

#	Ch	From Page	From Line	To Page	To Line	Comment
1	28	0	0	0	0	This chapter focuses slightly more on terrestrial and freshwater ecosystems than on marine ones. If the marine ecosystem is concerned the authors focus on the shelf or possibly upper slope system, but not on what is known of deep-sea systems. The benthos (the most heterogeneous marine ecosystem) is not referred to in detail compared to the pelagic environment. (Dr. Brandt, Angelika, University of Hamburg)
2	28	0	0	0	0	I suggest blending this into previous section on Infrastructure. This is all infrastructure. (Francis, Jennifer, Rutgers University)
3	28	0	0	0	0	It seems there should be some discussion of projected security needs added to this section. (Francis, Jennifer, Rutgers University)
4	28	0	0	0	0	The chapter has given many interesting results and thoughts. I realize that all activity and life forms of Ch. 28-Polar regions are not really in the “polar regions”, but rather in a fringe around the polar regions, i.e. the lower latitudes of the Arctic and Antarctic. I realize that I have had an oversimplified view of poleward displacement of species as a result of climate change before I read this chapter. My general view has earlier been that poleward displacement of species should be accompanied by species extinctions at the extremes, i.e. species extinctions at the extreme warm end for the warmest-adapted species in the tropics, and species extinctions at the extreme cold end for the coldest-adapted species in polar regions. This view, I think, still holds for the tropics, but it is not correct for the polar regions, simply because of the extreme aridness in polar regions. In fact, it seems that there are hardly species at all near the poles, let’s say north and south of 80-85 degrees. This means that there will be no species extinctions at all in polar regions, only poleward displacement of species and species invasion of the regions. Am I right? If so, it would be interesting to give this consideration a couple of sentences in your chapter. (Sundby, Svein, Institute of Marine Research)
5	28	0	0	0	0	In the various parts of the chapter there seems to be some degree of opposing views about how indigenous people will be able to handle climate change. Some places it seem to be the view that they are particularly vulnerable to climate change, other places they seem to be quite robust to climate change (Sundby, Svein, Institute of Marine Research)
6	28	0	0	0	0	This Chapter is well written and easy to read. (AUSTRALIA)
7	28	0	0	0	0	More detail on the research and data gaps, and the priorities for significantly reducing uncertainty, is required in order to provide clear guidance to governments on what needs to be done in the future. (AUSTRALIA)
8	28	0	0	0	0	A more cohesive story of the impacts of climate change on these regions needs to be developed in Chapter 28. At present, much of the detail of change in the physical environment and in biota is referenced to other chapters and is not given any detail or understanding in this chapter. In the other chapters, the detail is insufficient to understand the change and how that might be important to the region. A coherent, but still concise, narrative needs to be developed that can be used by regional managers and governments. (AUSTRALIA)
9	28	0	0	0	0	Greater balance is needed between the two polar regions in detailing the impacts of climate change on biota, particularly marine mammals and birds; more consideration should be given to explaining how the responses of biota to climate change might be different or similar between the poles. (AUSTRALIA)
10	28	0	0	0	0	Correct citation of SWIPA is: AMAP 2011. Snow, Ice, Water and Permafrost in the Arctic (SWIPA); Climate Change and the Cryosphere. Arctic Monitoring and Assessment Programme (AMAP), Oslo, Norway. Xii+538 pp. Reference in text should be SWIPA (AMAP, 2011). (DENMARK)
11	28	0	0	0	0	Figures on undiscovered/undeveloped oil and gas resources in the Arctic mentioned in the chapter are inconsistent. (DENMARK)

#	Ch	From Page	From Line	To Page	To Line	Comment
12	28	0	0	0	0	Recognizing the importance of climate change impacts on traditional livelihood and indigenous peoples and communities in the Arctic, it is disappointing that the chapter does not attempt to also comprehensively address climate effect concerns and adaptation options for non-traditional indigenous communities/societies and for non-indigenous populations and inhabitants of the Arctic such as for instance the Faroese and the Icelandic populations. Given the rate of change in the Arctic and the many recognized second and higher order effects of climate change it is also somewhat surprising the the chapter does not attempt to address cumulative effects of climate change and the effects on human living conditions. (DENMARK)
13	28	0	0	0	0	The chapter is well written but the organization is somewhat difficult. I don't find the text completely consistent with the titles of the sub chapters 28.2 Observed changes and Vulnerability under Multiple Stressors and 28.3 Key projected impacts and Vulnerabilities under Different Climate Pathways. More specifically, both sub chapters have information about observed changes and possible future changes. I choosen just one example (there are many): 28.2.2.1.1 Overview of Arctic marine plankton and fish is supposed to deal with observed changes and vulnerability, but still in that text (p.13, line26-27) we find "there is low confidence that climate change will reduce the abundance of C. marshallae in the Bering Sea". This is a projected impact and should be in chap 28.3. In chap. 28.3 on the other hand, which is suppose to deal with projected impacts, we find (p.42, line 36-37) information about observed changes. Thus it is hard to see the difference between sub chapters 28.2 and 28.3 as it is written now. (Ingvaldsen, Randi, Institute of Marine Research)
14	28	0	0	0	0	The chapter could be better organized as there is much repetition. Given that the chapter should focus on both impacts and adaptation, there is a lack of balance with respect to these two aspects (i.e. much more on impacts compared to adaptation). Progress has been made since TAR with respect to adaptation. In particular, there is greater acknowledgement that climate change needs to be considered in design of northern infrastructure and there is much effort to develop best practices etc. (certainly the case for Canada). This advance was highlighted in the permafrost chapter of SWIPA but does not come out clearly in this chapter (and should probably be a key finding in executive summary etc). (Smith, Sharon, Geological Survey of Canada)
15	28	0	0	0	0	Regarding chapter organization - It is unclear why information in section 28.2.6.1 on Traditional Knowledge is not presented with information in sections 28.2.1 - 28.2.5 as these sections also provide evidence of observed changes in natural and human systems. It would be more effective to provide information on evidence/observation of changes acquired through scientific studies or TK together. This would provide a more focussed discussion with less repetition as well as demonstrate the importance of both scientific studies and TK in change detection. (Smith, Sharon, Geological Survey of Canada)
16	28	0	0	0	0	Organization could be greatly improved if changes in the physical environment were clearly discussed first followed by discussion of implication with respect to ecosystems, human populations, economic sectors etc. (Smith, Sharon, Geological Survey of Canada)
17	28	0	0	0	0	Congratulations! Much improved from the FOD version. (Molau, Ulf, University of Gothenburg)
18	28	0	0	0	0	Two new Arctic Council reports ought to be included, both released on May 15, 2013: the Arctic Biodiversity Assessment (ABA) and the Arctic Resilience Report (ARR). Both include a wealth of adequate information for Chapter 28. ARR can be downloaded from www.arctic-council.org/arr . The ABA is still incomplete as the chapter Terrestrial Ecosystems is missing (see CAFF website). (Molau, Ulf, University of Gothenburg)
19	28	0	0	0	0	Please use same wording in the whole Ch.: either 'the Antarctic' without 'a' (meaning the region in a whole) or just 'Antarctica' (which only means the continent itself, not the surrounding sea), better use "the Antarctic". (GERMANY)
20	28	0	0	0	0	overall, a strong analysis of marine issues in the polar areas (Menzel, Lena, Alfred Wegener Institute for Polar and Marine Research)

#	Ch	From Page	From Line	To Page	To Line	Comment
21	28	0	0	0	0	Several references to potential for oil and gas development in chapter, but make sure there is consistency between these. Particularly use the same references and estimates for potential. These repetitions are noted below. Also - only one place(28.2.5.1.6) mentions that the estimates may be too optimistic. Add reference to: Lindholdt, L., & Glomsrød, S. (2012). The Arctic: No big bonanza for the global petroleum industry. Energy Economics, 34, 1465-1474. (Amundsen, Helene, CICERO - Centre for international climate and environmental research - Oslo)
22	28	0	0	0	0	The chapter could be better organized as there is much repetition. For example it is unclear why the information in section 28.2.6.1 on Traditional Knowledge is not presented with information in sections 28.2.1 - 28.2.5 as these sections also provide evidence of observed changes in natural and human systems. It would be more effective to provide information on evidence/observation of changes obtained through scientific studies or TK together. This would also provided a more focussed discussion with less repetition. (CANADA)
23	28	0	0	0	0	Organization of the chapter could also be greatly improved if the changes in the physical environment were clearly discussed first followed by discussion of implications with respect to ecosystems and human populations, economic sectors etc. (CANADA)
24	28	0	0	0	0	Chapter 28 might benefit from having a subsection that discusses the lack of infrastructure (especially transportation) in the Polar Regions and linking it to climate change (e.g., transportation challenges exacerbated by climate change). The following references provide useful insight on the subject: http://www.arctic.gov/publications/AMSA/infrastructure.pdf http://www.cmts.gov/downloads/CMTS_Draft_Arctic_MTS_Overview_and_Priorities_Paper_for_Public_Comment-Feb2013.pdf http://www.parl.gc.ca/Content/LOP/ResearchPublications/prb0808-e.htm http://www.statcan.gc.ca/pub/16-002-x/2009001/article/10820-eng.htm (CANADA)
25	28	0	0	0	0	A discussion of "here is why everyone should care about polar oceans" should be presented and perhaps highlighted as an FAQ. In part, this is due to the teleconnections between polar changes and impacts at lower latitudes. (UNITED STATES OF AMERICA)
26	28	0	0	0	0	A significant gap in the chapter is that it does not address the impacts of extreme events. There is a brief mention of "event-driven changes in ecosystems" on p. 25, but that hardly captures the importance of extreme events. These events (storms, extreme temperature swings, floods, droughts, etc.) affect humans and infrastructure as well as ecosystems. Their impacts are generally greater than the impacts of changes in the means. (UNITED STATES OF AMERICA)
27	28	0	0	0	0	All text should only relate directly to climate change - not to just general economic or population changes. (UNITED STATES OF AMERICA)
28	28	0	0	0	0	Figures and Tables: there are only 2 tables and 8 figures. Figures (or perhaps tables) on the loss of sea ice would be very helpful for the reader. (UNITED STATES OF AMERICA)
29	28	0	0	0	0	Overall, this chapter does a good job on presenting important information. There are some systemic problems, however. Some topics are quite unevenly treated. For example, consideration of species in the marine environment covers polar bears extensively but gives much less attention to other, top level predators. In the terrestrial environment, there is an over emphasis on reindeer. Box 28-1 focuses on Canada, and it is not clear why infrastructure in that country is emphasized or whether it is in any way representative. (UNITED STATES OF AMERICA)

#	Ch	From Page	From Line	To Page	To Line	Comment
30	28	0	0	0	0	<p>The authors have done a good job covering an enormous amount of literature in 52 pages of text; however, there are a number of sections that appear under-represented relative to other sections (see specific comments below- e.g., terrestrial environment in the Antarctic, ocean acidification research in the western Arctic, impacts of climate change by LME in the Arctic). The presentation would benefit from additional effort to provide syntheses of the available data, as well as focusing on impacts in a given region in the Arctic or Antarctic (as regional differences are significant [e.g., differences in climate and ecology of western and eastern Arctic]). As written, the chapter includes a large number of references that are not linked to other references in the same region. The use of "in prep" or "submitted" papers is disturbing and should be strongly discouraged. As is often the case, the definition of the Arctic (i.e., whether it includes the Bering Sea) seems inconsistent throughout the chapter. The introductory section refers to a definition that defines the Arctic as the area above the Arctic Circle (p. 28); however, there is considerable text describing the environment and ecology of the southeast Bering Sea (which of course is partially ice-covered in the winter). This should be clarified in the text. In addition, climate change impacts on living marine resources would be easier to follow for sections on the Arctic and Antarctic if the authors were more careful to clarify the species and population structure, when making predictions about how climate will impact a given region or taxon. Finally, there is remarkably little on tourism in the Arctic (eastern or western), which doesn't seem in balance with the section on tourism for the Antarctic - at least as an emerging issue. References: Ice seal status: KELLY, B. P., J. L. BENGTON, P. L. BOVING, M. F. CAMERON, S. P. DAHLE, J. K. JANSEN, E. A. LOGERWELL, J. E. OVERLAND, C. L. SABINE, G. T. WARING, and J. M. WILDER. 2010. Status review of the ringed seal (<i>Phoca hispida</i>). U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-212, 250 p. (.pdf, 8.7 MB). Online. CAMERON, M. F., J. L. BENGTON, P. L. BOVING, J. K. JANSEN, B. P. KELLY, S. P. DAHLE, E. A. LOGERWELL, J. E. OVERLAND, C. L. SABINE, G. T. WARING, and J. M. WILDER. 2010. Status review of the bearded seal (<i>Erignathus barbatus</i>). U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-211, 246 p. (.pdf, 12.4 MB). Online. DBO Grebmeier, J.M., Biological community shifts in Pacific Arctic and sub-Arctic seas, 2012, Annual Review of Marine Science, Vol. 4. (in press). Note the paper will appear first as a web article in fall 2011 (http://www.annualreviews.org/toc/marine/forthcoming) Grebmeier, J. M., Moore, S. E., Overland, J. E., Frey, K. E., and Gradinger, R., EOS Trans. AGU, 91, 18, doi:10.1029/2010EO180001, 2010 RUSALCA http://www.arctic.noaa.gov/aro/russian-american/ Seabirds High latitude changes in ice dynamics and their impact on polar marine ecosystems [Download PDF] Moline, M. A., N. J. Karnovsky, Z. Brown, G. J. Divoky, T. R. Frazer, C. A. Jacoby, J. J. Torres and W. R. Fraser. 2008. Pp 267-319 in: The Year in Ecology and Conservation Biology 2008. R. S. Ostfeld and W. H. Schlesinger (eds.). Annals New York Acad. Sci., 1134. Supernormal delay in hatching, embryo cold tolerance and egg fostering in the Black Guillemot <i>Cephus grylle</i>. Divoky, G.J. and B.B. Harter. 2010. Marine Ornithology 38:7-10. (UNITED STATES OF AMERICA)</p>
31	28	0	0	0	0	<p>The chapter is much too long and too detailed. Many of the sections are more reviews of general changes in polar regions with little or no direct links to climate change. There is also little emphasis about what is new in this report since AR4. Although most of the references are new (this is good), it is not clear how the new information contradicts or amplifies what was reported before. Every section should begin with something like "Since AR4 the following important new developments have emerged in documenting changes in the XXXX system that are directly related to climate changes." The fact that climate change interacts in important complex ways with other changes in the systems is repeated over and over again; once is enough. All text should only relate directly to climate change, not to just general economic or population changes. Change "annual ice" to "seasonal ice" throughout the chapter. In the sea ice community, ice is divided between seasonal, first year, and multiyear ice. Seasonal ice is found in areas that commonly melt entirely in the summer. First year ice is ice that has not survived a summer melt - all seasonal ice is first year ice but first year ice is also found in areas that may or may not melt on a regular basis. (UNITED STATES OF AMERICA)</p>

#	Ch	From Page	From Line	To Page	To Line	Comment
32	28	0	0	0	0	The chapter is very uneven in its conveyance of confidence levels. Sections 28.2.1-28.2.3 and 28.3.2, for example, contain many expressions of "low confidence", "medium-to-high confidence", etc., while other sections such as 28.2.4-28.2.6 as well as 28.3 contain essentially no mention of confidence levels. The parts of the chapter seem to have been written by different authors who had different understandings about how confidence levels were to be included in the chapter. (UNITED STATES OF AMERICA)
33	28	0	0	0	0	The coverage of ocean acidification in the Arctic (p. 10, lines 42-50) is not adequate. The authors need to reference recent work and link to Fig 30-7 (which needs to be updated to include polar regions). The issue is not addressed sufficiently in the Oceans chapter and, given the fact that OA in the Arctic is amplified relative to the rest of the world (given solubility issues), it needs to be a key focus, especially given the chain of impacts that it will have on the Arctic food web and resulting impacts on Arctic populations. (UNITED STATES OF AMERICA)
34	28	0	0	0	0	The fact that climate change interacts in important ways with other changes in the systems is repeated over and over again, once is enough. (UNITED STATES OF AMERICA)
35	28	0	0	0	0	There is a tendency in Executive Summary to bias summary towards very high and high confidence findings. It conveys a false sense to decision makers that the science as a whole is well-understood. It is important to also summarize where there is low confidence and why (e.g. significant gaps in the observational record); or the example of polar bear extinction. It is important to highlight that something that has generated significant public concern (e.g. polar bear extinction) is low confidence. It is also important that low confidence findings are attached to a research gap that can be addressed. (UNITED STATES OF AMERICA)
36	28	0	0	0	0	We believe the chapter is too long, with uneven coverage of issues (e.g., some taxa receive extensive text, others little or none; impacts on herding extensive, wildlife harvests little or none.) It appears as though polar bears are singled out for long treatment, but economically and culturally more important Arctic mammals receive little attention. Sends message that scientific efforts should focus on iconic megafauna species. Several places (e.g., herding discussion) are long on detail but take-away is unclear. --- Important information on teleconnections between Arctic and lower latitude climates needs to be covered. (UNITED STATES OF AMERICA)
37	28	0	0	0	0	Please add the scientific names for all species the first time they are mentioned with their common name. Done in some sub-chapters, but not in all. (NORWAY)
38	28	0	0	0	0	Consider including more on effects on benthic communities, both in the Arctic and the Antarctic. (NORWAY)
39	28	0	0	0	0	If not dealt with in other chapters, more on coastal ecosystems should be included. Less sea ice in coastal areas has huge impact on these ecosystems, e.g. species composition, growth and production rates of for example macroalgae. (NORWAY)
40	28	0	0	0	0	Change of species composition, including size classes for microalgae should be dealt with more thoroughly, both for the Arctic and the Antarctic. Huge impact on total production and food quality for upper trophic levels. Now it is only touched upon a few (NORWAY)
41	28	0	0	0	0	The Antarctic sections are more up to date in terms of literature coverage than the Arctic sections – which seem to largely “stop” with the SWIPA review. Please consider using those references: Gilg, O., Kovacs, K.M., Aars, J., Fort, J., Gauthier, G., Gra (NORWAY)
42	28	0	0	0	0	General comment: We were surprised to find that this entire chapter contains few cross-references to the WGI AR5, with only very few citations to WGI Chapter 4 concerning observed changes in Sea Ice, Permafrost, and river ice. For example, there is no reference to WGI AR5 concerning projected changes in temperature/precipitation in the polar regions, or related impacts on the cryosphere. Please update relevant statements to ensure consistency and cross-referencing with the WGI AR5 chapters, including the Annex I: Atlas of global and regional climate projections, and the SREX Chapter 3. (Plattner, Gian-Kasper, IPCC WGI TSU)

#	Ch	From Page	From Line	To Page	To Line	Comment
43	28	0	0	0	0	There are some missing/ incorrect citations in the chapter. These discrepancies have been highlighted in the ref check document for chapter 28 and is available in the supporting material web page. Chapter team may wish to rectify these errors before starting to work on SOD revisions and FGD preparation. (Chatterjee, Monalisa, IPCC WGII TSU)
44	28	0	0	0	0	1) Overall -- The chapter team has developed a strong assessment in its 2nd-order draft. In the final draft, the chapter team is encouraged to continue its prioritization of compact and rigorous assessment, effective figures, and clear writing. (Mach, Katharine, IPCC WGII TSU)
45	28	0	0	0	0	2) Coordination across Working Group II -- In developing the final draft of the chapter, the chapter team should continue to ensure coordinated assessment, both in the chapter text and at the level of key findings. As appropriate, cross-references to the sections of other chapters and/or their assessment findings should be used, reducing overlaps and harmonizing assessment. (Mach, Katharine, IPCC WGII TSU)
46	28	0	0	0	0	3) Harmonization with the Working Group I contribution to the AR5 -- In developing the final draft, the chapter team should also ensure all cross references to the Working Group I contribution are updated, with discussion of climate, climate change, and climate extremes referencing the assessment findings in that volume. (Mach, Katharine, IPCC WGII TSU)
47	28	0	0	0	0	4) Tightening the assessment and supporting a maximally rigorous executive summary -- In developing the final draft, the chapter team is encouraged to revise each section so that the core nuanced key findings emerge clearly from each section with full and traceable support. Revision geared towards highlighting the key findings will further support an executive summary that richly communicates the assessment. The chapter team should aim to shorten the chapter text by at least 15 pages. Additionally, when presenting assessment and conclusions on observations, projections, and vulnerabilities/sensitivities, the chapter team should ensure that they are not conflated and that the reader can understand which type of information is being discussed at each point. (Mach, Katharine, IPCC WGII TSU)
48	28	0	0	0	0	5) Characterization of future risks -- In characterizing future risks for Polar Regions, to the degree appropriate the chapter team should indicate the extent to which risks (or key risks) can be reduced through mitigation, adaptation, development, poverty reduction, etc. That is, is it possible to indicate how risks may increase as the level of climate change increases or, potentially, to indicate the relative importance of changes in mean conditions, as compared to changes in extreme events, as compared to potential non-linear changes associated with biome shifts or tipping points? And then, how much can risks be reduced through adaptation or development, in the near-term and long-term? How are factors or stressors that multiply risks relevant in this context? As supported by its assessment of the literature, the author team should consider communicating risks for the era of climate responsibility (the next few decades, for which projected temperatures do not vary substantially across socioeconomic/climate scenarios) and for the era of climate options (the 2nd half of the 21st century and beyond). As might be helpful to the chapter, the framing of table SPM.4 could be considered in characterization of future risks, along with the key and emergent risk typology of chapter 19. (Mach, Katharine, IPCC WGII TSU)
49	28	0	0	0	0	6) Informing the summary products -- To support robust and insightful summary products for the report, the chapter team is encouraged to maximize nuance and traceability in its key findings, continuing to use calibrated uncertainty language effectively. In addition to nuanced characterization of future risks (see the previous comment), the chapter team is encouraged to consider themes emerging across chapters, indicating for example how extreme events have demonstrated adaptation deficits and vulnerabilities to date and may relate to future risks, how limits to adaptation may be relevant in the context of this chapter, how multidimensional inequality is relevant in the context of climate change, how adaptation experience has been relevant to date, and how interactions among mitigation, adaptation, and sustainable development may occur. (Mach, Katharine, IPCC WGII TSU)

#	Ch	From Page	From Line	To Page	To Line	Comment
50	28	0	0	0	0	7) Report release -- The chapter team should be aware that the final drafts of the chapters will be posted publicly at the time of the SPM release, before final copyediting has occurred. Thus, the chapter team is encouraged to continue its careful attention to refined syntax and perfected referencing. (Mach, Katharine, IPCC WGII TSU)
51	28	0	0	0	0	8) Further distinguishing 28.2 versus 28.3 -- The chapter team should remove all future-oriented material from 28.2; doing so will substantially shorten the section. While vulnerabilities and sensitivities are relevant to both 28.2 and 28.3, a refined approach should be taken to reduce overlap. Observations should be restricted to 28.2, and projections restricted to 28.3. (Mach, Katharine, IPCC WGII TSU)
52	28	0	0	0	0	GENERAL COMMENTS: I congratulate the author team for all their work on the SOD, recognizing that there is more work to be done. When considering the suite of review comments, please look for opportunities to continue to focus the text in revision, reducing length and overlap wherever possible. Please see my detailed comments for suggestions related to such opportunities, as well as specificity of ES findings and traceable accounts, refining figures and tables, and specific clarifications. In addition, where likelihood terms are used ("likely," "very likely," etc.), it is also not always clear whether they are intended as calibrated language or not--please carefully check this and avoid casual usage. (Mastrandrea, Michael, IPCC WGII TSU)
53	28	0	0	0	0	SUMMARY PRODUCTS: In preparing the final draft of your chapter and particularly your executive summary, please consider the ways in which your chapter material has been incorporated into the draft SPM and TS. For Chapter 28, relevant sections include presentation of observed impacts and vulnerabilities in section A.i, adaptation experience in section A.ii, sectoral and regional risks in section C.i, and interactions between adaptation and mitigation in section D.ii, as well as related figures and tables. Are there opportunities for presenting chapter findings and material in a way that further supports broad themes highlighted in the summary products and that facilitates additional cross-chapter synthesis in specific findings or figures/tables? Do the existing summary product drafts suggest additional coordination that should occur between Chapter 28 and other chapters at LAM4? (Mastrandrea, Michael, IPCC WGII TSU)
54	28	1	0	1	0	Organization: The order of topics in this chapter would be more logical, and thus flow better, if the Hydrology and Freshwater Ecosystems section directly preceded the Terrestrial Ecosystems section, as the hydrology more directly and substantially affects the terrestrial system. (Francis, Jennifer, Rutgers University)
55	28	1	0	55	0	Various sections of the text use the IPCC qualitative terms (likely, very likely, etc) very inconsistently. For example, section 28.2.2.1.1 uses them well, while other sections almost not at all. (Francis, Jennifer, Rutgers University)
56	28	1	0	55	0	Focus on human impacts is almost exclusively on those in low-lying areas and almost nothing about humans living in Greenland. This seems to be a gap. (Francis, Jennifer, Rutgers University)
57	28	1	1	1	1	The tile" Polar Regions" is hanging. Let the title capture the sprit of the underlying text in the entire document. In otherwords, the title always prepares the reader what he expects in the text of the document (KENYA)
58	28	2	0	5	0	Executive summary needs to be better organized. Group statements according to topics in TOC, and begin each with more general comments followed by more specific ones. (Francis, Jennifer, Rutgers University)
59	28	2	33	0	0	Executive Summary. Organisation of section is unclear. It could more closely follow chapter sub-headings to improve clarity. Would also benefit from an introduction paragraph. Consider that some readers of the summary will be policymakers without technical knowledge - slight adjustments to the language and word choice throughout the summary would help readability for this audience. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)

#	Ch	From Page	From Line	To Page	To Line	Comment
60	28	2	33	0	0	Regional Key Risks in the Executive Summary -- The chapter team is strongly encouraged to present clearly the key regional risks for Polar Regions within the executive summary. For the key risks, how do they vary with level of climate change, and what is the potential for adaptation to reduce the risks? What are the risks in the near-term (which can be considered an era of climate responsibility) versus the long-term (which can be considered an era of climate options)? The framing of SPM table SPM.4 or the framing of chapter 25's executive summary and table 25-8 could be considered. Identifying key risks would enable the chapter team to continue to tighten the executive summary with a strong organizing principle. (Mach, Katharine, IPCC WGII TSU)
61	28	2	33	0	0	Clarifying the Role of Climate Change in the Executive Summary-- For each key finding, the chapter team should make sure the role of climate change is clear for the conclusion made. (Mach, Katharine, IPCC WGII TSU)
62	28	2	33	0	0	Shortening and Refining the Executive Summary -- By reducing overlap across findings and paragraphs within the executive summary, the chapter team will create a richer executive summary. A length of 2 pages may be ideal. (Mach, Katharine, IPCC WGII TSU)
63	28	2	33	0	0	Executive Summary: The current draft executive summary contains good material, but the clarity and specificity of the presentation can be improved while overlap can be reduced. Please group findings on similar topics together, and consider opportunities for condensation. Please also make the role of climate change as opposed to other drivers as clear as possible in each finding. To the extent possible as supported by the literature, please also emphasize what risks are projected to emerge over different time horizons (e.g., mid century vs. end-of-century), as well as the potential or lack of potential for mitigation and adaptation to reduce them. See my specific comments for other suggestions. Finally, please provide calibrated uncertainty language for all findings, and please carefully check line of sight to chapter sections throughout the executive summary, as there are some instances where the wrong section is cited as well as a few cases where support in the chapter text is not clear (see specific comments). (Mastrandrea, Michael, IPCC WGII TSU)
64	28	2	33	5	11	Executive summary: The risks and potential impacts related to nuclear powerplants, facilities and waste should be addressed in the executive summary. E.g. in connection to extreme events, sea-level rise, erosion and change in permafrost. E.g. see page 2 (NORWAY)
65	28	2	35	2	35	Please specify line of sight for the physical and biological impacts mentioned here, as the existing line of sight mainly covers socioeconomic impacts. (Mastrandrea, Michael, IPCC WGII TSU)
66	28	2	35	2	39	The bolded sentence here does not tell us anything - it is more like background information. The second unbolded sentence is of more importance, with the bolded sentence as background information. (AUSTRALIA)
67	28	2	37	2	37	For the phrase "there is evidence" it would be preferable to present summary terms for evidence and agreement, ideally within the parentheses at the end of the sentence, or to delete the phrase. (Mach, Katharine, IPCC WGII TSU)
68	28	2	37	2	39	Please be more specific as to what evidence is available that climate change has compounded existing vulnerabilities, and how it has compounded them. Please also provide clear line of sight to the discussion of this evidence. (Mastrandrea, Michael, IPCC WGII TSU)
69	28	2	41	2	43	Over what broad timeframe does this statement hold? Over what levels/scenarios of climate change? Is it possible to indicate more specifically what "changes" and "dramatic impacts" are meant? (Mach, Katharine, IPCC WGII TSU)
70	28	2	41	2	43	Please clarify the line of sight for this finding, as it is not supported by 28.4.2. In addition, are the changes referenced in the bold sentence specifically changes in sea ice, or a broader set? Please clarify this. (Mastrandrea, Michael, IPCC WGII TSU)
71	28	2	41	2	47	In addition to "rate of change" the large interannual variability should be mentioned especially for short term impacts. (Comiso, Josefino, NASA Goddard Space Flight Center)

#	Ch	From Page	From Line	To Page	To Line	Comment
72	28	2	43	1	44	Suggest adding snow cover to statement "The decline of sea ice [and snow cover] in summer is occurring at a rate that exceeds most model projections" (Derksen, C. and R. Brown, 2012: Spring snow cover extent reductions in the 2008-2012 period exceeding climate model projections. Geophys. Res. Lett., 39, L19504, doi:10.1029/2012GL053387, 2012) (CANADA)
73	28	2	45	2	47	In place of "there is some evidence," it would be preferable here to present any uncertainty language assigned within working group 1. (Mach, Katharine, IPCC WGII TSU)
74	28	2	47	2	49	Impacts in the Arctic and Antarctic are very different and should be discussed separately. (Comiso, Josefino, NASA Goddard Space Flight Center)
75	28	2	49	0	0	I do not see why we refer to the primary concern being polar bears. They are an iconic species, but many other species will be threatened by warming and loss of sea ice. Of greater concern, perhaps, are the ice-dependent pinnipeds, as they are not only the food source for the polar bears, but also for the subsistence hunters. (Hunt, George, University of Washington)
76	28	2	49	1	52	Suggest deleting this bullet as it is repeated later in the Executive Summary in a more appropriate place (CANADA)
77	28	2	49	2	49	Is not clear what is meant by "over the foreseeable future or 3 generations." Additionally, this paragraph repeats on page 3, and later in the executive summary would seem to represent preferable placement for the paragraph. (Mach, Katharine, IPCC WGII TSU)
78	28	2	49	2	52	This paragraph appears twice in the Executive Summary. (Head, Erica, Fisheries and Oceans Canada)
79	28	2	49	2	52	Why single out polar bears? They are an icon, but many other species are undergoing at least as rapid decline. Combine this bullet with the last one on page 3, also referring to polar bears. (Francis, Jennifer, Rutgers University)
80	28	2	49	2	52	This paragraph is repeated on page page 3, 51 to 54. Suggest deleting this paragraph and leaving the one on page 3. (AUSTRALIA)
81	28	2	49	2	52	This paragraph on polar bears is repeated on pg 3. Suggest deleting the first reference (this page). (AUSTRALIA)
82	28	2	49	2	52	Duplication from page 3 line 51-54. Should be deleted on page 2. (DENMARK)
83	28	2	49	2	52	This text is repeated at the end and should be deleted. (Ingvaldsen, Randi, Institute of Marine Research)
84	28	2	49	2	52	Delete. Paragraph repeats later in Executive Summary at page 3 line 51. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)
85	28	2	49	2	52	This paragraph is repeated on page 3 lines 51-54. I recommend it be deleted here. But where retained, please provide the intended time horizon instead of "foreseeable future or three generations," as these phrases are ambiguous and also are not usually interpreted as equivalent. In addition, please clarify the timeframe over which population declines have been recorded, and provide line of sight for the paragraph (which it appears should be 28.2.2.1.3). (Mastrandrea, Michael, IPCC WGII TSU)
86	28	3	1	3	1	Are the described environmental changes and ecosystem responses those occurring due to climate change? It is important to clarify the role of climate change more explicitly. (Mach, Katharine, IPCC WGII TSU)
87	28	3	1	3	3	Please consider this para in the TS (p.13 l.29) (GERMANY)
88	28	3	1	3	3	Please clarify the intended relationship between climate change and the environmental changes and ecosystem responses referenced here. (Mastrandrea, Michael, IPCC WGII TSU)
89	28	3	1	3	7	For the less-informed reader, I think it would be helpful to emphasize that these changes are to the bottom of the food web, which will have a ripple effect to the rest of the ecosystem. (Francis, Jennifer, Rutgers University)
90	28	3	1	3	7	This paragraph starts by noting there are differences in responses between the Arctic and the Antarctic - but only provides an example for the Arctic and West Antarctica. There are key differences between West and East Antarctica and this paragraph could benefit by highlighting an example for East Antarctica as well. (AUSTRALIA)

#	Ch	From Page	From Line	To Page	To Line	Comment
91	28	3	3	3	5	The timeframe of these observations should be clarified. Additionally, what are the "measurable changes"? (Mach, Katharine, IPCC WGII TSU)
92	28	3	4	3	4	Please specify what is meant by measurable changes. (Mastrandrea, Michael, IPCC WGII TSU)
93	28	3	5	0	6	appropriate to mention southeastern Bering Sea here and impact on both krill and large lipid-rich copepods (Hunt, George, University of Washington)
94	28	3	5	3	7	Please clarify this point and/or its line of sight, as currently the description on page 19 of relevant material does not provide a clear basis for a high confidence statement. (Mastrandrea, Michael, IPCC WGII TSU)
95	28	3	6	3	6	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. If being used as a likelihood term, it should be italicized. (Mach, Katharine, IPCC WGII TSU)
96	28	3	9	3	10	Please consider this para in the TS (p.13 l.29) (GERMANY)
97	28	3	9	3	10	The timeframe for this statement should be specified. Also, can any further nuance be provided, in terms of differences across levels/scenarios of climate change and in terms of what species will be affected and what sort of variations in response are expected? (Mach, Katharine, IPCC WGII TSU)
98	28	3	9	3	14	Please provide line of sight for this paragraph, which it appears should be 28.2.2. (Mastrandrea, Michael, IPCC WGII TSU)
99	28	3	10	3	11	What is the timeframe for this statement, and which types of marine species have demonstrated shifts in distribution? (Mach, Katharine, IPCC WGII TSU)
100	28	3	11	3	13	This finding should indicate more specifically how responses will differ by species. The statement also overlaps with line 10. (Mach, Katharine, IPCC WGII TSU)
101	28	3	14	0	0	the krill will not only be farther south, they well may be less abundant (Hunt, George, University of Washington)
102	28	3	16	3	16	Say "enhance secondary pelagic production" in a more lay fashion (Francis, Jennifer, Rutgers University)
103	28	3	16	3	16	Would be clarifying to explain what is meant with "secondary pelagic production". Is it copepods? Copepods of boreal origin? I guess the endemic amphipods are expected to decrease? Should also use more understandable word for the public, e.g. zooplankton, instead of secondary pelagic production (Sundby, Svein, Institute of Marine Research)
104	28	3	16	3	16	Should a more conditional formulation be used to describe loss of sea ice? (Mach, Katharine, IPCC WGII TSU)
105	28	3	16	3	19	"energy pathways." Not clear what this means in this context. Explain. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)
106	28	3	16	3	19	Section 28.2.2.1 is supposed to be a section on observed changes, but this is a forward looking statement. Please clarify the placement of the traceable account--should it be in another section instead? (Mastrandrea, Michael, IPCC WGII TSU)
107	28	3	21	3	21	Define phenologies and other technical terms the first time they appear in the Exec Summary, as non-technical folks will be reading just this section. (Francis, Jennifer, Rutgers University)
108	28	3	21	3	21	The role of climate change should be indicated more explicitly for this finding--shifts in timing due to climate change? Can differences across scenarios/levels of climate change be characterized? Across time frames? (Mach, Katharine, IPCC WGII TSU)
109	28	3	21	3	28	Please provide further support for these statements in the referenced chapter text, as currently this is not clear. (Mastrandrea, Michael, IPCC WGII TSU)
110	28	3	21	3	30	"trophic levels" and "phenologies." Consider using less technical terms as summary readers may not understand. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)
111	28	3	30	0	0	Suggest being more clear that stating "...but the scientific documentation for this is weak". Would an uncertainty assessment be appropriate here? (CANADA)
112	28	3	30	3	30	This statement doesn't seem to jive with the discussion in 28.2.2.1.2 (Francis, Jennifer, Rutgers University)

#	Ch	From Page	From Line	To Page	To Line	Comment
113	28	3	30	3	30	I think you meant "Antarctic" instead of "Arctic." (Rosales, Jon, St. Lawrence University)
114	28	3	32	0	0	ocean acidification only refers to pelagic key species, no mention of benthic response. (Dr. Brandt, Angelika, University of Hamburg)
115	28	3	32	3	32	Indicate areas of the Antarctic where ocean acidification has been observed. Not all are affected. (Comiso, Josefino, NASA Goddard Space Flight Center)
116	28	3	32	3	37	This fact reaffirms that SPM Pg. 10 line 41-43 needs to be revised to include farther-reaching consequences of acidification beyond just 'coral in coastal ecosystems', such as what is mentioned here. (Wong, Andrew, University of Waterloo)
117	28	3	32	3	37	Lines 32-33 and 36-37 are heavily repetitive. Each statement within the paragraph should add new insight. Additionally, it would be preferable to indicate more specifically what is meant by "far-reaching" on lines 33 and 37. (Mach, Katharine, IPCC WGII TSU)
118	28	3	34	3	35	Please clarify this point and/or its line of sight, as currently the short description on page 19 of relevant material does not provide a clear basis for a high confidence statement. (Mastrandrea, Michael, IPCC WGII TSU)
119	28	3	39	3	40	The role of climate change should be clearly specified. Also, how will outcomes vary with level/scenario of climate change and timeframe? (Mach, Katharine, IPCC WGII TSU)
120	28	3	40	3	44	The general time frames for these changes should be specified. (Mach, Katharine, IPCC WGII TSU)
121	28	3	42	3	44	A short explanation of different impacts by increasing east-Antarctic sea-ice and decreasing west-Antarctic sea-ice is recommended. (GERMANY)
122	28	3	44	0	0	sea ice what? Extent, thickness, duration??? (Hunt, George, University of Washington)
123	28	3	44	3	44	Word choice of "physical," consider changing to "habitat" as would make more sense in this context. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)
124	28	3	46	3	46	Typo: change "Antarctica" to "Antarctic." (Rosales, Jon, St. Lawrence University)
125	28	3	46	3	46	"some areas." Be more specific - how large and what sort of distribution? (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)
126	28	3	46	3	47	Change "the Antarctica and Arctic" to "Antarctica and the Arctic" (Head, Erica, Fisheries and Oceans Canada)
127	28	3	46	3	47	The overall timeframe for this statement should be specified. Additionally, more specifically what types of ecosystems are being affected and how? (Mach, Katharine, IPCC WGII TSU)
128	28	3	46	3	49	This paragraph notes climate change is impacting on terrestrial and freshwater ecosystems in some areas - this is quite vague and the paragraph could benefit from providing information on what types of impacts and which areas. (AUSTRALIA)
129	28	3	51	3	53	Point of clarification:"The primary conservation concern for polar bears over the foreseeable future or three generations..." - is that three generations of polar bears? Or of human generations? (Smith, Inga, University of Otago)
130	28	3	51	3	54	This paragraph appears twice in the Executive Summary. (Head, Erica, Fisheries and Oceans Canada)
131	28	3	51	3	54	This text is an exact copy of p. 2, ll. 49-52. (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
132	28	3	51	3	54	This paragraph appears twice in the Executive Summary. (Rosales, Jon, St. Lawrence University)
133	28	3	51	3	54	Please delete this para, because it is already presented at p. 2 l.49-52 (duplication) (GERMANY)
134	28	3	51	3	54	This paragraph on the conservation concern for polar bears appears to be a repetition of the text given on P.2, L.49-52. (Gerland, Sebastian, Norwegian Polar Institute)
135	28	3	51	3	54	The paragraph is repeated from previous page. May be you should consider deleting on page 2. (Silva Mora, Carla Andreia, University of Lisbon)

#	Ch	From Page	From Line	To Page	To Line	Comment
136	28	3	51	3	54	Please consider adding "and not up-to-date in several places." (UNITED STATES OF AMERICA)
137	28	3	51	3	54	This is a duplicate of Ch. 28 Pg. 2 line 49-52 and should be removed. (Wong, Andrew, University of Waterloo)
138	28	3	51	3	54	This location for this paragraph is preferable to the earlier instance on page 2. Additionally, what is meant by "over the foreseeable future or 3 generations" should be clarified. (Mach, Katharine, IPCC WGII TSU)
139	28	3	51	3	54	This paragraph is repeated on page 2 lines 49-52. Where retained, please provide the intended time horizon instead of "foreseeable future or three generations," as these phrases are ambiguous and also are not usually interpreted as equivalent. In addition, please clarify the timeframe over which population declines have been recorded, and provide line of sight for the paragraph (which it appears should be 28.2.2.1.3). (Mastrandrea, Michael, IPCC WGII TSU)
140	28	3	52	3	52	Change "annual ice" to "spring and summer sea ice." Changes in other seasons are not so relevant. (Comiso, Josefino, NASA Goddard Space Flight Center)
141	28	4	2	4	3	In place of "recent years" it would be preferable to indicate the timeframe more specifically. Also, is climate change being asserted as the probable primary driver of change? (Mach, Katharine, IPCC WGII TSU)
142	28	4	2	4	4	Please provide line of sight for this paragraph. (Mastrandrea, Michael, IPCC WGII TSU)
143	28	4	2	4	9	It seems these paragraphs should be merged. As is, it is not clear how the deciduous shrubs described on line 2 are different from those described on line 7. (Mach, Katharine, IPCC WGII TSU)
144	28	4	4	4	4	Specific how this information is different from what was reported in AR4. New results have come in since and refer to WG1/AR5/Chapter 4 (Comiso, Josefino, NASA Goddard Space Flight Center)
145	28	4	6	4	6	"northward" and "upward," not northwards and upwards" (Rosales, Jon, St. Lawrence University)
146	28	4	6	4	7	What is the timeframe for this statement? Do "many places" include tundra and boreal regions?? (Mach, Katharine, IPCC WGII TSU)
147	28	4	11	4	11	It would be preferable to say "warming" instead of "increased energy available (warming)" (Mach, Katharine, IPCC WGII TSU)
148	28	4	11	4	17	Please provide line of sight for this paragraph. The referenced section does not exist. (Mastrandrea, Michael, IPCC WGII TSU)
149	28	4	13	4	13	"confounded" may not be the most illustrative word here--confounded, yes, for scientists looking at change, but a more precise descriptor of the interactions could be used here. (Mach, Katharine, IPCC WGII TSU)
150	28	4	14	4	14	Are research stations really a substantial stressor? (Mach, Katharine, IPCC WGII TSU)
151	28	4	15	4	15	Add examples for non-native species: grasses, rodents (GERMANY)
152	28	4	15	4	15	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Mach, Katharine, IPCC WGII TSU)
153	28	4	16	4	16	Is it possible to indicate more explicitly what is meant by "greatest threat"? (Mach, Katharine, IPCC WGII TSU)
154	28	4	19	4	20	Please consider this para in the TS (p.10 l.23). (GERMANY)
155	28	4	19	4	20	Couldn't the same thing be said of Arctic lakes? Arctic lakes are seeing longer open water seasons (earlier break-ups and later freeze-ups) and higher productivity. (Wong, Andrew, University of Waterloo)
156	28	4	19	4	23	The relevant time frames of changes and the role of climate change should be clarified for all statements within this paragraph. (Mach, Katharine, IPCC WGII TSU)
157	28	4	25	4	26	Can anything be said about the time frames of changes observed so far and projected in the future? Is it possible to indicate what precisely what is meant by "significant" or "increase"? (Mach, Katharine, IPCC WGII TSU)
158	28	4	25	4	33	What are the positive impacts? Please describe. (UNITED STATES OF AMERICA)
159	28	4	25	5	2	There seems to me to be a good deal of overlap in the ideas expressed in these four paragraphs. There could be some condensation and less words. (Head, Erica, Fisheries and Oceans Canada)

#	Ch	From Page	From Line	To Page	To Line	Comment
160	28	4	25	5	11	This point and the rest of the points in this section describe the significant climate impacts that indigenous peoples of the North will face in the near to long term. It supports my recommendation for SPM Pg. 6 line 8-10 arguing that indigenous peoples don't actually have a high adaptive capacity to handle many of the impacts listed in this paragraph and are currently not prepared for all of these challenges. For example, little has been done to increase the resilience of housing infrastructure to permafrost melt. For SPM Pg. 6 line 8-10, the assessment of high adaptive capacity should be changed to 'low and uncertain adaptive capacity'. (Wong, Andrew, University of Waterloo)
161	28	4	28	0	0	some hunters speak of increased access, but now by boat (Hunt, George, University of Washington)
162	28	4	35	0	42	Suggest revising the last sentence to better characterize adaptation in the context of Arctic indigenous people. While some examples of resilience and knowledge sharing have been found, vulnerability is high for this population as a result of isolation, socioeconomic issues (poor education, changes in market, high suicide rates, poor diets etc) - E.g., see Owens et al 2013 Climatic Change vol 115 (CANADA)
163	28	4	35	4	37	This claim that "Food security of many indigenous and rural residents ...is being impacted by climate change" needs to be substantiated somewhere in the chapter. Examples are needed if this statement is to be made. (UNITED STATES OF AMERICA)
164	28	4	35	4	42	A well documented challenge for residents of northern communities effecting food security is a result of aboriginal people having abandoned their previously semi nomadic lifesyle which were at least parially accessing resources to settlement in permanent and in most cases rapidly growing settlements. Populations of country foods within esy access to communities is heavily harvested. Difficulties at least partially as a result of effects of climate change along with time limitations resulting from a "wage economy" make it difficult to access more distant resources, Store bought food shipped in to destinations beyond the road network are extremely expensive. In Canada elimination of the food mail program and replacement withthe Nutrition North Program has not resolved the problems. Examples of papers on the theme: Food security in Times of Change- A Policy Brief onFood Security for Northern Canada; Arctic Health Research Network-Yukon www.arctichealthyukon.ca http://www.naho.ca/inuit/health-determinants/food-security/ http://www.naho.ca/jah/english/jah08_02/08_02_food-security.pdf (Church, Ian, Canadian Foundation for Climate and Atmospheric Science/ IPY Canada)
165	28	4	35	4	42	The timeframe of all statements within the paragraph should be clarified. Additionally, is it possible to indicate more precisely what is meant by "significantly" and how changes would differ with timeframe or scenario of climate change? (Mach, Katharine, IPCC WGII TSU)
166	28	4	35	4	42	All references to 28.2.7.X should be 28.2.6.X, I believe. (Mastrandrea, Michael, IPCC WGII TSU)
167	28	4	37	4	37	There is no section 28.2.7.1 in SOD (DENMARK)
168	28	4	39	4	42	There is no section 28.2.7.1 or 28.2.7.2 in SOD. Statement line 29-42 is suportred by technical report section 28.2.6.1. (DENMARK)
169	28	4	40	4	40	I don't think it is accurate to say that, "Arctic indigenous people... and have begun to develop novel solutions..." It is more accurate to say that, "Arctic indigenous people... and novel solutions have begun ..." In my experience, it has usually been the scientists initiating TEK and science projects and programs not indigenous peoples. (Rosales, Jon, St. Lawrence University)
170	28	4	41	4	42	"such as .." Find a better example of how indigenous people have adapted, maybe related to food sources or fisheries management. (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)
171	28	4	44	4	45	It is not clear if this statement pertains to observed changes or future changes. What "other large-scale changes" are meant? Additionally, it would be preferable to provide uncertainty language to characterize the author team's degree of certainty in the statement. (Mach, Katharine, IPCC WGII TSU)

#	Ch	From Page	From Line	To Page	To Line	Comment
172	28	4	44	4	45	What other large-scale changes are meant here? In addition, the line of sight should be to 28.2.5.1.5 instead. (Mastrandrea, Michael, IPCC WGII TSU)
173	28	4	45	4	46	It would be beneficial to indicate more precisely what type of economic activity is meant. (Mach, Katharine, IPCC WGII TSU)
174	28	4	49	4	49	The line of sight should be to 28.2.5.1.4 instead of 28.2.6.1.4 here. (Mastrandrea, Michael, IPCC WGII TSU)
175	28	4	51	4	52	It would be preferable to provide calibrated uncertainty language to characterize the author team's degree of certainty in this statement. Additionally, to what broad time frames and level/scenarios of climate change does this this statement apply? (Mach, Katharine, IPCC WGII TSU)
176	28	4	53	4	54	It would be preferable to specify the timeframe for this statement. (Mach, Katharine, IPCC WGII TSU)
177	28	5	1	5	2	To maximize directness of wording, the chapter team should consider presenting "high confidence" within parentheses at the end of the sentence. (Mach, Katharine, IPCC WGII TSU)
178	28	5	2	0	0	Chapter reference (28.6.1.7) does not exist in document. Please review. (CANADA)
179	28	5	2	5	2	Delete "and greater risk for long-term viability of polar bear population." This point is already made elsewhere. (Rosales, Jon, St. Lawrence University)
180	28	5	2	5	2	Line of sight should be to 28.2.5.1.7 instead here. (Mastrandrea, Michael, IPCC WGII TSU)
181	28	5	4	5	5	suggested revision "..thawing of ice-rich permafrost and...." It is the ice-rich permafrost that is particularly problematic for infrastructure stability. (Smith, Sharon, Geological Survey of Canada)
182	28	5	4	5	5	What are the changing precipitation patterns referred to here? There were no examples or further discussion in the chapter. The claim that precipitation patterns are changing needs, at a minimum, supporting references. (UNITED STATES OF AMERICA)
183	28	5	4	5	7	Suggest adding in the end of paragraph. "Permafrost thermal state in the Antarctic Peninsula region makes it also a highly sensitive region for permafrost degradation (Vieira et al. 2010, Bockheim et al. 2013), but impacts on infrastructure in this very environmentally sensitive region are lacking assessment." Bockheim J, Vieira G, Ramos M, Lopez-Martinez J, Serrano E, Guglielmin M, Wilhelm K, Nieuwendam A. 2013. Climate Warming and Permafrost Dynamics in the Antarctic Peninsula Region . Global and Planetary Change, 100: 215-223; Vieira, G., Bockheim, J., Guglielmin, M., Balks, M., Abramov, A.A., Boelhouwers, J., Cannone, N., Ganzert, L., Gilichinsky, D.A., Goryachkin, S., López-Martínez, J., Meiklejohn, I., Raffi, R., Ramos, M., Schaefer, C., Serrano, E., Simas, F., Sletten, R., Wagner, D. 2010 - Thermal State of permafrost and active-layer monitoring in the Antarctic: advances during the International Polar Year 2007-09. Permafrost and Periglacial Processes, 21(2): 182-197. (Vieira, Goncalo, University of Lisbon)
184	28	5	4	5	7	Over approximately what time span do we expect these changes affecting infrastructure to take place? (UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND)
185	28	5	4	5	7	Please provide further support for this finding. The material in 28.2.5.1.5 (please correct the line of sight) does not fully cover the scope laid out here. (Mastrandrea, Michael, IPCC WGII TSU)
186	28	5	5	5	5	Have the potential to is a very weak statement. It could mean anything. Are there any positive impacts on infrastructure? (UNITED STATES OF AMERICA)
187	28	5	9	5	9	Redundant with line page 4, lines 25-49. Please revise removing the redundant material from the appropriate section. (UNITED STATES OF AMERICA)
188	28	5	9	5	11	Please consider this para in the TS (p.28 l.37) as a 3rd bullet point. (GERMANY)
189	28	5	11	5	11	For the described "unprecedented challenges," is it possible to indicate broadly how they would vary with scenario/level of climate change and time frame? (Mach, Katharine, IPCC WGII TSU)

#	Ch	From Page	From Line	To Page	To Line	Comment
190	28	5	29	0	0	Summary of Knowledge Assessed in other Reports: Please aim to shorten this section substantially, to provide a more compact summary of other reports. Please also ensure clear cross-referencing to specific chapter sections of other IPCC reports/volumes. (Mastrandrea, Michael, IPCC WGII TSU)
191	28	5	29	5	29	Note that IPY was not an assessment but rather a coordinated/comprehensive research program in the polar regions. It is important to highlight this research more in this section as climate change was an important focus. Advances were made regarding climate change impact assessment and also adaptation. A key outcome of IPY was quantification of changes that have occurred/are occurring in various components of polar regions including cryosphere, marine environments, terrestrial ecosystems etc. (Smith, Sharon, Geological Survey of Canada)
192	28	5	29	5	29	This section should be reduced in length by well over 50%. (Mach, Katharine, IPCC WGII TSU)
193	28	5	29	8	27	"Summary of knowledge assessed in other reports": include ABA and ARR (Molau, Ulf, University of Gothenburg)
194	28	5	29	8	27	A brief one or two paragraph introduction to the observed changes outlined in WGI chapters is enough: It is warming and ice is shrinking. Much of this section is redundant with subsequent sections. Please consider deleting this section. (UNITED STATES OF AMERICA)
195	28	5	32	5	32	Here and later (e.g. P.5 L. 47, P. 6, L. 21) citations of SWIPA 2011 and SOAC 2010 (2011) appear. I did not see the abbreviation SOAC explicitly explained (although it is written out in P.5, L.32), and I did not find the two references in the reference list at the end of the chapter. The shorter summary of the SWIPA report is referenced in the reference list as AMAP 2012. (Gerland, Sebastian, Norwegian Polar Institute)
196	28	5	37	5	37	You probably mean "variables" instead of "parameters". Or both? (Molau, Ulf, University of Gothenburg)
197	28	5	41	5	41	All references to working group 1 and working group 2 reports should reference the specific relevant chapters at least, and ideally even the specific relevant chapter sections. (Mach, Katharine, IPCC WGII TSU)
198	28	5	43	5	43	as above (Molau, Ulf, University of Gothenburg)
199	28	5	43	5	43	It would be preferable to specify which "selected parameters" are meant here. (Mach, Katharine, IPCC WGII TSU)
200	28	5	43	5	45	It is 'the' Arctic, not only 'Arctic'. (GERMANY)
201	28	5	43	7	5	The temperature of the Arctic is dominated by ocean currents , not surface temperatures. The area of the ice is misleading because the thickness changes.conceals (Gray, Vincent, Climate Consultant)
202	28	5	44	5	44	This should be "Assessment of such changes is essential for understanding a cascading..." (or characterization or understanding of such changes) (Smith, Sharon, Geological Survey of Canada)
203	28	5	44	5	44	change "changes" to "phenomena." It is the rate of change that is being discussed (Comiso, Josefino, NASA Goddard Space Flight Center)
204	28	5	44	5	45	Replace sentence that begins "Such changes are essential" with "An examination of these changes is essential to understand the cascade of societal impacts addressed in this chapter." (Head, Erica, Fisheries and Oceans Canada)
205	28	5	44	5	45	The sentence beginning with "Such changes are essential for understanding a cascade..." does not make sense. Logically it is equivalent to saying "Global warming is essential for understanding the changes brought on by global warming", and is probably not what the authors wanted to say. The sentence would make sense if it started with: "A solid grasp of these changes is essential for understanding the cascade...." (ICELAND)
206	28	5	47	0	0	Sea ice extent declined... (Ridley, Jeff, UK Met Office)

#	Ch	From Page	From Line	To Page	To Line	Comment
207	28	5	47	5	47	I suggest to write "Sea ice extent", and not just sea ice, since the number in the following line corresponds to sea ice extent. The number given is the number for a specific day, but by writing "September 2012", one might think this is a monthly mean. The day for the observation could be given, or instead the monthly mean could be listed. Same interesting as the total value, also the trend of Arctic sea ice extent for September since 1979 might be worth to be mentioned in the text. See for numbers and further reading: http://nsidc.org/arcticseaicenews/2012/10/ , and http://nsidc.org/arcticseaicenews/2012/09/ . (Gerland, Sebastian, Norwegian Polar Institute)
208	28	5	47	5	49	May be worth including that the September 2012 sea ice extent was 49% below the 1979 to 2000 average: http://nsidc.org/arcticseaicenews/2012/09/arctic-sea-ice-extent-settles-at-record-seasonal-minimum/ (Wong, Andrew, University of Waterloo)
209	28	5	47	5	50	The paragraph needs to be updated to be consistent with WG1/AR5/Chapter 4. It should also be emphasized that it is the decline in the perennial ice as represented by sea ice minimum that may be causing the rapid change. The perennial ice represents the thick component and its rapid decline means that the Arctic summer ice will eventually disappear. (Comiso, Josefino, NASA Goddard Space Flight Center)
210	28	5	48	0	0	quoting 18% is redundant information. Suggest "...which followed the previous record of 4.17 million km2 in 2007. (Ridley, Jeff, UK Met Office)
211	28	5	48	5	48	"...which is 18%..." This is not exactly the value, so I recommend to state 18.23% or rephrasing as "...which is about 18%..." (Velázquez, David, Universidad Autónoma de Madrid)
212	28	5	49	5	49	Please provide a specific reference to WGI AR5. (Plattner, Gian-Kasper, IPCC WGI TSU)
213	28	5	49	5	50	sentence structure: Climate models project an nearly ice free Arctic Ocean this century, with some suggesting in may occur within the next 30-40 years. (Ridley, Jeff, UK Met Office)
214	28	5	49	5	50	It would be preferable to specify if this is an outcome expected across all scenarios of climate change or just some? (Mach, Katharine, IPCC WGII TSU)
215	28	5	49	5	51	Please provide a specific reference to WGI AR5. (Plattner, Gian-Kasper, IPCC WGI TSU)
216	28	5	50	5	51	I assume the reference here to "IPCC WG1 Fifth AR" to support the statement about future loss of Arctic sea-ice will be updated to a specific WG1 Chapter reference ? (This matter is dealt with on Page 6 of Chapter 11 of the WG1 SOD). (Wratt, David, NIWA, New Zealand)
217	28	5	51	5	52	sentence structure: The duration of snow extent and snow depth are dereasing in North America and increasing in Eurasia (SWIPA, 2011). (Ridley, Jeff, UK Met Office)
218	28	5	51	5	52	This statement is incorrect. Changes in snow cover extent vary by season. On both continents extent is generally increasing in fall and early winter, but decreasing dramatically in spring and early summer. Data can be viewed at climate.rutgers.edu/snowcover . (Francis, Jennifer, Rutgers University)
219	28	5	51	5	52	The statement about snow trends (particularly the increasing duration and extent in Eurasia) needs to be modified in view of recent paper by Derksen and Brown (2012, GRL), who showed that the May-June decrease of snow coverage is significant on both landmasses. There have been five consecutive years (2008-2012) of new record minima for June in Eurasia, according to Derksen and Brown. (UNITED STATES OF AMERICA)
220	28	5	52	5	54	Romanovsky et al. (2010) is the key reference that should be cited here regarding changes in permafrost temperature. Ref: Romanovsky, V.E., Smith, S.L., and Christiansen, H.H. 2010. Permafrost thermal state in the polar Northern Hemisphere during the International Polar Year 2007-2009: a synthesis. Permafrost and Periglacial Processes, 21: 106-116. (Smith, Sharon, Geological Survey of Canada)
221	28	6	6	6	6	Note that "relocation" is a form of adaptation (Smith, Sharon, Geological Survey of Canada)

#	Ch	From Page	From Line	To Page	To Line	Comment
222	28	6	8	6	9	According to SWIPA (section 11.4.4.5 page 11-31) "Changing sea ice conditons (less multi-year ice, more seasonal ice, earlier melt, later freeze up) may lead to increased light availability for photosyntehsis and therefore increased biological productivity at all levels." Change "will" to "may" (DENMARK)
223	28	6	12	0	0	why not fish, ice seals, polar bears. Why polar bears first? (Hunt, George, University of Washington)
224	28	6	13	6	13	p. 6, line 13: See the references below. The remark that ice dependent seals will be disadvantaged is likely too general. Ice seals that require spring ice for pupping and nursing (i.e., spotted and ribbon seals) may not be affected (at least in the next 50-100 years), whereas species dependent on sea ice for feeding outside of the spring (e.g., bearded seal) or dependent on sea ice with adequate snow cover for birth lairs (e.g., ringed seal) will likely be disadvantaged. (UNITED STATES OF AMERICA)
225	28	6	13	6	15	Across which scenarios of climate change is this outcome expected? (Mach, Katharine, IPCC WGII TSU)
226	28	6	21	6	21	Permafrost degradatation and subsequent hydrological changes are highlighted in ARR. Also dealt with in ABA (under Freshwater Ecosystems). (Molau, Ulf, University of Gothenburg)
227	28	6	23	6	23	Note that global warming would cause less ice and therefore less ice jams. Other factors like more frequent storms may be the key reasons for the ice jams that cause the flooding. (Comiso, Josefino, NASA Goddard Space Flight Center)
228	28	6	27	6	28	Does this statement also pertain to the next decade? (Mach, Katharine, IPCC WGII TSU)
229	28	6	31	6	31	Permafrost is not seasonal but exists for more than two years. Use the term "seasonally frozen ground" if referring to seasonal occurrence of cryospheric components. Note that changes in permafrost distribution over time can also have implications for transportation and other infrastructure. (Smith, Sharon, Geological Survey of Canada)
230	28	6	37	6	38	The statement on increase of navigation days along the Northern Sea Route is not followed by a citation (unless the citation of IPCC WG2 2007 at the end of the sentence refers also to this). Assuming the statement relates to work of the recent years, I wonder if there is one or several corresponding reference(s) to it, which could be added. Possibly references given in section 28.2.5.1.4 (page 31-32), including Mokhow and Khon 2008, also cited for Fig. 28-8 (P.92), could be relevant here. This Reference is not given in the reference list. (Gerland, Sebastian, Norwegian Polar Institute)
231	28	6	37	6	39	What proportion of the world's population (or absolute number) live in Arctic areas? i.e. what would the actual magnitude of reduced heating demand be for example? This is stated as being between 4-9 million in a different part of the chapter (page 26). (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
232	28	6	38	6	39	It would be preferable to specify the baseline for the described 15% decline. (Mach, Katharine, IPCC WGII TSU)
233	28	6	43	6	54	This is more evidence suggesting that Arctic idigenous adaptive capacity should be assessed as 'low and largely uncertain' instead of 'high' in SPM Pg. 6 line 8, due to 'an unprecedented combination of rapid and stressful changes...' (Wong, Andrew, University of Waterloo)
234	28	6	47	6	49	This thought should be finished. Why is it significant that adaptation be mainstreamed in to policy and win-win options? (Rosales, Jon, St. Lawrence University)
235	28	6	51	6	51	authors may want to add the word "living" or something equivilent to the term "natural resources". Likewise in line 54 (Church, Ian, Canadian Foundation for Climate and Atmospheric Science/ IPY Canada)
236	28	7	0	0	20	I've read through Ch 28, the Antarctic portion. The treatment is quite brief as well as highly localized compared to the Arctic portion. I realize doing the writing isn't easy and largely thankless. I have the comments below. At this point I'd be willing to contribute more substantively, i.e. help to expand, but only if current authors are amenable to incorporating what I might have to say. (Ainley, David, H.T. Harvev & Associates Ecological Consultants)
237	28	7	2	7	5	TK is paramount in ARR (Molau, Ulf, University of Gothenburg)

#	Ch	From Page	From Line	To Page	To Line	Comment
238	28	7	4	7	5	Recognition by whom of the value of traditional ecological knowledge? The sentence seems to be imply that local residents need to recognize the importance of traditional ecological knowledge, since it is their resilience and adaptive capacity that is needed. Are the local communities unaware of their TEK? If this statement means that external groups are the ones who need to do the recognizing, it say who those groups are. In any event, clarification is needed here. (UNITED STATES OF AMERICA)
239	28	7	8	7	8	All citations used within this section should be very carefully checked--given the scope of this section, ONLY citations to previous assessment reports should be used. (Mach, Katharine, IPCC WGII TSU)
240	28	7	8	8	27	You might like to provide a cross-reference somewhere in this section on Antarctica, to the section of WG1 Chapter 14 (Section 14.7.14 in the WG1 SOD) which assesses observed and predicted climate changes in Antarctica ? (Wratt, David, NIWA, New Zealand)
241	28	7	10	0	24	This is a very one-sided treatment. While Stammerjohn et al. (2012, see also 2008) are cited for decreasing sea ice, these same authors document the expansion of sea ice in the Ross Sea sector and so much so that it accounts for a net increase in sea ice Southern Ocean wide (Zwally et al. 2002). The modeling of Joellen Russell (in Ainley et al. 2010) indicates that the sea ice expansion will continue for at least the next few decades (maybe the AR5 report discusses this, too????). A lot of this is related to the ozone hole. Nothing is said about retreat of ice shelves and consequences for benthic communities (well, not until p 18, quite briefly), as well as for range adjustments for land creatures (including seals, penguins). These ice shelf retreats have mostly to do with intrusion of warmer CDW, i.e. subsurface melting (Binschadler & Co). The increased freshening of the Ross Sea, in fact, has nothing to do with precipitation, as inferred in this paragraph, but has to do with intrusions of fresh water from melting Pine Island Glacier and vicinity (Jacobs et al. 2002, Jacobs 2006). (Ainley, David, H.T. Harvey & Associates Ecological Consultants)
242	28	7	10	7	10	This chapter contains the phrase: "While temperatures over the bulk of the Antarctic Continent have not changed markedly in recent decades ...". I note that WG1 SOD Chapter 2 Page 29 lines 28-30 states: "Although these agree that Antarctica as a whole is warming, substantial differences in reconstructed magnitude and spatial trend structure yield only low confidence in Antarctic region LSAT changes". I suggest a little more congruence between the WG1 and WG2 statements would be useful, perhaps by including within the WG2 sentence a recognition that Antarctica as a whole has warmed, with a cross-reference back to WG1. (Wratt, David, NIWA, New Zealand)
243	28	7	10	7	10	It would be preferable to indicate more specifically the timeframe implied by "recent decades." (Mach, Katharine, IPCC WGII TSU)
244	28	7	10	7	12	Misleading context: The trend in total sea ice extent in the Antarctic has remained steady, or even increased slightly, over the past three decades, confounding climate model predictions showing moderate to strong declines. This apparent intransigence masks dramatic regional trends; declines in sea ice in the Bellingshausen Sea region that rival the high-profile decline in the Arctic have been matched by opposing increases in the Ross Sea. Over the Antarctic continent temperatures have remained constant over recent decades, except for marked warming over the West Antarctic ice sheet, the peninsula and the islands of the Scotia Arc. (Ridley, Jeff, UK Met Office)
245	28	7	14	0	0	This addition is needed to tie in with 28-18-34. "As a consequence of the regional warming, number of ice shelves on the Antarctic Peninsula have collapsed in recent decades with large effects on the ice dynamics of the inland grounded glaciers [Scambos et al., 2004]" Scambos, T. A., J. A. Bohlander, C. A. Shuman, and P. Skvarca (2004), Glacier acceleration and thinning after ice shelf collapse in the Larsen B embayment, Antarctica, Geophys. Res. Lett., 31, L18402, doi:10.1029/2004GL020670. (Ridley, Jeff, UK Met Office)
246	28	7	14	7	18	There should be a discussion about the large regional differences, especially around Antarctica. For example, sea ice extent is increasing very rapidly in the Ross Sea but is decreasing also very rapidly in the Bellingshausen and Amundsen Seas. Refer to WG1/AR5/Chapter 4. (Comiso, Josefino, NASA Goddard Space Flight Center)

#	Ch	From Page	From Line	To Page	To Line	Comment
247	28	7	14	7	21	It would be beneficial to specify the approximate time frames for these statements. (Mach, Katharine, IPCC WGII TSU)
248	28	7	16	0	18	Please be specific. The only areas that have experienced 'significant' warming are northern Antarctic Peninsula and points north. You say Ross Sea, but the warming there, on annual average, might be something like -30 warming to -28C. Therefore, ecologically insignificant (but see LaRue et al. 2013). And for sure, there has been well documented increased snow fall in the Antarctic Peninsula region, contrary to what is said here (papers by Fraser and references therein). (Ainley, David, H.T. Harvey & Associates Ecological Consultants)
249	28	7	17	7	17	after "permafrost habitats in the coastal margins" consider adding citation to Bockheim J, Vieira G, Ramos M, Lopez-Martinez J, Serrano E, Guglielmin M, Wilhelm K, Nieuwendam A. 2013. Climate Warming and Permafrost Dynamics in the Antarctic Peninsula Region . Global and Planetary Change, 100: 215-223, which is the 1st study with observation on permafrost degradation in the West Antarctic Peninsula region. (Vieira, Goncalo, University of Lisbon)
250	28	7	19	7	21	Confusing description as winds drive the ACC. Suggest: "The Southern Annular Mode (SAM)describes the north–south movement of the westerly wind belt that circles Antarctica, dominating the middle to higher latitudes of the southern hemisphere. Recently the SAM has been in a possitive phase which means the band of westerly winds contracts towards Antarctica. Consequently the Antarctic Circumpolar Current, the extent of which is regionally variable, has moved to the south. (Ridley, Jeff, UK Met Office)
251	28	7	21	7	21	Explain the acronym SAM (Molau, Ulf, University of Gothenburg)
252	28	7	21	7	21	Please insert: '...with increasing Southern Annual Mode (SAM) is...'. (GERMANY)
253	28	7	21	7	21	SAM needs to be defined. (UNITED STATES OF AMERICA)
254	28	7	21	7	22	Summary of knowledge, Antarctic: Tying effects of ocean acidification to the saturation horizon of carbonates is an oversimplification as explained in WGII ch. 6. (Menzel, Lena, Alfred Wegener Institute for Polar and Marine Research)
255	28	7	22	7	24	Misplaced clause, connection to text before not clear. Please start a new para or at least a new line with 'Aragonite undersaturation...', because it is a new issue. (GERMANY)
256	28	7	22	7	24	It would be preferable to specify the relevant scenarios of climate change for the expected change. Also, casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Mach, Katharine, IPCC WGII TSU)
257	28	7	23	0	0	undersatuarion of aragonite: effects on pteropods are described but not on benthic animals No effect? (Dr. Brandt, Angelika, University of Hamburg)
258	28	7	23	7	24	Under the Arctic paragraph above on page 6 there is no reference to aragonite saturation. Should perhaps mention the aragonite saturation in the Arctic, as well. The depth level of aragonite saturation will also rise considerably in the Arctic, although there might not be literature describing surfacing of the saturation level, but at least up above the Arctic shelves (e.g. Orr et al 2005) , and I would assume surfacing in certain areas here, as well. (Sundby, Svein, Institute of Marine Research)
259	28	7	26	7	28	As appropriate, the general time frame for these outcomes should be specified. (Mach, Katharine, IPCC WGII TSU)
260	28	7	27	7	28	On Antarctic islands there is also an increase in abundance of alien species (King George Island). (GERMANY)
261	28	7	37	0	0	Surface freshwater systems- there are extensive hydrological systems beneath the ice. (Church, Ian, Canadian Foundation for Climate and Atmospheric Science/ IPY Canada)
262	28	7	39	7	39	"...in a simple food web." I do not really thing that microbial mats food webs are simple, in fact there is a lack of knowledge about that. I recommned rephrasing as:"...in a relatively simple food web with many interactions (Velázquez et al, 2013). Velázquez D, Jungblut D, Rochera C, Rico E, Camacho A, Quesada A (2013). Seasonal dynamics and trophic interactions of a microbial mat in maritime Antarctica. Submitted to Environmental Microbiology. (Velázquez, David, Universidad Autónoma de Madrid)
263	28	7	40	7	40	insert "aquatic" before "higher plants" (for clarity) (Molau, Ulf, University of Gothenburg)

#	Ch	From Page	From Line	To Page	To Line	Comment
264	28	7	42	0	0	Authors are confusing the readers. Signy Island is not sub-Antarctic by the definition of Antarctic given above nor actually anyone's definition. Could get away with 'maritime Antarctic'. (Ainley, David, H.T. Harvey & Associates Ecological Consultants)
265	28	7	43	0	0	Signy Island itself is not well known, maybe it is better to use the whole group of South Orkney Islands as an example. (GERMANY)
266	28	7	45	7	45	p. 7, line 45: It would be useful to specify the species and population referred to rather than "fur seal populations". (UNITED STATES OF AMERICA)
267	28	7	48	0	50	Strange that micronutrient levels, i.e. Fe, not mentioned, particularly in the extinguishment of blooms, which few people for some reason don't consider. Seemingly, p 19 (ln 45) by referencing glacial melt as influencing PP you're implying a Fe role?? (Ainley, David, H.T. Harvey & Associates Ecological Consultants)
268	28	7	49	7	49	I believe that "insolation" would be a better word than "irradiance" here, as it seems the discussion is about solar wavelengths. Irradiance does not refer to the wavelength of energy. (Francis, Jennifer, Rutgers University)
269	28	7	50	0	52	This statement is false. In coastal waters, especially those of polynyas, Phaeocystis is the dominant phyto-producer. In fact, the Ross Sea contributes 28% of total Southern Ocean PP, and a large part of that is Phaeocystis (see Smith et al. 2012; also various Arrigo papers). (Ainley, David, H.T. Harvey & Associates Ecological Consultants)
270	28	7	50	7	50	Has this paper been published yet? Check for all "submitted" references. (Francis, Jennifer, Rutgers University)
271	28	7	51	7	51	Point of clarification: Should the word "which" be replaced with "and"? The word "and" would make it clear that diatoms are referred to, rather than waters. (Smith, Inga, University of Otago)
272	28	8	2	8	6	[NOTE: Biology is not my area of expertise, but I think someone needs to check this]Explicit mention of Ross Sea ecosystem structure (silverfish versus krill) might be important? (Smith, Inga, University of Otago)
273	28	8	4	8	5	Summary of knowledge, Antarctic: wouldn't krill dominated systems always be found south of the circumpolar current? (Menzel, Lena, Alfred Wegener Institute for Polar and Marine Research)
274	28	8	8	0	0	What does 800m refer to? Is that an average depth? In fact, this number is often used to designate the shelf break, which means as an average it doesn't characterize shelf topography very well. 'Deep shelf areas' are much deeper than 800m. (Ainley, David, H.T. Harvey & Associates Ecological Consultants)
275	28	8	10	0	0	hard to know what Constable has to say about this, but in the Ross Sea (largest of all Antarctic continental shelves) benthic communities are primarily determined by near-bottom current velocities, i.e. the rate of food delivery (Barry et al. 2003). (Ainley, David, H.T. Harvey & Associates Ecological Consultants)
276	28	8	10	8	12	"Coastal polynyas are prevalent, caused by land forms, glacier tongues, bottom topography or grounded icebergs (Massom and Stammerjohn, 2010)" - presumably latent heat (wind driven) polynyas are what are being referred to here? Not sensible heat (warm water upwelling) polynyas? (Smith, Inga, University of Otago)
277	28	8	11	0	0	No. Coastal polynyas are driven by winds, i.e. almost all are latent heat polynyas (Arrigo & van Dijken 2003). The little open water areas around grounded icebergs are insignificant, other than to very local creatures. Yes, there are a few sensible heat polynyas here and there but not a lot in the Antarctic. (Ainley, David, H.T. Harvey & Associates Ecological Consultants)
278	28	8	16	8	25	The specific relevant chapter sections in the 4th assessment report could be specified here. (Mach, Katharine, IPCC WGII TSU)
279	28	8	20	8	20	p. 8, line 20: it is not accurate to imply that all large whale populations and all ice seal populations were decimated by overharvesting - some were not. Perhaps revise "recovery of whales and seals from past over-exploitation" to "recovery of those populations of whale and seal species from past over-exploitation". (UNITED STATES OF AMERICA)
280	28	8	21	8	25	Summary of knowledge, Antarctic: several paragraphs need references (Menzel, Lena, Alfred Wegener Institute for Polar and Marine Research)

#	Ch	From Page	From Line	To Page	To Line	Comment
281	28	8	23	8	23	should read" 5-10°C" (Molau, Ulf, University of Gothenburg)
282	28	8	23	8	23	"may be vulnerable if water temperatures rise to 5-10oC" Is this "to" or "by" 5 to 10 degrees? And note that degree symbol should be superscripted. (Smith, Inga, University of Otago)
283	28	8	27	8	27	this seems like an orphan comment. (Francis, Jennifer, Rutgers University)
284	28	8	30	0	0	If this section is about observed changes, then the authors should consider removing mentions of the future. Many sections speculate about what will happen under climate change or make general observations about changes that have or may occur. It could be made much tighter; focus only on recent observed changes. (UNITED STATES OF AMERICA)
285	28	8	30	0	0	Section 28.2: Please undertake a careful edit to ensure that only observed changes are discussed in this section, as currently there are some projections mixed in, which makes for confusing overlap with 28.3. This is particularly an issue with 28.2.2. Throughout, be as clear as possible regarding the timeframe for specific observed changes, as this is often unclear. (Mastrandrea, Michael, IPCC WGII TSU)
286	28	8	32	0	0	Section 28.2.1. The chapter team should ensure that the observed changes are the focus throughout this section, eliminating future-oriented discussion, especially for projected impacts. (Mach, Katharine, IPCC WGII TSU)
287	28	8	38	8	47	Reference should be made to Zhang et al. (2012, GRL), who showed that the variations and trends of Eurasian river discharge are consistent with corresponding variations of atmospheric moisture flux convergence. (UNITED STATES OF AMERICA)
288	28	8	40	8	41	Change this to "decreased flow in major high-latitude Canadian rivers etc." (Head, Erica, Fisheries and Oceans Canada)
289	28	8	43	9	16	Much of this information seems to belong in the WGI report. (Francis, Jennifer, Rutgers University)
290	28	8	50	8	53	The timeframe for these changes should be specified. (Mach, Katharine, IPCC WGII TSU)
291	28	9	1	9	3	The general time frame for these changes should be specified. (Mach, Katharine, IPCC WGII TSU)
292	28	9	6	9	6	"Others argue....." It would be more useful to present data instead of arguments. (UNITED STATES OF AMERICA)
293	28	9	20	9	20	It would be preferable to indicate more precisely the timeframe for the described "recent" drying. (Mach, Katharine, IPCC WGII TSU)
294	28	9	29	9	29	The timeframe of the documented changes should be specified. (Mach, Katharine, IPCC WGII TSU)
295	28	9	29	9	37	Role of thaw slumping including possible increase is also discussed in Kokelj et al. (2009). Impacts on aquatic ecosystems has also been discussed by Kokelj et al. (2009); Lamoureux and Lafrenière (2009); Dugan et al. (2009). Refs: Kokelj, S.V., Zajdik, B., and Thompson, M.S. 2009. The impacts of thawing permafrost on the chemistry of lakes across the subarctic boreal-tundra transition, Mackenzie Delta region. Permafrost and Periglacial Processes, 20: 185-199. Kokelj, S.V., Lantz, T.C., Kanigan, J., Smith, S.L., and Coutts, R. 2009. Origin and polycyclic behaviour of tundra thaw slumps, Mackenzie Delta region, Northwest Territories, Canada. Permafrost and Periglacial Processes, 20(2): 173-184. Lamoureux, S.F., and Lafrenière, M.J. 2009. Fluvial Impact of Extensive Active Layer Detachments, Cape Bounty, Melville Island, Canada. Arctic, Antarctic, and Alpine Research, 41: 59-68. Dugan, H.A., Lamoureux, S.F., Lafrenière, M.J., and Lewis, T. 2009. Hydrological and sediment yield response to summer rainfall in a small high Arctic watershed. Hydrological Processes, 23: 1514-1526. (Smith, Sharon, Geological Survey of Canada)
296	28	9	32	9	42	The timeframe of these changes should be specified. (Mach, Katharine, IPCC WGII TSU)
297	28	9	39	9	42	This "decrease in the supply of ice-jam floodwaters" seems to run counter to the projected increase of ice-jam flooding on Siberian rivers (p. 6, lines 24-28). Some reconciliation is needed. (UNITED STATES OF AMERICA)
298	28	9	40	0	0	here you speak of a decrease in the serverity of ice break-up whereas earlier there was mention of an increase in the serverity of ice break-up. Why should the severity change? (Hunt, George, University of Washington)

#	Ch	From Page	From Line	To Page	To Line	Comment
299	28	10	0	0	0	Stratification due to ice melt and the cold halocline is a substantial important issue for the Arctic Ocean. This stratification often prevents nutrient availability (Tremley and Gagon, 2009) making the Arctic Ocean a low productive region even when ice vanish (Wassmann, 2011). This theme is poorly described in sub chapter 28.2.2. (Ingvaldsen, Randi, Institute of Marine Research)
300	28	10	3	10	17	Suggest considering including the most recent observations on permafrost, due to relationships with ecosystems: "Permafrost in the Antarctic Peninsula region has been shown to be at temperatures close to thaw and even lacking in lowest areas (Vieira et 2010). Bockheim et al. (2013) report on changes in permafrost in the region that follow the general warming that has been reported. Such changes should have significant impacts on the terrestrial ecosystems and surface hydrology." Bockheim J, Vieira G, Ramos M, Lopez-Martinez J, Serrano E, Guglielmin M, Wilhelm K, Nieuwendam A. 2013. Climate Warming and Permafrost Dynamics in the Antarctic Peninsula Region . Global and Planetary Change, 100: 215-223; Vieira, G., Bockheim, J., Guglielmin, M., Balks, M., Abramov, A.A., Boelhouwers, J., Cannone, N., Ganzert, L., Gilichinsky, D.A., Goryachkin, S., López-Martínez, J., Meiklejohn, I., Raffi, R., Ramos, M., Schaefer, C., Serrano, E., Simas, F., Sletten, R., Wagner, D. 2010 - Thermal State of permafrost and active-layer monitoring in the Antarctic: advances during the International Polar Year 2007-09. Permafrost and Periglacial Processes, 21(2): 182-197. (Vieira, Goncalo, University of Lisbon)
301	28	10	4	10	6	The timeframe of these changes should be specified. Also, the relevant supporting citation could be specified. (Mach, Katharine, IPCC WGII TSU)
302	28	10	14	10	14	I recommend to support the sentence by the reference:Quesada A and Velázquez D (2012). Global Change Effects on Antarctic Lakes. In: Effects of Global Warming on Freshwater Ecosystems of the World: what can be done to reduce negative impacts? (M Kumagai, CR Goldman and RD Robarts eds). Wiley-Blackwell Ltd .pp 367-382 (Velázquez, David, Universidad Autónoma de Madrid)
303	28	10	19	10	23	I would like to see a summary statement like this at the end of each major section in the report. (Francis, Jennifer, Rutgers University)
304	28	10	19	10	23	The chapter team should ensure a focus on observed changes in the summary paragraph. Clear support for each statement in the preceding assessment should be ensured. "High confidence" could be placed within parentheses at the end of the 1st sentence to maximize direct of wording. Also, casual usage of "likely" on line 20 should be avoided. (Mach, Katharine, IPCC WGII TSU)
305	28	10	20	10	21	Change this to "Antarctica. The exact nature of these impacts is likely to vary regionally depending on the magnitude of the temperature change, how much change is required for the temperature to rise above freezing, the depth to" (Head, Erica, Fisheries and Oceans Canada)
306	28	10	23	10	23	I reomment to complete the sentence with: "..., but some international innitiatives have been carried out (Quesada et al., 2013).". Quesada, a, Lyons WB and Camacho A (2013) Byers Peninsula- A new refrence site for the maritime Antarctic. Antarctic Science- Special Issue. 25 (2) (Velázquez, David, Universidad Autónoma de Madrid)
307	28	10	26	0	0	Section 28.2.2. This section should be very carefully revised. 1st, focus on OBSERVED (not expected or projected) changes should be ensured throughout. 2nd, the length of the section should be reduced by much more than 50%. (Mach, Katharine, IPCC WGII TSU)
308	28	10	26	0	0	Section 28.2.2: Please undertake a careful edit to ensure that only observed changes are discussed in this section. Currently there are projections mixed in, which makes for confusing overlap with 28.3. Please also aim to shorten this section substantially, reducing background material as much as possible and focusing on the key messages emerging from assessment of the relevant literature. At the same time, please also be specific about the timeframes related to specific observed changes mentioned, as this is often unclear. (Mastrandrea, Michael, IPCC WGII TSU)

#	Ch	From Page	From Line	To Page	To Line	Comment
309	28	10	28	14	8	The linkages amongst species is difficult to follow for non-subject matter experts. It would be very helpful to have a food chain illustration to follow and (if such a thing exists) indications of where key impacts and stressors are affecting the system. The key take aways of this section didn't come through. Lots of distributed impacts described. (UNITED STATES OF AMERICA)
310	28	10	31	10	31	I understand the statement on sea ice retreat is addressing seasonal retreat in spring and early summer. I suggest that also the timing (and especially delay) of seasonal sea ice return (late summer/autumn/winter) is mentioned here. The timing of onset of freezing/sea ice return has implications for (i) the amount of snow on sea ice in the following spring (which can be relevant for certain marine mammals, and for the optical transmittance of the snow and ice system, controlling the light conditions in and under the ice), (ii) the access for polar bears from drifting ice areas to coastal areas, and (iii) the availability of solar radiation in the water column around the time of onset of freezing/sea ice return (relevance depending on ambient light conditions relative to latitude and time of year). (Gerland, Sebastian, Norwegian Polar Institute)
311	28	10	31	10	31	Timing and extent of sea ice are important, but in many ways, volume is even more important. (UNITED STATES OF AMERICA)
312	28	10	32	10	32	Add "mixing processes and transport of water masses" to generate "increased freshwater supplies, mixing processes and transport of water masses". (NORWAY)
313	28	10	34	10	34	This section (28.2) is about observed changes. Discussion of expected changes is out of place. (UNITED STATES OF AMERICA)
314	28	10	34	10	34	This section should focus on observed impacts, not expected or projected impacts. (Mach, Katharine, IPCC WGII TSU)
315	28	10	36	10	40	Focus on observed changes should be ensured. The rigor of the logic of the last sentence of the paragraph, in terms of this support of the previous statements, should also be ensured. Also, on line 37, specific cross-reference to the relevant chapter and chapter sections within the working group 1 contribution is needed. (Mach, Katharine, IPCC WGII TSU)
316	28	10	42	10	42	"..impacted by" is quite vague. (UNITED STATES OF AMERICA)
317	28	10	42	10	42	Again, this section is about observed changes. Discussion of expected changes is out of place. (UNITED STATES OF AMERICA)
318	28	10	42	10	42	Focus on observed changes should be ensured. (Mach, Katharine, IPCC WGII TSU)
319	28	10	45	0	0	A link to Box CC-OA would seem very useful here. (Gattuso, Jean-Pierre, Centre National de la Recherche Scientifique)
320	28	10	45	10	51	Tying effects of ocean acidification to the saturation horizon of carbonates is an oversimplification as explained in WGII ch. 6. WGI ch. 6 is a good reference for changing ocean physicochemistry but not for biological impact. Cross-referencing to WGII ch.s 5, 6 and the cross-chapter box on ocean acidification appears warranted. (Menzel, Lena, Alfred Wegener Institute for Polar and Marine Research)
321	28	10	48	10	48	Focus on observed changes should be ensured. (Mach, Katharine, IPCC WGII TSU)
322	28	10	48	10	49	This sentence misses key papers by Comeau et al. Which are mentioned elsewhere. (Gattuso, Jean-Pierre, Centre National de la Recherche Scientifique)
323	28	11	1	0	0	Section 28.2.2.1.1 should be omitted. It does not say much about impacts that are not covered elsewhere in the chapter. (UNITED STATES OF AMERICA)
324	28	11	1	0	0	Section 28.2.2.1.1. This section should be very substantially reduced and tightened in revision, shortening its length by much more than 50%. (Mach, Katharine, IPCC WGII TSU)
325	28	11	3	11	3	Unclear what is meant with fall ice algal bloom, please clarify. (NORWAY)
326	28	11	14	11	14	Calanus in italics. (NORWAY)

#	Ch	From Page	From Line	To Page	To Line	Comment
327	28	11	21	11	21	Retention of phytoplankton in water column of Bering Sea is a response to climate change. That is not clear in this text. (UNITED STATES OF AMERICA)
328	28	11	30	0	0	what about the recent papers by Bluhm et al about grey whales consuming euphausiids in the southern Chukchi Sea (Hunt, George, University of Washington)
329	28	11	34	11	36	There is something missing in the latter part of this sentence: "In general, dominant pelagic species are smaller sized fish capable of rapid growth in the first year of life (e.g. capelin, Mallotus villosus) and in some cases antifreeze proteins to tolerate cold temperatures (e.g. polar cod, Boreogadus saida)" . The latter part will have to contain "with" or "having" to read something like ".....and in some cases with anti freeze proteins". (ICELAND)
330	28	11	35	11	35	Change to "the first year of life (e.g. capelin, Mallotus villosus) and in some cases have antifreeze proteins to enable them to tolerate cold" (Head, Erica, Fisheries and Oceans Canada)
331	28	11	35	11	35	insert "have" or something before "antifreeze" (Molau, Ulf, University of Gothenburg)
332	28	11	38	11	38	Change "Spebcer" to "Spencer" (Head, Erica, Fisheries and Oceans Canada)
333	28	11	40	11	43	This is a not very useful statement - there are not many taxa that have NOT evoloved such traits. (UNITED STATES OF AMERICA)
334	28	11	49	11	49	In addition to stratification, the depth of the upper mixed layer will change. It is very important for total production and should be included here. Please consider rephrasing to "... and stratification, as well as the depth of the upper mixed layer..." (NORWAY)
335	28	11	49	11	49	Focus on observed changes should be ensured. (Mach, Katharine, IPCC WGII TSU)
336	28	11	53	11	53	Focus on observed changes should be ensured. (Mach, Katharine, IPCC WGII TSU)
337	28	11	54	11	54	Omit the word "trophic". (Head, Erica, Fisheries and Oceans Canada)
338	28	11	54	11	54	Suggest to delete the word "trophic" (Sundby, Svein, Institute of Marine Research)
339	28	11	54	11	54	Consider adding that there will be local differences. (NORWAY)
340	28	12	2	12	2	What is the difference between this statement and the one on the previous page (line 53-54) other than the latter using climate change and the first physical and chemical change (which also is related to climate change)? Please clarify. (NORWAY)
341	28	12	2	12	22	Throughout these paragraphs, focus on the observed changes should be ensured. (Mach, Katharine, IPCC WGII TSU)
342	28	12	10	12	11	To what extent? Please give more details. (NORWAY)
343	28	12	20	12	21	Change "2011) however, these adjustments etc" to "2011) although these adjustments etc" (Head, Erica, Fisheries and Oceans Canada)
344	28	12	20	12	22	"...long time periods" is too vague. What is important is the rate of change relative to generation time (i.e., evolutionary adaptation time horizons for bacteria are very different than those for walruses). (UNITED STATES OF AMERICA)
345	28	12	27	13	6	Observed spatial shifts in response to climate: Many phenomena described under this subtitle are projections rather than observations. (Menzel, Lena, Alfred Wegener Institute for Polar and Marine Research)
346	28	12	27	13	6	Relate this section to previous sections 28.2.3 Terrestrial Ecosystems: Changes in tree line, changes in animal population cycles systems and section 28.2.2 Oceanographic and marine ecosystems . (UNITED STATES OF AMERICA)
347	28	12	28	12	31	Focus on observed changes should be ensured. (Mach, Katharine, IPCC WGII TSU)
348	28	12	30	12	30	"impact the decrease the" Some text seems missing. (DENMARK)
349	28	12	30	12	30	impact the derease --> decrease (?) (Jung, Sukgeun, Jeju National University)
350	28	12	31	12	31	Genus name should be spelled out the first time the species is metioned in a new sub-chapter. Check the whole chapter for this. (NORWAY)

#	Ch	From Page	From Line	To Page	To Line	Comment
351	28	12	32	12	33	"Additional observations are needed" is vague. Explain further. (UNITED STATES OF AMERICA)
352	28	12	35	12	35	Focus on observed changes should be ensured. Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Mach, Katharine, IPCC WGII TSU)
353	28	12	39	12	42	The sentence refers to four sea areas and four references are listed at the end. One of the sea areas "west Greenland Sea". None of the reference mentioned specifically covers the west Greenland Sea. Instead of "west Greenland Sea" should be written "the Northeast Atlantic Ocean and Icelandic waters". The references Hátún et al., 2009 and Valdimarsson et al., 2012 cover these two areas. Further, it is unclear if any one of the other references cover the Chukchi Sea. The authors have to the authors carefully check if bringing the Chukchi Sea into the discussion on the basis of these references is valid. (ICELAND)
354	28	12	44	12	48	This seems like a key and general point to guiding the reader through the section yet is nested within the spatial shifts. We recommend an earlier highlight of this point. (UNITED STATES OF AMERICA)
355	28	12	45	12	45	Change "abundance of marine fish throughout its life cycle" to "abundance of marine fish throughout their life cycles" (Head, Erica, Fisheries and Oceans Canada)
356	28	12	46	12	47	Again, relative to generation time is important. (UNITED STATES OF AMERICA)
357	28	12	52	12	52	Clarify why winter is important. (UNITED STATES OF AMERICA)
358	28	12	53	12	53	Focus on observed changes should be ensured. (Mach, Katharine, IPCC WGII TSU)
359	28	13	1	13	6	"Shfits" is too vague. Overall productivity? Community composition? Functional dynamics? (UNITED STATES OF AMERICA)
360	28	13	2	13	5	Focus on observed changes should be ensured. (Mach, Katharine, IPCC WGII TSU)
361	28	13	19	13	23	These lines seem more appropriate to the discussion of projections (Section 28.3.2). (UNITED STATES OF AMERICA)
362	28	13	19	13	28	Focus on observed changes should be ensured. (Mach, Katharine, IPCC WGII TSU)
363	28	13	20	13	21	Change "across its geographic range (Beaugrand and Kirby, 2010) and the ability of the species to adapt" to "across their geographical ranges (Beaugrand and Kirby, 2010) and the abilities of species to adapt" (Head, Erica, Fisheries and Oceans Canada)
364	28	13	25	13	28	Logic of this paragraph is unclear. Are you saying that there is low confidence that the Bering Sea will warm by 2100? (UNITED STATES OF AMERICA)
365	28	13	30	13	43	There doesn't seem to be a coherent take away from this listing. The significance of these species, in relation to each other or a part of the big picture, is not clear. (UNITED STATES OF AMERICA)
366	28	13	37	0	0	Observed variations in fish and shellfish: The next lines are not so much about the mechanisms but again on statistical relationships between abiotic or biotic conditions and the effect observed. (Menzel, Lena, Alfred Wegener Institute for Polar and Marine Research)
367	28	13	41	13	43	Ch 28 p 13 lines 41 - 43. More recent observational work on trophic linkages in the Bering Sea indicates that temperature alone is not sufficient to predict year class strength in pollock (Coyle et al. Fisheries Oceanography 20:2, 139-156, 2011). The fact that year class strength in pollock does not appear to vary in concert with warm and cold years is due to the changes in food-web pathways created by changes in species composition of zooplankton (see Coyle et al. 2011; Stabeno et al. 2012 Deep-Sea Research II 65-70, 14-30 and Stabeno et al. 2012 Deep-Sea Research II 65-70, 31-45). (UNITED STATES OF AMERICA)
368	28	13	46	0	0	This section is mostly about what will happen, not observed changes. Drop the section. (UNITED STATES OF AMERICA)
369	28	13	48	13	48	Please provide a specific reference to WGI AR5. (Plattner, Gian-Kasper, IPCC WGI TSU)
370	28	13	48	13	48	Instead of saying "as described" it would be preferable to specify what the changes are. Specific reference to the relevant chapters and chapters sections of working group 1 should be provided. (Mach, Katharine, IPCC WGII TSU)

#	Ch	From Page	From Line	To Page	To Line	Comment
371	28	13	48	13	53	Focus on observed changes should be ensured. (Mach, Katharine, IPCC WGII TSU)
372	28	13	52	13	52	It would be preferable to indicate more specifically what is meant by "implications" and "considerable." (Mach, Katharine, IPCC WGII TSU)
373	28	13	52	13	53	Other stressors: The degree of ocean acidification effects does not depend upon undersaturation as explained before. (Menzel, Lena, Alfred Wegener Institute for Polar and Marine Research)
374	28	13	53	0	0	..exposure to environmental contaminants, and infectious diseases Hueffer K, Parkinson AJ, Gerlach R, and Berner J. Zoonotic infectious in Alaska: Disease prevalence, potential impact of climate change and recommended actions for earlier disease detection, research, prevention and control. Int J Circumpolar Health 2013 72: 19562 http://dx.doi.org/10.3402/ijch.v72i0.19562 (UNITED STATES OF AMERICA)
375	28	14	5	14	6	Other stressors: while fully agreed on the paucity of analyses, esp if it concerns a whole region, cross-referencing to chapter 6 appears warranted where the principles of such multiple stressor effects have been addressed. (Menzel, Lena, Alfred Wegener Institute for Polar and Marine Research)
376	28	14	6	14	6	Focus on observed changes should be ensured. (Mach, Katharine, IPCC WGII TSU)
377	28	14	11	15	28	Please specify why ivory gull (which has received attention by scientists because of effects of climate change) is not mentioned? (NORWAY)
378	28	14	13	0	0	Upwelling or convergence areas should be changed to Upwelling or subsurface convergence areas. Upwelling is often caused by changes at surface causing divergence in the surface layer and thereby causing convergence at the subsurface layer. (Ingvaldsen, Randi, Institute of Marine Research)
379	28	14	15	14	15	Focus on the observed changes should be ensured. (Mach, Katharine, IPCC WGII TSU)
380	28	14	16	0	0	Add Levintova 2010 reference. (UNITED STATES OF AMERICA)
381	28	14	19	14	22	Change "Such spatial mismatch between prey base and breeding has been" to "Such spatial mismatches between prey base and breeding have been" Change "The percentage of important prey in the diet etc" to "The percentage of Arctic Cod in the diet etc" and "which was the habitat of the prey" to "which is the habitat of the prey" (Head, Erica, Fisheries and Oceans Canada)
382	28	14	29	14	30	"Current trends suggest that continued warming etc." I looked in the reference (Gaston et al., 2009), but did not find this idea expressed there. The reference is inappropriate and either the correct one should be given, or the sentence omitted. (Head, Erica, Fisheries and Oceans Canada)
383	28	14	33	14	33	p. 14, line 33: Many of the references in this section on seabirds refer to the SE Bering Sea. References to some of the work by Divoky and others should be included. See below. (UNITED STATES OF AMERICA)
384	28	14	33	14	33	Correct spelling: Brünnich's guillemot (NORWAY)
385	28	14	33	14	33	Capitalize species names: Brünnich's guillemots and Common guillemots. This should be done throughout the text. (NORWAY)
386	28	14	37	14	39	28.2.2.1.2. Is any explanation available for these contrasting observations? (Menzel, Lena, Alfred Wegener Institute for Polar and Marine Research)
387	28	14	43	14	46	The Grebmeier et al. (2006) reference seems dubious, as it is seven years old. The Bering Sea has turned colder in the past six years, with below-normal water temperatures and above-normal ice extent in winter, so how likely is it that the northward ecosystem shift is still ongoing? (UNITED STATES OF AMERICA)
388	28	14	44	14	0	(Typo) "1990tiescaused" should be replaced with "1990s caused." (JAPAN)
389	28	14	44	14	46	Change "1990tiescaused" to "1990s caused" and "these populations in the area have declined" to "these populations have declined in the area" (Head, Erica, Fisheries and Oceans Canada)
390	28	15	2	15	2	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Mach, Katharine, IPCC WGII TSU)

#	Ch	From Page	From Line	To Page	To Line	Comment
391	28	15	2	15	3	28.2.2.1.2. Unless there is a full understanding of underlying principles this may be overstated. Reasons should be specified more than done here. Otherwise the term likely does not really apply. (Menzel, Lena, Alfred Wegener Institute for Polar and Marine Research)
392	28	15	3	15	6	The Gaston and Woo 2008 reference is used inappropriately. I suggest changing "While phenological changes and changes in productivity of some breeding colonies related to climate change etc" to "Phenological changes and changes in productivity of some breeding colonies have been observed, as well as northward expansions for sub-arctic species, as ice cover decreases and their prey species move north (e.g. Razorbills, Alca torda, Gaston and Woo, 2008). Negative trends in population size, observed over the last few decades for several species of widespread Arctic seabirds, may be related to over-harvesting and pollution as well as climate change effects (Gaston, 2011)." Reference: (Head, Erica, Fisheries and Oceans Canada)
393	28	15	3	15	6	Gaston, A. J. (2011) Arctic seabirds: Diversity, populations, trends, and causes. in R. T. Watson, T. J. Cade, M. Fuller, G. Hunt, and E. Potapov (Eds.). Gyrfalcons and Ptarmigan in a Changing World, Volume I. The Peregrine Fund, Boise, Idaho, USA. Pp. 147-160, http://dx.doi.org/10.4080/gpcw.2011.0201 (Head, Erica, Fisheries and Oceans Canada)
394	28	15	8	15	25	Focus on the observed changes should be ensured. (Mach, Katharine, IPCC WGII TSU)
395	28	15	9	15	9	Item #2 Fishtahler(L.E.&C.R.): Chapter 28 pg. 15, line 9 Sec. 28.2.2.1.2. Current changes in Arctic seabird populations Title: Cite current literature #2 Issue: cite current literature Change: "(Wang and Overland, 2009)" To: "(Wang and Overland, 2012)" Rationale: Wang and Overland (2012) is an update of Wang and Overland (2009) Wang, M., and J. E. Overland (2012), A sea ice free summer Arctic within 30 years: An update from CMIP5 models, Geophys. Res. Lett., 39, L18501, doi:10.1029/2012GL052868. (UNITED STATES OF AMERICA)
396	28	15	18	15	25	There must be a more recent reference available than the ACIA 2005 report. (Francis, Jennifer, Rutgers University)
397	28	15	28	16	39	Polar bears should be folded in with other marine mammals and the text devoted to bears should be shortened. Pulling them out as here since the wrong message about their overall importance in the ecosystem. (UNITED STATES OF AMERICA)
398	28	15	40	0	0	mention polar bears so that one knows that this paragraph focuses on them (Hunt, George, University of Washington)
399	28	15	47	15	54	The difference between the terms "declining body condition" and "lower body condition" is not clear - do these both refer to lower mass? Suggest clarifying. (CANADA)
400	28	15	50	15	52	To maximize directness of wording, "high confidence" could be placed within parentheses at the end of the statement. (Mach, Katharine, IPCC WGII TSU)
401	28	16	0	0	0	section 28.2.21.4: This section seems weak. My understanding is that there is considerable concern about walrus and bearded seal in the Pacific Arctic when ice retreats over the basin. (Hunt, George, University of Washington)
402	28	16	5	0	0	Unclear what "the Southern Beaufort Sea is projected to decline by 99%....." refers to. Probably bear population growth rate. Likewise the next sentence. (Church, Ian, Canadian Foundation for Climate and Atmospheric Science/ IPY Canada)
403	28	16	5	16	5	Do you mean "population decline"? (Smith, Sharon, Geological Survey of Canada)
404	28	16	5	16	5	Something is missing after "The Southern Beaufort Sea". (UNITED STATES OF AMERICA)
405	28	16	5	16	5	Please consider rephrasing the start of the sentence: "The Southern Beaufort Sea subpopulation is projected to decline by 99% by 2100..." (NORWAY)
406	28	16	5	16	10	Focus on observed changes should be ensured. (Mach, Katharine, IPCC WGII TSU)
407	28	16	6	16	6	Please consider rephrasing the start of the sentence: "The Northern Beaufort Sea subpopulation is currently stable although decline..." (NORWAY)
408	28	16	12	16	12	What the level of evidence (if it can be quantified) supports the finding that "Projected extinction of polar bears has low confidence." (UNITED STATES OF AMERICA)

#	Ch	From Page	From Line	To Page	To Line	Comment
409	28	16	15	0	0	First sentence should be reworded for clarity. I assume it means that at periods of maximal melt multiyear ice is used. (Church, Ian, Canadian Foundation for Climate and Atmospheric Science/ IPY Canada)
410	28	16	15	15	20	Shouldn't changes in physical environment (sea ice) be discussed first, followed by implications of changing sea ice conditions. (Smith, Sharon, Geological Survey of Canada)
411	28	16	15	16	15	Is multiyear or seasonal ice better habitat? Can we say why? (UNITED STATES OF AMERICA)
412	28	16	15	16	16	As in the first order draft, this first sentence is still unclear to me. I suggest: "Since multiyear ice is used by some polar bears at maximal ice melt (Ferguson et al., 2010), replacement of multiyear ice by annual ice could increase polar bear habitat (Derocher et al., 2004)." (Rosales, Jon, St. Lawrence University)
413	28	16	26	16	27	To maximize directness of wording, "high confidence" could be placed within parentheses at the end of the statement. (Mach, Katharine, IPCC WGII TSU)
414	28	16	29	16	39	Occupying the terrestrial niche exposes polar bears to additional threat from hybridization with grizzly bears (Kelly, B. P., A. R. Whiteley, and D. A. Tallmon. 2010. Arctic melting pot. Nature 468:891.). (UNITED STATES OF AMERICA)
415	28	16	35	16	35	Focus on the observed changes should be ensured. (Mach, Katharine, IPCC WGII TSU)
416	28	16	50	16	53	Most populations of ringed and bearded seals are associated with sea ice year round. (UNITED STATES OF AMERICA)
417	28	17	4	17	4	In place of "vary" it would be preferable to indicate more precisely the variations expected. (Mach, Katharine, IPCC WGII TSU)
418	28	17	4	17	49	For all statements in these paragraphs, focus on the observed changes should be ensured. (Mach, Katharine, IPCC WGII TSU)
419	28	17	8	17	8	Reference to the possibility of species adapting should not be made without reference to generation time. Evolutionary adaptation has to occur over multiple generations, so the rate of environmental change to generation time is critical. (UNITED STATES OF AMERICA)
420	28	17	12	17	12	What is the timeframe for these observed effects? (Mach, Katharine, IPCC WGII TSU)
421	28	17	12	17	23	Laidre et al. used a very crude set of indicator variables to make very broad extrapolations to likely impacts. For example, they assumed that species with broad distributions and broad diets were less vulnerable than species with narrow distributions and diets. In that way, they built a matrix, assigned arbitrary weightings, and, based on the sum of those scores, predicted which species would and would not be vulnerable. Much more detailed and recent analyses of habitat requirements, however, came to the opposite conclusion. That is, ringed seals (http://www.afsc.noaa.gov/Publications/AFSC-TM/NOAA-TM-AFSC-212.pdf) and bearded seals (http://www.afsc.noaa.gov/Publications/AFSC-TM/NOAA-TM-AFSC-211.pdf) were the MOST sensitive to changing ice (and snow) conditions. See also Hezel et al (2012) cited elsewhere in this chapter. (UNITED STATES OF AMERICA)
422	28	17	15	17	15	p. 17, line 15: See note above regarding references to status review on ringed and bearded seals in the western Arctic. We do not believe ringed seals and bearded seals would be considered "least sensitive" in the western Arctic. (UNITED STATES OF AMERICA)
423	28	17	25	17	25	"medium agreement" should be used instead of "moderate agreement." (Mach, Katharine, IPCC WGII TSU)
424	28	17	27	17	31	More significant to walrus populations is the decoupling of nursing substrate (pack ice) and feeding areas (on-shelf benthos) (Kelly 2001 - cited elsewhere in this chapter). (UNITED STATES OF AMERICA)
425	28	17	30	17	37	The timeframe for observed changes and effects should be specified. (Mach, Katharine, IPCC WGII TSU)
426	28	17	33	17	33	Is "Baltic" correct? Please check whether it should not be "Barents" instead. (NORWAY)
427	28	17	44	17	44	remove future tense (UNITED STATES OF AMERICA)
428	28	17	44	17	44	"high confidence" could be placed within parentheses at the end of the statement to maximize directness of wording. (Mach, Katharine, IPCC WGII TSU)

#	Ch	From Page	From Line	To Page	To Line	Comment
429	28	17	44	17	49	p. 17, line 44-49: The concerns for ringed and bearded seals in the western Arctic should be incorporated into this concluding paragraph. (UNITED STATES OF AMERICA)
430	28	18	1	20	27	If possible, more details should be presented and with the same approach (sub-chapters) as for 28.2.2.1 Arctic? One example: little on ice algal communities in the Antarctic, but also other groups and themes should be discussed more thoroughly. (NORWAY)
431	28	18	1	20	27	Section 28.2.2.1. For Arctic, some of the statements are connected to confidence (high, medium, low). Where possible, this should also be done for 28.2.2.2 Antarctic. (NORWAY)
432	28	18	5	18	12	The relevant time frames for these observed changes should be specified. (Mach, Katharine, IPCC WGII TSU)
433	28	18	8	18	8	Please use the proper spelling: "Emiliana huxleyi". (NORWAY)
434	28	18	8	18	8	"Noctiluca scintillans" in italics. (NORWAY)
435	28	18	8	18	9	"McLeod, Hallegraeff et al. 2012" is not in the reference list, please check for consistency. (NORWAY)
436	28	18	11	0	0	Antarctic vulnerability and change...lithodid crabs on WAP line 11 – but benthos? (Dr. Brandt, Angelika, University of Hamburg)
437	28	18	11	18	11	Define lithodid (Francis, Jennifer, Rutgers University)
438	28	18	11	18	15	Are the statements on lines 11-12 and 14-15 consistent? (Mach, Katharine, IPCC WGII TSU)
439	28	18	19	18	20	Focus on observed changes should be ensured. (Mach, Katharine, IPCC WGII TSU)
440	28	18	19	18	32	This is a good summary of ocean acidification impacts in the Antarctic drawing on relevant recent research. (AUSTRALIA)
441	28	18	20	18	21	[NOTE: Paleoclimate is not my area of expertise, but I think someone needs to check this as I found it confusingly worded] "Shell thickness in foraminifera in the Southern Ocean are thinner than in the Holocene " is this a reference to results from Moy, Howard et al. (2009)? If so, they referred to shell "weights" being less, rather than any reference to thickness? Also, the Holocene includes present day, although it was used interchangeably with "pre-industrial" in the Moy and Howard (2009) paper, so perhaps change to "pre-industrial Holocene"? (Smith, Inga, University of Otago)
442	28	18	23	18	26	28.2.2.2.1.Arctic studies should not be cited here? (Menzel, Lena, Alfred Wegener Institute for Polar and Marine Research)
443	28	18	29	18	30	What is the timeframe for this observation? (Mach, Katharine, IPCC WGII TSU)
444	28	18	31	18	31	It would be helpful to clarify what is meant by "short-term negative effects need to be considered together with..." (Mach, Katharine, IPCC WGII TSU)
445	28	18	34	0	0	Collaps of ice shelves may alter benthic communities (Gutt et al. only citation). What about ocean acidification, food-web and deeper water including benthos? See: Ingels, J., Vanreusel, A., Brandt, A., Catarino, A.I., David, B., De Ridder, C., Dubois, P.; Gooday, A.J.; Martin, P.; Pasotti, f.; Robert, H. (2012): Possible effects of global environmental changes on Antarctic benthos: a synthesis across five major taxa. Ecology and Evolution, pp. 453-485. doi: 10.1002/ece3.96 (Dr. Brandt, Angelika, University of Hamburg)
446	28	18	34	18	40	Focus on observed changes should be ensured. (Mach, Katharine, IPCC WGII TSU)
447	28	18	43	19	43	Observed and expected changes on krill outlined in this section are significant, particularly for the Antarctic food web. Suggest a comment on krill is included in the Executive Summary. (AUSTRALIA)
448	28	18	45	19	43	This discussion of krill in a very small part of the Southern Ocean is fine but really doesn't this give a very narrow view of what is happening, and especially elsewhere? Especially as sea ice expands elsewhere, especially Ross Sea sector? The text cites Montes-Hugo et al. 2009 (see also Scofield et al. 2010) which have a much broader view of biotic changes in this region, including certain fish species whose presence, or not, likely has little to do with E superba. (Ainley, David, H.T. Harvey & Associates Ecological Consultants)

#	Ch	From Page	From Line	To Page	To Line	Comment
449	28	18	46	18	52	The time frames for these observations could be specified. (Mach, Katharine, IPCC WGII TSU)
450	28	19	1	19	21	In connection to climate, does it make sense to distinguish between Antarctic krill (<i>E. superba</i>) occurring in areas with sea ice as opposed to those areas never experiencing sea ice? (NORWAY)
451	28	19	6	19	8	Reword - confusing prose. (UNITED STATES OF AMERICA)
452	28	19	7	19	7	Change "indicates" to "gives" (Head, Erica, Fisheries and Oceans Canada)
453	28	19	19	19	21	28.2.2.2.2. This should be put into context and CO2 levels mentioned, see chapter 6 for a broader discussion. (Menzel, Lena, Alfred Wegener Institute for Polar and Marine Research)
454	28	19	19	19	21	As mentioned in the context of the executive summary, it is not clear that this is a basis for a high confidence statement as presented there. Please clarify. (Mastrandrea, Michael, IPCC WGII TSU)
455	28	19	20	19	20	Saba, Schofield et al, 2012 missing from references (Francis, Jennifer, Rutgers University)
456	28	19	26	0	36	This Forcada et al. paper is based on 3 flights over a one week period, and then a whole lot of modeling. And, so, this statement is going to be based on that analysis? Which ice-breeding seals? Weddells, crabeaters, leopards or Ross? See Siniff et al. 2008 on likelihoods of how Antarctic seals will respond to climate change. (Ainley, David, H.T. Harvey & Associates Ecological Consultants)
457	28	19	26	19	29	Reword - confusing prose. (UNITED STATES OF AMERICA)
458	28	19	27	19	27	The mechanism through which this outcome is expected should be clarified. (Mach, Katharine, IPCC WGII TSU)
459	28	19	34	19	35	Reword - confusing prose. (UNITED STATES OF AMERICA)
460	28	19	34	19	43	As mentioned in the context of the executive summary, it is not clear that this is a basis for a high confidence statement as presented there. Please clarify. (Mastrandrea, Michael, IPCC WGII TSU)
461	28	19	35	19	35	In place of "believed" it would be preferable to indicate the basis of evidence. (Mach, Katharine, IPCC WGII TSU)
462	28	19	38	0	0	What is being talked about here, i.e. greater range of prey items, re Gentoo penguins, e seals??? Emslie & Paterson 2007 conclude that diet of these sorts of predators has become more simplified. (Ainley, David, H.T. Harvey & Associates Ecological Consultants)
463	28	19	41	0	43	Again, why just the talk about WAP? (Ainley, David, H.T. Harvey & Associates Ecological Consultants)
464	28	19	42	19	43	Where does the iron come from specifically? Please mention at least the relevant key-processes. (GERMANY)
465	28	19	46	19	46	p. 19, line 46: This section would be more helpful if the references to marine mammals and birds were specific to population or region. (UNITED STATES OF AMERICA)
466	28	19	48	0	50	Complex? Then also cite Scofield et al., Trivelpiece et al., Lynch et al. (Ainley, David, H.T. Harvey & Associates Ecological Consultants)
467	28	19	48	19	48	Change to "The response of marine mammals, penguins and flying birds will be complex, involving a number of direct and" (Head, Erica, Fisheries and Oceans Canada)
468	28	19	50	0	52	This statement in general is false at least as climate change may be involved. The other half of the Barbraud et al. paper deals with fishery bycatch; and the Ainley & Blight 2008 paper deals with population change related to fishery harvest levels. (Ainley, David, H.T. Harvey & Associates Ecological Consultants)
469	28	19	50	19	54	It would be preferable to specify the timeframe for these observations. Additionally, on lines 53-54 are the described declines and increases for population size? It could be helpful to indicate this more specifically. (Mach, Katharine, IPCC WGII TSU)
470	28	19	53	0	0	according to cited reference, Adelies have been increasing in southern WAP and gentoos maybe decreasing in some locations in north WAP. (Ainley, David, H.T. Harvey & Associates Ecological Consultants)

#	Ch	From Page	From Line	To Page	To Line	Comment
471	28	19	54	0	0	Wilson et al. (2001) and Ainley et al. (2005) indicate that penguins populations have long been increasing in the Ross Sea region. Is that East Antarctica? (Ainley, David, H.T. Harvey & Associates Ecological Consultants)
472	28	20	1	0	0	There is no evidence that emperor penguins are generally decreasing, except at a few places way in the north of their range. However, there are lots of predictions of eventual decrease among cited references but that's not 'evidence'. (Ainley, David, H.T. Harvey & Associates Ecological Consultants)
473	28	20	2	0	4	Unfortunately many of the declines correspond with fishery depletion (Ainley & Blight 2008). (Ainley, David, H.T. Harvey & Associates Ecological Consultants)
474	28	20	6	20	6	Presumably these are observed direct effects? Over what time frame have they been observed? (Mach, Katharine, IPCC WGII TSU)
475	28	20	7	0	0	. I thought earlier it had been said that there are no precipitation trends? (Ainley, David, H.T. Harvey & Associates Ecological Consultants)
476	28	20	9	0	12	This dome shaped response was long ago discussed by Smith et al. 1999, and has been cited widely. (Ainley, David, H.T. Harvey & Associates Ecological Consultants)
477	28	20	9	20	10	Explain "dome shaped relationships" (UNITED STATES OF AMERICA)
478	28	20	12	0	0	. I thought earlier it had been said that there are no precipitation trends? (Ainley, David, H.T. Harvey & Associates Ecological Consultants)
479	28	20	13	20	13	Typographical error: "can decreases" should be "can decrease"? (Smith, Inga, University of Otago)
480	28	20	16	20	17	Change to "Movement south of the frontal systems, and therefore movement of productive foraging areas, in the Indian sector have been linked to declines in King penguin colonies etc." (Head, Erica, Fisheries and Oceans Canada)
481	28	20	16	20	27	It would be preferable to specify the relevant time frames for the statements in these paragraphs. Additionally, use of "attributed" on line 17 could be avoided given the broader context of attribution in the report. (Mach, Katharine, IPCC WGII TSU)
482	28	20	21	0	23	It's far more complex than incidental mortality in regard to fishery effects; clearly direct effects due to fishery extraction (Ainley & Blight 2009, Barrera-Oro/Casaux papers for WAP; see also papers by Murphy et al., Croxall et al. etc). (Ainley, David, H.T. Harvey & Associates Ecological Consultants)
483	28	20	24	0	25	Cite Branch (2012) for results of IWC circumpolar surveys. (Ainley, David, H.T. Harvey & Associates Ecological Consultants)
484	28	20	24	20	24	Insert thus "some Antarctic whale populations are recovering, such as" (Head, Erica, Fisheries and Oceans Canada)
485	28	20	40	20	41	Change to "Phenological responses attributable to warming are apparent in Arctic terrestrial ecosystems (medium confidence), although compare to temperate regions, there have been few long-term studies in the Arctic." (Head, Erica, Fisheries and Oceans Canada)
486	28	20	40	20	46	It would be preferable to indicate the general time frame for statements in this paragraph. (Mach, Katharine, IPCC WGII TSU)
487	28	20	42	20	42	Insert a very important comma after vary - thus "Phenological responses to warming vary, from little overall trend etc" (Head, Erica, Fisheries and Oceans Canada)
488	28	21	4	21	4	It would be preferable to indicate more specifically what time frame is meant by "recent years." (Mach, Katharine, IPCC WGII TSU)
489	28	21	6	21	7	Reconcile "_steadily intensifying reindeer grazing/trampling" and evidence presented in 28.2.3.5 about broad population declines. Probably just a geographic qualifier saying where there is intensified grazing versus where there is less. (UNITED STATES OF AMERICA)
490	28	21	14	21	14	The decrease in NDVI in easternmost Russia is not apparent in Fig. 28.3. There is at least as much green as yellow in that area. (UNITED STATES OF AMERICA)

#	Ch	From Page	From Line	To Page	To Line	Comment
491	28	21	16	21	16	What is "Nenets Autonomous Okrug"? It is not in Fig. 28.1; many readers will not know what (or where) it is. (UNITED STATES OF AMERICA)
492	28	21	24	21	26	I think there should be a figure illustrating the NDVI changes (Francis, Jennifer, Rutgers University)
493	28	21	24	21	28	Increases in degree days per month is confusing and misleading. Usually we express the "thawing degree days" as a total for the year (summer season) and then consider the long-term trend (magnitude of increase per year). Perhaps this could be expressed better. Alternatively you could say monthly total degree days are xx higher. (Smith, Sharon, Geological Survey of Canada)
494	28	21	29	21	29	Is landslide activity natural, accelerated, etc.? It is not clear if this is a climate change factor or not. (UNITED STATES OF AMERICA)
495	28	21	38	21	38	delete an "a" in "aand" (Molau, Ulf, University of Gothenburg)
496	28	21	44	21	44	and in NE Siberia (Blok et al. 2011, Biogeoscience 8, 169-179) (Molau, Ulf, University of Gothenburg)
497	28	21	46	21	46	define fell field (Francis, Jennifer, Rutgers University)
498	28	21	52	21	53	Over what time frame was this study conducted? (Mach, Katharine, IPCC WGII TSU)
499	28	22	10	22	33	define bryophytes, graminoids, herbivory (Francis, Jennifer, Rutgers University)
500	28	22	23	22	33	Given the breadth of the synthesis document discussed in this section, it lacks a clear take away, e.g. is forage better or worse; are indigenous species being choked out? The synthesized message is not clear. (UNITED STATES OF AMERICA)
501	28	22	38	22	42	Perhaps tree line is more sensitive to the variability in temperature (rather than mean) or to extreme events? (Francis, Jennifer, Rutgers University)
502	28	22	38	22	49	The second paragraph repeats much of what is said in the first. I suggest condensing them into one. (Head, Erica, Fisheries and Oceans Canada)
503	28	22	39	22	39	It would be preferable to provide specific reference to the relevant chapters and chapter sections. Also please note that the acronym used refers to the 1st assessment report, not the 4th assessment report. (Mach, Katharine, IPCC WGII TSU)
504	28	22	40	22	42	Unclear - reword. (UNITED STATES OF AMERICA)
505	28	22	40	22	42	To maximize directness of wording, "high confidence" could be placed within parentheses at the end of the statement. (Mach, Katharine, IPCC WGII TSU)
506	28	22	44	22	49	I recommend to include a most recent reference like: Laura Parducci, et al. (2012) Glacial Survival of Boreal Trees in Northern Scandinavia. Science 335, 1083 (Velázquez, David, Universidad Autónoma de Madrid)
507	28	22	44	22	53	Scale issues confounded. Clarify. (UNITED STATES OF AMERICA)
508	28	23	4	23	5	The relevant baseline for the described projections is not clear. Additionally, the focus of this section should be on observations, not projections. (Mach, Katharine, IPCC WGII TSU)
509	28	23	4	23	9	Very good and important paragraph. This information seems to merit mention in the Executive Summary. (UNITED STATES OF AMERICA)
510	28	23	7	23	9	Given the wording of this statement, presumably these are average rates over the entirety of the 20th century? (Mach, Katharine, IPCC WGII TSU)
511	28	23	11	23	11	It would be preferable to indicate more precisely what's meant by "robust and consistent." (Mach, Katharine, IPCC WGII TSU)
512	28	23	22	23	28	Odd discussion - of course, herbivory and disturbance can influence plants. (UNITED STATES OF AMERICA)
513	28	23	25	23	26	does "large herbivores" include hares? In northern Fennoscandia, mountain hare (<i>Lepus timidus</i>) is the main grazer on dwarf birch. Reindeer graze on that species only when willows are absent (strongly preferred), as shown by ongoing research. Hare grazing is important in retarding the treeline expansion. Mentioned in Callaghan et al. 2013, Phil. Trans. Roy. Soc. B. Biology, in press (online publ. 8 July. 2013) (Molau, Ulf, University of Gothenburg)

#	Ch	From Page	From Line	To Page	To Line	Comment
514	28	23	30	23	40	There is no discussion regarding the impact that changing drainage conditions resulting from changing permafrost conditions has on vegetation (e.g. transition from black spruce that favour poor drainage condition of frozen soils to species that favour better drainage conditions) (Smith, Sharon, Geological Survey of Canada)
515	28	23	31	23	35	It would be helpful to specify the relevant time frame for these statements. (Mach, Katharine, IPCC WGII TSU)
516	28	23	37	23	38	Consider using more precise language: e.g. the probability of fire that will have a positive feedback on climate <warming> or similar. To a lay reader "a positive feedback on climate" suggests that something good is going to happen versus "climate warming" which is more indicative of a vicious cycle. (UNITED STATES OF AMERICA)
517	28	23	40	23	40	Mann et al. 2012 (Arct Antarct Alp Res 44, 319-331) from observations and modeling show that northernmost conifer forests in Alaska are changing into broadleaf forest, becoming a carbon source rather than sink. (Molau, Ulf, University of Gothenburg)
518	28	23	43	24	16	In addition to animals, a strong cyclicity is known in a few plant species, i.e., arctic cottangrass <i>Eriophorum vaginatum</i> . It shows mass flowering about every fourth year in northern Alaska (Shaver et al., several papers, e.g., 1986, J. Ecol. 74, 257-278) but follows a 3-yr cycle in northern Fennoscandia (Molau 2010, Plant Ecology & Diversity 3, 29-34). Cottongrass cyclicity is synchronized over large areas (e.g., NW North America, entire Beringia, northern Fennoscandia) and mainly coupled with summer temperature (best fit when expressed as thawing degree days 3-4 years before flowering), but grazing during lemming peak year may set off the cyclicity 1-2 years. In the taiga and temperate forest biomes, <i>E. vaginatum</i> is common in peat bogs but show no cyclicity whatsoever, why a disintegration of mass flowering is expected in a warmer climate in the Arctic. (Molau, Ulf, University of Gothenburg)
519	28	24	3	24	3	see also Hansen et al. 2013 (Science 339, 313-315) for the effect of rain-on-snow events in Svalbard (Molau, Ulf, University of Gothenburg)
520	28	24	13	24	14	The timeframe for this expansion could be specified. Casual usage of "likely" should be avoided as it is a reserved likelihood term. (Mach, Katharine, IPCC WGII TSU)
521	28	24	13	24	16	Scabies (mange) dispersed by red fox has recently infected the already weak population of arctic fox in Norway and Sweden. A massive vet programme is undertaken at present to cure the animals one by one. (Molau, Ulf, University of Gothenburg)
522	28	24	15	24	15	It is unclear whether "this species" refers to the red fox or the arctic fox. (UNITED STATES OF AMERICA)
523	28	24	19	24	19	p. 24, line 19: The subheading refers to reindeer and muskox, but the text makes no mention of muskox specifically. Again, population specific predictions regarding impacts, unless they really are Arctic wide, would be helpful. (UNITED STATES OF AMERICA)
524	28	24	20	24	20	p. 24, line 20: This section seems a little brief, at least relative to the section on Arctic terrestrial systems. (UNITED STATES OF AMERICA)
525	28	24	28	24	34	see also Hansen et al. 2013 (Science 339, 313-315) for the effect of rain-on-snow events in Svalbard (Molau, Ulf, University of Gothenburg)
526	28	24	36	24	48	Focus on observed changes should be ensured. (Mach, Katharine, IPCC WGII TSU)
527	28	24	40	24	41	The timeframe of these changes could be specified. (Mach, Katharine, IPCC WGII TSU)
528	28	24	43	24	48	define ungulate populations and behavioral plasticity (Francis, Jennifer, Rutgers University)
529	28	24	50	24	51	It would be helpful to state what was the cause of decline in populations if it was not ice (if the cause is clear). Or to so state if the cause has not been determined. (UNITED STATES OF AMERICA)
530	28	25	1	25	1	Through effects other than greenhouse gas warming? (UNITED STATES OF AMERICA)
531	28	25	7	25	8	It would be helpful to clarify in what systems and in what sense tipping points are being referred to here. (Mach, Katharine, IPCC WGII TSU)

#	Ch	From Page	From Line	To Page	To Line	Comment
532	28	25	7	25	9	It seems that this statement should be made much earlier in the report, and the effects of long-term change vs tipping points addressed in other sections, as well. (Francis, Jennifer, Rutgers University)
533	28	25	22	25	22	Focus on observe changes should be ensured. (Mach, Katharine, IPCC WGII TSU)
534	28	25	27	25	32	The general time frame for these observations could be specified. (Mach, Katharine, IPCC WGII TSU)
535	28	25	30	25	32	There is little recognition in this and other statements that many people of aboriginal descent are also now engaged in what could be termed the western economy. It could also be added that for most of these people identification with traditional values and lifestyles/ activities is still a very important cultural- something that is often expressed in various ways including art, recreational and leasure pursuits. I am not sure if included in the multiple stressors includes things such cultural influences from elsewhere, loss of tradtional languages, education systems, economic pressures, employment etc. (Church, Ian, Canadian Foundation for Climate and Atmospheric Science/ IPY Canada)
536	28	25	48	0	0	This entire introduction is not needed\ - get to the direct climate impacts right away. (UNITED STATES OF AMERICA)
537	28	25	48	0	0	The opening section on human populations has a distinct difference in writing style/tone compared to the previous pages on polar science. The editors should look into this to make the writing style more unified. (Wong, Andrew, University of Waterloo)
538	28	25	48	29	32	Page 25, lines 51-54 note that the "human populations" section "focuses on indigenous, isolated and rural populations" rather than urban residents. Given that most of the Arctic population (more than two-thirds, according to p. 26) lives in urban areas, which are susceptible to climate-related energy costs and other challenges, it seems that there could be a better balance here. Indigenous/rural residents should certainly be addressed in this chapter, but so should other segments of the arctic population. Furthermore, there may be value in clarifying how an "urban area" in the Arctic differs from that in the more traditional sense as presented in Ch 8. (UNITED STATES OF AMERICA)
539	28	25	51	0	0	The phrase- "where people have been addressing change for centuries" is correct but because the focus of this report is climate change it might be appropriate to say something like "cultural, economic and environmental change including changes driven by climate" (Church, Ian, Canadian Foundation for Climate and Atmospheric Science/ IPY Canada)
540	28	25	51	0	52	"while it is recognized that several large industrial Arctic cities in Russia.....this section focuses on indigenous, isolated, and rural populations..." This is a fundamental choice that I consider a dangerous bias of the whole report's part on human population. Arguing that the report focuses on indigenous, isolated, and rural populations because "they are especially vulnerable to climate change" doesn't seem to me a convincing argument. The report recognized that the highest calculation of native inhabitants is 1.3 million (p. 35, lines 44-45) for at least 4 million inhabitants for the Arctic. The paper also recognizes that "two-thirds of the Arctic population live in relative large settlements of over 5,000 residents" (p. 26, lines 13-14). How, then, a report on human population in the Arctic can openly ignore two-third of the Arctic population? Indigenous people need obviously specific interest and protection, but that doesn't justify the exclusion of the majority of Arctic population from a report that presents itself as inclusive. At least one subsection should be devoted to non-indigenous populations and urban challenges, discussing demographic and migration changes, urban governance, infrastructures challenges, and the growing internationalization of Arctic cities, with a multiplicity of new actors, from migrants to private investors. Moreover, a growing number of indigenous people leave their traditional place of life for the city. An accurate analysis of challenges faced by indigenous people thus means to take into account the "modernization" of everyday life of a lot of indigenous people, and not to focus on a folkloristic definition of their way of life. At several occasions, the paper mentions 'Arctic residents' as a generalizing terms while in fact it means indigenous people. (Laruelle, Marlene, George Washington University)

#	Ch	From Page	From Line	To Page	To Line	Comment
541	28	25	51	25	54	There is still a need however to develop adaptation strategies for industry, natural resource development project etc. especially since impacts on infrastructure performance resulting from climate change could have potential environmental consequences (further causing stresses on the environment). This is an important consideration given the potential for increased development activity in the polar regions. (Smith, Sharon, Geological Survey of Canada)
542	28	25	51	25	54	Rephrase this sentence, particularly 'ultimate survival' (Amundsen, Helene, CICERO - Centre for international climate and environmental research - Oslo)
543	28	25	52	0	0	It could be argued that arctic urban populations partially because of their size and dependence on infrastructure and services such as transportation and supply from southern centres are also very vulnerable to climate and weather disruptions. This is alluded to in the next paragraph on page 26- lines 5 to 9 (Church, Ian, Canadian Foundation for Climate and Atmospheric Science/ IPY Canada)
544	28	25	53	25	53	I have heard other social scientists say that Arctic communities are NOT vulnerable to change because they have always had to deal with huge seasonal swings and interannual variability in their environment, and thus are especially adaptable. Both sides of this issue should be addressed and supported. (Francis, Jennifer, Rutgers University)
545	28	26	21	26	23	Not all indigenous populations and individuals depend on traditional lifestyles. suggest to add: ...are especially impacting the [traditional lifestyles of] indigenous populations... (DENMARK)
546	28	26	23	26	24	Numbers do not add up. Uncertainties seem very high. (DENMARK)
547	28	26	30	26	32	Connect this sentence with the following paragraph, which includes a discussion of stressors non-associated with climate change. (Amundsen, Helene, CICERO - Centre for international climate and environmental research - Oslo)
548	28	26	34	26	54	This section dwells on the negative effects, but what about the positive ones? More jobs, easier access to necessities, more tolerable temperatures? (Francis, Jennifer, Rutgers University)
549	28	26	48	27	23	Most of this discussion focusses on changes to the physical environment. As mentioned in earlier comments, it would have been better to discuss changes to the physical environment first and then comment on implications with respect to human activity/systems etc. (Smith, Sharon, Geological Survey of Canada)
550	28	26	50	27	10	While the statements in this paragraph are correct and it does address all residents in the first line there is little recognition that in today's north people do not just live in traditional ways, travel on land and water in the pursuit of traditional activities etc. As a result challenges and hazards are in some ways more problematic for the people who are less prepared who live in inadequate housing in communities, who are at risk because they are dependent on central utility systems and have no backup, who travel by air or on roads and are equally at risk in adverse conditions. While changes "on the land" pose risks for northerners equally "poorly adaptation" and adoption of western lifestyles and technologies operating in northern environments also put people at risk- something not unique to the north. Watch the evening news this last winter as massive highway accidents involving hundreds of people occurred during various storm events in the southern 48 states, provinces and in Europe. (Church, Ian, Canadian Foundation for Climate and Atmospheric Science/ IPY Canada)
551	28	27	1	27	1	Focus on observed changes should be ensured. (Mach, Katharine, IPCC WGII TSU)
552	28	27	6	27	6	"or inundated by large storm surges" (AKSIK 2013). This is the most disruptive and pressing fact we have found with our Alaskans Sharing Indigenous Knowledge (www.AKSIK.org) project. Our findings are "in revision" and have been resubmitted to the journal Climatic Change: Ignatowski, John and Jon Rosales. 2013. "Identifying the Exposure of Two Subsistence Villages in Alaska to Climate Change Using Traditional Ecological Knowledge and Climate Science." Climatic Change. In revision. If you are able to use an article that has been revised and resubmitted, I will suggest this article to support a few more points made in this chapter. If you cannot use an article in revision, our findings are documented on our website at www.AKSIK.org and could be cited as AKSIK 2013. (Rosales, Jon, St. Lawrence University)

#	Ch	From Page	From Line	To Page	To Line	Comment
553	28	27	12	27	13	Is it relevant to state that people get frostbite when the weather is cold? (Amundsen, Helene, CICERO - Centre for international climate and environmental research - Oslo)
554	28	27	12	27	23	This paragraph seems to me very speculative, but I am not human physiologist (Velázquez, David, Universidad Autónoma de Madrid)
555	28	27	14	27	15	It would be preferable to indicate the timeframe over which this association was observed. (Mach, Katharine, IPCC WGII TSU)
556	28	27	17	27	17	reference missing after 'Finland' (Amundsen, Helene, CICERO - Centre for international climate and environmental research - Oslo)
557	28	27	18	27	19	Focus on observed changes should be ensured. Additionally, in place of "believed," a discussion of the relevant basis in evidence would be preferable. (Mach, Katharine, IPCC WGII TSU)
558	28	27	28	29	32	Section 28.2.4 Section on Arctic definition and population not well defined. Suggest a map outlining circumpolar administrative regions and population. Suggest using a map and population data from www.circumpolarhealthjournal.net/public/journals/32/chs/CHS_2008_3.pdf . Another source for Arctic Health is the recently published Circumpolar Health Atlas, University of Toronto Press, Kue Young Ed. www.utppublishing.com (UNITED STATES OF AMERICA)
559	28	27	33	27	34	The statement "local and traditional ... unusual environmental conditions" is based on the observations at two sites in North America. Although it may be likely that this applies to the whole arctic, that is currently not supported. Also, it may be better to first mention "increasingly unusual conditions", as the two references mainly support this statement. (NETHERLANDS)
560	28	27	34	27	34	It would be preferable to specify which "extremes" and types of "unusual environmental conditions" are meant here. (Mach, Katharine, IPCC WGII TSU)
561	28	27	35	27	35	The citation Ignatowski and Rosales, 2012 should be changed to 2013 if you can use articles in revision and resubmitted. Otherwise you could cite as AKSIK, 2013. (Rosales, Jon, St. Lawrence University)
562	28	27	35	27	35	The reference "Ignatowski and Rosales, 2012" is unclear. It appears to be referring to a website that contains videos. (NETHERLANDS)
563	28	27	35	27	36	Same information is presented on p. 28. (UNITED STATES OF AMERICA)
564	28	27	35	27	37	Explain better what these are (Amundsen, Helene, CICERO - Centre for international climate and environmental research - Oslo)
565	28	27	39	27	39	It would be preferable to specify the specific relevant sections in Chapter 11. (Mach, Katharine, IPCC WGII TSU)
566	28	27	42	27	42	The term "Underlying" is not accurate; contaminants don't underlie climate change, they are in addition to climate change. (Rosales, Jon, St. Lawrence University)
567	28	27	46	27	47	Is there solid evidence for climate-related increases of transport to and from the Arctic? If the evidence exists, it should be cited here. Otherwise drop the part about increased transport. (UNITED STATES OF AMERICA)
568	28	28	12	28	14	It would be helpful to specify the general time frame for these changes. (Mach, Katharine, IPCC WGII TSU)
569	28	28	18	28	18	Focus on the observed changes should be ensured. (Mach, Katharine, IPCC WGII TSU)
570	28	28	23	28	25	The key findings of chapter 6 could be cross-referenced here, with harmonized assessment ensured. (Mach, Katharine, IPCC WGII TSU)

#	Ch	From Page	From Line	To Page	To Line	Comment
571	28	28	23	28	26	Harmful algal blooms are mentioned here, there is no mention of their relationship with the Arctic environment. Perhaps a discussion on harmful algal blooms in the Arctic context should be included here. See: 'Massive Phytoplankton Blooms Under Arctic Sea Ice' by Arrigo et al., 2012: http://www.sciencemag.org/content/336/6087/1408.abstract and 'Trophic cascades and future harmful algal blooms within ice-free Arctic Seas north of Bering Strait. A simulation analysis' by Walsh et al., 2011: http://www.sciencedirect.com/science/article/pii/S0079661111000164 (Wong, Andrew, University of Waterloo)
572	28	28	23	28	30	This paragraph could be dropped. No new observed changes are reported. (UNITED STATES OF AMERICA)
573	28	28	27	28	27	What is the timeframe for this observation? (Mach, Katharine, IPCC WGII TSU)
574	28	28	37	28	37	Gathering should be added to "hunting, fishing, and herding" (Rosales, Jon, St. Lawrence University)
575	28	28	40	28	42	This sentence does not reflect the nuances in the description of the marine mammals on pages 16 and 17 (Sundby, Svein, Institute of Marine Research)
576	28	28	40	28	42	Need mention of respiratory diseases caused by increases in dust, pollens molds and smoke. Exposure to these airborne pollutants increase the risk of respiratory diseases, incite asthma attacks bronchitis and compromise peoples with respiratory disease, the elderly and mothers and newborns (Rylander C. 2011, Odland J.O., Sandanger TM. Climate change and environmental impacts on maternal and newborn health with a focus on Arctic populations. Global Health Action 2011; 4: 10.3402/gha.v4i0.8452). (UNITED STATES OF AMERICA)
577	28	28	40	28	42	It would be preferable to specify the general time frame for these changes. (Mach, Katharine, IPCC WGII TSU)
578	28	28	42	28	42	We also have documented these changes. Ignatowski and Rosales 2013 could be cited here if you can use an article in revision, or you could cite AKSIK 2013. (Rosales, Jon, St. Lawrence University)
579	28	28	48	28	49	general globalisation pressures' is imprecise (Amundsen, Helene, CICERO - Centre for international climate and environmental research - Oslo)
580	28	28	53	28	53	Relate this section to previous sections (28.2.3 Terrestrial Ecosystems: Changes in tree line, changes in animal population cycles) which explains the rational for flora and fauna northward movement, changing insect and animal vectors patterns and potential spread of infectious diseases. (UNITED STATES OF AMERICA)
581	28	29	6	29	7	Salt water intrusion - are we referring to surface or groundwater supplies? There is a need to be clear here. If referring to groundwater supplies, then information should be provided on where this is an issue (groundwater use is very limited in most of the polar regions, therefore not an issue everywhere) (Smith, Sharon, Geological Survey of Canada)
582	28	29	7	29	15	This discussion could be more specific with respect to where these things are already happening - where is it currently an issue? Impacts will not be the same everywhere and this will depend on the design of sewage lagoons and other infrastructure. (Smith, Sharon, Geological Survey of Canada)
583	28	29	11	29	11	It would be better to say "no municipal water supply" rather than "no in-house piped water" as several locations in the Canadian Arctic for example, receive their water supplies (and sewage removal) by truck but it is still from a municipal supply. (Smith, Sharon, Geological Survey of Canada)
584	28	29	17	29	32	It seems that the suffering of Arctic communities should be placed into context relative to people elsewhere who are dealing with effects of climate change: Africa, Bangladesh, Pacific Islanders, even New Yorkers come to mind. (Francis, Jennifer, Rutgers University)
585	28	29	17	29	32	This paragraph seems to imply that climate change is contributing to the increasing suicide rate (lines 29-30). There are certainly other stressors on indigenous residents, especially youth, but has a climate-suicide linkage really been documented? If so, the connection should be explained more explicitly. (UNITED STATES OF AMERICA)
586	28	29	19	29	19	It would be preferable to specify the specific relevant subsections of Chapter 11. (Mach, Katharine, IPCC WGII TSU)

#	Ch	From Page	From Line	To Page	To Line	Comment
587	28	29	19	29	21	There is a need to be clear about natural changes/processes vs impacts resulting from a changing climate. Note that shoreline or coastal erosion is a natural process that would occur under a stable climate - i.e. river shorelines and coastal zones are dynamic environments. Effects of these processes may be exacerbated by changing climate including higher water levels, increased storminess, wave activity etc. (Smith, Sharon, Geological Survey of Canada)
588	28	29	32	29	32	Add reference Hueffer K, Parkinson AJ, Gerlach R, and Berner J. Zoonotic infectious in Alaska: Disease prevalence, potential impact of climate change and recommended actions for earlier disease detection, research, prevention and control. Int J Circumpolar Health 2013 72: 19562 http://dx.doi.org/10.3402/ijch.v72i0.19562 (UNITED STATES OF AMERICA)
589	28	29	37	30	2	We recommend that the authors consider revising this introduction deleting it. As written, it doesn't add much to the material in the section. (UNITED STATES OF AMERICA)
590	28	29	45	29	45	Add gathering to "Hunting and herding, and fishing" (Rosales, Jon, St. Lawrence University)
591	28	29	53	29	53	Ignatowski and Rosales, 2012 should be 2013 if an article in revision can be used, otherwise you could cite AKSIK 2013. (Rosales, Jon, St. Lawrence University)
592	28	29	53	29	53	The references refer twice to the website Aksik.org: once directly, and once through the reference "Ignatowski and Rosales, 2012" (NETHERLANDS)
593	28	30	4	31	6	Pollock and halibut could be added to this list. (Rosales, Jon, St. Lawrence University)
594	28	30	5	30	5	p.30, line 5: A section on tourism in the Arctic should be included. There is a strong expectation that the number of cruise ships tours in the High Arctic in the Chukchi and Beaufort Seas will increase in the next few decades. Given the anthropogenic noise from all sources is a source of concern, cruise ships could be an important contribution to anthropogenic noise in the High Arctic. In addition, references to publications by Lawson Brigham (e.g. Brigham and Sfraga 2010) on shipping should be incorporated into the text and integrated with projections for other regions in the Arctic. (UNITED STATES OF AMERICA)
595	28	30	9	30	10	Focus on the observed changes should be ensured. Casual usage of "very likely" should be avoided. Additionally, over what geographic area are positive impacts for agriculture expected? (Mach, Katharine, IPCC WGII TSU)
596	28	30	9	30	19	As far as I know there has been developed a tree planting campaign in Iceland over the last 40 years. I think climate alone cannot explain the increase in forest in Iceland. (Sundby, Svein, Institute of Marine Research)
597	28	30	9	30	21	Previously ACIA and IPCC talked about Spruce Bark Beetle infestations in boreal Alaska and Yukon. In the last few years the Pine Bark Beetle has encroached upon the pine forests of the Yukon and NWT. Lodpole Pine, a commercial species is commonly found in the southern areas of both of these jurisdictions. http://www.scientificamerican.com/article.cfm?id=pine-bark-beetles-poised-for-new-attacks-on-canadas-boreal-forests and http://www.emr.gov.yk.ca/forestry/pdf/forest_health_report_2012_web.pdf pages 8-15. There is also no mention of the role of climate in species change and fire frequency and the potential impact on commercial forest harvesting activity (Church, Ian, Canadian Foundation for Climate and Atmospheric Science/ IPY Canada)
598	28	30	11	30	11	the word "latitudes" should be replaced by "altitudes" (ICELAND)
599	28	30	11	30	11	The reference to Bjornsson et al, 2011 is missing (Correct reference is: Bjornsson H., T. Johannesson and A. Snorrason, 2011. Recent climate change, projected impacts and adaptation capacity in Iceland. Í Linkov, I. & T. S. Bridges (Ed.) Global change and local adaptation. NATO Science for Peace and Security Series - C: Environmental Security. Springer, Dordrecht, s. 465-475.) Correct reference needs to be added. see further comment on ch 28, p 57, l. 4 (ICELAND)
600	28	30	12	30	12	Aaheim et al, 2009 is not in reference list (Amundsen, Helene, CICERO - Centre for international climate and environmental research - Oslo)
601	28	30	12	30	12	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Mach, Katharine, IPCC WGII TSU)

#	Ch	From Page	From Line	To Page	To Line	Comment
602	28	30	13	30	14	Reword - confusing prose. (UNITED STATES OF AMERICA)
603	28	30	14	30	14	Is it forestry activities or transportation systems that are vulnerable? (Smith, Sharon, Geological Survey of Canada)
604	28	30	16	30	16	(Björnsson et al, 2011) should be replaced by (Sigurdsson et al, 2007; Björnsson et al, 2011). See also comment below (ch 28. p 77, line 40) (ICELAND)
605	28	30	16	30	16	To the sentence beginning with "Tree limits in Iceland, .." add a subsentence behind the reference: "(Sigurdsson et al, 2007; Björnsson et al, 2011), but number of new insect pests on trees and shrubs has also increased significantly in Iceland during the past 20 years and there is a strong relationship between rate of new insect pest colonisation and outbreak intensity in forests with changes in annual temperature during the past century (Halldorsson et al, 2013)." See also comment below (ch 6. p. 65 I.6). (ICELAND)
606	28	30	16	30	16	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Mach, Katharine, IPCC WGII TSU)
607	28	30	16	30	19	Can we be more specific about how much expansion of agricultural activities and where this might be. It would seem that there are many factors in addition to climate that would influence suitability for agricultural activities such as soil, drainage conditions etc. (Smith, Sharon, Geological Survey of Canada)
608	28	30	16	30	19	Focus on observed changes should be ensured. (Mach, Katharine, IPCC WGII TSU)
609	28	30	17	30	17	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Mach, Katharine, IPCC WGII TSU)
610	28	30	21	30	21	Appears to be a key finding which has lost its way (DENMARK)
611	28	30	21	30	21	This sentence should be moved to the beginning of the previous paragraph. (Rosales, Jon, St. Lawrence University)
612	28	30	21	30	21	No examples or substantiation of the climate-related costs/benefits for forestry and agriculture are provided. Something more than the isolated sentence is needed here. (UNITED STATES OF AMERICA)
613	28	30	21	30	21	This finding is overly vague, non-specific as written. (UNITED STATES OF AMERICA)
614	28	30	21	30	21	It is not clear how this statement is distinct from the statement on line 9 or how it is supported by the assessment of the chapter. Casual usage of "very likely" should be avoided. (Mach, Katharine, IPCC WGII TSU)
615	28	30	26	30	54	Really important for this section on Open water fisheries is to make specific mention of how the international waters of the Central Arctic Ocean are opening up and are expected to be ice-free during summer by mid-century. Since commercial fishing has never occurred here, no fishing regulations currently exist in this region. See: http://oceansnorth.org/resources/international-waters-central-arctic-ocean-protecting-fisheries-emerging-ocean . In summer 2012, 40 percent of the Central Arctic Ocean (the region outside each nation's 200-nautical-mile exclusive economic zone (EEZ)) was open water (see Page 3 of the PDF in the link). (Wong, Andrew, University of Waterloo)
616	28	30	30	0	0	With reference to figure 28-4 it is argued that there are low volume subsidence fisheries in the coastal regions of the Arctic Ocean. These regions have No data according to figure 28-4. How can that be interpreted as low volume? (Ingvaldsen, Randi, Institute of Marine Research)
617	28	30	34	30	34	AMSA is listed as a source, but it is not included in the reference list. I assume this relates to the AMSA report from 2009 (Arctic Council). (Gerland, Sebastian, Norwegian Polar Institute)
618	28	30	36	30	44	This paragraph is not needed. We recommend that it be deleted. (UNITED STATES OF AMERICA)
619	28	30	46	30	53	This discussion also should reference the moratorium on commercial fishing north of Bering Strait as well as TEK and other observations of salmon moving in to Beaufort Sea. (UNITED STATES OF AMERICA)
620	28	30	47	30	47	should read "lack of infrastructure" (UNITED STATES OF AMERICA)
621	28	31	7	31	8	We believe stating that "survival depends on complex suite of conditions" without describing those conditions is not particularly useful. Please expand the discussion to describe those conditions (with appropriate references), refer to the appropriate section that does or delete the statement. (UNITED STATES OF AMERICA)

#	Ch	From Page	From Line	To Page	To Line	Comment
622	28	31	8	31	9	Type of comment: partial page, IPCC WGII AR5 Chapter 28, Start Page Number 31, Start Line Number 8, End Page Number, 31 End Line Number, 9 Comment: Citation is incorrect, "Mundy 2011". Cite is correctly written in the references Mundy and Evenson 2011, and it should not be cited in the context of salmon survival. The correct reference to Mundy and Evenson is, "Successful conduct of Arctic coastal subsistence fisheries for salmon is dependent on the timing of the salmon's marine exit, which is tightly coupled to environmental conditions that are linked to climate (Mundy and Evenson 2011). (UNITED STATES OF AMERICA)
623	28	31	14	32	3	Why is there not a similar discussion of terrestrial transportation? Note that there other challenges associated with changing marine and sea ice conditions such as challenges to oil and gas development, design of infrastructure in coastal and nearshore areas etc. (Smith, Sharon, Geological Survey of Canada)
624	28	31	14	32	3	It would be good if you could provide some numbers on traffic increase here. Something in the order of 5-10 freighters passed through the North-East Passage in 2007 and over 100 in 2011. Understandable increase since cruising time (and fuel consumption) from e.g. Rotterdam to Yokohama is reduced by 30% - and no waiting at Suez and no pirates! (Molau, Ulf, University of Gothenburg)
625	28	31	16	31	16	Be specific - not ice free - nearly ice free in late summer. (UNITED STATES OF AMERICA)
626	28	31	16	31	16	Future tense. Drop speculations about the future. (UNITED STATES OF AMERICA)
627	28	31	16	31	25	A paper with more current information on changes in marine access (via the Northern Sea Route and Northwest Passage) is Smith and Stephenson (2013, PNAS). Among other improvements over the earlier studies (e.g., Mokhov and Khon, 2008), this new paper uses CMIP5 models rather than CMIP3 models. It also includes distributions of access paths for future timeslices, preserving the interannual variability that will be a part of any future scenarios of marine access. Information from this new paper should be included. (UNITED STATES OF AMERICA)
628	28	31	16	31	45	Some of the references in the section Marine Transportation in the Arctic Ocean seem to be in error. Peters 2011, referenced several times on this page, is not listed in the bibliography. Is it this Citation? Peters, G. P., Nilssen, T. B., Lindholt, L., Eide, M. S., Glomsrød, S., Eide, L. I., and Fuglestad, J. S.: Future emissions from shipping and petroleum activities in the Arctic, Atmos. Chem. Phys., 11, 5305-5320, doi:10.5194/acp-11-5305-2011, 2011. "Mokhov and Khon" line 23 is like "Khon and Mokhov"? The reference for Mikkelsen (page 71 line 53) bibliographic information is incomplete. Meschytyb (page 31 line 29) is not in the bibliography. Is it this article from 2009? http://pubs.aina.ucalgary.ca/arctic/Arctic58-3-322.pdf Social Impact Assessment along Russia's Northern Sea Route: Petroleum Transport and the Arctic Operational Platform (ARCOP) by Nina A. Meschytyb, Bruce C. Forbes and Paula Kankaanpää. The work referenced to Furgal 2008 - could it possibly be really be the work by Furgal and Prowse 2008? http://www.nrcan.gc.ca/earth-sciences/climate-change/community-adaptation/assessments/132 See chapter 3 (UNITED STATES OF AMERICA)
629	28	31	16	31	54	Throughout these paragraphs, a focus on observed, not expected or projected, changes and outcomes should be ensured. (Mach, Katharine, IPCC WGII TSU)
630	28	31	27	31	27	What is a "vulnerable natural resource?" (UNITED STATES OF AMERICA)
631	28	31	32	31	32	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Mach, Katharine, IPCC WGII TSU)
632	28	31	34	0	0	The sentence: "In the case of Svalbard, oil spills have increased due to the growth in activities related to tourism and research" need a reference, the AMSA 2009 report is probably suitable. (Ingvaldsen, Randi, Institute of Marine Research)
633	28	31	34	31	35	reference missing (Amundsen, Helene, CICERO - Centre for international climate and environmental research - Oslo)
634	28	31	37	31	37	NorACIA 2010 is cited but not included in the reference list. (Gerland, Sebastian, Norwegian Polar Institute)
635	28	31	45	31	49	this information on Great Lakes seems out of place here (Francis, Jennifer, Rutgers University)

#	Ch	From Page	From Line	To Page	To Line	Comment
636	28	31	45	31	49	Unless this sentence can somehow inform projected water levels in the Arctic it seems to be more appropriately added to the North America Chapter (Church, Ian, Canadian Foundation for Climate and Atmospheric Science/ IPY Canada)
637	28	31	47	31	47	What Great Lakes are being referred to here? Great Slave, Great Bear (Great Lakes in southern Ontario- polar relevance?) (Smith, Sharon, Geological Survey of Canada)
638	28	31	50	31	50	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Mach, Katharine, IPCC WGII TSU)
639	28	32	0	0	0	The references offered this section, and the mention that "Arctic resources will likely play a growing role in the world economy" could be seen as outdated: with the oil and gas "shall revolution," the global picture of hydrocarbons changed drastically in 2011-12, with probably a decreasing interest for Arctic resources. This important and recent change should be better reflected in the text, that seems to have been written before the "shall revolution". Same comments for p. 33, lines 27-28: Arctic hydrocarbons have more than an uncertain future, and must be clearly separated from the mining prospects, that are indeed growing. (Laruelle, Marlene, George Washington University)
640	28	32	1	32	3	unclear meaning - increase in black carbon leading to increase economic activity? (Amundsen, Helene, CICERO - Centre for international climate and environmental research - Oslo)
641	28	32	1	32	3	A focus on observed changes should be ensured. (Mach, Katharine, IPCC WGII TSU)
642	28	32	8	32	23	It is very surprising that infrastructure impact from changes in permafrost conditions and that combined effects of climate change (cryospheric changes) and climate change impacts on infrastructure are only dealt with superficially in section 28.2.5.1.5. (DENMARK)
643	28	32	13	32	14	This sentence could be better written. Note thawing permafrost may still be an issue but it may or may not be a result of a changing climate as construction and operation of infrastructure can have impacts on permafrost resulting in warming and thawing of the ground. For infrastructure that has a long operating life, climate change becomes a more important consideration (especially if ice-rich permafrost). (Smith, Sharon, Geological Survey of Canada)
644	28	32	20	32	23	We recommend deletion of this paragraph. (UNITED STATES OF AMERICA)
645	28	32	22	32	33	Remove Prowse et al. (2009) and just cite Smith and Riseborough (2010) which is the reference for this material and also provides a more detailed discussion regarding the relative importance of climate change and ground disturbance. (Smith, Sharon, Geological Survey of Canada)
646	28	32	26	0	0	Section 28.2.5.1.6 - Why is resource extraction not considered here? This may also be affected by climate change especially since the activity occurs over a longer time period and there is potential for increased impacts on the environment. This section could also be more focussed on the climate change effects. Other issues related to climate change that could be mentioned are reduced ice road seasons, issues with drilling sumps (including impact of storm surges in low lying areas). (Smith, Sharon, Geological Survey of Canada)
647	28	32	26	32	47	This section is not about observed changes. Please revise it accordingly. (UNITED STATES OF AMERICA)
648	28	32	26	32	47	This section should include increased emissions from in-Arctic resource exploration associated with refining, gas flaring, smelting, etc. that will affect air quality, human health and introduce short-lived climate forcers into the Arctic. (UNITED STATES OF AMERICA)
649	28	32	28	32	28	Haven't the large reserves been proven? Suggest deleting "potentially". (Francis, Jennifer, Rutgers University)
650	28	32	28	32	28	Reference Linholdt, 2006 missing from reference list (Amundsen, Helene, CICERO - Centre for international climate and environmental research - Oslo)
651	28	32	28	32	47	Section is called resource exploitation, but few reference to resources other than petroleum. (Amundsen, Helene, CICERO - Centre for international climate and environmental research - Oslo)
652	28	32	29	32	30	Is the amount of reserves certain or an estimate? (Amundsen, Helene, CICERO - Centre for international climate and environmental research - Oslo)

#	Ch	From Page	From Line	To Page	To Line	Comment
653	28	32	33	32	33	Add reference to Lindholdt, L., & Glomsrød, S. (2012). The Arctic: No big bonanza for the global petroleum industry. Energy Economics, 34, 1465-1474. (Amundsen, Helene, CICERO - Centre for international climate and environmental research - Oslo)
654	28	32	33	32	40	Focus on observed, not expected or projected, changes should be ensured. (Mach, Katharine, IPCC WGII TSU)
655	28	32	37	32	37	Here it would seem more appropriate to provide a level of confidence instead of a likelihood term. (Mach, Katharine, IPCC WGII TSU)
656	28	32	39	0	0	Due to expected increases in economic activity from shipping, oil and gas exploration, land-based mineral extraction, and tourism, the storminess of the Arctic may routinely result in a confluence of accidents that will complicate disaster preparedness and exacerbate resource requirements. (Backus, George, Sandia National Laboratories)
657	28	32	50	33	32	It seems this section could be blended with sec. 28.2.4.2 (Francis, Jennifer, Rutgers University)
658	28	32	52	32	52	"The" should be added to the front of this sentence. (Rosales, Jon, St. Lawrence University)
659	28	33	1	33	7	Repetition of material presented earlier. (Smith, Sharon, Geological Survey of Canada)
660	28	33	2	33	2	Odd to highlight polar bears - several marine mammals more important to subsistence hunters in Arctic. (UNITED STATES OF AMERICA)
661	28	33	9	33	15	Much of this information repeated on p. 38. Please consider revising as appropriate. (UNITED STATES OF AMERICA)
662	28	33	27	0	28	The references offered this section, and the mention that "Arctic resources will likely play a growing role in the world economy" could be seen as outdated: with the oil and gas "shall revolution," the global picture of hydrocarbons changed drastically in 2011-12, with probably a decreasing interest for Arctic resources. This important and recent change should be better reflected in the text, that seems to have been written before the "shall revolution". Same comments for p. 33, lines 27-28: Arctic hydrocarbons have more than an uncertain future, and must be clearly separated from the mining prospects, that are indeed growing. (Laruelle, Marlene, George Washington University)
663	28	33	27	33	32	This paragraph is not climate-related. (UNITED STATES OF AMERICA)
664	28	33	27	33	33	"the increasing global demand for energy etc" these exact same word are repeated in Chapter 28, Page 38, Lines 23-26. This degree of repetition seems a bit much. (Head, Erica, Fisheries and Oceans Canada)
665	28	33	38	0	0	Since Antarctica has no real communities besides scientific stations, please delete "and communities". To avoid misunderstanding please add in the text: '...communities of local species.' (GERMANY)
666	28	33	41	0	0	It is not section 28.2.7 but 28.2.6. (GERMANY)
667	28	33	54	0	0	Please insert: '...for by Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR)...'. (GERMANY)
668	28	33	54	33	54	This acronym should be specified. (Mach, Katharine, IPCC WGII TSU)
669	28	34	10	0	0	Section 28.2.4.2.2 - Why is there no discussion of tourism in the Arctic? (Smith, Sharon, Geological Survey of Canada)
670	28	34	10	34	26	This section is not about climate change. Please tie it to climate change or consider deleting it. (UNITED STATES OF AMERICA)
671	28	34	14	35	3	Have all potential benefits from reduced distances/emissions for shipping across previously unnavigable parts of the Arctic been quantified? Reduced shipping costs of 15% are mentioned on page 50, line 17. (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
672	28	34	16	0	0	Please add: In general the Antarctic Peninsula and the surrounding islands receive the highest amounts of all visits. The region is characterized by a comparatively mild climate and rich flora and fauna. Tourism can only take place during the Antarctic Summer from November until March - the breeding period for the Antarctic fauna. So most tourists visit the Antarctic at exactly the time and exactly the region when and where the wildlife is most fragile. (GERMANY)

#	Ch	From Page	From Line	To Page	To Line	Comment
673	28	34	17	0	0	Please add: As the number of tourists have increased and the activities offered by organizers have strongly diversified, concerns... (GERMANY)
674	28	34	19	0	0	Please add: Additionally the encroachment of the tourists to pristine areas is an issue of concern. (GERMANY)
675	28	34	29	0	0	Section 28.2.6 - It is difficult to see how this discussion on Governance is relevant to climate change adaptation - Should focus on concrete examples of how this advances adaptation policy etc. This section should probably come later within the discussion on adaptation. Also, why are sections on Traditional Knowledge and Reindeer Husbandry included as sub sections? (Smith, Sharon, Geological Survey of Canada)
676	28	34	29	0	0	This section (28.2.6) covers a mix of things which do not appear to have much to do with Governance in Polar Regions. Sub sections 28.2.6.1 and 28.2.6.2 appear to focus on impacts and implications of climate change as well as other stressors rather than governance. In the section that does discuss governance the linkages to climate change policy and adaptation are not clear - this material should probably come later in the report where adaptation is discussed. (CANADA)
677	28	34	37	34	53	Named are the Antarctic Treaty, the Protocol on Environmental Protection and CCAMLR, in order to complete the list of agreements that follow the AT please add the Convention on the Conservation of Antarctic Seals (CCAS). Furthermore the annual Antarctic Treaty Consultative Meetings (ATCM) should be mentioned at least because this is the international forum for management and administration in the treaty-region. Treaty Parties - especially the consultative parties have the option to develop the existing legal regulations further by their decisions and resolutions. (e.g. allocation of protected areas or regulations for the tourism industry) (GERMANY)
678	28	34	37	34	53	Please add the current work within the framework of CCAMLR to develop a representative system of Antarctic Marine Protected Areas (MPAs) with the aim of conserving marine biodiversity in the Convention Area, and in accordance with the decision at the World Summit on Sustainable Development to achieve a representative system of MPAs. Actual there are discussed two proposals for a MPA in the Ross Sea and in the East Antarctic within CCAMLR. But also ATCM should make use of the responsibilities for the protection and preservation of the Antarctic environment and, in particular, their responsibilities under Article IX, paragraph 1 (f) of the Antarctic Treaty in respect of the preservation and conservation of living resources in Antarctica, and under Annex V of the Environmental Protocol in order to establish Antarctic Specially Protected Areas. (GERMANY)
679	28	34	52	34	52	Some specific examples of "mechanisms for managing the effects of climate change in their areas of jurisdiction" would add some substance to this section. (UNITED STATES OF AMERICA)
680	28	35	0	0	0	The second half of this page has a lot of repetition of earlier statements. Examples are lines 30-32 and 45-49, among others. (UNITED STATES OF AMERICA)
681	28	35	1	0	0	Governance in the Arctic cannot begin with the role of the Arctic Council: Arctic governance is before all national governances by the littoral states. It is important to be better dissociated the international status of Antarctica from the nationally-governed status of Arctic. The Arctic Council cannot be compared to the Antarctic Treaty: it is mostly a coordination organ for nationally-based systems of governance. (Laruelle, Marlene, George Washington University)
682	28	35	1	35	1	The Arctic Council is not comparable to the Antarctic Treaty System for the last is an international treaty system. The Arctic council however is an institution. From this point of view, the Antarctic Council is comparable to the ATCM. (GERMANY)
683	28	35	1	35	1	It is inaccurate to call the Arctic Council the 'parallel' of the Antarctic Treaty for the Antarctic. The Arctic Council, as described, is an intergovernmental forum, but is not a treaty. To correct this, the sentence could be started by saying: "The Arctic region is governed by the Arctic Council, which was formally...." (Wong, Andrew, University of Waterloo)
684	28	35	1	35	11	(on Governance): here you should absolutely insert reference to ARR (Molau, Ulf, University of Gothenburg)

#	Ch	From Page	From Line	To Page	To Line	Comment
685	28	35	1	35	11	The opportunities concerning the reinforcement of international regulation relating to the Arctic are too brief. Options within the framework of UNCLOS or opportunities for action through the IMO should be added, e. g.: • UNCLOS: The claims could make use of their responsibilities under Article 234, 208 and 214 of UNCLOS, the contracting parties should make use of Article 194 of UNCLOS; both in respect of their responsibility for the protection of the marine environment through activities with adverse impacts (shipping or mining). • IMO should bring forth the work on the Polar Code with strict environmental regulations for the polar regions and should tighten the requirements for the introduction of pollutants (especially in regard to short-lived climate forcers), garbage and sewage concerning the Arctic (options: Arctic as Particularly Sensitive Sea Area). (GERMANY)
686	28	35	4	35	6	unclear meaning (Amundsen, Helene, CICERO - Centre for international climate and environmental research - Oslo)
687	28	35	10	35	11	an institution being 'tentative' is not the same as being a 'soft law regime' (Amundsen, Helene, CICERO - Centre for international climate and environmental research - Oslo)
688	28	35	42	0	0	Section 28.2.6.1 - It is not clear why this discussion on Traditional Knowledge etc. is included as a sub section of the section on Governance. As mentioned in earlier comments, part of this section provides evidence based on TK of impacts of changing climate etc. and should be included with scientific observations (not clear why this is considered separately). There is also much repetition in this section. (Smith, Sharon, Geological Survey of Canada)
689	28	35	42	0	0	Section 28.2.6.1. The chapter team should reduce all overlap of this section with 28.2.4. (Mach, Katharine, IPCC WGII TSU)
690	28	35	42	37	33	this whole section seems redundant and could be combined with previous sections, particularly with 28.2.4. (Francis, Jennifer, Rutgers University)
691	28	35	42	37	33	This section is not about observed changes due to climate. Some has to do with policy. The entire section should be dropped. (UNITED STATES OF AMERICA)
692	28	35	44	0	46	Suggest including % of arctic indigenous people in Canadian Arctic as well. (CANADA)
693	28	35	44	35	46	Repetition from page 26. Suggest to delete here. (DENMARK)
694	28	35	44	35	46	I have begun to spot repetitious statements in this Chapter. This may be internetioanl since often readers will not read the entire document but pick and choose particular secitons that refer to the informaiton that they are interested in. In this case page 26 lines 5-32 contained this information plus more. Lokewise some of the information on pages 37 line 52 to page 36 line 6 is the same as page 33 lines 12-17. (Two examples of many I have noticed) (Church, Ian, Canadian Foundation for Climate and Atmospheric Science/ IPY Canada)
695	28	35	44	35	52	These sentences also appear on page 26. (Rosales, Jon, St. Lawrence University)
696	28	35	47	35	47	Suggest to add: Indigenous populations [with traditional lifestyles] are considered.. (DENMARK)
697	28	35	52	35	52	(Nakashima et al 2011) has now been peer-reviewed and formally published. Therefore please now cite as (Nakashima et al 2012): Nakashima, D.J., Galloway McLean, K., Thulstrup, H.D., Ramos Castillo, A. and Rubis, J.T. 2012. Weathering Uncertainty: Traditional Knowledge for Climate Change Assessment and Adaptation. Paris, UNESCO, and Darwin, UNU, 120 pp. (Nakashima, Douglas, UNESCO)
698	28	36	4	36	6	awkward sentence, rephrase 'scientists are forced to think...' (Amundsen, Helene, CICERO - Centre for international climate and environmental research - Oslo)
699	28	36	7	36	13	Ignatowski and Rosales 2013 could be added to this list if articles in revision and resubmitted are acceptable, otherwise these findings are consistent with what we found with the AKSIK project. (Rosales, Jon, St. Lawrence University)
700	28	36	15	0	25	Suggest that this information regarding TEK emerging as a critical source of information for comprehensively addressing the impacts of environmental and other changes as well as the development of appropriate adaptation and response strategies for indigenous populations could be highlighted in the Executive Summary. (CANADA)

#	Ch	From Page	From Line	To Page	To Line	Comment
701	28	36	24	36	24	It may be most appropriate to delete "for the IPCC 5th assessment report" given that all literature published by the cutoff date is relevant to the report. (Mach, Katharine, IPCC WGII TSU)
702	28	36	42	36	44	reference missing (Amundsen, Helene, CICERO - Centre for international climate and environmental research - Oslo)
703	28	36	51	36	51	should reference be: Berkes & Jolly, 2001? (Amundsen, Helene, CICERO - Centre for international climate and environmental research - Oslo)
704	28	37	1	37	3	Ignatowski and Rosales 2013 could be added to this list if articles in revision and resubmitted are acceptable, otherwise these findings are consistent with what we found with the AKSIK project. (Rosales, Jon, St. Lawrence University)
705	28	37	3	37	5	Not clear if the Gearheard et al. 2010 reference provides explicit wind data and methodology used, outside of reporting on the general overview of the Igliniit project. (NETHERLANDS)
706	28	37	13	37	13	p. 37, line 13; This could be generalized to include the western Arctic as well. Subsistence hunters along the north and western coast of Alaska refer to the unpredictability of sea ice as well. (UNITED STATES OF AMERICA)
707	28	37	20	37	20	Suggest to add: While Arctic indigenous peoples [with traditional lifestyles] are considered.. (DENMARK)
708	28	37	20	37	23	"life ways" should be amended to either 'ways of life' or 'livelihoods' (NETHERLANDS)
709	28	37	24	37	24	Indigenous knowledge..replace by "traditonal knowledge". Alternatively define term. (DENMARK)
710	28	37	31	37	31	Indigenous knowledge..replace by "traditonal knowledge". Alternatively define term. (DENMARK)
711	28	37	31	37	31	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Mach, Katharine, IPCC WGII TSU)
712	28	37	32	37	32	Indigenous knowledge..replace by "traditonal knowledge". Alternatively define term. (DENMARK)
713	28	37	36	0	0	Section 28.2.6.2. The chapter team should reduce all overlap with 28.2.5.1.7, most especially for the 1st 2 paragraphs of this section. (Mach, Katharine, IPCC WGII TSU)
714	28	37	36	38	47	This section is also redundant and could be combined with 28.2.5.1.7 (Francis, Jennifer, Rutgers University)
715	28	37	38	37	50	How does herding compare to wildlife harvests in subsistence economies? (UNITED STATES OF AMERICA)
716	28	37	52	38	47	This section generally repeats what has been said earlier in the chapter. For example, much of p. 38 has already appeared on p. 33. (UNITED STATES OF AMERICA)
717	28	38	1	38	15	Too much detail on herding - lack of balance. (UNITED STATES OF AMERICA)
718	28	38	6	38	9	The single reference within this sentence is a study focused on northernmost Finland. Suggested for additional reference to be included supporting this trend in other geographic areas. (NETHERLANDS)
719	28	38	12	38	12	repetition from earlier in chapter (Amundsen, Helene, CICERO - Centre for international climate and environmental research - Oslo)
720	28	38	23	38	26	"the increasing global demand for energy etc these same word also appeared on page 38, lines 23-26. This degree of repetition seems a bit much. (Head, Erica, Fisheries and Oceans Canada)
721	28	38	30	38	31	p. 38, line 30-31: It seems like additional references are needed. (UNITED STATES OF AMERICA)
722	28	38	33	38	35	repetition from earlier in chapter (Amundsen, Helene, CICERO - Centre for international climate and environmental research - Oslo)
723	28	38	39	38	43	IN addition to the placement of infrastructure. Pollution etc. just the destruction of the vegetation communities and environment (soils, water regimes, localized topography etc.) that support them- plant and environment associations (ecological relationships) that have taken centuries to develop. (Church, Ian, Canadian Foundation for Climate and Atmospheric Science/ IPY Canada)
724	28	39	1	39	1	A small introductory paragraph should set the stage for what this section hopes to ,accomplish. (UNITED STATES OF AMERICA)

#	Ch	From Page	From Line	To Page	To Line	Comment
725	28	39	1	50	27	No mention is made anywhere of any different climate pathways. Presumably the future impacts should be tied to different climate forcing scenarios. Few if any of the projections mentioned in this section have any time horizon, so they are largely useless. (UNITED STATES OF AMERICA)
726	28	39	1	50	27	There is an inconsistent use of confidence levels. Some sections list many findings and no confidence levels. We suggest a more coherent approach or a discussion in the section introduction about what approach will be taken. (UNITED STATES OF AMERICA)
727	28	39	5	0	0	Section 28.3.1.1.: see ARR, Chapter 4, on hydrological changes brought about by a shrinking cryosphere (thawing permafrost, disappearing snowbeds) (Molau, Ulf, University of Gothenburg)
728	28	39	5	40	45	We find no information/discussion regarding effects on freshwater fish or anadrome salmon populations. Please consider including findings related to this topic. (NORWAY)
729	28	39	7	39	7	Should this be WGI? (Francis, Jennifer, Rutgers University)
730	28	39	7	39	7	It would be preferable to indicate the specific relevant section of chapter 3. (Mach, Katharine, IPCC WGII TSU)
731	28	39	11	39	11	The baseline for these projected increases should be specified. (Mach, Katharine, IPCC WGII TSU)
732	28	39	15	39	15	WG1 Ch4 focusses more on observations of change rather than projections. (Smith, Sharon, Geological Survey of Canada)
733	28	39	15	39	15	It would be preferable to indicate the specific relevant sections of chapter 4. (Mach, Katharine, IPCC WGII TSU)
734	28	39	15	39	39	This seems to be material more appropriate to Working Group I. (UNITED STATES OF AMERICA)
735	28	39	23	0	0	I have noted that on several occasions the use of technical terms that are so specialized that even the probable audience of these reports won't know their meaning. A Glossary is probably needed or terms might be foot noted- hyporheic zone was one of those for me though I am very familiar with the concept and use it often when discussing hydrology. Stamukhi lakes is another example (line 44) (Church, Ian, Canadian Foundation for Climate and Atmospheric Science/ IPY Canada)
736	28	39	27	0	0	These results are reinforced by those in Nakaegawa et al. (2013) Nakaegawa, T., A. Kitoh, M. Hosaka. 2013: Discharge of major global rivers in the late 21st century climate projected with the high horizontal resolution MRI-AGCMs -overview-. Hydrological Processes. 27. DOI: 10.1002/hyp.9831 (Nakaegawa, Toshiyuki, Meteorological Research Institute)
737	28	39	31	39	31	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Mach, Katharine, IPCC WGII TSU)
738	28	39	44	39	48	define stamukhi lakes and lentic ecology (Francis, Jennifer, Rutgers University)
739	28	39	53	0	0	I assume "thicknes" is ice thickness (Church, Ian, Canadian Foundation for Climate and Atmospheric Science/ IPY Canada)
740	28	40	4	40	5	It would be good to expose what those affected processes are for a better comprehension (Velázquez, David, Universidad Autónoma de Madrid)
741	28	40	16	40	18	In what ways- I can imagine direct impact on some that are preyed on by fish while other species that depend on increased detritus from fish carcasses may be negatively impacted. Obviously "lower" species dependent on higher oxygen levels would be positively impacted etc. (Church, Ian, Canadian Foundation for Climate and Atmospheric Science/ IPY Canada)
742	28	40	28	40	31	Possible to internally cite the forthcoming Working Group 1 climate warming scenarios, in place of IPCC 2007 report? (NETHERLANDS)

#	Ch	From Page	From Line	To Page	To Line	Comment
743	28	40	53	40	53	Recent papers emphasise on this problem in the region, linking it to the high temperatures of permafrost. therefore, I would add after "can have widespread ecosystem impacts", "including permafrost, active layer and hydrological changes (Vieira et al. 2010, Bockheim et al. 2013)". Vieira, G., Bockheim, J., Guglielmin, M., Balks, M., Abramov, A.A., Boelhouwers, J., Cannone, N., Ganzert, L., Gilichinsky, D.A., Goryachkin, S., López-Martínez, J., Meiklejohn, I., Raffi, R., Ramos, M., Schaefer, C., Serrano, E., Simas, F., Sletten, R., Wagner, D. 2010 - Thermal State of permafrost and active-layer monitoring in the Antarctic: advances during the International Polar Year 2007-09. Permafrost and Periglacial Processes, 21(2): 182-197; Bockheim J, Vieira G, Ramos M, Lopez-Martinez J, Serrano E, Guglielmin M, Wilhelm K, Nieuwendam A. 2013. Climate Warming and Permafrost Dynamics in the Antarctic Peninsula Region . Global and Planetary Change, 100: 215-223. (Silva Mora, Carla Andreia, University of Lisbon)
744	28	40	54	40	54	Define epishelf lakes (Francis, Jennifer, Rutgers University)
745	28	41	16	41	16	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Mach, Katharine, IPCC WGII TSU)
746	28	41	16	41	18	Likelihood statement in this sentence would require a reference to back it. (NETHERLANDS)
747	28	41	18	41	18	I recommend to support the sentence by: Velázquez D, Frías A, Lezcano MA and Quesada A (2013). Ecological relationships and stoichiometry within a maritime Antarctic watershed. Antarctic Science 25(2) 191-197. (Velázquez, David, Universidad Autónoma de Madrid)
748	28	41	18	41	19	I recommend to complete the sentence as: "...benthos and plankton and mismatched dynamic populations (Quesada and Velázquez, 2013)." Quesada A and Velázquez D (2012). Global Change Effects on Antarctic Lakes. In: Effects of Global Warming on Freshwater Ecosystems of the World: what can be done to reduce negative impacts? (M Kumagai, CR Goldman and RD Robarts eds). Wiley-Blackwell Ltd .pp 367-382 (Velázquez, David, Universidad Autónoma de Madrid)
749	28	41	27	41	27	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Mach, Katharine, IPCC WGII TSU)
750	28	41	29	41	30	I do not really follow this sentence for an Antarctic scenario. For example, a complete dry up of lakes could be difficult if the water discharged (e. g.) from glaciers would increased. Please, reconsider rephrasing. (Velázquez, David, Universidad Autónoma de Madrid)
751	28	41	33	41	33	To maximize directness of wording, "medium confidence" could be placed within parentheses at the end of the sentence. (Mach, Katharine, IPCC WGII TSU)
752	28	41	40	0	0	Are these surface lakes or sub-glacial lakes? (Church, Ian, Canadian Foundation for Climate and Atmospheric Science/ IPY Canada)
753	28	41	44	41	44	p. 41, line 44: It would help the reader to be more specific as to species and population of fur seal. (UNITED STATES OF AMERICA)
754	28	41	47	41	47	Something's missing here! (Francis, Jennifer, Rutgers University)
755	28	42	1	0	0	Section 28.3.2. In revising this section, the chapter team should very carefully consider material assessed here as compared to in 28.2. The focus here should be on future-oriented assessment of impacts, risks, and vulnerability. All assessment of observed changes should occur in 28.2. (Mach, Katharine, IPCC WGII TSU)
756	28	42	1	0	0	Section 28.3.2: Just as section 28.2.2 should focus on observed changes, this section should focus on projected changes. Please ensure a clear handoff between these sections. (Mastrandrea, Michael, IPCC WGII TSU)
757	28	42	5	42	9	To prevent repetition, I suggest changing the sentence that begins "While there is abundant evidence" to "On the other hand, however, predictions of the magnitude and spatial extent of ecosystem change for the entire Arctic region are uncertain." (Head, Erica, Fisheries and Oceans Canada)
758	28	42	7	42	7	How will marine ecosystems be impacted? It would be preferable to be a bit more specific here. (Mach, Katharine, IPCC WGII TSU)

#	Ch	From Page	From Line	To Page	To Line	Comment
759	28	42	14	42	21	Deletion of these paragraphs could be considered. The paragraph on lines 14-16 could be moved to 28.2. (Mach, Katharine, IPCC WGII TSU)
760	28	42	15	42	15	"hindcasted", not "projected". (UNITED STATES OF AMERICA)
761	28	42	16	28	26	Other studies show variability with respect to increase , if any, in marine primary productivity. Please consider including a reference here (e.g. Wassmann 2011, already in the reference list). (NORWAY)
762	28	42	18	42	19	The sentence "There is medium confidence that in the deep basins of the Arctic Ocean changes in stratification and the number of ice free days will lead to greater drawdown of nutrients and higher pelagic primary production". This sentence is unclear. What is "drawdown" of nutrients? Do you mean higher sedimentation to deeper layers or larger utilization of the nutrients available? What is pelagic primary production? What kind of primary production is not pelagic? I suggest to rewrite the sentence and include the following aspects: With less ice due to climate change, the length of the productive season may become somewhat extended (Slagstad et al., 2011). However, due to the strong stratification preventing nutrient availability (Tremblay and Gagon, 2009), the central Arctic Ocean will most probably remain a low productive region (Wassmann, 2011). The benthic fauna, which is an integral component of the food web, exhibits a strong association with the overlying primary productivity regime (Tremblay et al., 2011). A shift from an ice-influenced tightly coupled pelagic-benthic system, to a less coupled ice-free system, can be expected in regions experiencing future reductions in ice cover. (Ingvaldsen, Randi, Institute of Marine Research)
763	28	42	19	42	19	With respect to higher pelagic primary production, it is important do distinguish between short and long term. After some time primary production is not likely to increase further due to stratification and low nutrient concentrations. (NORWAY)
764	28	42	20	42	20	Change "may" to "will" (Head, Erica, Fisheries and Oceans Canada)
765	28	42	27	42	27	"diet" is not a rate, and cod don't make the active choice to "shift" their vital rate, so change this to "Historical records show Atlantic cod respond to differences in local conditions via changes in feeding behaviour (diet), key vital rates (growth rate" (Head, Erica, Fisheries and Oceans Canada)
766	28	42	34	43	11	Not clear the reasons behind which organisms groups are mentioned/discussed in the different areas. Please clarify. (NORWAY)
767	28	42	36	42	37	No evidence of northward movement of walruses. (UNITED STATES OF AMERICA)
768	28	42	39	42	40	Change to "Further climate warming may lead to a further northward movement of these conditions (e.g. into the Chukchi Sea). If this occurred it would provide higher levels of prey for pelagic planktivores and baleens whales in the Bering Sea, but could have a negative impact on the macro-benthic community that sustains the walrus and grey whales." (Head, Erica, Fisheries and Oceans Canada)
769	28	42	42	42	42	"Calanus" in italics. (NORWAY)
770	28	42	42	42	43	Karnovsky et al. 2010 were talking about the Greenland Sea, where the currents from the south bring C. finmarchicus north and where currents from the north bring both C. glacialis and C. hyperboreus south through Fram Strait. C. hyperboreus does not get transported south through Bering Strait and does not occur in the Bering Sea, and C. finmarchicus is an Atlantic species, which is not going to be transported north from the Pacific. The Calanus species found in the Pacific is C. pacificus, but I am not aware that it has ever been seen in the Bering Sea. Overall, this sentence is rubbish and the reference is inappropriate. I suggest replacing it with this. "In addition, changes in the zooplankton community composition, including a decrease in the abundance of larger forms, such as the lipid-rich Arctic species, Calanus glacialis, could have a negative impact on some planktivorous predators." (Head, Erica, Fisheries and Oceans Canada)

#	Ch	From Page	From Line	To Page	To Line	Comment
771	28	42	45	42	47	28.3.2.1.2.reference to the respective discussion in WG II ch. 6 may be useful. (Menzel, Lena, Alfred Wegener Institute for Polar and Marine Research)
772	28	42	49	42	49	To maximize directness of wording, "medium confidence" could be placed within parentheses at the end of the sentence. (Mach, Katharine, IPCC WGII TSU)
773	28	43	8	43	11	28.3.2.1.2. this is an interesting statement, however it lacks references. It should be considered in ch6 in the part on species migration due to warming, as an ideal example illustrating that not only high-latitude species may face "barriers" for poleward migration. (Menzel, Lena, Alfred Wegener Institute for Polar and Marine Research)
774	28	43	9	43	9	"fewer" relative to what? relative to Atlantic species? (UNITED STATES OF AMERICA)
775	28	43	14	43	23	What is the reasons for presenting this in a seperate section? Could this be included in the previous section? (NORWAY)
776	28	43	16	43	17	Change "In the Bering Sea etc." to "There is medium confidence, based on observations, that increased summer sea surface temperatures will cause a decrease in the abundance of the large, energy rich copepod, Calanus marshallae, and euphausiids over the Bering Sea shelf (Coyle et al., 2011). This is expected to etc." The reference is already in the reference list. (Head, Erica, Fisheries and Oceans Canada)
777	28	43	16	43	23	Seabirds?? Marine Mammals?? (UNITED STATES OF AMERICA)
778	28	43	26	43	31	Why is cumulative effects only discussed for fish and shellfish, but not for other organism groups? (NORWAY)
779	28	43	28	43	31	These statements should be rigorously supported by citations, or they should be deleted. (Mach, Katharine, IPCC WGII TSU)
780	28	43	36	43	36	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Mach, Katharine, IPCC WGII TSU)
781	28	43	36	43	37	Insert "ectothermic" thus "metabolic costs in many ectothermic pelagic species". Insert "limit" and change "temperature" to "temperate" thus "movement south of the northern distribution limit of polar species and southern distribution limit of temperate and subantarctic species." (Head, Erica, Fisheries and Oceans Canada)
782	28	43	36	43	37	28.3.2.2.The metabolic generalizations are far from clear as warm acclimatization may reduce metabolic costs. Warm acclimatization has been described in several species. (Menzel, Lena, Alfred Wegener Institute for Polar and Marine Research)
783	28	43	38	43	38	Should "temperature" be "temperate"? (UNITED STATES OF AMERICA)
784	28	43	45	43	45	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Mach, Katharine, IPCC WGII TSU)
785	28	43	50	43	50	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Mach, Katharine, IPCC WGII TSU)
786	28	44	4	44	4	Change "are" to "is" and add (WAP) thus "western Antarctic Peninsula (WAP) is expected to" (Head, Erica, Fisheries and Oceans Canada)
787	28	44	6	0	0	References - Several references cited in text do not appear in the list. This makes it difficult for reviewers to check that material in the text correctly reflects conclusions in publications. (Smith, Sharon, Geological Survey of Canada)
788	28	44	9	44	10	Change "can" to "could" and omit "on" thus - "This mismatch in timing could also propagate through the food web to impact krill and upper trophic levels etc." (Head, Erica, Fisheries and Oceans Canada)
789	28	44	23	0	0	Section 28.3.3.1.: there is nothing mentioned on invasive species for the Arctic but very much information for the Antarctic in the subsequent section. Consult ABA for information on invasives in the Arctic! (Molau, Ulf, University of Gothenburg)
790	28	44	23	45	25	We find the information/discussion regarding effects on fauna quite limited, please consider extending it. (NORWAY)
791	28	44	25	44	30	Enumerate the two approaches in order to make it clear what is the second approach. (UNITED STATES OF AMERICA)

#	Ch	From Page	From Line	To Page	To Line	Comment
792	28	44	38	44	38	Insert additional references on this topic: Jiang, D., Zhang, Y., and Lang, X.: Vegetation feedback under future global warming, Theor. Appl. Climatol., 106, 211–227, 2011; Falloon, P. D., Dankers, R., Betts, R. A., Jones, C. D., Booth, B. B. B., and Lambert, F. H.: Role of vegetation change in future climate under the A1B scenario and a climate stabilisation scenario, using the HadCM3C earth system model, Biogeosciences 9, 4739-4756, doi:10.5194/bg-9-4739-2012; Strengers, B. J., M"uller, C., Schaeffer, M., Haarsma, R. J., Severijns, C., Gerten, D., Schaphoff, S., van den Houdt, R., and Oostenrijk, R.: Assessing 20th century climate–vegetation feedbacks of land-use change and natural vegetation dynamics in a fully coupled vegetation–climate model, Int. J. Climatol., 30, 2055–2065, doi:10.1002/joc.2132, 2010; Swann, A. L., Fung, I. Y., Levis, S., Bonan, G., and Doney, S.: Changes in Arctic vegetation induce high-latitude warming through the greenhouse effect. P. Natl. Acad. Sci. USA, 107, 1295–1300, doi:10.1073/pnas.0913846107, 2010. (Falloon, Peter, Met Office Hadley Centre)
793	28	44	40	44	42	what is the time range for this projection? (Amundsen, Helene, CICERO - Centre for international climate and environmental research - Oslo)
794	28	44	40	44	42	For this projection, what are the relevant time frames, scenarios of climate change, and baselines for the percentage increase? Also, what exactly is the percentage increase a measure of? It would be helpful to indicate this more specifically. (Mach, Katharine, IPCC WGII TSU)
795	28	44	44	44	46	It would be helpful to specify the relevant scenarios of climate change for this projection. (Mach, Katharine, IPCC WGII TSU)
796	28	45	24	45	24	Ims reference? (Francis, Jennifer, Rutgers University)
797	28	45	31	45	31	What type of organisms are the "colonists"? The chapter team should ensure that the reader would not think that people are meant. (Mach, Katharine, IPCC WGII TSU)
798	28	45	32	46	1	I guess the citation format for references with more than 2 co-authors in this section is different from the rest of the document. Please, consider revising (Velázquez, David, Universidad Autónoma de Madrid)
799	28	46	13	46	13	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Mach, Katharine, IPCC WGII TSU)
800	28	46	13	46	16	Excellent point that seems to deserve inclusion in the Executive Summary. (UNITED STATES OF AMERICA)
801	28	46	15	46	15	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Mach, Katharine, IPCC WGII TSU)
802	28	46	19	0	0	Section 28.3.4.: see ARR for in-depth review of this field (Molau, Ulf, University of Gothenburg)
803	28	46	19	46	48	What about Greenlanders? (Francis, Jennifer, Rutgers University)
804	28	46	23	46	23	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Mach, Katharine, IPCC WGII TSU)
805	28	46	25	46	25	insert "traditional" before "way of life"? (Francis, Jennifer, Rutgers University)
806	28	46	27	46	27	"thru" - are you kidding me? Replace it with "through", please! "Arctic communities are exposed to the effects of climate change through multiple pathways etc" (Head, Erica, Fisheries and Oceans Canada)
807	28	46	31	46	31	Replace "with" with "within" thus "Communities within the same eco-zone etc" (Head, Erica, Fisheries and Oceans Canada)
808	28	46	35	46	35	Change thus - "Economic cost estimates have been made for the case of the Alaskan economy, which suggest that a heavy reliance etc" (Head, Erica, Fisheries and Oceans Canada)
809	28	46	35	46	48	Citations not in Literature cited. (UNITED STATES OF AMERICA)

#	Ch	From Page	From Line	To Page	To Line	Comment
810	28	46	40	46	41	Better terminology should be used - "Thawing of ice-rich permafrost can cause hydrocarbon pipelines...." Note that it is the thawing of ice-rich permafrost (or ice-rich frozen ground) which may or may not be in tundra environments (it occurs below treeline also) that will have these impacts. Epstein et al 2008 is not a good reference. Prowse et al. 2009 may be better. Ref: Prowse, T.D., Furgal, C., Chouinard, R., Melling, H., Milburn, D., and Smith, S.L. 2009. Implications of climate change for economic development in Northern Canada: energy, resource, and transportation sectors <i>Ambio</i> , 38(5): 272-281. (Smith, Sharon, Geological Survey of Canada)
811	28	46	41	0	0	design yes but also operations monitoring and maintenance (Church, Ian, Canadian Foundation for Climate and Atmospheric Science/ IPY Canada)
812	28	46	46	47	22	The emphasis in this chapter is frozen soils (permafrost) and challenges it poses with warming such as subsidence. There is little recognition of other terrain hazards to infrastructure such as some related to permafrost (examples slumps, land slides hydrological challenges etc.) and others related to climate and weather such as avalanches. A classic example of such a challenge was the Mt Steele landslide probably triggered by degrading permafrost.(example of a publication on this event http://www.sfu.ca/cnhr/papers/Lipovsky%20Landslides%202008.pdf) This event did not actually impact infrastructure but is a classic example of how cumulative processes in a similar landscape could cause a catastrophic impact on infrastructure. The mapping along the the Alaska Highway corridor by the Geological Survey of Canada (50 1:50,000 NTS map sheets) illustrates the diversity of natural hazards northern environments can pose for infrastructure- many of which have at least a partial weather of climate signature. (GEOLOGICAL SURVEY OF CANADA, OPEN FILE 6654, Landslide inventory along the Alaska Highway Corridor, Yukon, Blais-Stevens, A., Couture, R., and Page, A.) Mt Steele and other related publications are listed the web site, http://www.geology.gov.yk.ca/pdf/Selected_Publications.pdf . I also am reviewing this after the highway connecting the Yukon with Skagway Alaska through the White Pass has been intermittently closed over a period of several days as a result of avalanches- not a new phenomenon but occurrences that are likely to be more common as a result of greater variability of temperatures impacting the stability of alpine snow packs.- also an issue for the next session- transportation (Church, Ian, Canadian Foundation for Climate and Atmospheric Science/ IPY Canada)
813	28	47	5	47	7	Section 28.3.4.1, Page 47 Line 5 to Line 7 Page 47. Although included in the literature cited of Chapter 28, the information and citation for Mundy and Evenson 2011 was left out of Section 28.3.4.1, Page 47 Line 5 to Line 7 Page 47. It should read as follows, "Climate change will impact coastal Arctic fisheries for salmon because of the relation between ice cover and timing of marine exit for salmon (Mundy and Evenson 2011). Loss of sea ice cover in the spring will change fish behavior in ice bound areas, making fishery management more challenging. Subsistence harvesters are place-based, having limited mobility." (UNITED STATES OF AMERICA)
814	28	47	7	47	10	Apparent poleward changes in latitudinal gradients of Bering Sea epibenthic invertebrate megafauna and fishes is associated with short-term (5-yr) fluctuations in position of cold pool, which is under the influence of spring sea ice distribution (Stevenson and Lauth 2012 Deep-Sea Research II 65-70, 251-259; Stabeno et al. 2012 Deep-Sea Research II 65-70, 14-30). Warming of the Bering Sea and associated effects have been recently called into question (Overland et al. 2012 Deep-Sea Research II 65-70; Lomas et al. 2012 Deep-Sea Research II 65-70, 126-140; Stabeno et al. 2012 Deep-Sea Research II 65-70, 14-30; Stabeno et al. 2012 Deep-Sea Research II 65-70, 31-45). (UNITED STATES OF AMERICA)
815	28	47	8	47	8	Here it would be preferable to present a level of confidence in italics, in place of "medium certainty," following the guidance for authors. (Mach, Katharine, IPCC WGII TSU)
816	28	47	30	47	30	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Mach, Katharine, IPCC WGII TSU)
817	28	47	30	47	30	For the described "access conditions and plant illnesses" it would be helpful to specify the context--farming or forestry? (Mach, Katharine, IPCC WGII TSU)
818	28	47	34	47	34	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Mach, Katharine, IPCC WGII TSU)

#	Ch	From Page	From Line	To Page	To Line	Comment
819	28	47	40	47	40	What is meant by "limited storage space" for wood? Limited timber weight on trucks? Please clarify. (NORWAY)
820	28	47	41	47	43	A warmer climate and prolonged growing season are probably more important than reduced snow damage in this respect? (NORWAY)
821	28	47	49	47	49	for a range of activities including economic development (Smith, Sharon, Geological Survey of Canada)
822	28	48	4	48	8	The design of the infrastructure will also influence its vulnerability. For example, shallow foundations on ice-rich soils will be more vulnerable than deep foundations (e.g. piles driven into bedrock). (Smith, Sharon, Geological Survey of Canada)
823	28	48	4	48	15	Citations fully supporting these statements must be provided. (Mach, Katharine, IPCC WGII TSU)
824	28	48	4	48	22	very few references in this paragraph (Amundsen, Helene, CICERO - Centre for international climate and environmental research - Oslo)
825	28	48	7	48	8	Unclear sentence. For structures on which type of soils are the impacts likely to be negligible? Sentence needs rewording. (UNITED STATES OF AMERICA)
826	28	48	8	48	8	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Mach, Katharine, IPCC WGII TSU)
827	28	48	11	48	11	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Mach, Katharine, IPCC WGII TSU)
828	28	48	11	48	12	Note that the operating temperature of the pipeline is important and they can operate at temperatures above 0°C - this is not uncommon and is the reason the pipeline in Alaska was built above ground where permafrost existed. A buried warm pipeline can have greater impacts on permafrost and ground thermal regime than climate change. (Smith, Sharon, Geological Survey of Canada)
829	28	48	13	48	14	What does NGL stand for??? (Head, Erica, Fisheries and Oceans Canada)
830	28	48	21	48	22	The meaning of this sentence is not clear. It would benefit from being rewritten. (UNITED STATES OF AMERICA)
831	28	48	41	48	43	Change thus "Several communities have reported the need for more frequent water-quality testing for both municipal systems and untreated water sources to ensure its suitability for drinking (Furgal, 2008)." (Head, Erica, Fisheries and Oceans Canada)
832	28	48	43	48	43	Casual usage of "likely" should be avoided, as it is a reserved likelihood term. (Mach, Katharine, IPCC WGII TSU)
833	28	48	49	48	50	Citations supporting these statements are needed. (Mach, Katharine, IPCC WGII TSU)
834	28	48	52	48	52	This sentence seems to be disconnected with the previous and next paragraph. Please, consider revising (Velázquez, David, Universidad Autónoma de Madrid)
835	28	49	1	49	4	repetition from earlier in chapter, but with new references and estimates (Amundsen, Helene, CICERO - Centre for international climate and environmental research - Oslo)
836	28	49	1	49	10	I suggest combining this paragraph with sec. 28.2.5.1.6 (Francis, Jennifer, Rutgers University)
837	28	49	13	49	53	This is not discussing projections. I suggest moving to section 28.2 (Francis, Jennifer, Rutgers University)
838	28	49	24	49	24	Something should be said here about the connection between fossil fuels and climate change. As the chapter reads there is a clear disconnect between all the documented impacts of climate change in the polar regions in the first part of the chapter and then simply stating that there is oil and gas in the Arctic, the cause of the impacts in the first place. Could a statement about the estimated ppm increase that would come from burning the estimated amounts of oil and gas be included? (Rosales, Jon, St. Lawrence University)
839	28	49	25	49	25	According to Table 28-1, the Arctic's share is projected to increase as a % of non-OPEC production but decrease as a % of world oil production. This apparent contradiction seems to call for an explanation. (UNITED STATES OF AMERICA)
840	28	49	25	49	33	Citations for this material should be specified. (Mach, Katharine, IPCC WGII TSU)

#	Ch	From Page	From Line	To Page	To Line	Comment
841	28	49	38	49	40	The definition of Arctic in Figure 28.6 deviates from what is considered in this chapter as the Faroes and Iceland is included here. Figure is based on the AMAP definition of the Arctic, I guess. (Sundby, Svein, Institute of Marine Research)
842	28	49	42	49	44	In Line 42 "Figure 28-6" should be replaced by "Figure 28-7". Also, there should be a sentence added somewhere which makes reference to Figure 28-7. I suggest adding it to the end of this paragraph - something like this. "are the major elements in the Faroe Islands, Greenland and Iceland. Russia has by far the highest rates of natural gas production among the Arctic nations, although contributions from other regions are expected to increase in future (Figure 28-7)." (Head, Erica, Fisheries and Oceans Canada)
843	28	49	42	49	44	This discussion is too narrow in scope with regards to Iceland. As in Russia and Canada the energy industry is an important part of the economy. Virtually 100% of electricity use in Iceland derives from renewable sources, hydropower plants producing 73% and geothermal plants 27%, but 3/4 of the electricity produced is used by power-intensive aluminium smelters operated in the country (Thorsteinsson Th. 2012). In 2011 energy sector was about 4.6% of the economy and the industry was 11.4%. In comparison the fishing sector mentioned in the sentence was 10.9% of the economy (Sigurdardottir et al 2012). The sentence needs to be rewritten to better reflect the economic reality. The references here are: a) Thorsteinsson, Th (2012) Renewable Energy in Iceland. In Thorsteinsson, Th., and H. Björnsson, eds. Climate Change and Energy Systems. Impacts, Risks and Adaptation in the Nordic and Baltic Countries. Nordic Council of Ministers, TemaNord 2011:502, 91–111. and b) Sigurdardottir R. et al (2012) The Economy of Iceland. Published by Central Bank of Iceland, Reykjavik Oct 2012; ISSN 1024-6680 (ICELAND)
844	28	50	4	50	7	The acronyms GCM, NSR and NWP should be explained the first time they are used. Thus Line 4 becomes "Global Climate Models (GCMs) generally underestimate etc". (Head, Erica, Fisheries and Oceans Canada)
845	28	50	4	50	21	As noted, the more current information on model-projected arctic marine access is in Smith and Stephenson (2013, PNAS). Preference should be given to the CMIP5-based projections used by Smith and Stephenson, not the CMIP3-based projections cited here. (UNITED STATES OF AMERICA)
846	28	50	7	50	10	The text does not discuss why the NWP projection in Fig. 28-8 (P.92) is reaching only to about 2012, but levels throughout and for the end of 21. century are discussed/listed. As mentioned with another comment above, the reference Mokhow and Khon 2008 is not listed in the reference list. (Gerland, Sebastian, Norwegian Polar Institute)
847	28	50	12	50	12	I think that Figure 28-8 should include another panel showing where the NSR and NWP routes are expected to go (even if only approximately). (Head, Erica, Fisheries and Oceans Canada)
848	28	50	13	50	14	Figure 28-8: is missing most of the time series for the Northwest Passage. (UNITED STATES OF AMERICA)
849	28	50	16	50	21	Demand for ice breakers expected to increase as more vessels attempt to operate in more variable ice conditions. Note, winter ice will still form. (UNITED STATES OF AMERICA)
850	28	50	21	50	21	Casual usage of "unlikely" should be avoided, as it is a reserved likelihood term. (Mach, Katharine, IPCC WGII TSU)
851	28	50	23	50	25	Question - do the containment facilities have to maintain their structural integrity ONLY while projects are active? Surely there should, in addition, be plans for continued containment or remediation after projects are finished - no? (Head, Erica, Fisheries and Oceans Canada)
852	28	50	30	0	0	Section 28.4 - This section could benefit from inclusion of more concrete examples of adaptation efforts to illustrate the advances that have been made. Adaptation is to be a focus of WG2 but very little attention is given to it in this chapter compared to the amount of material on impacts. There are several Canadian examples (some of which are provided below) that could be given. There may be a reluctance to include too many examples from one country but these are examples others could follow and go beyond some of the academic publications that are cited in this section. Note that the North American ch 26 (pg 40 line 46) makes reference to efforts in Nunavut including study on vulnerability of mining sector mentioned below. (Smith, Sharon, Geological Survey of Canada)

#	Ch	From Page	From Line	To Page	To Line	Comment
853	28	50	30	0	0	Section 28.4 - There are several key examples of adaptation efforts in Canada that should be mentioned: (1) The Nunavut Climate Change Partnership (see Mate & Reinhart 2011) which had a focus on community adaptation (and included collaboration with Canadian Institute of Planners). (2) A more recent effort is the Regional Adaptation Collaboratives (for one related to Nunavut see: http://www.climatechangenunavut.ca/en/project/nunavut-regional-adaptation-collaborative). Relevant Refs: Mate DJ and Reinhart, F (ed.) 2011. Nunavut climate change partnership workshop, Feb 15-16 2011. Geological Survey of Canada Open File 6867 http://geoscan.ess.nrcan.gc.ca/cgi-bin/starfinder/0?path=geoscan.fl&id=fastlink&pass=&format=FLSHORTORG&search=R=288645 (Smith, Sharon, Geological Survey of Canada)
854	28	50	30	0	0	Section 28.4 - Additional examples showing advances with respect to adaptation. There have been efforts in Canada to assess the vulnerability of the northern mining sector and develop best practices and there are specific examples for Nunavut including reports available on the Nunavut Adaptation Collaborative web site (http://www.climatechangenunavut.ca/en/project/nunavut-regional-adaptation-collaborative). The relevant reports are: Golder (2012) Vulnerability Assessment of the Mining Sector to Climate Change Task 1 Report. Prepared for Nunavut Regional Adaptation Collaborative. AND Golder (2012) Good Environmental Practices for Northern Mining and Necessary Infrastructure Task 2 Report. Prepared for Nunavut Regional Adaptation Collaborative. Reports produced by Mine Environmental Neutral Drainage (MEND) Program that are available at http://www.mend-nedem.org . These include a general report on climate change risks to mining (MEND 1.61.7) that does include references to northern mines. Others that are relevant are associated with cover design for northern mine waste disposal facilities and include MEND 1.61.4, 1.61.5a, 1.61.5b. (Smith, Sharon, Geological Survey of Canada)
855	28	50	30	0	0	Section 28.4 could benefit from inclusion of more concrete examples of adaptation efforts to illustrate the advances that have been made. Adaptation is to be a focus of WG2 but very little attention is given to it in this chapter compared to the amount of material on impacts. There are several key examples in Canada that should be mentioned: (1) The Nunavut Climate Change Partnership (see Mate & Reinhart 2011) which had a focus on community adaptation (and included collaboration with Canadian Institute of Planners). (2) A more recent effort is the Regional Adaptation Collaboratives (for one related to Nunavut see: http://www.climatechangenunavut.ca/en/project/nunavut-regional-adaptation-collaborative). Relevant Refs: Mate DJ and Reinhart, F (ed.) 2011. Nunavut climate change partnership workshop, Feb 15-16 2011. Geological Survey of Canada Open File 6867 http://geoscan.ess.nrcan.gc.ca/cgi-bin/starfinder/0?path=geoscan.fl&id=fastlink&pass=&format=FLSHORTORG&search=R=288645 (CANADA)
856	28	50	30	50	30	Again, a small introductory paragraph saying what you want to accomplish with this section would help constrain its scope. (UNITED STATES OF AMERICA)
857	28	50	30	53	5	Change of section title needed: "28.4. Adaptation in the Polar Regions" - section 28.4, as it is written, is exclusively about the Arctic. However, the title implies that it covers both Antarctica and the Arctic. Although it is clear from some subsections that only the Arctic is discussed, this is not the case for subsection "28.4.2. Adaptation and Industrial Development", which talks about access to minerals and fossil fuels without making it explicitly clear that only the Arctic is being discussed. I suggest changing the title of 28.4 to "28.4. Adaptation in the Arctic". Although information on human "Adaptation in Antarctica" might be interesting, it is probably too late to insert it now, so the change of title I suggest would be the most simple approach. (Smith, Inga, University of Otago)
858	28	50	43	50	47	Likewise rivers and lakes (frozen and unfrozen) in terrestrial regions. Most communities have been strategically located along water courses for similar reasons as coastal communities (Church, Ian, Canadian Foundation for Climate and Atmospheric Science/ IPY Canada)

#	Ch	From Page	From Line	To Page	To Line	Comment
859	28	50	46	50	46	Ignatowski and Rosales 2013 could be added to this list after Ford et al. 2010 if articles in revision and resubmitted are acceptable, otherwise these findings are consistent with what we found with the AKSIK project. (Rosales, Jon, St. Lawrence University)
860	28	50	51	50	51	National guidelines for adaptation?? Please clarify. (UNITED STATES OF AMERICA)
861	28	51	2	51	2	Amundsen et al, 2010 is not in reference list (Amundsen, Helene, CICERO - Centre for international climate and environmental research - Oslo)
862	28	51	16	0	0	Section 28.4.1.: see ARR for in-depth review of this field (Molau, Ulf, University of Gothenburg)
863	28	51	16	0	0	This assessment of Arctic indigenous peoples' adaptive capacity is too optimistic and slightly simplified. Please read Arctic Council's report on Arctic resilience to understand the complexities of Arctic adaptive capacity and why their Indigenous present adaptive capacity is not necessarily high: http://www.arctic-council.org/arr/wp-content/uploads/2012/01/Arctic-Resilience-Interim-Report-2013-Part-III.pdf . It is worth including content from the Arctic Council report in the AR5 report. (Wong, Andrew, University of Waterloo)
864	28	51	21	51	21	Is this statement corroborated by science? (DENMARK)
865	28	51	21	51	22	Sharing should be added to this list, "patience, persistence, ..." (Rosales, Jon, St. Lawrence University)
866	28	51	41	51	44	These adaptation measures, mostly use of new technology, would be undertaken even if there were no change in climate. (UNITED STATES OF AMERICA)
867	28	51	48	51	54	It sounds as though these groups are adapting very well on their own! (Francis, Jennifer, Rutgers University)
868	28	52	2	52	4	This may be a good point to mention the role of the Aboriginal Organizations that are Arctic Council Permanent Participants and who sit on other national and international bodies such as those dealing with Biodiversity. They have become proponents and spokespersons for driving adaptive strategies at different scales. (Church, Ian, Canadian Foundation for Climate and Atmospheric Science/ IPY Canada)
869	28	52	4	0	0	Abele et al 2009 reference not in reference list. (CANADA)
870	28	52	9	52	14	Again, this emphasizes all the possible negative effects. What about higher paying jobs? More jobs? Better incomes? A higher standard of living? (Francis, Jennifer, Rutgers University)
871	28	52	16	52	16	Relate to previous section 28.2.1 .1 Hydrology and Freshwater systems and section 28.2.2 (Oceanographic and marine ecosystems) which describes increases in nutrient loading and higher abundance of phytoplankton and zooplankton. (UNITED STATES OF AMERICA)
872	28	52	20	52	25	Challenges Shell experienced with their Beaufort Sea drilling program appears to have resulted in industry looking to adapt by bringing on line an entirely new suite of technology- See Macleans Magazine- April 29 2013- pages 44 & 45 - "Oil Firms want to put offshore rigs on the ocean floor". (Church, Ian, Canadian Foundation for Climate and Atmospheric Science/ IPY Canada)
873	28	52	36	52	36	CEAA (2003) deals with environmental impact assessment and may not be the correct reference. The screening tool for considering climate change in engineering design was included in CSA (2010) and also discussed by Hayley and Horne (2009). (Smith, Sharon, Geological Survey of Canada)
874	28	52	44	52	54	This section misses the main contribution of CSA (2010) which is the development of guidelines for adaptation to climate change. As mentioned above, there have been efforts to develop guidelines and best practices in addition to assessments of vulnerability of various economic sectors, infrastructures and communities. These are important as they can assist communities, practitioners and decision makers with development of climate change adaptation plans. The Transportation Association of Canada (2010) has also developed guidelines for the transportation sector. Ref: Transportation Association of Canada (2010) Guidelines for development and management of transportation infrastructure in permafrost regions. May 2010 TAC, Ottawa. (Smith, Sharon, Geological Survey of Canada)

#	Ch	From Page	From Line	To Page	To Line	Comment
875	28	52	44	52	54	An important adaptive strategy that is part of the CSA approach is to attempt to project utilizing climate modelling- to project the rate of change and design for the projected service life of infrastructure. There are several other initiatives underway that also build upon the NRTEE True North report under the banner of the Northern Infrastructure Standards Initiative 9nisi http://www.scc.ca/en/stakeholder-participation/roadmaps-and-standardization-solutions/northern-Infrastructure-standardization-initiative) (Church, Ian, Canadian Foundation for Climate and Atmospheric Science/ IPY Canada)
876	28	52	44	52	54	This section misses the main contribution of CSA (2010) which is the development of guidelines for adaptation to climate change. As mentioned in the comments above there have been efforts to develop guidelines and best practices in addition to assessments of vulnerability for various economic sectors, infrastructure and communities. These are important as they can assist communities, practitioners and decision makers with climate change adaptation plans. The Transportation Association of Canada (2010) has also developed guidelines for the transportation sector, and there are also other adaptation techniques that are being studied in Canada's territories/provinces (e.g., heat drains, longitudinal culverts and sun/snow sheds are all potential adaptation techniques for highway embankments). Refer to these references for additional information: Transportation Association of Canada (2010) Guidelines for development and management of transportation infrastructure in permafrost regions. May 2010 TAC, Ottawa http://pubs.aina.ucalgary.ca/cpc/CPC6-526.pdf http://ygsftp.gov.yk.ca/YukonPermafrostNetwork/MacBride%20Lecture%20Series%202012%20Paul%20Murchison.pdf (CANADA)
877	28	52	44	52	54	There might be some value in distinguishing between housing/building infrastructure and transportation infrastructure. In its present form, it is unclear whether some of the adaptation techniques (e.g., air convection embankments) are applied to all types of infrastructure or whether it is specific to one. (CANADA)
878	28	53	10	0	0	Section 28.5. This section is highly overlapping with previous sections. The chapter team should strongly consider integrating material from 28.5 into earlier assessment of health, for example in 28.2.4.2 or 28.3. (Mach, Katharine, IPCC WGII TSU)
879	28	53	10	53	38	This section seems light in terms of detail and assessment. The discussion should include (or strongly restate lighter comments in 28.2.5.1.4 and 28.2.5.1.6) in-Arctic pollution expected from increased resource extraction activities (shipping, flaring, smelting, etc.) It should include a discussion of black carbon, as a short-lived climate forcer, an air quality issue (e.g. Arctic Haze) and a health issue for residents. Likewise with tropospheric ozone - increasing in-Arctic emissions (and precursors) act as short-lived climate forcer, air quality/health issue. Also, Ma et al. and Hung et al., AMAP 2011 and UNEP/AMAP 2011 were all missing from the bibliography. (UNITED STATES OF AMERICA)
880	28	53	12	53	18	A significant gap (at the interface of Working Groups I and II) is the failure to address changes in atmospheric pathways (circulation pathways) as they pertain to contaminant transport. This concern also applies to the ocean transport pathways. The chapter should either address this gap by including relevant discussion of changes in pathways, or it should acknowledge that there is a gap in our knowledge of this issue. (UNITED STATES OF AMERICA)
881	28	53	41	0	0	This section does not really address the heading. Please revise to be more specific and directly address the subject matter of the section title. (UNITED STATES OF AMERICA)

#	Ch	From Page	From Line	To Page	To Line	Comment
882	28	53	41	54	7	Overall this section is very weak, full of generalizations, and not a good synthesis of the gaps that were detailed in the chapter as a whole. For example, I found (p.14, lines 5-8; p. 15, lines 23-25; p.25 lines 14-17; p.25 lines 24-25; etc) all very well articulated. "Systematic monitoring will be essential" is sort of a "motherhood" comment; while there are very good examples of systematic monitoring gaps that are provided in the text of the chapter. Please summarize the major ones or try to define them in higher roll-up categories (increased spatial density; improved technology in xyz; better collaboration between observers and modellers, etc.). These can also be "motherhood" comments, but at least a bit more specific. (UNITED STATES OF AMERICA)
883	28	53	43	53	48	Tipping points are not discussed much in this chapter, particularly those which could influence the large scale climate system. E.g. rapid permafrost thaw risk. Although these will be discussed elsewhere (e.g. WGI), some cross-referencing could be beneficial. (Kentarchos, Anastasios, European Union DG Research, Directorate Environment Climate Change & Environmental Risks Unit)
884	28	53	43	53	48	Derksen et al. (2012) also made recommendations with respect to monitoring. It should be noted that a focus of IPY was to enhance observation networks, in fact some of the key results were based on information gathered from monitoring networks. The challenge will be to maintain these in the long-term. Ref: Derksen, C., Smith, S.L., Sharp, M., Brown, L., Howell, S., Copland, L., Mueller, D.R., Gauthier, Y., Fletcher, C., Tivy, A., Bernier, M., Bourgeois, J., Brown, R., Burn, C.R., Duguay, C., Kushner, P., Langlois, A., Lewkowicz, A.G., Royer, A., and Walker, A. 2012. Variability and change in the Canadian cryosphere. Climatic Change, 115: 59-88. (Smith, Sharon, Geological Survey of Canada)
885	28	53	47	53	48	p. 53, line 47-48: In general, the report does not adequately summarize on-going monitoring at least in the western Arctic. (UNITED STATES OF AMERICA)
886	28	53	50	53	54	This point is needs more emphasis though I would suspect that WG 1 has probably dealt with it. The role of the poar regions in the global biophysical systems including extreme weather events but also that the challenges of polar change be it environmental or socio economic is usually over shadowed by events some where else in the world but that often these events have at least a polar fingerprint. (Church, Ian, Canadian Foundation for Climate and Atmospheric Science/ IPY Canada)
887	28	53	54	53	54	Wording here should be considered to ensure a policy neutral statement. (Mach, Katharine, IPCC WGII TSU)
888	28	54	0	0	0	It seems there should be an FAQ parallel to 28.2 about changes in land ice. (Francis, Jennifer, Rutgers University)
889	28	54	3	54	3	Wording here should be considered to avoid a prescriptive formulation. (Mach, Katharine, IPCC WGII TSU)
890	28	54	7	54	7	Wording could be reconsidered in order to avoid a prescriptive formulation. (Mach, Katharine, IPCC WGII TSU)
891	28	54	10	0	0	FAQs - This seems to repeat information already provided - are these necessary? It is also unclear how choice of questions was made. (Smith, Sharon, Geological Survey of Canada)
892	28	54	10	55	3	Why is Arctic sea ice rapid decreasing but Antarctic sea ice increasing? (Duan, Juqi, National Climate Center, Chinese Meteorological Administration)
893	28	54	10	55	3	What is role of ozone hole to the changes in the Antarctic environment, ice sheets and sea ice? (Duan, Juqi, National Climate Center, Chinese Meteorological Administration)
894	28	54	10	55	3	Why is the Arctic sea ice rapid decreasing but Antarctic sea ice increasing? It is a hot topic of the latest study. SUGGESTION: enrich and add latest literatures on this. (PAN, Jiahua, Chinese Academy of Social Sciences)
895	28	54	10	55	3	What is role of the ozone hole to changes in the Antarctic environment, ice sheets and sea ice? It is also a hot topic of the latest study. SUGGESTION: enrich and add latest literatures on this. (PAN, Jiahua, Chinese Academy of Social Sciences)

#	Ch	From Page	From Line	To Page	To Line	Comment
896	28	54	12	0	0	FAQ 28-1 An excellent question with a lot of details. To make all these details easy to access, authors may wish to use some categories. At present the prose style with out any text break or organzing priniciple will negatively impact general audience interest. (Chatterjee, Monalisa, IPCC WGII TSU)
897	28	54	12	54	37	Again, what about increased tourism and more employment opportunities for northern residents? (Francis, Jennifer, Rutgers University)
898	28	54	12	54	37	The question posed on line 12 is not answered in the narrative that follows. The response, as written, simply identifies some positive and many negative impacts of climate change in Polar Regions. Could a statement such as, "On balance, the numerous negative impacts of climate change seem to outweigh the positive impacts in the Arctic, and XXX (I cannot comment for the Antarctic)." This would answer the question posed on line 12. (Rosales, Jon, St. Lawrence University)
899	28	54	12	54	37	The "Frequently Asked Question" 28.1 is not really answered in the accompanying paragraph. This entire FAQ could easily be omitted. (UNITED STATES OF AMERICA)
900	28	54	16	54	16	Accessibility to onshore resources could also grow as a result of deglaciation and increased shipping opportunities. Suggest to delete "offshore" (DENMARK)
901	28	54	16	54	16	For the described percentage decline, what is its baseline? If it is not approximately 2010, it should be specified. (Mach, Katharine, IPCC WGII TSU)
902	28	54	22	54	28	this section is not balanced with the rest of the statements in the box and should be shortened. (DENMARK)
903	28	54	26	54	27	More context is needed for the reader to understand the percentages given. (Mach, Katharine, IPCC WGII TSU)
904	28	54	34	54	35	No where is the potential of the introduction of disease into the seasoanlly isolated semi permanent or seasonal research stations and also arctic communiteis by visiting tourists been mentioned. "Residents" are often isolated and have not developed immunities to the latest infections and often isolated communiteis don't have adequate capacity to manage these outbreaks. (Church, Ian, Canadian Foundation for Climate and Atmospheric Science/ IPY Canada)
905	28	54	39	0	0	Suggest that this FAQ be revised to "Why are changes in sea ice so important to the polar regions?". While sea ice change have broader implications as well, the response to this FAQ focuses on issues specific to the polar regions, and other issues are covered elsewhere in the report. (CANADA)
906	28	54	39	0	0	FAQ 28-2 Authors may wish to categorize on the basis of impacts on human and natural systems. (Chatterjee, Monalisa, IPCC WGII TSU)
907	28	54	39	54	39	The correctly formulated question should be "Why are changes in sea ice so important for Arctic food webs?", or the answer should include sections referring to the importance of sea ice to physical processes as well, e.g. albedo. (NORWAY)
908	28	54	40	54	41	I suggest to explain in more detail what growing season refers to. I assume it addresses either ice growth or algae growth. (Gerland, Sebastian, Norwegian Polar Institute)
909	28	54	49	54	49	Inaccurate to indicate in parenthesis that polar bears are one species that utilize sea ice as haul-outs during foraging trips. Sea ice is the main habitat for polar bears, and you can't really say that polar bears are hauling out. Please consider rephras (NORWAY)
910	28	54	50	54	53	This may be a statement where presentation of a level of confidence within a frequently asked question is merited. (Mach, Katharine, IPCC WGII TSU)
911	28	55	5	0	0	Please add as 3rd FAQ: 'Why the Arctic climate is changing so rapidly?' (GERMANY)
912	28	57	4	57	4	In accordance with comment above (ch 28, p.30, l. 11), the missing reference is: Bjornsson H., T. Johannesson and A. Snorrason, 2011. Recent climate change, projected impacts and adaptation capacity in Iceland. Í: Linkov, I. & T. S. Bridges (Ed.) Global change and local adaptation. NATO Science for Peace and Security Series - C: Environmental Security. Springer, Dordrecht, s. 465-475. (ICELAND)

#	Ch	From Page	From Line	To Page	To Line	Comment
913	28	65	6	65	6	In accordance with comment above (ch 6. p 30 l. 16) the following reference should be added: Halldorsson, G., B.D. Sigurdsson, B. Hrafnkelsdottir, E.S. Oddsdottir, O. Eggertsson and E. Olafsson, 2013: New pests on trees and shrubs and changes in pest dynamics: a review. <i>Icelandic Agricultural Sciences</i> , 26, 16-25. (ICELAND)
914	28	65	45	65	45	Mismatch in reference style: The surnames of Hjálmar Hátún and Mark Payne are written out full but for conformity with other references "Hjálmar" should only be "H" and "Mark" should be "M" (ICELAND)
915	28	67	13	67	14	If articles in revision can be included here, this citation should be changed to: Ignatowski, J.A., and J. Rosales, 2013: Identifying the Exposure of Two Subsistence Villages in Alaska to Climate Change Using Traditional Ecological Knowledge and Climate Science. <i>Climatic Change</i> . In revision. If you cannot use an article in revision, our findings are documented on our website at www.AKSIK.org and could be cited as AKSIK 2013. (Rosales, Jon, St. Lawrence University)
916	28	73	22	0	0	*Observation: Incorrect reference details *Reference should read: Nakashima, D.J., K. Galloway McLean, H.D. Thulstrup, A. Ramos Castillo, and J.T. Rubis (2012). <i>Weathering Uncertainty: Traditional Knowledge for Climate Change Assessment and Adaptation</i> . UNESCO and UNU, Paris and Darwin, 120pp. (Galloway McLean, Kirsty, United Nations University - Institute of Advanced Studies)
917	28	73	22	73	25	(Nakashima et al 2011) has now been peer-reviewed and formally published. Therefore please now cite as (Nakashima et al 2012): Nakashima, D.J., Galloway McLean, K., Thulstrup, H.D., Ramos Castillo, A. and Rubis, J.T. 2012. <i>Weathering Uncertainty: Traditional Knowledge for Climate Change Assessment and Adaptation</i> . Paris, UNESCO, and Darwin, UNU, 120 pp. (Nakashima, Douglas, UNESCO)
918	28	77	40	77	40	In accordance with comment above (ch 28., p. 30., l. 16) a reference should be added: Sigurdsson, B. D., A. Snorrason, B.Th.Kjartansson and J.A. Jonsson, 2007: Total area of planted forests in Iceland and their carbon stocks and fluxes. In: <i>Effects of afforestation on ecosystems, landscape and rural development</i> [Halldórsson, G., E. S. Oddsdóttir, and O. Eggertsson (eds.)]. TemaNord 508. Nordic Council of Ministers. pp. 211-217. (ICELAND)
919	28	82	0	0	0	Table 28-1: We do not believe that this table is needed because it is not climate-related. Please consider deletion. (UNITED STATES OF AMERICA)
920	28	82	0	0	0	Table 28-2: We do not believe that this table is needed because it is not climate-related. Please consider deletion. (UNITED STATES OF AMERICA)
921	28	84	0	0	0	Table 28-2: Not needed and too specific. (UNITED STATES OF AMERICA)
922	28	84	0	0	0	Tables 28-1 and 28-2. Citations for the information presented in these tables must be provided. (Mach, Katharine, IPCC WGII TSU)
923	28	85	0	0	0	Figure 28-1 contains a world map with national borders. It is suggested to use a map without borders to avoid unnecessary disputes. (CHINA)
924	28	85	0	92	0	All Figure captions (except Figure 28-2): The author team should further develop the caption for these figures to provide guides for the reader in interpreting the information illustrated. The author team should include a sentence in the figure caption explaining the main message of each figure. (Estrada, Yuka, IPCC WGII TSU)
925	28	86	0	0	0	Fig. 28-2; legend: under (b), provide the time period over which changes were assessed. (Molau, Ulf, University of Gothenburg)
926	28	86	0	0	0	Figure 28-4: For what year? (UNITED STATES OF AMERICA)
927	28	87	0	0	0	Fig. 28-3: Fennoscandia and Iceland not included in the figure. Why? (Molau, Ulf, University of Gothenburg)
928	28	88	0	0	0	Figure 28-4: This is an excellent graphic, as it clearly notes the importance of regional influences in the Arctic. In general, the report should attempt to be more specific as to how climate change will impact specific regions, as for the most part, the impacts will vary considerably by region. (UNITED STATES OF AMERICA)
929	28	89	0	0	0	Fig. 28-5: Define bboe (Francis, Jennifer, Rutgers University)

#	Ch	From Page	From Line	To Page	To Line	Comment
930	28	89	0	0	0	Figure 28-5: We do not believe that this table is needed because it is not climate-related. Please consider deletion. (UNITED STATES OF AMERICA)
931	28	89	0	0	0	Figure 28-5. The acronym NGL should be specified within the caption. (Mach, Katharine, IPCC WGII TSU)
932	28	90	0	0	0	Figure 28-6: We do not believe that this table is needed because it is not climate-related. Please consider deletion. (UNITED STATES OF AMERICA)
933	28	91	0	0	0	Figure 28-7: We do not believe that this table is needed because it is not climate-related. Please consider deletion. (UNITED STATES OF AMERICA)
934	28	91	0	0	0	Figure 28-7. It would be helpful to indicate further what is meant by "reference scenario" within the caption, in the descriptions of parts A and B. (Mach, Katharine, IPCC WGII TSU)
935	28	92	0	0	0	Fig. 28-8: Why is (1) so short? Is it not a projection? (Francis, Jennifer, Rutgers University)
936	28	92	0	0	0	Fig. 28-8: y axis legend in Russian! (Molau, Ulf, University of Gothenburg)
937	28	92	0	0	0	Figure 28-8 Is stated in Russian. Please, consider translation to English (Velázquez, David, Universidad Autónoma de Madrid)
938	28	92	0	0	0	Figure 28-8: What does the shading signify? Make it more visible. Make caption in English. Label x axis (UNITED STATES OF AMERICA)
939	28	92	0	0	0	Figure 28-8. For what scenarios of climate change is this projection being made? What is the y-axis? (Mach, Katharine, IPCC WGII TSU)
940	28	92	1	92	1	The vertical axis label for Fig. 28-8 is not given in English. The figure contains some gray shading (possibly indicating standard dev., starting at around 1984 on y-axis values from about 25 to 60) which is not explained in the caption or text. See also comment on corresponding section in text (page 50). (Gerland, Sebastian, Norwegian Polar Institute)