal…Moreover, India….” [Elizabeth Weatherhead, USA]	Taken into account - The sentence was deleted
15624	2	33	54	33	56	It has been mentioned that the focus of the adaptation policy is primarily on water and flood management (Pandey et al., 2016; Gain et al., 2017). However, the emergent issues such as sea level rise due to climate change are posing an additional threat to coastal regions of Bangladesh. This is one of the reasons for the Government to take the initiative of preparing the Bangladesh Delta Plan 2100 (http://www.bangladeshdeltaplan2100.org/). [Akm Saiful Islam, Bangladesh]	Taken into account - the sentence was deleted. It is discussed in chapter 4 (sea level rise) and cross chapter box in low-lying delta. Close link to other parts of this report is given.
13424	2	34	0	44		2.3.3 Definition are needed of different concepts like "rock avalanche", "rockfall", "movement of frozen debris", "landslides from frozen sediments", "landslides", "debris flow", "rock slides", "moranic slide or collapse" which seem to be discussed in different paragraphs. What is the difference between them? Each paragraph could perhaps clearly discuss one topic, define the topic, list the evidence for how climate change has impacted in the past and is expected to impact in future, and then give a confidence statement, based on the evidence. Currently this section reads like a random list of statements, it needs a clearer structure. The entire section 2.3 could do with some restructuring and consolidating. [Debra Roberts and Durban Team, South Africa]	Accepted - more terms explained or replaced, and section restructured
24834	2	34	5	34	16	It would be good to offer some interpretation of these efforts to monitor. Is this sufficient? Is this appropriate? Are there lessons learned? [Elizabeth Weatherhead, USA]	Rejected - out of scope of this section. We intended to list key impact and vulnerabilities and key responses related to water supply in 2.3.1, with scientific likelihood and confidence based on literature. Evaluation of quality and confidence of monitoring and assessing change in cryosphere are given in individual subsections.
3944	2	34	8	34	16	Suggested institution in the list: Establishment of Central Asian regional glaciological center (category 2) in the Republic of Kazakhstan, under the auspices of UNESCO Ref: http://www.government.kz/en/novosti/1007471-senate-ratifies-the-agreement-on-establishing-a-regional-glaciological-center.html [Anil Mishra, France]	Rejected - limitation in space and not all individual activities are covered in this examples.
19620	2	34	8	34	11	Include "the" before Alps, Governments, Andes and Regional Project… [Michelle A. North, South Africa]	Accepted - text revised
19162	2	34	11			In 2011 Argentina approved the law for protection of glaciers which includes a national survey of glaciers and also aims at these goals. I think Chile as a similar approach. [Goncalo Vieira, Portugal]	Noted - brief references and discussion (assessment) on studies looking at glacier law purpose and context have now been provisionally been added to sub-sections under glacier (section 2.2.3) and subsection on water (2.3.1.3), subject to further editing for final SOD version.
6950	2	34	14			lacks to mention examples from Asia, e.g. ICIMOD and river commissions [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
19622	2	34	14	34	14	Place the five country names in paretheses [Michelle A. North, South Africa]	Accepted - text revised
11036	2	34	18	34	20	Please consider the work of the "Water Management in the Alps" Platform of the Alpine Convention, http://www.alpconv.org/en/organization/groups/WGWater [Nathalie Morelle, Austria]	Rejected - limitation in space and not all individual activities are covered in the examples.
15506	2	34	24	34	31	It is difficult to accept that mining or extractive industries can be considered as an environmental service provided by the cryosphere or by the retreat of any of its components. Instead, they could be regarded as anthropic or economic activities performed on the (changing) cryosphere. Additionally, it is known that these kind of activities release dust or light-absorbing impurities into the air that accelerate snow and ice melting, and in this way they threaten the continuity of any environmental service provided by glaciers and also their own stability along time (mass balance). Besides, mining or extractive industries are frequently linked with high water consumption and chemical waste generation, explosions, vehicle traffic, etc. that can also endanger the quality of the water, soil and air. On the other hand, in many countries (several of them located in South America, central Asia, etc.), mining in high mountain and/or glaciated areas has been highly questioned after the occurrence of a series of different human-health and environmental harmful experiences. As a consequence, in Argentina, a special legal-environmental regime has been settled in order to protect glaciers and the periglacial environment against any detrimental action (including mining). For this reason, in accordance with the National Law N° 26.639, it is not acceptable to consider neither the glaciers nor the periglacial environment as a mining resource. (National Law 26.639. Regime for the Preservation of Glaciers and the Periglacial Environment. Available at: http://servicios.infoleg.gob.ar/infolegInternet/anexos/170000-174999/174117/norma.htm (in Spanish)). [Hernan Sala, Argentina]	Noted - text has been revised to take into account the 'provisioning service' context in which extractive industries were introduced in this subsection in FOD. Additional text elaborated in reference to studies that mention impacts to/from mining in changing cryosphere, including aerosols and dust/debris deposition.
19624	2	34	26	34	26	Alter to read: "...categorized as provisioning services." [Michelle A. North, South Africa]	Noted - text has now been revised and chnaged since FOD version.
22342	2	34	29	34	29	the paper by Zang et al. (2018): Hydrochemical and environmental isotope analysis of groundwater and surface water in a dry mountain region in Northern Chile. In: Environmental Monitoring and Assessment 190:334 fits in this context. [Marcus Nüsser, Germany]	Noted - however, recommended paper makes reference to elevated Manganese on surface water as possibly linked to mining actiity, but there is apparently no direct link/discussion on whether this mining activity comes a a result of increased access due to retreating glacier. The suggested paper may be suitable under section on water supply/quality (2.3.1.2).
6948	2	34	30	34	30	Italicize 'medium agreement' [APECS Group Review, Germany]	Noted - text and assessment revised for SOD
6952	2	34	30			add polination. Ludricous to claim there is not sufficient evidence for that and other impacts… [APECS Group Review, Germany]	Rejected - not clear what reviewer mentions regarding 'polination'. Furthermore, no information or references supplied to support this request.

SROCC First Order Draft Expert Review Comments - Chapter 2							
Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
17130	2	34	34	25	25	extractive industries': Maybe it is worth adding that in some regions (e.g. Kumtor Gold Mine in Ak-Shirak) the extractive industries just remove the glaciers in the case they cover a potential mining pit. The related impact of water/river pollution with toxic elements might be much higher in such regions than due to glacier retreat or other human activities. [Frank Paul, Switzerland]	Noted - however, would be great to receive papers and examples of publications that provide evidence to assess.
17132	2	34	34	32	32	One might add here that in extreme cases (summer 2003 in the Alps) reduced run-off in rivers (that are no longer fed by glaciers) might have severe economic impacts, ranging from water that is too hot to be available for cooling of nuclear power plants, to low flows in rivers (Rhine) that prohibits transport of fuel to important infrastructures (e.g. airport Frankfurt). I do not have a citation for this at hand but think this has been written somewhhere. [Frank Paul, Switzerland]	Noted - however, would be great to receive papers and examples of publications that provide evidence to assess. Without the evidence, it is difficult to ascertain the link between glacier retreat and changes in water temperature that affect use for nuclear plants. My searches have (unfortuntaley) not located such papers since 2013.
22916	2	34	36	18	39	The section title is not in agreement with the sub-section titles 'close to medium reaching hazards' and 'far reaching hazards' that are not commonly used in the litterature. We suggest to reorganise the section, dividing in each specific hazards as observed in the different areas over the world and at the end the cascading ones. A recapitulative figure (or table) is also missing for this section. [Romy Schlogel, UK]	Taken into account - after team discussions, we prefer to structure the hazards loosly according to their potential reach as this is what matters most for mountain communities. Primary structure according to hazard types might become too theoretical/geoscientific for an IPCC report. We used the reach not anymore as strict primary structure but as less visible and dominant, and better explained, factor to sort the sequence of hazards. A summarizing figure was created and added.
24836	2	34	52	34	55	This sentence needs a rewording and possibly needs to be broken into two or even three sentences: “The sporadic nature…” [Elizabeth Weatherhead, USA]	Accepted - text revised.
19626	2	34	53	34	54	Modify to read: "…vulnerability and exposure require that assessments of change are based not only on statistial evidence…" [Michelle A. North, South Africa]	Accepted - text revised.
22848	2	34	53	34	54	"exposure require to base assessments" is not correctly constructed sentence! [Lena Rubensdotter, Norway]	Accepted - text revised.
128	2	34	55	34	56	(Pandey et al., 2016; Gain et al., 2017) and of course it can be don by range management and all type of vegetation. [Mostafa Jafari, Iran]	Taken into account - the sentence was deleted.
24838	2	35	1	35	8	Landslides are often identified by human reports—even in well monitored areas. Start with that and then move on to automated ways of observing, including satellites? Does this paragraph belong in 2.3.3.1.1 ? [Elizabeth Weatherhead, USA]	Accepted - method paragraph had to be removed. Subtitle moved.
2028	2	35	10	35	10	"Close to medium reaching hazards": I have no idea what this means. Perhaps "Close and nearby hazards"? [J. Graham Cogley, Canada]	Accepted - term removed. Concept toned down and explained. Thanks!
5956	2	35	11	35	12	This sentence refers to paragraph 2.2.4, while nothing is mentioned about subsidence (except shortly in the introduction on page 9) in this report, only in this paragraph. [Roderik Van De Wal, Netherlands]	Accepted - reference placed correctly.
6954	2	35	14	35	16	The text is solely focused on permafrost, and nothing is said about seasonal frost dynamics. Some processes (ie solifluction) are also being affected by the changing climate and can also affect infastructures and equiments located in the periglacial belt. [APECS Group Review, Germany]	Rejected - seasonal frost not in the mandate of SROCAccepted - text revised
22850	2	35	14	35	14	"structures n them" should be clarified to "above them" or "on top of them" [Lena Rubensdotter, Norway]	Accepted - text revised.
6958	2	35	21	35	34	inconsistent use of comma and semicolon [APECS Group Review, Germany]	Editorial – copyedit to be completed prior to publication
24840	2	35	23	35	23	“good permafrost data is lacking” -> “good permafrost data are lacking” [Elizabeth Weatherhead, USA]	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
22852	2	35	26	35	26	add; "in the detachment zone <of previous events>.." [Lena Rubensdotter, Norway]	Accepted - text revised
19628	2	35	29	35	30	Modify to read: "Summer heat waves in 2010 may also have triggered the largest recorded…" [Michelle A. North, South Africa]	Accepted - text removed
2030	2	35	30	35	30	"triggered the largest … in British Columbia in 2010 at". [J. Graham Cogley, Canada]	Accepted - text removed
22854	2	35	30	35	30	second word in line; "for" should be removed [Lena Rubensdotter, Norway]	Accepted - text removed
5958	2	35	32	35	34	It is stated that the rock instability may be caused by mechanisms not involving permafrost, with a reference to Luethi et al, 2015. However, this paper mentiones mechanisms like stress distribution by large temperature variations, which is a mechanism which is still important for climate change. Since this paragraph (2.3.3.1.1) is not only about permafrost, it is maybe nice to mention this as well [Roderik Van De Wal, Netherlands]	Accepted - text revised
24842	2	35	32	35	32	“This is in line..” What does “this” refer to? The landslide? [Elizabeth Weatherhead, USA]	Accepted - text clarified
19630	2	35	42	35	42	Replace "plus" with "and" [Michelle A. North, South Africa]	Accepted - text revised
24844	2	35	43	35	45	This sentence needs a reference. [Elizabeth Weatherhead, USA]	Accepted - text revised
6956	2	35	47	35	49	As said before (comment number 8) I would include a reference to the shrinking response of some rock glaciers as a signal of permaforst degradation [APECS Group Review, Germany]	Rejected - rock-glacier accelleration and destabilisation are discussed elsewhere in terms of their indication of degradation.
2032	2	35	51	35	57	There is a serious omission here, namely of the collapse of the Aru Co glaciers in western Tibet in 2016. See Kaeaeb et al. 2018, Nature Geoscience, https://doi.org/10.1038/s41561-017-0039-7. This is cited at P38 L18 but needs to be here as well. [J. Graham Cogley, Canada]	Noted - glacier collapses covered later in the section due to their much farther reach compared to ice break-offs.
19632	2	35	53	35	53	Modify to read: "may cause related ice avalanche hazards to either increase or decrease…" [Michelle A. North, South Africa]	Accepted - text revised
24846	2	35	54	35	55	“General trends are unknown and are not expected theoretically.” This sentence needs a reference. It may also need some caveats. [Elizabeth Weatherhead, USA]	Accepted - sentence and previous sentence revised
6962	2	36	2	36	11	Some human activities can also affect the cryosphere and led to changes in glacial dynamics, promoting glacial surges. This is the case of mining activities, which have favoured glacier surging (e.g. Stewart S. R. Jamieson, Marek W. Ewertowski, David J. A. Evans. Rapid advance of two mountain glaciers in response to mine-related debris loading. Jourrnal of Geophysical, Research, Earth Journal, 120 (7), 1418-1435) [APECS Group Review, Germany]	Accepted - text revised
10682	2	36	2	36	11	Surges very often connected with a rock barrier at the bottom of glacier, which prevents ice till an ice mass reach some sugnificant point. This reqieres ice accumulation anв impossible at the melting stage. Such type surges will become more rare in case of glacier melting. Please add. [Oxana Lipka, Russian Federation]	Rejected - there is limited evidence in the literature about these conditions and the related response of glacier surging to climate change.
10980	2	36	4	36	5	Consider citing Steiner et al., 2017 on the Khurdopin Glacier surge for an example of a surge-type glacier advance that caused a dammed lake and destruction from flooding. Clarke and Mathes (1981) discuss the dammed Donjek River due to the surging of Donjek Glacier. Bevington and Copland (2014) show that Lowell Glacier has caused the Alsek River to dam in the past and has flooded. Cruikshank (1981) gives an oral history of Alsek damming and flooding from the native perspective to show that these hazards have exsisted for a over a hundred years. [William Kochtitzky, USA]	Accepted - text revised

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
19634	2	36	4	36	5	Please reference these statements [Michelle A. North, South Africa]	Accepted - text revised.
24848	2	36	4	36	4	“In a number of documented cases…”. This sentence needs references. If you are using it to introduce the rest of the paragraph, consider leaving out this phrase and start with “Glacier advances due to…” [Elizabeth Weatherhead, USA]	Accepted - references added.
6960	2	36	5	36	7	Include citation: Kamb, B. (1987), Glacier surge mechanism based on linked cavity configuration of the basal water conduit system, J. Geophys. Res., 92(B9), 9083–9100, doi:10.1029/JB092iB09p09083 Murray, T., and G. Stuart (2000), Glacier surge propagation by thermal evolution at the bed, J. Geophys. Res. Solid Earth, 105(B6), 13491–13507, doi:10.1029/2000JB900066. [APECS Group Review, Germany]	Taken into account - recent overview paper referenced.
19636	2	36	8	36	8	Delete "in order" [Michelle A. North, South Africa]	Accepted
10978	2	36	10	36	11	There is substantial evidence to suggest that surging is realted to climate and that surge behavior can change with climate. 1) We know that surge-type glaciers exsist in a constrained climate window (Sevestre and Benn, 2015) 2) Several glaciers have stopped surging due to a strong negative mass balance (e.g. Black Rapids (Kienholz et al., 2016)) 3) Studies have shown that glaciers have stopped surging due to warming and negative mass balance (e.g. Svalbard (Dowdeswell et al., 1995)) 4) Studies have shown that positve mass balance can cause glaciers in a region to surge (e.g. Karakoram (Copland et al., 2009)). These studies suggest that fewer glaciers will surge given a negative mass balance regime [William Kochtitzky, USA]	Accepted - text revised
19638	2	36	15	36	15	Modify to read: "…directly after glacier retreat, have been documented to slide or collapse. These typically only lead to local hazards…" [Michelle A. North, South Africa]	Accepted - text revised
3288	2	36	18	36	20	Revegetation (e.g. rise of the tree and timber limits) also have a noticeable role in stabilizing the slopes. [Castor Muñoz Sobrino, Spain]	Accepted - text revised
6964	2	36	18	36	18	In August 2017 a massive event took place in the Central Pyrenees, starting from the LIA moraine. Refeence: Serrano, E.; Oliva, M.; González-García, M.; López Moreno, J.I.; González-Trueba, J.J; Martín-Moreno, R.; Martín-Díaz, J.; Gómez-Lende, M.; Nofre, J. & Palma, P. (reviewed). Post-Little Ice Age paraglacial processes and landforms in the high mountains of the Iberian Peninsula. Land Degradation & Development. [APECS Group Review, Germany]	Accepted - text revised
2034	2	36	28	36	28	What does "topping" mean? [J. Graham Cogley, Canada]	Accepted - removed
6966	2	36	29	36	31	Slope mass movements are particularly enchanced in in ice-rich permafrost environments following glacial retreat. Ex: Oliva, M. & Ruiz-Fernández, J. (2015). Coupling patterns between paraglacial and permafrost degradation responses in Antarctica. Earth Surface Processes and Landforms, 40 (9): 1227-1238. [APECS Group Review, Germany]	Accepted - text revised
24850	2	36	33	36	36	Please address this problem: the paragraph starts with “there is high confidence that glacial retreat..” and then goes on to address incomplete knowledge. I feel this could be more appropriately addressed. [Elizabeth Weatherhead, USA]	Accepted - text revised
17134	2	36	36	5	5	Maybe add a few references after 'hazard' (e.g. Round et al. 2017 for Kyagar glacier) [Frank Paul, Switzerland]	Accepted - text revised.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
17136	2	36	36	55	57	In general, hazardous avalanches are related to extreme snow fall events that will likely also occur in a future, even warmer world. So the pure statistical relation between higher temperatures and less snow being available for avalanches might ot be fully correct (e.g. the 2 deg temperature increase in the Alps had so far no effect). Maybe this can be critically commented? [Frank Paul, Switzerland]	Accepted - revised text provides better information on the attribution of changes of snow avalanches to climate change.
10684	2	36	38	36	41	Please add earthquakes to the list of snow avalanche triggers [Oxana Lipka, Russian Federation]	Accepted - text revised.
19640	2	36	38	36	44	Please provide references for this paragraph [Michelle A. North, South Africa]	Accepted - explanatory and background references added.
19642	2	36	38	36	44	Modify to read: "These natural causes are behind most avalanches that reach valley bottoms and damage infrastructure. Avalanches can also be triggered by the passage of skiers, snowmobiles or animals, rock or ice-falls, or explosives used as control measures. These latter 'artificial' avalanches are those that typically cause fatalities among recreationists. Based on theoretical and empirical considerations, it is expected that changes in snow cover characteristics..." [Michelle A. North, South Africa]	Taken into account - the text was revised to increase clarity.
24852	2	36	38	36	39	This wording seems difficult to process: “Snow avalanches can occur spontaneously, following significant snow precipitation…” That doesn’t seem like “spontaneously;” that seems like cause-effect. [Elizabeth Weatherhead, USA]	Taken into account - spontaneous avalanches refer to avalanches triggered purely by meteorological causes without external triggers (skier passage, animals, earthquakes, control measures). This is the term used in the snow and avalanches community. Explanation was added for this term.
2036	2	36	39	36	39	Word missing after "natural"? [J. Graham Cogley, Canada]	Accepted - text revised.
13108	2	36	39			"These natural avalanches can correspond to ..." [Christoph Marty, Switzerland]	Accepted - text revised.
22856	2	36	39	36	39	Wording; "These natural correspond.." ??? [Lena Rubensdotter, Norway]	Accepted - text revised.
22858	2	36	42	36	42	The statement that is read lite hte only casualities comes from artificial avalanches is not true and needs to be reworded. Several of the larges snow avalanche tragedies in Scandinavia have been naturally released and this still happens almost as frequently as artificially released avalanches. So the author might here come from a region with different history, but then that should be more specified and perhaps also references.. now it is to generally worded and become false. [Lena Rubensdotter, Norway]	Accepted - the text was revised and made more general, acknowledging that travelling in avalanche terrain is not only performed by recreationists.
19644	2	36	46	36	46	Insert "the" in front of Western Himalaya [Michelle A. North, South Africa]	Accepted - text revised.
19646	2	36	48	36	48	Delete: "favouring wet-snow avalanches in the release areas." [Michelle A. North, South Africa]	Accepted - text revised.
3290	2	36	49	36	49	I suggest the use of capitals here: Little Ice Age [Castor Muñoz Sobrino, Spain]	Accepted
6968	2	36	49	36	49	Little Ice Age [APECS Group Review, Germany]	Accepted

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6970	2	36	49	36	49	Changes in avalanche activity over time have been also related to land use changes. A rreferencecould be also made to the Cantabrian Mountains (to enlage also the number of mountain environments mentioned in the text). Reference: García-Hernández, C.; Ruiz-Fernández, J.; Sánchez-Posada, C.; Pereira, S.; Oliva, M. & Vieira, G. (2017). Reforestation and land use change as drivers for a decrease of avalanche damage in mid-latitude mountains (Asturian Massif, NW Spain). Global and Planetary Change, 153: 35-50. [APECS Group Review, Germany]	Taken into account - and text revised to better acknowledge non-climatic causes in avalanche changes.
13106	2	36	51	36	53	"Past changes in meteorological and snow conditions were shown to correlate with avalanche frequency and runout altitude in the French (e.g., Eckert et al., 2013) and in the Swiss Alps (Teich et al. 2012). [doi.org/10.1016/j.coldregions.2012.06.007] [Christoph Marty, Switzerland]	Taken into account
13110	2	36	53	36	54	"A positive trend in wet snow avalanche activity in the core winter season (December thru February) as proportion of total avalanche activity was shown in the Swiss Alps (Pielmeier et A positive trend in wet snow avalanche activity in the core winter season (December thru February) as proportion of total avalanche activity was shown in the Swiss Alps (Pielmeier et al., 2013) ..." [Christoph Marty, Switzerland]	Taken into account - this comment is hard to understand, however the text was checked again for clarity.
22860	2	36	53	36	54	The sentence " The ratio of wet-now.." is badly worded and unclear in meaning [Lena Rubensdotter, Norway]	Accepted - text revised for better clarity.
2038	2	36	55	36	56	"that avalanche mass and run-out distance tend to decrease, and that ...". [J. Graham Cogley, Canada]	Taken into account - text revised for better clarity.
3292	2	36	55	37	3	In my opinion also the changes in the tree/timber line in the basin may have any influence here (e.g. Muñoz Sobrino et al. 2013. Quaternary Science Reviews, 80: 58-77). [Castor Muñoz Sobrino, Spain]	Taken into account - text revised to better account for land cover/land use change impacts on avalanche changes.
24854	2	37	1	37	1	Remove the parentheses inside the parentheses: (Eckert et al., 2013 in the French Alps; Gadsk et al, 2017 in the Tara.) [Elizabeth Weatherhead, USA]	Accepted - text revised
19648	2	37	3	37	5	Modify to read: "However, confounding factors like land use in avalanche terrain and changes in disaster risk reduction measures (...), make these relationships difficult to detect." [Michelle A. North, South Africa]	Taken into account - text revised for better clarity.
24856	2	37	3	37	3	“Yet, these remain difficult..” What does “these” refer to? [Elizabeth Weatherhead, USA]	Taken into account - text shortened and revised for better clarity
24858	2	37	7	37	7	Consider changing “in particular through a change in the partitioning” to “due to a shift.” [Elizabeth Weatherhead, USA]	Taken into account - text revised.
19650	2	37	10	37	26	This paragraph could do with being completely rewritten [Michelle A. North, South Africa]	Taken into account - text was revised for improved clarity.
19652	2	37	10	37	11	Delete "amounts" after snow and snow precipitation [Michelle A. North, South Africa]	Accepted - text revised
19654	2	37	13	37	17	Rewrite something like: "Castebrunet (2014) show that for the French Alps, under an SRES A1B scenario, climate conditions in the mid to end-century may favour the development of a wet snowpack at high elevations or earlier in the season. This will have important consequences for risk management, due to the need to modify prevention measures ()..." [Michelle A. North, South Africa]	Taken into account - text revised for better clarity.
24860	2	37	17	37	17	Change “in” to “for” [Elizabeth Weatherhead, USA]	Accepted

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
19656	2	37	18	37	19	This sentence is a duplicate of one earlier in the paragraph, delete. [Michelle A. North, South Africa]	Accepted - text revised
22862	2	37	18	37	18	Wrong order words, should be; "Only a few studies have…". [Lena Rubensdotter, Norway]	Taken into account - and text revised
3498	2	37	19	37	21	The sentence should refer to the twenty-first century, not the twentieth century, hence: "Castebrunet et al. (2014) estimated an overall 20-30% decrease of natural avalanche activity for mid and end of the twenty-first century, respectively, under SRES A1B scenario, compared to the reference period 1960-1990." [Deborah Verfaillie, Spain]	Accepted - text revised.
22864	2	37	19	37	19	What does "these" in end of sentence relate to - wording..? [Lena Rubensdotter, Norway]	Taken into account - text revised (typo)
19658	2	37	21	37	22	Delete the sentence "Changes are expected to vary as a function of the season and altitude." [Michelle A. North, South Africa]	Accepted
19660	2	37	22	37	24	Modify to read: "Marked reductions in avalanche activity are expected during spring compared to winter, due to reduced snow. The overall trend in avalanche activity will depend on the season, region and altitude, and…" [Michelle A. North, South Africa]	Taken into account - text revised for better clarity.
13426	2	37	28	37	31	Not a good summary of what went before. "favour major shifts" is too vague. Delete and simply state the changes that are expected, each with their own confidence statement. [Debra Roberts and Durban Team, South Africa]	Taken into account - text was revised with better use of confidence language.
24356	2	37	28	37	28	Do not mix uncertainty language [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account - text was revised with better use of confidence language.
24862	2	37	28	37	31	Please consider breaking this into two sentences. Also, for parallel construction, change "reduce" to "reducing." [Elizabeth Weatherhead, USA]	Taken into account - text was revised for improved clarity.
2040	2	37	33	37	37	A reference that might be relevant: McClung, D.M., 2016, Avalanche character and fatalities in the high mountains of Asia, Annals of Glaciology, 57(71), 114-118, https://doi.org/10.3189/2016AoG71A075 [J. Graham Cogley, Canada]	Rejected - this publication is not relevant to avalanche changes related to climate change.
24864	2	37	33	37	33	Clarify use of "artificial". [Elizabeth Weatherhead, USA]	Accepted - text revised.
24866	2	37	33	37	37	Do you want to include animal activity as a trigger for avalanches, in addition recreationists. Additionally, some humans in the mountains are there for reasons other than recreation. [Elizabeth Weatherhead, USA]	Accepted - text revised.
2042	2	37	39	37	39	Change "Far reaching" to something like "Distant". [J. Graham Cogley, Canada]	Accepted - titles removed and concept explained better.
17930	2	37	39			The distinction of close-range and far-reaching hazards can make sense and content is mostly good in my opinion. But most far-reaching hazards are also combined hazards, GLOF being an example. Lahards are also very far-reaching (>100km) but I see these are treated under the combined hazard section. Jökulhlaups (s.s., i.e. the classical Icelandic ones) are missing here. Concerning the interaction of cryosphere and volcanoes and tectonic processes you may want to consult SREX and AR5 and see what could be added on more recent literature. [Christian Huggel, Switzerland]	Accepted - distinction according to range toned down and revised; new paragraph on lahars added and jökulhlaups included.
19662	2	37	41	37	41	Replace "underneath" with "below" [Michelle A. North, South Africa]	Accepted - text revised
24868	2	37	41	37	44	Consider not using the acronym GLOFs, as it is used only a few times throughout several sections and the reader may have forgotten the explanation of the term. [Elizabeth Weatherhead, USA]	Accepted - text revised

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
22866	2	37	46	37	46	wording; should be "to often develop on <top of> downwasting.." [Lena Rubensdotter, Norway]	Accepted - text revised.
12748	2	37	51			Buckel et al. 2018 Buckel, J., Otto, J.C., Prasicek, G., Keuschnig, M. Glacial lakes in Austria - Distribution and formation since the Little Ice Age (2018) Global and Planetary Change, 164, pp. 39-51. [Jan-Christoph Otto, Germany]	Accepted
6972	2	37	54	37	54	Include citation: ICIMOD (2011), Glacial lakes and glacial lakes outburst floods in Nepal, ISBN: 978 929115 1936 [APECS Group Review, Germany]	Accepted
6974	2	37	55	37	57	Include citation: Ives, J.D., Shrestha, R.B nd Mool, P.K (2010), Formation of glacial lakes in the Hindu Kush-Himalayas and GLOF risk assessment, ICIMOD. 1SBN: 978 929115 170 [APECS Group Review, Germany]	Accepted
19664	2	37	55	37	55	Delete "thereby" [Michelle A. North, South Africa]	Accepted
24870	2	38	11	38	13	Please explain the mechanism for lower stability and contribution to outburst floods. [Elizabeth Weatherhead, USA]	Accepted - text revised
12750	2	38	13			"contribute to outburst floods" and debris flows. [Jan-Christoph Otto, Germany]	Accepted
6978	2	38	18			One must add here the direct link and outcome with the ESTUARIES all over the world, e.g. Bangladesh or Yellow Sea, Arabian Sea, even Amazonas basin and Atlantic, and then Gulf of Mexico etc. [APECS Group Review, Germany]	Rejected - the sentence was deleted (page would be 33?)
19666	2	38	19	38	20	Modify to read: ", the likelihood of other cases of massive glacier instability leading to such glacial collapse is still unknown." [Michelle A. North, South Africa]	Accepted - text revised
6976	2	38	26	38	28	Include citation: Dube. A, Asrit. R, Ashish. A, Sharma. K, Iyengar. G.R, Rajagopal. E.N, and Basu.S (2014), Forecasting the heavy rinfall during Himalayan flooding - June 2013, Weather and Climate Extremes, 4(2014), 22-34. DOI: 10.1016/j,wace.2014.03.004 [APECS Group Review, Germany]	Rejected - this publication is not relevant to climate change
17932	2	38	26	39	17	Are all these rain on snow events related to floods (and the literature mentioned)? I guess that rain on snow events are only relevant for hazards if they imply high intensity precip events. [Christian Huggel, Switzerland]	Taken into account - text revised.
19668	2	38	26	38	27	Modify to read: " Floods originating from the combination of rapid snowmelt and intense rain precipitation (rain-on-snow events), are some of the most damaging in mountain areas..." [Michelle A. North, South Africa]	Accepted
19670	2	38	30	38	30	"responsible for", not "of" [Michelle A. North, South Africa]	Accepted
19672	2	38	35	38	35	Replace "positive association for" with "an increase in" [Michelle A. North, South Africa]	Accepted
19674	2	38	36	38	36	Fix reference (Surfleet and Tullos, 2013) [Michelle A. North, South Africa]	Accepted
17138	2	38	38	40	40	I suggest writing 'despite higher temperatures' [Frank Paul, Switzerland]	Taken into account - text was revised for better clarity.
19676	2	38	40	38	41	Modify to read: "...despite warmer temperatures and associated decreased precipitation and snow cover during autumn and spring..." [Michelle A. North, South Africa]	Taken into account - text revised.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
5962	2	38	46	38	48	It is stated that "despite a clear trend of warming", there is an increase of rain-on-snow events. This doesn't feel counterintuitive. Also, the reference (Ye et all, 2008) mentions that you would expect that this event is more common with an increase in rainfall days. So, why is despite used in this sentence? [Roderik Van De Wal, Netherlands]	Accepted - "despite" was replaced by "under"
24872	2	38	47	38	52	Very nicely written. [Elizabeth Weatherhead, USA]	Noted
2044	2	38	52	38	52	"meridional" is ambiguous as to hemisphere, and should probably be "low-latitude". [J. Graham Cogley, Canada]	Accepted
22868	2	39	2	39	2	end sentence needs to clarify; " this threshold <elevation>" [Lena Rubensdotter, Norway]	Accepted
19678	2	39	5	39	5	"likelihood of", not likelihood for… [Michelle A. North, South Africa]	Accepted
17250	2	39	19	39	20	space between the title and the paragraph is missing [Iulian Florin Vladu, Germany]	Noted - title removed
22870	2	39	31	39	31	The use of the word "trimline" is confusing and should be explained, as this is mostly used for glaciers. Perhaps expand into two sentences, and cal it "wave-erosion line" or elevation.." [Lena Rubensdotter, Norway]	Accepted - text revised.
19680	2	39	36	39	37	Modify to read: "…incorporating additional loose glacial sediments or water bodies and eventually…" [Michelle A. North, South Africa]	Accepted - text revised.
6980	2	39	41			cementing sounds odd, put in quotes or phrase better [APECS Group Review, Germany]	Noted - we prefer to keep. Copyedit to be completed prior to publication.
162	2	39	46	39	54	As mentioned above, this seems like an astonishingly brief consideration of a key aspect of high mountain hazards (i.e., volcano - cryophere interactions). I suggest more information be added. [Iestyn Barr, UK]	Accepted - entire new paragraph developed
19682	2	39	46	39	46	Add (see Glossary) after lahars, and include a dscription of a lahar in the glossary [Michelle A. North, South Africa]	Accepted - text revised.
2046	2	39	57	40	1	I do not know what this sentence means. It needs to be restructured. [J. Graham Cogley, Canada]	Accepted - sentence removed
13428	2	40	1	40	4	This paragraph is not clear. There is 'limited evidence' of how event chains …could increase, involving slope (med-hi confidence) and glacier lakes (high conf). [Debra Roberts and Durban Team, South Africa]	Accepted - text revised
17934	2	40	1	40	4	Is it reasonable to have medium to high confidence for expected glacier shrinkage and high conf. For expected increase of glacier lake numbers? Glacier lake formation depends on glacier retreat. Furthermore, I rather think that high to very high confidence should be given to expected glacier shrinkage. [Christian Huggel, Switzerland]	Accepted - text revised
24874	2	40	1	40	4	Awkward sentence. Consider rewrite or breaking into two. [Elizabeth Weatherhead, USA]	Accepted - text revised
22872	2	40	2	40	2	first word; "reasonable" is very strange in the sentence - revise meaning? Expand to clarify? [Lena Rubensdotter, Norway]	Accepted - text revised
2670	2	40	8	40	19	What is the meaning of the “systematic risk assessment” in mountain areas? [Mohammad Javad Zareian, Iran]	Accepted - revised wording in last sentence to ", and for mountain regions, comprehensive risk assessments considering all components of hazard, exposure and vulnerability are lacking (Allen et al. 2018)"
5976	2	40	8	40	19	It remains unclear what exactly ' climate risk ' is. Like how it is quantified (if even). Maybe it is nice to provide a precise definition [Roderik Van De Wal, Netherlands]	Rejected - covered in Chapter 1

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
19684	2	40	11	40	11	Ideally, please write out the IPCC acronyms for the special reports etc. [Michelle A. North, South Africa]	Accepted - written out at first appearance
6982	2	40	19			Allen in review needs details [APECS Group Review, Germany]	Accepted - text revised. Meanwhile published.
6984	2	40	21			What is an exposure ? Needs a better explanation [APECS Group Review, Germany]	Rejected - covered in Chapter 1 and glossary
2048	2	40	22	40	22	"exposure to risk". Or define "exposure" in the previous paragraph. [J. Graham Cogley, Canada]	Accepted - text revised.
5978	2	40	22	40	22	Why start here with a statistical conclusion? Isn't it better to put it at the end? [Roderik Van De Wal, Netherlands]	Rejected - both sequences ok for IPCC
19686	2	40	22	40	22	Exposure of high mountain people and infrastructure to what? [Michelle A. North, South Africa]	Accepted - text revised
3946	2	40	26	40	27	The 2015 snow- ice avalanche in Nepal is not caused by climate, but triggered by earthquake. The link is not clear in the paragraph? Ref: Geomorphic and geologic controls of geohazards induced by Nepal's 2015 Gorkha earthquake; Science 08 Jan 2016: Vol. 351, Issue 6269, DOI: 10.1126/science.aac8353 [Anil Mishra, France]	Accepted - text revised
4524	2	40	28			Sentence structure suggests that religious pilgrims are tourists; this could be viewed as disparaging. [Graham Mcdowell, Canada]	Accepted - text revised.
2050	2	40	33	40	33	"emigration from some". [J. Graham Cogley, Canada]	Editorial – copyedit to be completed prior to publication
2052	2	40	39	40	39	"prepare for, respond to and recover from". [J. Graham Cogley, Canada]	Accepted - text revised.
13430	2	40	41			This conclusion is perhaps too strongly worded. Their vulnerabilities are sometimes unique, yes, and this gets discussed below. [Debra Roberts and Durban Team, South Africa]	Accepted - text revised.
4526	2	40	43			These citations are dated in this context. Citing recent synthesis work by Carey et al would be better. See: Carey, M., et al. (2017). "Impacts of Glacier Recession and Declining Meltwater on Mountain Societies." Annals of the American Association of Geographers 107(2): 350-359. [Graham Mcdowell, Canada]	Accepted - text revised.
2054	2	40	45	40	51	Break up this long sentence into six. [J. Graham Cogley, Canada]	Accepted - text revised.
22874	2	40	45	40	51	Too long sentence. Divide. [Lena Rubensdotter, Norway]	Accepted - text revised.
4528	2	40	47			Marston, 2008 does not appear in the reference list at the end of the report. [Graham Mcdowell, Canada]	Accepted - text revised
19688	2	40	49	40	49	Modify to read: "…difficulty accessing remote mountain…" [Michelle A. North, South Africa]	Accepted - text revised.
5964	2	40	53	40	55	The text mentiones a "few studies", but only one study is mentioned [Roderik Van De Wal, Netherlands]	Rejected - the study cited discusses several other studies.
13432	2	41	0			Section 2.3.3.3 a summary table of expected climate change related impacts, risks and adaptation options would be helpful [Debra Roberts and Durban Team, South Africa]	Noted - for the moment not feasible due to space limitations
4530	2	41	1	41	20	This section should also mention impacts related to drinking water and impacts on livelihoods, as these are increasingly well documented in the scientific literature and have been mentioned in preceding sections of the report. [Graham Mcdowell, Canada]	Accepted - references to respective sections added
6988	2	41	5			needs a comma for 6300 deaths [APECS Group Review, Germany]	Accepted - text revised
19690	2	41	8	41	8	Replace "immediate" with "nearby" [Michelle A. North, South Africa]	Accepted - text revised
6986	2	41	16	41	16	Change '$US' to 'USD' for consistency. [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
19692	2	41	16	41	16	Be consistent with the US $ symbols [Michelle A. North, South Africa]	Accepted - text revised
4540	2	41	19			adaption' should be replaced with 'adaptation' [Graham Mcdowell, Canada]	Accepted - text revised
5966	2	41	24	41	39	Major: There are no references in this paragraph. Wouldn't it be better to include some references to back up the statements? (like behind line 28-32, 33-37 and 37-39), especially because there is a confidence statement (line 37)? [Roderik Van De Wal, Netherlands]	Taken into account - this was intended as a summary for the paragraphs that follow (in which references are cited). To make this clearer the text has been moved to the end of the section, with wording revised.
5980	2	41	24	41	39	Major: There are no sources in this section, while there are statements made and there is a statistical conclusion drawn. This should be backed up with some literature [Roderik Van De Wal, Netherlands]	Taken into account - this was intended as a summary for the paragraphs that follow (in which references are cited). To make this clearer the text has been moved to the end of the section, with wording revised.
19694	2	41	24	41	26	Please provide a citation for this sentence [Michelle A. North, South Africa]	Accepted - text revised
21386	2	41	24	42	21	HIMAP chapter on DRR needs to be referenced here, and it content reflected. [Philippus Wester, Nepal]	Accepted - HIMAP chapter 11 now cited, but SROCC content not yet revised as only a pre-review version of HIMAP chapter 11 was available.
19696	2	41	26	41	26	Rather use something like "considerable" instead of "significant", which has statistical meaning [Michelle A. North, South Africa]	Accepted
19698	2	41	27	41	32	These lines should include citations [Michelle A. North, South Africa]	Taken into account - this was intended as a summary for the paragraphs that follow (in which references are cited). To make this clearer the text has been moved to the end of the section, with wording revised.
4532	2	41	28			McDowell et al (in Review) provides a critical, comprehensive, and up to date systematic review of exiting adaptation action and research in mountain systems. It has helped to address this gap. Sentence could be reworked to reflect this development. See: McDowell, G., Huggel, C., Frey, H., Wang, F., Cramer, R., Ricciardi, V. (In Review) Adaptation action and research in glaciated mountain systems: Are they enough to meet the challenge of climate change? [Graham Mcdowell, Canada]	Taken into account - a new sentence based on the new paper of McDowell et al. has been added. However, the general statement remains valid that critical reflections from scientists or practitioners invovled in on-ground adaptation actions
2056	2	41	33	41	33	"reconfirm". [J. Graham Cogley, Canada]	Accepted
6990	2	41	34			what is SREX, abbreviation [APECS Group Review, Germany]	Accepted - now explained at first appearance
19700	2	41	34	41	34	Please define this acronym at first use [Michelle A. North, South Africa]	Accepted - now explained at first appearance
19702	2	41	36	41	36	Delete the "a" before "high-level communication" [Michelle A. North, South Africa]	Accepted
4534	2	41	37	41	39	McDowell and Koppes (2017) could be cited to support this claim. See: McDowell, G. and M. Koppes (2017). "Robust adaptation research in high mountains: Integrating the scientific, social, and ecological dimensions of glacio-hydrological change." Water 9(10): 739. Carey et al (2014) would also be appropriate. See: Carey, M., McDowell, G., Huggel, C., Jackson, J., Portocarrero, C., Reynolds, J., Vicuna, L. (2014). "Integrated Approaches to Adaptation and Disaster Risk Reduction in Dynamic Socio-cryospheric Systems." Snow and Ice-related Hazards, Risks and Disasters. Elsevier: 219-261. [Graham Mcdowell, Canada]	Taken into account - papers have been added

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
17140	2	41	41	1	1	Maybe add in this section that also false alarms from non-experts could have a huge economic impact and that this topic (remote sensing based assessments) is a rather delicate one. [Frank Paul, Switzerland]	Rejected - reviewer has not provided any references to support this statement regarding false alarms and economic impacts. This sentence is not about remote sensing based assessment, so second part of reviewers comment is not clear.
19704	2	41	41	41	43	While it is understood that publication dates do not match the dates of the cases they describe, the publications cited in this sentence seem odd. Please check that the "beginning of the 20th century" citations are the original papers and not more recent updates, because the timeline of this sentence feels awkward. [Michelle A. North, South Africa]	Rejected - the papers cited are providing a historical review.
4536	2	41	43			Ives citation date does not follow logic of sentence. Suggest citing more recent scholarship. [Graham Mcdowell, Canada]	Accepted - replaced reference with Ives 2010 (Ives, J. D., R. B. Shrestha, and P. K. Mool, 2010: Formation of glacial lakes in the Hindu Kush-Himalayas and GLOF risk assessment. ICIMOD, Kathmandu)
19706	2	41	43	41	43	Please note where the Cordillera Blanca is (Peru), and reference Box 2.6 [Michelle A. North, South Africa]	Accepted - text revised
2058	2	42	13	42	13	"precedent". [J. Graham Cogley, Canada]	Accepted
4538	2	42	18			Along with Carey, McDowell et al (In review) and/or McDowell et all 2014 should be cited to support this observation, as this work has made the same argument, specifically in an adaptation context. See: McDowell, G., Huggel, C., Frey, H., Wang, F., Cramer, R., Ricciardi, V. (In Review) Adaptation action and research in glaciated mountain systems: Are they enough to meet the challenge of climate change? ; McDowell, G., et al. (2014). "Adaptation to climate change in glaciated mountain regions." Climatic Change 126(1-2): 77-91. [Graham Mcdowell, Canada]	Accepted - both citations have been added to this sentence
19708	2	42	21	42	21	"mountain regions", plural [Michelle A. North, South Africa]	Accepted
17936	2	42	26			I found this box rich and informative. Also a bit of redundancy in there, and probably rather long for a box. [Christian Huggel, Switzerland]	Accepted. - text edited
208	2	42	29	42	33	Climate historical context is missing. The Cordillera Blanca glaciers have experienced significant fluctuations in pre-industrial times and reached their maximum extent of the entire Holocene during the Little Ice Age (LIA). See e.g. Stansell et al 2013 (doi: 10.1016/j.quascirev.2013.03.003). The glacier retreat after the LIA appears to be presented in this chapter as retreat from something like a "baseline", which however is not representative for the vast majority of the Holocene. Authors need to stay balanced and mark the extreme natural cold phase (LIA) as such by presenting the full context of natural pre-industrial variability. Otherwise this remains a strongly biased report that may be even misleading the readers because of lack of climate historical context. [Sebastian Luening, Portugal]	Accepted- historical information provided within the length constraints of the box.
19710	2	42	29	42	29	Modify to read: "The Cordillera Blanca of Peru contains most of the glaciers in the tropics…" [Michelle A. North, South Africa]	Accepted
19712	2	42	34	42	34	Delete "still" before today [Michelle A. North, South Africa]	Accepted
2060	2	42	41	42	41	Delete "overall". [J. Graham Cogley, Canada]	Accepted

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
19714	2	42	41	42	41	Delete "overall" [Michelle A. North, South Africa]	Accepted
2062	2	42	47	42	47	"formation on". Delete "and" (the overdeepening happened well before they became exposed). [J. Graham Cogley, Canada]	Accepted
6992	2	42	55			what is Lakes 513 ? [APECS Group Review, Germany]	Accepted - ammended to correct glacial lakes, and 'Lake 513' (Laguna 513, in Spanish)
19716	2	42	55	42	55	Small letter 'L' for lakes [Michelle A. North, South Africa]	Accepted
19718	2	43	12	43	12	"supply from glaciers" singular [Michelle A. North, South Africa]	Accepted
19720	2	43	16	43	16	Replace "alongside" with "as well as" [Michelle A. North, South Africa]	Accepted
19722	2	43	17	43	17	Modify to read: "…reservoirs of water for use in agriculture or hydropower…" [Michelle A. North, South Africa]	Accepted
13436	2	44	0			Figure 2.6 could be integrated into 2.7. [Debra Roberts and Durban Team, South Africa]	Accepted - figure revised
5982	2	44	1	44	7	These are nice and clarifying figures. Therefore, it is maybe better to show them earlier in the chapter and also to refer to them more frequently in the paragraphs of 2.3.3.2. [Roderik Van De Wal, Netherlands]	Noted - Final figure placement to be decided later.
13434	2	44	1	44	1	Figure 2.6 should be enlarged if additional texts/information will not be added in subsequent drafts [Debra Roberts and Durban Team, South Africa]	Noted - figure completely revised
17938	2	44	2			Figure 2.6: I suggest to either complement the points listed for the risk components, or indicate that these are examples and not a exhaustive list [Christian Huggel, Switzerland]	Noted - figure completely revised
18342	2	44	2	44	2	Fig. 2.6 should include adaptability solutions too. [Carmen Burghelea, Romania]	Noted - figure completely revised

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
1802	2	45	1	46	2	This section neglects to mention the biodiversity and ecology of snow and glacier surfaces, which act as repositories for biomass, biodiversity, organic carbon and nutrients (Stibal et al., 2012). There is also potential for bioaccumulation of pollutants such as radioisotopes and heavy metals in ice surface ecosystems (Tieber et al., 2009; Łokas et al., 2016). These materials will be released into downstream environments as snow and ice melt (Hood et al., 2009; 2015). Cook et al. (2015) suggested cryoconite ecosystems on glaciers should be thought of as biofactories transforming organic carbon and nutrients prior to release into extraglacial environments and sites of special interest for bioprospecting (e.g. for novel antibiotics, antifreeze compounds and cold-active enzymes). Cook, J.M, Edwards, A., Takeuchi, N., Irvine-Fynn, TDI. 2015. Cryoconite: Dirty biological secrets of the cryosphere. Progress in Physical Geography, 40 (1): 66-111 Łokas, E., Zaborska, A., Kolicka, M., Różycki, M., Zawierucha, K. (2016) Accumulation of atmospheric radionuclides and heavy metals in cryoconite holes on an Arctic glacier, Chemosphere, 160: 162-172, https://doi.org/10.1016/j.chemosphere.2016.06.051. Stibal, M., Šabacká, M. & Žárský, J. Biological processes on glacier and ice sheet surfaces. Nature Geosci. 5, 771–774 (2012). Tieber A, Lettner H, Bossew P, Hubmer A, Sattler B and Hofmann W (2009) Accumulation of anthropogenic radionuclides in cryoconites on Alpine glaciers. J. Environ. Radioact., 110 (7): 590–598, doi: 10.1016/j.jenvrad.2009.04.008 Hood, E. et al. (2009) Glaciers as a source of ancient and labile organic matter to the marine environment. Nature, 462, 1044–1047 (2009). Hood, E., Fellman, J., O'Neel, S., Spencer, R.G.M (2015) Storage and release of organic carbon from glaciers and ice sheets, Nature Geoscience, 8: 91-96, doi: 10.1038/ngeo2331 [Joseph Cook, UK]	Accepted - now in text
23660	2	45	1	47	48	Missing from this section is a thorough assessment of the vertebrate fauna, including mammals, birds, reptiles, or at least an explanation as to why there currently is no information and how this information should be gathered. A hint is given in section 2.3.4.4 that one paper provides examples for birds and voles above the treeline; however, this publication is pre-AR5 and limited to Scandinavia, and surely it is not the only publication on the matter. Please also consider projections, and studies of past species distributions. [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - this is now included
23662	2	45	1	47	48	This entire section 2.3.4 is missing from the ES. Please revise it so that it provides an assessment of the current and future ecological impacts, and include a paragraph in the ES. [Hans-Otto Poertner and WGII TSU, Germany]	Accepted
24358	2	45	3			This whole section is under-developed, lacks a focus on climate change and the risks to terrestrial and aquatic biodiversity [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - text revised extensively

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
24362	2	45	6	45	13	Not clear, are you saying here that there are biodiversity hotspots in high mountain regions? [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - this term removed
24364	2	45	6	45	19	What is the point of this section, are these at risk from climate change? Can you assess the risks? [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - this section has been extensively revised
6994	2	45	7	45	29	Technical language (nival, snowbed, NDVI, etc.) makes this paragraph inaccessible to policy makers, needs to be rewritten. [APECS Group Review, Germany]	Accepted - the section has been substantially revised, NDVI is not stated. Snowbeds and nival remain included.
10686	2	45	8	45	8	Using 'mitigation' here is very confusing. Plase use better other term. [Oxana Lipka, Russian Federation]	Rejected - text revised
19724	2	45	9	45	9	Change the word "affect" to something more appropriate, like "reach" or "trigger" the tipping point… [Michelle A. North, South Africa]	Rejected - text revised
1612	2	45	10	45	10	high confidence not bounded by paretheses correctly [Brown Lee, UK]	Accepted
6996	2	45	10	45	11	Italicize 'high confidence' [APECS Group Review, Germany]	Accepted
13438	2	45	10	45	11	Italicise 'high confidence' and open parenthesis. [Debra Roberts and Durban Team, South Africa]	Accepted
19726	2	45	10	45	11	Confidence language in italics [Michelle A. North, South Africa]	Accepted
19728	2	45	13	45	14	Please write out acronym in full and rewrite sentence to make sense [Michelle A. North, South Africa]	Accepted
6998	2	45	14	45	14	Define NDVI and what it tells us about plants. Could say 'plant greenness' instead. [APECS Group Review, Germany]	Accepted - 'greenness' is used.
7000	2	45	16	45	17	What is 'snow's propelling effects'? Please rewrite sentence for ease of reader comprehension. [APECS Group Review, Germany]	Accepted - mechanisms for how changing snow and permafrost are explained
19730	2	45	16	45	16	What is meant by: "snow's propelling effects on vegetation"? Please consider rewriting / rephrasing this point [Michelle A. North, South Africa]	Accepted - rewritten.
24360	2	45	16	45	16	Propelling effects? Do you mean advances in phenology? [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - subtantial revisions were undertaken.
19732	2	45	18	45	18	Consider adding 'nival' to the glossary and inserting "(see Glossary)" in this sentence [Michelle A. North, South Africa]	Accepted - text and glossary revised
11882	2	45	19			The reference for "Gottfried et al." is lacking the date [Dirk Hoffmann, Germany]	Noted - this refence is no longer included
10688	2	45	21	45	22	Does just snowbed vegetation provide the below-lying areas with watering of the pastures throughout the summer? I think, this is the role of snowbeds. Please correct. [Oxana Lipka, Russian Federation]	Noted - this sentence has been removed.
19734	2	45	21	45	22	How do plant communities provide "below-lying areas with watering of the pastures throughout summer"? I recommend rephrasing this, and replacing "i.e." with "e.g." [Michelle A. North, South Africa]	Noted - the sentence is removed.
23664	2	45	21	45	23	This statement requires a reference, and an explanation of how reindeers fit in, i.e. How are reindeers linked to refugia for bugs and predators? And with bugs, do you mean the "true bugs" i.e. Heteroptera, or do you mean arthropods in general? Please be clear and avoid using common language. [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - a more well developed section on wildlife is included.
2064	2	45	23	45	23	"refugium". But sections 2.3.4 and 2.3.5 as a whole both need language polishing. [J. Graham Cogley, Canada]	Accepted - subtantial revisions were undertaken.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
10690	2	45	23	45	23	a refugia FROM bugs and predators. The similar case for reindeers is reported from Altay. Artemov I.A. [Артемов И.А.], Bliakharchuk T.A. [Бляхарчук Т.А.], Bykov N.I. [Быков Н.И.], Vasilchenko A.A. [Васильченко А.А.], Vinogradov V.V. [Виноградов В.В.], Vlasenko V.I. [Власенко В.И.], … Shmakin A.B. [Шмакин А.Б.]. (2013). Изменение климата и биоразнообразие в российской части Алтае-Саянского экорегиона [Climate Change and Biodiversity in the Russian Part of Altay-Sayan Ecoregion]. (Mikhailov N.N. [Михайлов Н.Н.], Ed.). Krasnoyarsk: UNDP. [Oxana Lipka, Russian Federation]	Noted - this text was removed and a wildlife section was added.
19736	2	45	24	45	24	Replace "i.e." with "e.g." [Michelle A. North, South Africa]	Accepted
7008	2	45	26			Should cite Pauli et al. here too [APECS Group Review, Germany]	Noted - the citation was added.
10692	2	45	26	45	29	Are there any evidencies about shift upwards on slopes, where conditions become relevant and snowcover period is still long? [Oxana Lipka, Russian Federation]	Accepted - text notes that the heterogeneity in snow cover creates areas for species to survive
19738	2	45	31	45	36	Rewrite paragraph for clarity and move to before the sentence on line 19-20 [Michelle A. North, South Africa]	Accepted
7004	2	45	34	45	36	Rewrite sentence for clarity [APECS Group Review, Germany]	Accepted
7002	2	45	35	45	35	Need to define endemism (technical language) [APECS Group Review, Germany]	Accepted - see glossary added
5984	2	45	38	45	47	In the beginning of this section, it is stated that with high confidence the biodiversity will decrease due to glacier loss, but at the end of the section it is stated that there is only data available for limited mountain zones (lines 46-47). High confidence then seems too strong [Roderik Van De Wal, Netherlands]	Taken into account - changed to medium confidence
19740	2	45	40	45	40	Is this "distinct threshold" in the number of taxa or in glacier loss? Please rewrite for clarity [Michelle A. North, South Africa]	Accepted - text revised to say the number of taxa
1614	2	45	43	45	44	text refers to Pyrenees and N. American examples but the two references (Giersch) both cover N. America. The Pyrenees reference is Brown LE, Hannah DM, Milner AM (2007) Vulnerability of alpine stream biodiversity to shrinking glaciers and snowpacks. Global Change Biology 13: 958–966. [Brown Lee, UK]	Accepted - reference inserted
19742	2	45	45	45	45	Insert "(see Glossary)" after "functional-trait diversity" and describe this term in the glossary [Michelle A. North, South Africa]	Accepted
7010	2	45	46			I call that nonsense, please drop (or phrase better) "Limited taxonomic and genetic knowledge of aquatic invertebrates in many other mountain zones 47 limits our understanding of global biodiversity losses due to glacier retreat." [APECS Group Review, Germany]	Taken into account - sentence dropped
2066	2	45	49	45	54	The general reader, and specialists like me from other subjects, ought not to have to learn or remember jargon such as this alpha/beta/gamma distinction. Drop it and use instead the defining terms given in this paragraph. E.g. change "alpha" to "local" at P47 L16. [J. Graham Cogley, Canada]	Taken into account - alpha, beta kept but in brackets
19744	2	45	50	45	50	Insert "(see Glossary)" at the end of the paragraph and describe what is meant by alpha, beta and gamma diversity in more detail in the glossary [Michelle A. North, South Africa]	Accepted
7006	2	45	51	45	51	Need to define stenothermic (technical language) [APECS Group Review, Germany]	Accepted
23666	2	46	2			Please specify which large-bodied predators are meant here. Moreover, can you provide an assessment as to how large predators will be affected by cryosphere changes? This would be a good place. [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - inserted invertebrate predators

SROCC First Order Draft Expert Review Comments - Chapter 2							
Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
21388	2	46	4	46	19	Much more content is needed here. See the HIMAP chapter on Biodiversity. Needs to be referenced here, and its content reflected. [Philippus Wester, Nepal]	Accepted - section is substantially revised
5986	2	46	6	46	19	This section would be stronger when a short conclusion is drawn (maybe with a statistical of confidence statement) or a link to the changing cryosphere. In other words: how the changing cryosphere affects the hotspots of biodiversity [Roderik Van De Wal, Netherlands]	Accepted - this section has been removed
7012	2	46	6	46	7	Unclear how alpine vascular plants are connected to hotspots, rewrite. [APECS Group Review, Germany]	Noted - this text was removed.
19746	2	46	9	46	9	Replace "pronoucedly" with "substantially" [Michelle A. North, South Africa]	Accepted - section rewritten
10694	2	46	10	46	13	Caucasus is totally missed in the assesment of European Mountains. Please add here too. For example: Nakhutsrishvili, G. (2013). The Vegetation of Georgia (South Caucasus). Springer Science & Business Media. [Oxana Lipka, Russian Federation]	Noted - length limits restrict including all ranges in text. Supplementary Table includes studies across mountain regions.
19748	2	46	10	46	10	Replace "reaching" with "having" [Michelle A. North, South Africa]	Rejected - Section rewritten so not relevant.
10696	2	46	15	46	19	Sorry, can't understand. More free intermixing of individuals leads to more free gunus recombination, and as a result - to genitic diversity raising. Long isolation can lead to creation of new species, but genetic diversity in small populations is always lower, than in large group. So, if we are talking about species competitions, yes, sometimes we can have species biodiversity decline, especially because of active invasive species. But if we are talking about genetic diversity, the more wide and free communication leads to genetic diversity always. [Oxana Lipka, Russian Federation]	Rejected - Section rewritten so not relevant.
7018	2	46	16			I lack here reports on invasive plants [APECS Group Review, Germany]	Accepted - included a reference on invasive species
19750	2	46	16	46	19	Modify to read: "However, the loss of environmental heterogeneity in headwater habitats with decreasing glacier runoff reduces the isolation of individuals and permits intermixing to a greater degree, significantly reducing genetic diversity ()." [Michelle A. North, South Africa]	Accepted
210	2	46	21	47	4	This subchapter mostly focuses on biodiversity. However, there are other well-known effect on flora and fauna associated with warming that have been widely documented in the past. For example, warming in high altitude areas typically leads to a general boost in biological productivity. Organic richness of lake sediments typically rises, marking improved living conditions (e.g. . The Upper Forest Line typically climbs upslope during warming (e.g. Moscol-Oliveira and Hooghiemstra 2010, doi: 10.1016/j.revpalbo.2010.10.003). This also may impact bioversity positively in some of these vegetational belts. [Sebastian Luening, Portugal]	Accepted - phenology and ecosystem productivity are added.
13440	2	46	24	46	24	Italicise medium confidence'. [Debra Roberts and Durban Team, South Africa]	Accepted
19752	2	46	25	46	25	Confidence language in italics [Michelle A. North, South Africa]	Accepted
7014	2	46	35	46	35	Remove 'hydrology' as hydrology is not discussed in this paragraph. [APECS Group Review, Germany]	Accepted

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
7016	2	46	35	46	38	Include a brief discussion of the role of permafrost carbon release in ecosystem change and resilience. Schuur, E. A. G., A. D. McGuire, G. Grosse, J. W. Harden, D. J. Hayes, G. Hugelius, C. D. Koven, and P. Kuhry (2015), Climate change and the permafrost carbon feedback, Nature, 520(January 2016), 171–179, doi:10.1038/nature14338. [APECS Group Review, Germany]	Accepted - this was added to the feedbacks section.
19754	2	46	37	46	38	What is meant by "plant community altered to more arid expressions"? Consider using different terminology [Michelle A. North, South Africa]	Accepted - the text has been revised.
19756	2	46	40	46	40	Add (see Glossary) after ecotone, and include a dscription in the glossary [Michelle A. North, South Africa]	Noted - this term is no longer used in revised text
21390	2	46	40	46	56	The rich body of work on biodiversity in the HKH needs to be reflected here. See HIMAP chapter on Biodiversity. [Philippus Wester, Nepal]	Noted - regional studies are listed in supplemental table
24366	2	46	45	46	45	This climate change perspective is where this whole section should focus [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - text is subtantially revised.
5988	2	47	1	47	4	This section gives three sentences which doesn't really connect with each other. Maybe this information can be presented in a table, or using different headings and adding little more context to the sentences [Roderik Van De Wal, Netherlands]	Accepted - text extensively revised
7030	2	47	6		31	add small mammal study for Alaska, incuding Denali and other mountains and high arctic treeline, by Andy Baltensperger et al. (2015) on range shifts of small mammals, as well as Baltenperger et al (2017) on marten extension in mountain region of Alaska [APECS Group Review, Germany]	Accepted - text extensively revised
7032	2	47	6		31	add study on Cranes by 2070 on the Tibetan Plateau by Han et al. (2018) [APECS Group Review, Germany]	Noted - included in supplemental table
7034	2	47	6		31	add Review for Mammals and Climate Change by Huettmann (2017) Enyclopedia of the Anthropocene [APECS Group Review, Germany]	Noted - text on wildlife impacts is substantially revised
7036	2	47	6		31	Add SnowLeopard model outlook by WWF [APECS Group Review, Germany]	Noted - due to space limits, this could not be included.
7038	2	47	6		26	add river otters, and later, Ganges Dolphin etc [APECS Group Review, Germany]	Rejected - not relevant for mountain streams
24368	2	47	6	47	31	What is the point of this section, are these at risk from climate change? Can you assess the risks? [Hans-Otto Poertner and WGII TSU, Germany]	Accepted - text extensively revised
5990	2	47	8	47	31	This section would benefit when a conclusion in statistical terms about what the effect of a changing cryosphere means for the fauna is added [Roderik Van De Wal, Netherlands]	Noted - the wildlife section has been added and describes specific changes for animals due to changing snow.
7020	2	47	8	47	9	Remove the detail 'woody plants are generally slower to respond' since the next sentence is about animals, not plants. [APECS Group Review, Germany]	Accepted - this has been deleted.
19758	2	47	8	47	9	Modify to read: "…animals respond faster than plant communities, with woody plants generally the slowest to respond ()" [Michelle A. North, South Africa]	Accepted - this section has been greatly revised
7022	2	47	9	47	10	Would be helpful to summarize the findings of Callaghan et al. (2013) instead of referring readers to the paper. [APECS Group Review, Germany]	Noted - the text has been substantially revised.
19760	2	47	10	47	12	Modify to read: "…wheras there is adequate record of the up-slope movements of vascular plants, understanding the mobility of terrestrial animals…" [Michelle A. North, South Africa]	Noted - this section has been substantially revised.
7026	2	47	13			Incomplete citations, I propose you can add Huettmann 2012(Three Poles Protection) and also consider Kamel et al (2014) for Red Panda and climate layers and models [APECS Group Review, Germany]	Noted - this section has been substantially revised.
19762	2	47	15	47	15	Add "(see Glossary)" after stochastic, and add a description in the glossary [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
19764	2	47	21	47	24	Add references to this statement [Michelle A. North, South Africa]	Accepted - references are included
7028	2	47	26			add Pika study Rocky Mountain with Eric Beever and others, add studies by Dave Hik Yukon [APECS Group Review, Germany]	Accepted - this has been included in the supplemental table
3294	2	47	29	47	29	Insert a point (.) here. [Castor Muñoz Sobrino, Spain]	Editorial – copyedit to be completed prior to publication
18344	2	47	30	47	30	"to benefit amphibian species" should read "to benefit amphibian species temporarily" [Carmen Burghelea, Romania]	Taken into account Think this will be long term
5992	2	47	33	47	48	This section would also benefit from a conclusion with some statistical terms [Roderik Van De Wal, Netherlands]	Accepted - this section has been extensively revised
6316	2	47	35	47	48	This passage seems a little light, so it might benefit from incorporating information from a few additional studies. There is some evidence that glaciers are tied to fish populations and fish species richness, with obvious implications to climate change and glacier recession. The examples I know of are a little old but probably worth briefly summarizing in this passage anyway: (a) Dorava and Scott, 1998, Role of glaciers and glacial deposits in the Kenai River watershed and the implications for aquatic habitat, in: USGS Professional Paper 1595; (b) Fleming, 2005, Comparative analysis of glacial and nival streamflow regimes with implications for lotic habitat quantity and fish species richness, River Research and Applications, 21, 363-379; and (c) Dorava and Milner, 2000, Role of lake regulation on glacier-fed rivers in enhancing salmon productivity: the Cook Inlet watershed, south-central Alaska, USA, Hydrological Processes, 14, 3149-3159. [Sean Fleming, USA]	Rejected - these references are quite old now if we are following guidelines re recent references.
19766	2	47	35	47	36	Modify to read: "…influence fisheries through direct and indirect pathways. The key drivers of interest include…" [Michelle A. North, South Africa]	Accepted
19768	2	47	38	47	38	Please rewrite this sentence [Michelle A. North, South Africa]	Taken into account - text revised
19770	2	47	41	47	41	Modify to read "…migrate further upstream to find suitable habitat, or in some cases, become extinct ()" [Michelle A. North, South Africa]	Accepted
1616	2	47	47	47	47	word missing --> anadromous 'salmon'? [Brown Lee, UK]	Taken into account - salmon inserted
19772	2	47	47	47	48	Modify to read: "…potentially colonized by anadromous species that contribute to both commercial and sport fisheries…" [Michelle A. North, South Africa]	Taken into account - salmon inserted instead of species
5968	2	47	52	50	14	This paragraph provides some interesting information. However, it is really long, maybe it can be shortened. For example line 1-35 on p. 49. Those are all examples of adaptation, which can also be mentioned in one sentence. Not each case study needs to be outlined [Roderik Van De Wal, Netherlands]	Noted - some revision and text minimization done.
7024	2	47	52	50	14	Section 2.3.5.1 could also include a brief mention of the impact of changing ski tourism on workers. For example, when a ski resort has to open later in the year leaving seasonal workers unemployed longer than anticipated. [APECS Group Review, Germany]	Taken into account - we could mention it, but need evidence to back this up.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
11674	2	47	52	50	14	It could be interesting to add the work of Pröbstl-Haider U., Haider W., Wirth V., Beardmore B. 2015. Will climate change increase the attractiveness of summer destinations in the European Alps? A survey of German tourists. Journal of outdoor recreation and tourism, 11, pp. 44-57. Even if one of the conclusion is that it is very complex to analyze the effect of additional days of sunshine on visitation to the Alps during summer, it is interesting to note that climate change may also have positive effects on tourism. [Jacques Mourey, France]	Taken into account - thank you for paper suggestion. Note, however, that this is only indirectly related to the mountain cryosphere.
11688	2	47	52	50	14	The following reference could complete the section 2.3.5: Moreau M. 2010. Visual perception of changes in a high mountain landscape: the case of the retreat of the Evettes glacier (Haute-Maurienne, northern French Alps). Géomorphologie : reliefs, processus, environnements, 16 – 2, pp. 165 – 174. It shows that landscapes evolutions due to glacial retreat are perceived has not aesthetic by mountain tourists. [Jacques Mourey, France]	Taken into account - thank you for paper suggestion.
17940	2	47	52			I found this sectoin informative, yet largely case study based and oriented. Maybe synthesize further? [Christian Huggel, Switzerland]	Noted - some revision and text minimization to be done.
24370	2	47	52			Any economic perspectives on tourism and the potential risk from climate change? [Hans-Otto Poertner and WGII TSU, Germany]	Taken into account - no literature on economic valuation of tourism is found; still looking for information
19774	2	47	56	47	57	Please cite relevent literature to substantiate this statement. [Michelle A. North, South Africa]	Noted - removed the sentence to focus instead on the cases/studies presented in rest of the section, given lack of synthesis review literature to cite.
21392	2	47	56	47	57	Red flag: "An increasing boyd of literature suggests", but no references are given. Hence this statement is not traceable or verifiable. References have to be given. [Philippus Wester, Nepal]	Noted - removed the sentence to focus instead on the cases/studies presented in rest of the section, given lack of synthesis review literature to cite.
5994	2	48	1	48	57	This section shows some effects a changing cryosphere has on tourism, winter sports and such. Throughout the page there are methods shown on how to counteract these changes. It may be better to separate this section into a paragraph purely about change, and a paragraph about adaptation/geo-engineering [Roderik Van De Wal, Netherlands]	Noted - interesting suggestion for next version.
3500	2	48	7	48	18	I would have expected some reference to the works by P. Spandre et al. on grooming and snowmaking in the Alps in this section, for example Spandre et al., 2016. Integration of snow management processes into a detailed snowpack model, Cold Regions Science and Technology, 125, 48-64, https://doi.org/10.1016/j.coldregions.2016.01.002, and/or Spandre et al., 2017. Determination of snowmaking efficiency on a ski slope from observations and modelling of snowmaking events and seasonal snow accumulation, The Cryosphere, 11, 891–909, doi:10.5194/tc-11-891-2017. [Deborah Verfaillie, Spain]	Taken into account - thank you for paper suggestion.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
18714	2	48	10	48	11	"Efforts to reduce this vulnerability […] have been in place since the late 20th century". Snowmaking, as the main measure introduced by you in line 11 to 13, have not only been in place but has been sharply increasing since the 1990's (Steiger 2011a, Spandre2015). Such development illustrates a perception by ski resorts operators of climate change although this remains complex and somehow paradoxical (see quote below: Steiger, 2017). I therefore suggest to complete: "Efforts to reduce this vulnerability […] have been in place since the late 20th century and grown quickly in past decades, illustrating a complex perception of climate change by ski resorts stakeholders" [Pierre Spandre, France]	Taken into account - material was used for the preparation of the SOD
18716	2	48	10	48	11	Steiger, R. (2011a). The impact of climate change on ski touristic demand using an analogue approach. In K. Weiermair, H. echlahner, A. Strobl, M. Elmi, & M. Schuckert (Eds.), Coping with global climate change: Strategies, policies and measures for the tourism industry (pp. 247–256). Innsbruck: Innsbruck University Press. [Pierre Spandre, France]	Taken into account - material was used for the preparation of the SOD
18718	2	48	10	48	11	Spandre, P., François, H., Morin, S., & George-Marcelpoil, E. (2015). Snowmaking in the French Alps. Climatic context, existing facilities and outlook. Journal of Alpine Research| Revue de géographie alpine, (103-2). [Pierre Spandre, France]	Taken into account - material was used for the preparation of the SOD
18720	2	48	10	48	11	"There are also instances from more than one regional market where stakeholder perception studies document ski operators' disbelief in negative impacts of climate change on snow reliability, but hypocritically use climate change as a prominent argument to legitimate the expansion of existing snowmaking capacities (e.g. Aall & Høyer, 2005; Behringer et al., 2000)." Quote from page 24 of reference: Steiger, R., Scott, D., Abegg, B., Pons, M., & Aall, C. (2017). A critical review of climate change risk for ski tourism. Current Issues in Tourism, 1-37. [Pierre Spandre, France]	Taken into account - material was used for the preparation of the SOD
3758	2	48	11	48	13	other strategies to maximize the amount of snow on the ski slopes exist and should be mentioned here, in particular: earthworks to prepare the slopes in summer time (changing the shape and the characteristics of the soil) and snow fences and traps to collect wind blown snow [Carlo Carmagnola, France]	Accepted
18722	2	48	11	48	13	"Such measures include improved slope preparation, i.e., grooming, snowmaking…" The term "slope preparation" might be confusing. In this case it refers to snow management methods while it may also refer to slope contouring, landscaping (referred to as "slope development" by Scott, 2007, see below). I therefore suggest to replace "slope preparation" by "snowpack preparation" or any other term referring to snow. [Pierre Spandre, France]	Accepted
18724	2	48	11	48	13	Scott, D., & McBoyle, G. (2007). Climate change adaptation in the ski industry. Mitigation and adaptation strategies for global change, 12(8), 1411. [Pierre Spandre, France]	Noted - thank you for paper suggestion.
19776	2	48	11	48	13	Modify to read: "…improved slope prepraration, e.g., grooming, the artificial production of snow (Steiger et al, 2017), and more recently, snow farming (storage of snow over the summer season).." [Michelle A. North, South Africa]	Noted - however, sentence has since been modified given other comments.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
16548	2	48	32	48	43	Regarding glacier skiing, see also Falk (2016) "The stagnation of summer glacier skiing" article for empirical knowledge on demand sensitivity to snow depth as well as economic factors. Also look out for the forthcoming Demiroglu et al. (2018) "Climate change acknowledgement and responses of summer (glacier) ski visitors in Norway" article in the Scandinavian Journal of Hospitality and Tourism 18(4) for more insight to demand adaptation, especially in terms of the tendency towards activity substitution. [Osman Cenk Demiroglu, Sweden]	Taken into account - material was used for the preparation of the SOD
19778	2	48	35	48	35	Replace "too high" with excessive [Michelle A. North, South Africa]	Accepted
13000	2	48	36	48	57	There are additional field studies and concepts being explored to slow ice loss. Are there natural analogue observations of glacier mass growth, reduced loss rates, that could inform potential mitigation measures? (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.) [Gabrielle Dreyfus, USA]	Rejected - comment falls outside the scope of the report and in particular the section on Tourism.
19780	2	48	48	48	48	Change to "…increased exposure to hazards…" [Michelle A. North, South Africa]	Accepted
4542	2	48	53			Change 'mitigate' to 'adapt to' - Mitigation has a different use in an IPCC context than (I believe) is intended here. [Graham Mcdowell, Canada]	Accepted
17942	2	48	57	48	57	effective in terms of what? Hardly economically effective. [Christian Huggel, Switzerland]	Accepted - here effective is meant in terms of sustaining sufficient snow amounts for skiing. Text wes revised for better clarity.
3760	2	49	4	49	4	in addition, the new-formed proglacial lakes at the bottom of glaciers can be used as a reservoir for snowmaking (for example on the Les 2 Alpes glacier in France) [Carlo Carmagnola, France]	Accepted - although would be better if we had a citation to refer to this example
7040	2	49	6	49	6	Facilitate 'hiking' instead of 'hikers' [APECS Group Review, Germany]	Accepted
11676	2	49	21	49	25	It could be interesting to note the important risk represented by proglacial lakes in Nepal Himalaya. Worni R., Huggel C., Stoffel M. 2013. Glacial lakes in the Indian Himalayas – From an area-wide glacial lake inventory to on-site and modeling based risk assessment of critical glacial lakes. Science of Total Environment, 468-469, pp. 71 – 84. Bolch T., Buchroithner M. F., Peters J., Baessler M., Bajracharya S. 2008. Identification of glacier motion and potentially dangerous glacial lakes in the Mt Everest region/Nepal using spaceborne imagery. Natural Hazards and Earth System Sciences, 8, pp. 1329 -1340. [Jacques Mourey, France]	Noted - topic treated in section 2.3.3. including similar references
7042	2	49	23	49	24	Remove 'point to' and 'as much more serious issues' [APECS Group Review, Germany]	Noted - however text changed in the revision.
19782	2	49	31	49	31	"100,000 visitors in the 1990s": was this per year, or for the whole decade? If the latter, then the number of visitors has not decreased [Michelle A. North, South Africa]	Accepted - text was revised for better clarity.
7044	2	49	37	49	37	Remove 'upon' [APECS Group Review, Germany]	Accepted
11678	2	49	37	49	47	On this paragraph the words "shelters" and "refuges" are used. Do they designate different elements? I propose the term of "hut" has a generic term. [Jacques Mourey, France]	Accepted

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
11680	2	49	39	49	39	The following reference about the stability of high mountain infrastructure can be add: Duvillard PA., Ravanel L., Deline P. 2015. Risk assessment of infrastructure destabilization due to global warming in the high French Alps. Journal of Alpine Research, 103 – 2, DOI: 10.4000/rga.2896. [Jacques Mourey, France]	Accepted
11682	2	49	41	49	41	There is a word missing “according to” before “studies”. [Jacques Mourey, France]	Noted
1618	2	49	42	49	42	doesn’t make sense as written - seems to be missing a word [Brown Lee, UK]	Noted
7046	2	49	42	49	43	Rewrite as '...French Aps, have attributed glacier retreat to increased...' [APECS Group Review, Germany]	Accepted
11684	2	49	44	49	44	The conclusion “to facilitate access” is right but only for some itineraries. In some cases, ladders and fixed anchors are needed to “maintain” the access, that otherwise would be impossible. [Jacques Mourey, France]	Taken into account
11038	2	49	48	49	48	Please consider adding information on the impact of changes in the regime of rivers on wild water tourism; also on the impact of the decreasing level of water reservoirs in the summer where artificial lakes are used for tourism purposes (European Alps, for instance Serre-Ponçon lake in France). [Nathalie Morelle, Austria]	Rejected - not enough literture. Text releted impact on tourism partly covers the topic.
4544	2	49	49			Cite Kaenzig et al (2016) for 'last chance' tourism statement. See: Kaenzig, R., Rebetez, M., Serquet, G. (2016) Climate change adaptation of the tourism sector in the Bolivian Andes. Tourism Geographies 18, 111-128. [Graham Mcdowell, Canada]	Accepted
19784	2	49	49	49	51	Please include citations for the 'mentioned studies' [Michelle A. North, South Africa]	Accepted - temme 2015 and Purdie et al 2015 added
11686	2	49	56	49	56	I’m surprised that it is “likely” and not “very likely” that cryospheric changes due to climate change have been driving changes in tourism and recreation activities in the mountains. Are there not enough evidences? Or are they not concerning a large enough part of mountain tourism? I’m even more surprised that in the summary, there is a “high confidence that the exposure of people and infrastructure in high mountain regions has increased over recent decades, and this trend is expected to continue in the future. Tourism has been the main driver of this change”. [Jacques Mourey, France]	Taken into account - text has been revised to better reflect current state of knowledge. With the exception of a few knowledge hotspots, evidence is limited from most mountain regions.
7050	2	50	0	51		This is a massive shortcoming and disregard of spiritual and religious issues. It MUST be extended and widened, many citations exist, namely with ICIMOD, see Kailash study, see Dalai Lama, Northern India issues, Tibet and many many more all over the world. It’s a major oversight and western science bias. PLEASE correct. [APECS Group Review, Germany]	Noted - we acknowledge that there are tourism related aspects with respect to religious and sacred sites, however we have not located evidence/studies that make a direct link of their impacts to chnages in the cryosphere (and climate). It may also be addressed under Section 2.3.5.2.
4546	2	50	1			Mitigate' has a different use in an IPCC context. Suggest other word such as' reduce'. [Graham Mcdowell, Canada]	Accepted
3762	2	50	3	50	5	sentence not clear, please rephrase [Carlo Carmagnola, France]	Noted - we have revised the sentence.
4548	2	50	5			'Mitigate' has a different use in an IPCC context. Suggest other word such as' reduce'. [Graham Mcdowell, Canada]	Accepted
3502	2	50	8	50	14	There are no references in this paragraph; some should be included (here or before) to support the conclusions about projected changes in mountain tourism linked to changes in the cryosphere. [Deborah Verfaillie, Spain]	Rejected - this is a summary (assessment) building on the previous section, where relevant referneces are cited.
5970	2	50	8	50	14	While the summary is nice to have, it contains information which isn't mentioned in this paragraph. Like the limits of the mitigation strategies reaching their limit in a few decades, the major changes in the 21st century and the named other factors. Those aren't backed op in paragraph 2.3.5.1 [Roderik Van De Wal, Netherlands]	Accepted - text was revised, and SOD includes statements backed by very recent literature.

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Comment id	Chapter	From page	From line	To page	To line	Comment	Chapter Team Response
5996	2	50	8	50	14	There is nothing said in this section about innovation, learning curve and economies of scale. You would expect humans to find other, more efficient ways to cope with a changing cryosphere. This is hard to quantify, but it would affect the conclusion that ' Existing local mitigation measures are likely to reach their limits within a few decades' [Roderik Van De Wal, Netherlands]	Taken into account - we think it is appropriate in such an assessment to describe limits to adaptation of current technologies and approaches. We cannot speculate on disruptive transformations ; further, there is no literature on the matter.
4550	2	50	9			Change 'mitigation' to 'adaptation' - Mitigation has a different use in an IPCC context than (I believe) is intended here. [Graham Mcdowell, Canada]	Accepted
4552	2	50	9	50	11	What is the evidence base for these claims (I assume here that the term 'mitigation' actually refers to 'adaptation')? Is this claim only speaking to limits of narrow technological responses like snow making? If so, perhaps the claim is OK. If not, however, 'high agreement' and 'medium evidence' for limits to adaptation in the tourism sector more broadly seems like an overstatement (e.g. are there actually strong limits to business diversification in the next few decades?). I suggest greater precision in the scope of this claim. [Graham Mcdowell, Canada]	Taken into account - statement meant in terms of technological adaptation.
2068	2	50	18	50	19	What harms human well-being - the cryospheric changes or the spiritual values? And what are "intrinsic" values"? [J. Graham Cogley, Canada]	Accepted - text revised
2070	2	50	24	50	24	Change "held" to "valued differently". [J. Graham Cogley, Canada]	Accepted - text revised
5974	2	50	41	50	49	This paragraph almost suggest that we can gain information about the cryosphere by asking residents, using tales told for generations or use eyesight observations from local guides. This seems very unscientific in our opinion, what is the take-home message of this section? [Roderik Van De Wal, Netherlands]	Accepted - sentences revised to make reference to "indigenous knowledge" and "local knowledge," terms in the SROCC glossary.
7048	2	50	56			it is VERY LIKELY [APECS Group Review, Germany]	Rejected - it is unclear what this comment refers to.
19786	2	51	3	51	3	"cultural", not culture [Michelle A. North, South Africa]	Accepted - text revised
7054	2	51	18	51	19	Mountain systems are already marginal environments, as a result of their fragility, poor accessibility, and marginalisation from the mainstream. At the same time, mountain people's livelihoods depend to a great extent on natural resources, which are vulnerable to change, and people already tend to be poorer than in the plains and thus less able to cope with challenges. It can also be added atn the begining of the paragraph or where ever seems appropriate. Citation: ICIMOD (2010), Impact of Climate Change on Water Resources and Livelihoods in the Greater Himalayas, ISBN 978 92 9115 111 0 [APECS Group Review, Germany]	Accepted - text revised
13442	2	51	31	51	32	That households increased other livelihoods, including migration - what does this mean? [Debra Roberts and Durban Team, South Africa]	Accepted - text revised
2072	2	51	32	51	32	"by migration". Migration is not a lvelihood. [J. Graham Cogley, Canada]	Accepted - text revised to clarify wage labour migration as an income source
4554	2	51	41	51	42	This is a significant and consequential claim to make, especially based on once citation. Perhaps reflect on the implications of this claim and seek additional sources of support if deemed to be an appropriate claim. [Graham Mcdowell, Canada]	Accepted - three more references have been added

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7056	2	51	43	51	45	For eg. A study by ICIMOD (2010) in the districts of Tehri Garhwal, Bageshwar, and Almora in Uttarakhand, northwest India highlighted a trend towards increasing feminsation of agriculture as a result of migration of men for work. It can be added to highlight one among various outcome of changing climates in high Himalayas. Citation: ICIMOD (2010), Rural Livelihoods and Adaptation to Climate Change in the Himalayas [APECS Group Review, Germany]	Accepted - recent refernces from peer-reviewed literature have been added.
17944	2	51	47			Mobility and habitability are a very important topic for this chapter and the report. The text could be more condensed, I believe. Where it talks about transhumant pastoralism (P. 52 line 44) I suggest to add reference to evidence and experiences from Scandinavia. [Christian Huggel, Switzerland]	Accepted - text revised, reference added.
5998	2	51	49	52	57	This is hardly about mobility in the western world, while they also experience some impacts. As an example: the Vatnajökull in Iceland has a direct impact. Melting destroys an important piece of the driveway around Iceland. Such examples could also be incorporated in the report [Roderik Van De Wal, Netherlands]	Rejected - the comment confuses mobility and transportation.
19788	2	51	53	51	54	Delete everything after "limited economic opportunities", until the confidence language [Michelle A. North, South Africa]	Accepted - text revised.
4556	2	51	54			But population growth in mountains is still increasing. Perhaps a relevant point in the context of this claim? See: FAO (2015). Mapping the vulnerability of mountain peoples to food insecurity. R. Romeo, A. Vita, R. Testolin and T. Hofer. Rome, FAO: 68. [Graham Mcdowell, Canada]	Rejected - beyond the scope of the chapter.
7052	2	51	54	51	54	Need to better connect ideas between 'economic opportunities' and 'mountain people are'. [APECS Group Review, Germany]	Accepted - text revised.
4558	2	52	6			Consider changing ‘involves’ to ‘is influenced by the’. Consider changing ‘determinants’ to ‘drivers’. I believe this is more appropriate conceptually in this instance. [Graham Mcdowell, Canada]	Accepted - text revised.
7058	2	52	10	52	11	Need to define snowball sampling (technical language) [APECS Group Review, Germany]	Accepted - text revised to use more standard terminology
24876	2	52	11	52	11	“These studies..” needs more references—the prior sentences only has one reference. [Elizabeth Weatherhead, USA]	Accepted - text revised to clarify which studies.
7060	2	52	14			Not a risk, but a fact [APECS Group Review, Germany]	Rejected - it is unclear what this comment refers to.
19790	2	52	22	52	24	Please provide references for this paragraph [Michelle A. North, South Africa]	Taken into account - the sentence was deleted
5972	2	52	26	52	29	In this paragraph the report refers to "some literature". Isn't it better to specify this more? [Roderik Van De Wal, Netherlands]	Accepted - references added
19792	2	52	26	52	29	Please provide references for this paragraph [Michelle A. North, South Africa]	Accepted - references added
24878	2	52	26	52	29	“Some literature...”. This paragraph very much needs references.. [Elizabeth Weatherhead, USA]	Accepted - references added

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4560	2	52	27	52	29	The claim that climate-related hydrological changes are 'weakening livelihoods, reducing habitability and increasing human vulnerability' is rather environmentally deterministic and is not consistent with contemporary work on the human dimensions of climate change in (and beyond) mountain systems. I would suggest reframing to: "Changes in snow and glacier regimes and runoff, combined with changes in the timing and intensity of precipitation, magnify existing socio-economic challenges and disparities, threatening human well-being in and beyond mountains". [Graham Mcdowell, Canada]	Accepted - part of suggested language added.
2074	2	52	31	52	31	"emigration". [J. Graham Cogley, Canada]	Rejected - outmigration is a standard term.
24880	2	52	31	52	33	"Though large sample surveys.." needs a reference. Similarly on line 33, "A study in the central Peruvian…" needs a reference. Might it be the Warner reference five lines further down? Similarly on line 35, "In another region, the reverse relations ship was noted." If this is Hill's work, reference belongs with the first sentence that mentions the work. [Elizabeth Weatherhead, USA]	Accepted - text revised
19794	2	52	48	52	48	"…decrease in rainfall…", not "of rainfall" [Michelle A. North, South Africa]	Accepted - text revised
19796	2	52	51	52	51	Replace ", as cited for" with "in", so that it reads: "…caused deaths of a large number of livestock in northern Pakistan in 2009 ()." [Michelle A. North, South Africa]	Accepted - text revised
24882	2	53	4	53	4	"The most frequently mentioned driver…" needs a reference. [Elizabeth Weatherhead, USA]	Accepted - references added
2090	2	53	10	53	10	"emigration". Same at L28, 29, etc. [J. Graham Cogley, Canada]	Rejected - outmigration is a standard term.
7062	2	53	13	53	13	Delete comma before (Candonnet et al., 2015) [APECS Group Review, Germany]	Accepted - text revised
2076	2	53	24	53	24	What is "influence migration"? [J. Graham Cogley, Canada]	Accepted - term deleted in revisions.
19798	2	53	24	53	24	Delete "influence" before migration, so that it reads: "…migration patterns, the influence of perceptions on migration, and the issue of habitability." [Michelle A. North, South Africa]	Accepted - term deleted in revisions
2078	2	53	36	53	36	What is "artificial pasture"? [J. Graham Cogley, Canada]	Accepted - text revised
7064	2	53	50	53	50	Add point after (Kaenzig, 2015). [APECS Group Review, Germany]	Accepted - this paragraph was deleted in revisions.
4562	2	54	9	54	10	Well-developed literature on the social nature of limits to adaptation could be consulted/cited here. See: Adger, W. N., et al. (2009). "Are there social limits to adaptation to climate change?" Climatic Change 93(3): 335-354. [Graham Mcdowell, Canada]	Rejected - cryosphere-specific references are preferred to more general ones.
4564	2	54	13	54	29	Many relevant insights for these sections can be found in soon-to-be available results in McDowell et al (In Review) which provides a comprehensive and up to date systematic review of exiting adaptation action and research in mountain systems. See: McDowell, G., Huggel, C., Frey, H., Wang, F., Cramer, R., Ricciardi, V. (In Review) Adaptation action and research in glaciated mountain systems: Are they enough to meet the challenge of climate change? Results from this paper supersede findings from: McDowell, G., et al. (2014). "Adaptation to climate change in glaciated mountain regions." Climatic Change 126(1-2): 77-91. [Graham Mcdowell, Canada]	Noted - noting paper still in review. Text has been substantially changed and updated to focus on gaps and in international policy frameworks. Synthesis regarding impacts and adaptation are to be weaved and incorporated in other sections, inclusing the Executive Summary.
24372	2	54	13			please ensure these sections are completed for the next draft [Hans-Otto Poertner and WGII TSU, Germany]	Noted - some re-structuring of text/content in other areas (inclusing ES) mean that we know deal here exclusively with gaps and policy frameworks

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252	2	54	23			Section 2.4.2: The subject should be covered in the four aspects: scenarios, likelihoods, impacts and decision strategies. [Bilal Ayyub, USA]	Rejected - these items are covered and dealth with in previous sections under impacts and responses.
21402	2	54	23	54	28	Authors should be careful to adhere to the mandate and outline of the Special Report as approved at IPCC-47. Evaluating the alignment of strategies to global policy frameworks falls outside the scope of this mandate. Authors should be careful not to overcharacterize the nature of global frameworks that are not specific to ocean and cryosphere issues. Suggest that section 2.4.2 be removed. [Alice Alpert, USA]	Rejected - addressing key gaps and open questions falls within our manadate and need to make reference to these issues in the Chapter. This final section was considered the place in which to address it. Likewise, some discusison and placement of changes in cryosphere under climate chnage and global policy sonctests needs to be mentioned, as other Chapters are also considering doing (discussion had at LAM3).
21440	2	54	25	54	28	Please NOTE: O. Savoskul, E. Shevnina. Irrigated Crop Production in the Syr Darya Basin: Climate Change Rehearsal in the 1990s in C Hoanh, V Smakhtin, R Johnston (eds) Climate Change and Agricultural Water Management in Developing Countries, CABI, 2016, 176-192 The chapter might be of unique interest to the theme of adaptation experiences. We've run the water allocation model for the transbounadry Syr Darya basin (where the streamflow generates mainly from high mountain areas) under a set of GCM-based IPCC scenarios. The model runs indicate that due to the political situation in this region, the basin has undergone through a rehearsal of future CC impact already in 1990s after the desintegration of USSR. The conclusion is that a successful adaptation strategy has been tested in this basin prior to actual CC. [Oxana Savoskul, Sri Lanka]	Accepted - references added
12570	2	54	30	55	18	I am missing a paragraph on knowledgegaps in terms of process understanding [Thomas Vikhamar Schuler, Norway]	Noted - the text has been updated and changed to include a discussion on gaps in observations, detection and attribution, which link to (gaps in) understanding of climate change processes in high mountains.
21448	2	54	30	54	30	the major knowledge gap regarding glaciers and glacier runoff is the problem of quantifying CC impact on glacier systems, which up to date remains largely unsolved due to high diversity of glacier properties, such as morphology, mass-turnover rates and other features. The importance of the regional CC-ipmact driven glacier modeling is difficult to underestimate because in the absence of reliable methods for the assessment of future glacier states the large-scale hydrological modeling is hampered too. A paragraph elaborating on the current modeling approaches to CC impact on glacier area, volume and runoff might be added. [Oxana Savoskul, Sri Lanka]	Accepted - this knowledge gap is covered in this secton
21454	2	54	30	54	30	It might help to bring in a box to illustrate the role of glaciers and seasonal snow as a natural water storage agents, and the relation between precipitation, meltwater resources and their input to streamflow [Oxana Savoskul, Sri Lanka]	Noted - however, emphasis and focus for this section has been re-formulated, leaving such topics/issues to be integrated in to other sections of the chapter.
1804	2	54	32	55	15	Better constraining the radiative focing effects of light absorbing impurities and understanding their spatiotemporal dynamics is probably a key knowledge gap both in mountain and polar ice and snow. [Joseph Cook, UK]	Noted - a sentence has been added to reflect this gap, may be subject to further editing given other experts inputs

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212	2	54	39	54	41	Long-term temperature trends are better known than suggested here. A common theme of this chapter is that authors chose to ignore any natural climate change that occurred before the Little Ice Age, despite a vast amount of literature and syntheses on this subject. It is a bit of a mystery what reasoning is behind this decision as it weakens the report and the confidence into the attribution discussion enormously. [Sebastian Luening, Portugal]	Rejected - this section refers to the knowledge of the long term trends in the context of elevation dependent warming (EDW) suggested by the recent observations. So far this question was not addressed in paleostudies. Text was revised to clarify this. Authors follow the agreed outline of the Chapter2 and the Special report.
4566	2	55	8	55	10	Many relevant insights for this section can be found in soon-to-be available results in McDowell et al (In Review) which provides a comprehensive and up to date systematic review of exiting adaptation action and research in mountain systems. See: McDowell, G., Huggel, C., Frey, H., Wang, F., Cramer, R., Ricciardi, V. (In Review) Adaptation action and research in glaciated mountain systems: Are they enough to meet the challenge of climate change? Results from this paper supersede findings from: McDowell, G., et al. (2014). "Adaptation to climate change in glaciated mountain regions." Climatic Change 126(1-2): 77-91. [Graham Mcdowell, Canada]	Noted - noting paper still in review. Text has been substantially changed and updated to focus on gaps and in international policy frameworks. Synthesis regarding impacts and adaptation are to be weaved and incorporated in other sections, including the Executive Summary.
214	2	56	1	56	36	I suggest to add an important new FAQ complex: Have similar warming trends, like the one of the past 150 years, been oberserved in the High Mountain regions before in pre-industrial times? When did they occur, what temperature levels were reached, how rapid did temperatures change, what were the natural drivers for this change, could these drivers still be active today, if not - what might have switched them off?, can current climate models reproduce the significant natural climate change that has been documented for the past millennia? [Sebastian Luening, Portugal]	Rejected - FAQs have been chosen after stakeholder survey and internal review
17340	2	56	1	56	2	Suggest a FAQ here along the lines of, "What is the possibility of saving some mountain glacier systems?" and a very "lay" response based however on RCP scenarios per the above. As noted at many points in this chapter, both those who live near these systems, but also many who visit them have a strong attachment to mountain glaciers and are concerned by their disappearance. This might be a more widespread question therefore and motivates a resposne here. [Pamela Pearson, USA]	Rejected - FAQs was dropped
12752	2	56	11	56	17	consider citing Scherler et al. 2011 here: Scherler, D., Bookhagen, B., Strecker, M.R. Spatially variable response of Himalayan glaciers to climate change affected by debris cover (2011) Nature Geoscience, 4 (3), pp. 156-159. Cited 366 times. https://www.scopus.com/inward/record.uri?eid=2-s2.0-79952180398&doi=10.1038%2fngeo1068&partnerID=40&md5=b84ab94605c9d23be1661536fae1844a [Jan-Christoph Otto, Germany]	Rejected - FAQs are not supposed to have references
3296	2	56	13	56	13	Suggestion: perhaps sea-land correlations and the influence of the orography might be discussed here. [Castor Muñoz Sobrino, Spain]	Rejected - FAQs was dropped

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21446	2	56	13	56	13	It is not clear if the question is placed here for the contributing authors or for the reviewers. An express answer is that the glaciers respond to two major CC signals: changes in air temperature and in precipitation. In some instances, the precipitation increase may offset the mass-loss changes due to air temperature rise. It depends mainly on the intensity of glacier mass-turnover, which is a regional factor. In cold and arid areas glaciers respond more to changes in air temperature, whereas in warmer areas with higher precipitation the latter becames a dominant drive. Quotations may be provided on request. [Oxana Savoskul, Sri Lanka]	Noted - this was written as a placeholder
22336	2	61	44	61	44	reference incomplete. It should read: Erdkunde 64 (4), 355-370, doi:10.3112/erdkunde.2010.04.05 [Marcus Nüsser, Germany]	Accepted - reference corrected
1418	2	63	1	63	4	Engelhardt (2017b) = Engelhardt (2017c) [Harry Zekollari, Switzerland]	Accepted - duplicate reference deleted
12566	2	63	1			Engelhardt 2017b and 2017c are identical. [Thomas Vikhamar Schuler, Norway]	Accepted - duplicate reference deleted
22484	2	69	30	69	30	Add: Klein, G.; Vitasse, Y.; Rixen, C.; Marty, C.; Rebetez, M., (2016). Shorter snow cover duration since 1970 in the Swiss Alps due to earlier snowmelt more than to later snow onset. Climatic Change, 139 (3-4), 637-649. doi: 10.1007/s10584-016-1806-y [Martine Rebetez, Switzerland]	Taken into account - this material was considered for SOD
13444	2	73	7	73	7	Add 'on' before 'hunting' [Debra Roberts and Durban Team, South Africa]	Taken into account
13446	2	73	11	73	11	Add 'to' before 'resource governance' [Debra Roberts and Durban Team, South Africa]	Taken into account
22476	2	78	7	78	9	Replace Serquet... by : Serquet, G.; Marty, C.; Dulex, J.; Rebetez, M., (2010). Seasonal trends and temperature dependence of the snowfall/precipitation-day ratio in Switzerland. Geophysical Research Letters, 38, L07703 (5 pp.). doi: 10.1029/2011GL046976 [Martine Rebetez, Switzerland]	Taken into account - this material was considered for SOD
22478	2	78	10	78	10	Add: Serquet, G.; Marty, C.; Rebetez, M., (2013). Monthly trends and the corresponding altitudinal shift in the snowfall/precipitation day ratio. Theoretical and Applied Climatology, 114 (3-4), 437-444. doi: 10.1007/s00704-013-0847-7 [Martine Rebetez, Switzerland]	Taken into account - this material was considered for SOD