WMO

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE

UNEP

IPCC WGII
Fourth Assessment Report
Climate Change Impacts, Adaptation and Vulnerability

Government and Expert Review of Second Order Draft

Specific Comments

Responses to EXPERT REVIEW COMMENTS

Chapter 15

August 2006

Late comments are placed at the end.

Discussion of expert review comments and record keeping

IT IS RECOMMENDED THAT:

- AUTHORS BEGIN WORK ON THE COMMENTS IMMEDIATELY. SUBSTANTIVE COMMENTS NEED TO BE SEPARATED FROM NON-SUBSTANTIVE, AND THE TWO SHOULD BE TREATED DIFFERENTLY
- CONTACT IS MADE BETWEEN AUTHORS AND THEIR REVIEW EDITORS IN AUGUST

Substantive comments

- The chapter writing team should discuss all substantive expert review comments, by email and/or at Cape Town.
- Substantive comments require full and proper consideration. The *Principles Governing IPCC Work* state that:
  - genuine controversies should be reflected adequately in the text of the Report and
  - it is the role of the Review Editors to advise the lead authors on how to handle contentious/controversial issues
- You must record the outcome of these discussions in this document, under the column 'Notes of the Writing Team'.

Non-substantive comments

- For non-substantive comments, a very brief entry should be made in the column 'Notes of the Writing Team'. The following terms are acceptable:
  - Addressed
  - Not applicable
  - Text removed
  - A tick to denote a comment has been addressed (somewhere on the document this should be stated)

General

- The record should be kept in this document, ideally electronically.
- The document becomes part of the traceable account of the Working Group II Fourth Assessment. When completed to the satisfaction of the Review Editors, a copy should be returned to the TSU by the **8th December 2006**.

	Chapter 15 ZOD comments by Co-Chairs and TSU	Has this been addressed in the SOD?	Author responses:
15.Z1	**GENERAL** This is well constructed and researched, although some sections are short of references, for example, on indigenous peoples [see ACIA report], Antarctic biomes [a CA from Argentina or Chile would help], permafrost, and engineering infrastructure [short on references to Russian experience].	Indigenous peoples now well covered Antarctic biomes –OK, but no CA from south of the Equator Permafrost and engineering covered – good reference section	No response required No response required We anticipated that the South American input would have been provided by the RE from that region. In addition no evidence was forthcoming of missing essential scientific information from this region. No response required No response required
15.Z2	The Artic is covered pretty comprehensively in terms of history, current climate sensitivity and (mostly) future impacts. However, by comparison, the coverage of Antarctic issues is thin, and needs building. The authors should be encouraged to explore the Latin American literature developed by the Antarctic South American institutions. Currently interdisciplinary teams have undertaken specific studies and research work. Different projects are under development with the assistance of developed countries.	Enough on Antarctica now, but the authors have not explored the Latin American literature – they could usefully talk to Gino Cassasa in Cape Town.	Gino Cassasa was not able to come to Cape Town. Andres Rivera was also not available. Requests have been made but neither has contributed any Latin American literature that we can usefully include.
15.Z3	The TAR summary is compact and useful.	Still good, but as you read through the chapter you don't get the sense that the material you are reading is always new since the TAR.	Every effort has been made to include material that is new since the TAR. We include only material that is: Required by the specified section headings Represent rapidly changing themes Thematic issues that provide a more general insight. (Some evidence that our material is up to date is that most references are post-TAR)
15.Z4	Is there new literature suggesting some thresholds of impacts, that might be reported here but also passed onto Chapter 19?	No, and authors identify thresholds as a key uncertainty in their final section.	There are very few specific thresholds identified in the literature, except for those physical

			ones well covered by WGI
15.Z5	It is not always clear what the timescales are of your assessed effects under mean climate change: i.e., are they for the 2030s, or 2050s or 2080s?	Still not clear	This reflects the essential shortage of the information on scenarios coming from WG-1. We are quoting the literature that employs different time slices and we do not scale the findings, unless done by original authors to prescribed 2030, 2050, and 2080.
Of 15.Z6	Is it possible to say anything about effects under: 1. scenarios of stabilisation and 2. different development pathways (e.g. SRES scenarios)?	Nothing yet in the text; if it is/ is not, please say so.	See the response to previous comment.
15.Z7	Mention should be made of current knowledge about impacts/adaptation for the possibilities of a WAIS collapse, and Greenland Ice Sheet melting.	Abrupt climate change not dealt with; please do so and also refer across to Ch 19.	There was a lot concerning this subhect in the TAR, and there is a great deal in WG-I. We feel that providing there is good reference to Ch4 WG-I, we do not need to include an in depth discussion in Ch15.m when there are many other topics to cover.
15.Z8	Would it be possible to include some diagrams which could break up the text and make it more accessible to readers? Use of tables and figures is a good way of summarizing information and saving space.	Yes this has been done. Some very good figs. But not one table. Tables could be used to good effect not only to break up text but to shorten it – there are quite a lot of 'lists' in the text.	We include a table and retain figures as much as space allows
15.Z9	The ZOD does not refer to other WG II Chapters as it should, for example, regarding human health (Chapter 8). There is no reference to current increases of UV_B radiation, particularly in the Antarctic. References to other Chapters (3, 4 and 6) might be pertinent. However, reference to Chapter 1 and WG I is included.	Only two references to other chapters. On p.26 l.28 authors refer to Ch. 2 but must mean Ch. 4. On p.32 l.38-40 authors refer to Ch. 11 and Ch. 16 but Ch 16 has nothing on Antarctic Islands. UV now mentioned.	Noted and imporved Agreed References to other chapters have now been resolved
15.Z10	The whole Chapter relies heavily on bullet points. Is this good or bad? Maybe it will be necessary to convert some parts to continuous prose.	If anything, now too few bullet points	Bullet points have been reduced
15.Z11	**CONTENT** Section 15.2 is weak, but can be much improved by moving material from section 15.4. Section 15.4 (Impacts and Vulnerabilities) contains too much information on historical and current trends, which should be in Section 15.2.	Fixed – 15.2 now strong and material much better organized.	No response required

15.Z12	How much of the current draft in Section 15.2 is new material, not reported in TAR?	Most refs now post TAR, but authors need to go through and check where they are using pre-TAR references whether they are actually presenting a finding that was in the TAR. See, e.g., p.9 l.20-26	This is a very important subject area and we feel the need to include it, even if newer references are not available.
15.Z13	Maybe the distribution of Section 15.2 contents in three subsection: 15.2.1. Climate, environment and socio-economic conditions in the Arctic 15.2.2. Climate and environmental conditions in the Antarctic. 15.2.3. Vulnerability and adaptive capacity would improve the understanding of this section 15.2.	Done	No response required
15.Z14	Section 15.4 is uneven. The subsection 15.4.3.1, on historical variations in fish stocks, is far too long, and much (all?) of it should be in Section 15.2.	This is now fixed	No response required
15.Z15	Subsection 15.3.1: Mentions the effect of climate change on migrating species, but for the Artic. Regarding the Antarctic, and particularly the Southern Ocean, reference is made to the *Phaeocystis Antarctica*, related to CO2 sequestration. No reference is made to the Krill species.	Krill now covered in 15.2.2.1 and 15.4.5	No response required
15.Z16	LENGTH The ZOD Chapter 15 is incomplete. However, it already exceeds the Plenary-agreed page length of 25 printed pages in AR4. We estimate that the excess is around 11 text pages. It does not yet contain an Executive Summary, and items under subsections like 15.4.2.5, 15.4.2.6, 15.4.2.7 and 15.8 are still to be drafted or completed.	Still 5 pages too long	TSU are now happy with page length.
15.Z17	Section 15.5 will be created from parts of earlier sections, so will not add greatly to length. But adequate treatment of Section 15.6, 15.7 and 15.8 will take the chapter well over length. There is scope for pruning.	Prune more	The degree of the overrun is not clear at this stage due to uncertainties on the rules for formatting
15.Z18	A table of summarized conclusions, which would emphasize the new knowledge, and demonstrate whether it: a) confirms or b) revises TAR conclusions, would help to reduce length.	Not done	Conclusions improved and re-written
15.Z19	BALANCE As already mentioned, this Chapter is mostly devoted to the Arctic. Further information on the Antarctic and Southern Ocean conditions needs to be assessed.	Done	No response required
15.Z20	Section 15.4 starts on page 14 and goes on to page 39.	15.4 is now 13 pages long (down from 25), so	No response required

	We estimate that it should take around half the chapter.	certainly shouldn't be shortened further.	
15.Z21	The subsection on marine ecosystems in the Antarctic (15.4.4), showing 12 lines, is far too short, as compared with 15.4.3 (5 ½ pages), regarding the Arctic.	Is now section 15.4.5 and is 51 lines long (cf 15.4.3 marine ecosys in the Arctic which is 43 lines)	Marine ecosystems in the Southern Oceans, occupied two full pages of the TAR, including a text box, we believe that the reduced emphasis on this area is thus reasonable.
15.Z22	Some texts are repeated, i.e. lines 21 to 35, in page 12, repeat the information in lines 36 to 49, in page 10.	Fixed	No response required
	Chapter 15 FOD comments from Co-Chairs and TSU	**Has this been addressed in the SOD?**	**Author responses:**
	Martin Parry comments		
15.F1	1) Equivalent to max 25 printed pages would be xx pages in ZoD format; so some condensing of text is needed	Still 5 pages overlength	We will meet the page requirements and have considered the cuts.
15.F2	2) But current proportions of space allocated to each sections seem right.	15.4 needs to stay at the current length while other sections are cut. A possible strategy is: • Cut 0.5p from 15.5 • Cut 1.0 page from 15.6 (limit each case study to 0.5 page, but Megadeltas needs a map) • Cut 0.5 from 15.7, 15.2 and 15.3 each • Cut 15.4.7 and 15.4.6 by 0.5 p in total • • Cut ES by 0.5 page – it loses impact because it has too many points • Move 15.4.4 to Case Studies and give it 0.5 page This gives ~4 pages saving. Figs 15.1 and 15.2 will display on a page which brings you close to target.	We will meet the page requirements and have considered the cuts.
15.F3	Is there new information available that can be summarised regarding projected effects: a) at different timescales (eg the DDC's projections for 2020s, 2050s and 2080s); b) impacts	Apparently not, since not yet included. If this is the case, please say so	We already noted that this is a case, see response to comment 5.

	under stabilisations scenarios (550 and 750 GCM projections); and c) effects under GCM project with various SRES forcings.		
15.F4	Some small diagrams to alleviate the text?	Done	No response required
15.F5	Impacts under extreme scenarios: eg WAI collapse.	Not there	WAIS collapse is not one that can be dealt with briefly and we believe that the way to go here is to show adequate reference to chapters in WG-I where much space is given over to this.
15.F6	A table of summarised conclusions? (which would emphasis the new knowledge, and where this either a) confirms or b) revises TAR conclusions.	Not there	We do not believe that a table is suitable for conclusions. Materials in tables is prone to being miss-cited and so is not a suitable way to present conclusions.
15.F7	How much of current draft in section 2 is new material, and not reported in TAR?	Most refs now post TAR, but it still isn't clear which of their findings relate to post-TAR material, and which are actually pre-TAR.	All post-TAR references relate to new or improved understanding. We have removed some pre-TAR citations.
	Jean Palutikof comments		
15.F8	Length: this chapter is overlength by around 10 text pages, so some substantial trimming is required. This is especially the case since it is unfinished - Section 15.8 is incomplete.	Still overlength. See 15.F2	See above
15.F9	Executive Summary: this is a good Executive Summary, using bullet points to present the key findings of the chapter. Much of the first paragraph can be removed, although the statement that warming is likely to be greater at the Poles should be retained as background.	The first para is the same, except for some minor rewording and one extra sentence has been added.	Executive summary has been rewritten
15.F10	The figures are beautiful - can the TSU please talk to your graphic artist?	Yes, TSU have been given details of the artist. Thanks	No response required
15.F11	Contributing Authors: there are 8, which is perhaps enough, but the CLAs and LAs should ask themselves whether they have properly covered the field with the full range of expertise. The ZOD for this chapter showed a bias towards the Arctic and away from Antarctica - is there a proper balance this time, and could more CAs be used to help with this?	Geographic imbalance is now mostly addressed.	No response required
15.F12	Headings: the reduced-form headings are broadly followed. Section 15.8 is 'Key uncertainties' with nothing about Research Priorities - presumably research priorites will be added since this section is unfinished.	Research priorities still absent from title and section 15.8	These have been used
15.F13	Balance. Around half the text should be on Section 15.4 Impacts. Here there are around 17 pages for section 15.4 and 41 in total. This is about right, but it would be good if	Not done. still needs shortening outside section 15.4. See 15.F2	We have a suitable balance now.

	the shortening is concentrated outside Section 15.4.		
15.F14	The conclusions, as put in the bullet points of the Executive Summary, are rather general and quantitative. It would be good to have some more quantitative statements if possible. Tables have been built for the SPM which show impacts related to incremental global mean temperature changes, and to times in the future under different SRES scenarios. Chapter 4 Table 4.5 lists impacts against temperature changes, and Chapter 11 Table 11.11 lists impacts at future dates under SRES. Please have a look at these.	There are no tables in this chapter. Tables are a very good way of presenting a lot of information (qualitative and/or quantitative) in a readily accessible form, ESP WHEN ONE IS TRYING TO SAVE SPACE.	There is a table now.
15.F15	Some summarizing/synthesisng figures could be added. There a few good examples in the FODs, such as Chapter 4 Figures 4.9 and 4.10. Fig. 4.9 is a map of the location of major impacts. Figure 4.10 is a sectoral burning embers diagram, but surely the concept could be applied at the regional scale. We want to include such material in the SPM and TS, but need the underlying evidence from the chapters. Please consider whether you could usefully contribute.	The figure on Arctic sea ice and permafrost changes which was in the FOD has been removed, and is NOT in the SOD, which is unfortunate. Apart from that all the figures are the same and no new figs have been added. A map of the location of Key Vulnerabilities would still be useful.	The sea ice part of the figure is now incorporated elsewhere, the permafrost map was removed for reasons of justifiability rather than aesthetics, and so should not be used elsewhere. We note that one of the main messages of the chapter is sub-regional variability, it would thus be inappropriate to present regional summaries.
15.F16	There is not a single table in this chapter. Problems of length could be addressed by moving material into tables - these tend to take up less space than text. Readers will find it easier to access key findings It will help the authors to see what their key findings are, and will hopefully provide useful material for the SPM and Technical Summary	There are no tables in this chapter. Tables are a very good way of presenting a lot of information (qualitative and/or quantitative) in a readily accessible form, ESP WHEN ONE IS TRYING TO SAVE SPACE.	See above
	Chapter 15 SOD comments by Co-Chairs and TSU		**Author responses:**
15.S1	**LENGTH:**	36 (target = 31) therefore overlength	
15.S2	**ARE PAO HEADINGS PRESENT?**	15.2, 15.3 15.5 + 15.6 are correct 15.1, 15.4, 15.7 + 15.8 are not as prescribed; please use reduced-form POA headings exactly, as other chapters do, thus helping readers cross over between chapters	To the extent possible we have already modified the original headings developed by the author's team to PAO (or POA) format.
15.S3	**HAVE MOST GENERAL COMMENTS OF ERs FROM ZOD AND FOD BEEN COVERED?**	ZOD yes, mostly FOD, no, not really	Yes
15.S4	**ARE REFERENCES BROADLY COMPLETE?**	Yes	No response required
15.S5	**IS THERE LINE-OF-SIGHT TEXT → ES AND TEXT+ES → TS+SPM?**	No, ES doesn't have source notes in.	Has been added
15.S6	ES doesn't have source notes in. Please add them as they are very useful.		It does now.

15.S7	Figure 1 takes a lot of space for a location map. Could the geographic info not be given in any of the other maps? I only picked up one reference in the text to this figure, likewise the feature of 'polar front' is only mentioned once in the text – but with no ref to Fig. 1.	No. The polar front is a part of the definition of the Arctic and the Antarctic. We will add a definition of the Polar Front to the glossary. The Polar Front has been added on Figure 5.5
15.S8	There is text on coastal erosion due to changes in permafrost and sea ice (15.4.7), but nowhere did I see this linked to rising sea levels and what that would do to amplify the effect in future. [Unless it is implicit in this statement from section 15.7 on page 37: *Despite discrepancies in details, by the mid-21st Century, all IPCC scenarios yield a discontinuous high-risk zone around the Arctic Ocean, indicating a high potential for coastal erosion.*]	In the first sentence of 15.4.7.1. Sea level rise is listed as one of the factors that govern the coastal erosion, however is not addressed here in detail due to lack of publications on that.
15.S9	In the FOD there was a figure on Permafrost and sea ice in the Arctic up to 2090 which has been removed from the SOD. Some of the info it contained is now in the SOD fig 15.2, but a lot has been lost. Could we have the missing bits back, please (sea ice 2010-30, 2040-60; current permafrost boundary, projected permafrost boundary) Also include which scenarios/models were used in the projections.	No, the permafrost map was removed for reasons of justifiability and should not be replaced
15.S10	Page 17, lines 8 to 18: IPCC do not run models or have modelling centres! Either delete or reduce these two paragraphs, if the latter just talk about models assessed by the IPCC.	Text was changed.
15.S11	There are no tables in this chapter. Tables are a very good way of presenting a lot of information (qualitative and/or quantitative) in a readily accessible form, ESP WHEN ONE IS TRYING TO SAVE SPACE.	See above
15.S12	Need something/more on research needs at the end of the chapter.	A table linking uncertainties with related scientific recommendations/approaches has been included in section 15.8
15.S13	This chapter starts well, and is exciting; it tails off badly after page 31. It is suggested that the authors concentrate their efforts there, and think of shortening some of the text.	A conclusion and table have now been added.
15.S14	Some of the terminology, and some of the concepts, are not appropriate for the readership – you should be targeting the policymaking community but will only frighten them away. For example, 'trophic level structure' and 'genotypes' (p.23 27-31). This is a growing problem through the chapter, with the beginning being quite good in this respect.	As far as it is possible we have removed technical terms. Those that remain are defined in the glossary.
15.S15	The language is rather uneven in this chapter. The CLAs now need to work on editing to give it a more homogeneous feel.	Text has been revised and edited.
15.S16	The authors teeter on the edge of appearing a bunch of technocrats with no interest in communicating their message to policymakers, but only an urge to impress with technical terms. Come on, guys, we know you can do better than this.	We find this offensive and unconstructive! See above (15.S14).
15.S17	This is potentially one of the strongest chapters, but still has some way to go to achieve its potential. **Key things still to do:**	All these points have been considered and adjustments made

	• Some shortening.required • Removal of unnecessary technical terminology and technical explanations unnecessary to the story. • Re-write Executive Summary to include references to locations in main text and to shorten to give more 'punch'. • Editorial work by CLAs to get a more even feel to the chapter and to make it more accessible to the target readership. The latter sections need substantial 'brightening up'. • Authors need to make it clear what are new results from the TAR. All pre-TAR references need to be checked. Could post-TAR substitutions be made? Is this really new post-TAR material? • Think about including at least one summarizing map or figure, and a summary table. Where and what are the key vulnerabilities? Section 15.3.1 is essentially a summary table and is very effective. • Think about Section 15.7. This really doesn't work.	to the chapter in the spirit of the comments.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Notes of the writing team
E-15-1	A	0				This is potentially one of the strongest chapters, but still has some way to go to achieve its potential. Key things to do: • Some shortening.required • Removal of unnecessary technical terminology and technical explanations. • Re-write Executive Summary to include references to locations in main text, and to shorten it to give more 'punch'. • Editorial work by CLAs to get a more even feel to the chapter and to make it more accessible to the target readership. The latter sections need substantial 'brightening up'. • Authors need to make it clear what are new results from the TAR. All pre-TAR references need to be checked. Could post-TAR substitutions be made? Is this really new post-TAR material? • Think about including at least one summarizing map or figure. Where and what are the key vulnerabilities? Section 15.3.1 is essentially a summary and is very effective. • Think about Section 15.7 which really doesn't work. (Paul van der Linden, Met Office)	Repeated comment, see above.
E-15-2	A	0				This chapter still needs considerable editing. I find the sequience of presentation sometimes confusing in that pieces of informaiton that should be together appear in other places. Some the paragraphs do not seem to actually say anything explicit. The Secretariat of WGI and WGII should decide what material on the observed chanegs in the Arctic and Antatrctic and comments on projections should be in WGI and what in WGII. One has the sense that this chapter is written independently of what is in WGI and there is need for consistency. There is a sense that paragraphs were written by single authors and there is not yet any overall editing.	Accepted This is really a result of the prescribed section heading that demand repetition and fragmentation of material that could otherwise appear together Text has been re-written. There is only a quick reprise of WGI material as the basis for discussion. No change is necessary We are not aware of any inconsistency This is true, the final edit has allowed some homogenisation

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Notes of the writing team
						There are quite a few errors in reference list. (Gordon McBean, Institute for Catastrophic Loss Reduction, University of West. Ontario)	TSU will be checking this later
E-15-3	A	0				This chapter starts well, and is exciting; it tails off badly after page 31. It is suggested that the authors concentrate their efforts there, and think of shortening some of the text. (Paul van der Linden, Met Office)	Repeated comment
E-15-4	A	0				This chapter seems very thin. Given the recent ACIA report it would seem that this chapter should be much more robust on the Arctic component. Discussion of ice loss seems oddly optimistic, given what we know about the global ramifications of ice loss in the polar regions. Additionally discussion of the effects of climate change on such species as the polar bear and some penguin are virtually non-existant. Biodiversity and global climate system effects are very brief, while human impacts and benefits are the focus. (Lara Hansen, WWF)	Within the page constraint, the content is robust and updated from ACIA. The impacts of loss of polar ice on the rest of the globe is not focus of this chapter – see WGI A paragraph on marine mammals including polar bears has been included. Do not agree that Biodiversity and Global climate is under-represented, but human impacts is definitely a new focus.
E-15-5	A	0				there is very little reference to the errors associated with the data, results and projections that are presented in this chapter - while it is impossible to provide numerical margins for every piece of evidence that is provided it might be worth having a section that acknowledges the difficulty in collecting data in polar regions, the sparse observational network, the relatively short period for which satellite data are available etc, and thus qualifying the results that are presented. there are many more uncertainties pertaining to changes in the climate system, ocean system, ecosystem and cryospheric system that need to be addressed - and along with this the complexity of these systems, their close interaction and feedback, their sensitivity and potential to switch into a different state of (dis)equilibrium etc - the bias in this chapter appears to be towards the terrestrial and marine ecosystems and not enough is made of the atmospheric, oceanic and cryospheric processes that may effect some of those ecosystem changes A lot of grammatical errors.	We have made efforts to address these points in the text. Many of these issues are discussed extensively by WG-1.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Notes of the writing team
						(Fiona Cawkwell, University College Cork)	
E-15-6	A	0				There are no tables in this chapter. Tables are a very good way of presenting a lot of information (qualitative and/or quantitative) in a readily accessible form, ESP WHEN ONE IS TRYING TO SAVE SPACE. (Paul van der Linden, Met Office)	Repeated comment
E-15-7	A	0				The rest is excellent! (Hans Meltofte, National Environmental Research Institute)	Thanks!
E-15-8	A	0				The language is rather uneven in this chapter. The CLAs now need to work on editing to give it a more homogeneous feel. (Paul van der Linden, Met Office)	Repeated comment
E-15-9	A	0				Some of the terminology, and some of the concepts, are not appropriate for the readership – you should be targeting the policymaking community but will only frighten them away. For example, 'trophic level structure' and 'genotypes' (p.23 27-31). This is a growing problem through the chapter, with the beginning being quite good in this respect. (Paul van der Linden, Met Office)	As far as it is possible we have removed technical terms. Those that remain are defined in the glossary.
E-15-10	A	0				COMMENT: Whilst the chapter is about polar regions it has little on the Antarctic (except for a case study on the Antarctic Peninsula. Additional relevant literature includes Barbraud, C., and H. Weimerskirch (2001). "Emperor penguins and climate change." Nature 411(6834): 183-186. — (2003). "Climate and density shape population dynamics of a marine top predator." Proceedings of the Royal Society of London Series B-Biological Sciences 270(1529): 2111-2116. — (2006). "Antarctic birds breed later in response to climate change." PNAS: 0510397103. Beauplet, G., C. Barbraud, M. Chambellant, and C. Guinet (2005). "Interannual variation in the post-weaning and juvenile survival of subantarctic fur seals: influence of pup sex, growth rate and oceanographic conditions." Journal of Animal Ecology 74(6): 1160-1172. Forcada, J., P. N. Trathan, K. Reid, E. J. Murphy, and J. P. Croxall (2006).	Many of these references have now been included.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Notes of the writing team
						"Contrasting population changes in sympatric penguin species in association with climate warming." Global Change Biology 12(3): 411-423. Inchausti, P., C. Guinet, M. Koudil, J.-P. Durbec, C. Barbraud, H. Weimerskirch, Y. Cherel et al. (2003). "Inter-annual variability in the breeding performance of seabirds in relation to oceanographic anomalies that affect the Crozet and the Kerguelen sectors of the Southern Ocean." J Avian Biology 34(2): 170-176. Jenouvrier, S., C. Barbraud, and H. Weimerskirch (2003). "Effects of climate variability on the temporal population dynamics of southern fulmars." J Anim Ecology 72(4): 576-587. Jenouvrier, S., H. Weimerskirch, C. Barbraud, Y. Park, and B. Cazelles (2005). "Evidence of a shift in the cyclicity of Antarctic seabird dynamics linked to climate." Proc. R. Soc. Lond. B 272(1566): 887-895. Lovenduski, N. S., and N. Gruber (2005). "Impact of the Southern Annular Mode on Southern Ocean circulation and biology." Geophysical Research Letters 32(11). Moline, M. A., H. Claustre, T. K. Frazer, O. Schofield, and M. Vernet (2004). "Alteration of the food web along the Antarctic Peninsula in response to a regional warming trend." Global Change Biology 10(12): 1973-1980. Saether, B.-E., V. Grotan, P. Tryjanowski, C. Barbraud, S. Engen, and M. Fulin (2006). "Climate and spatio-temporal variation in the population dynamics of a long distance migrant, the white stork." Journal of Animal Ecology 75(1): 80-90. Smith, R. C., D. Ainley, and E. Domack (1999). "Marine Ecosystem Sensitivity to Climate Change." Bioscience 49(5): 393. Weimerskirch, H., P. Inchausti, C. Guinet, and C. Barbraud (2003). Trends in bird and seal populations as indicators of a system shift in the Southern Ocean. 249-256. (William Hare, Potsdam Institute for Climate Impact Research (PIK))	
E-15-11	A	1	1	39	20	General comments: (i) I find the chapter well written and informative; thus I very much welcome ist inclusion into the IPCC Report and look forward to ist publication;	No response required

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Notes of the writing team
						(ii) The whole chpater, though is heavily "Arctic-biased", i.e., the Arctic assumes a much larger fraction of the entire text than does Antarctica. While this may be fully understandable and justifiable, the chapter title ("Polar regions") is somewhat misleading. The reader is expecting a more balanced chapter that treats Antarctica at least somewhat on equal footing to the Arctic. (iii) Given this "bias" I really wonder how this chpater differs from the comprehensive ACIA report, which can, of course, due to its more limited scope (i.e., the Arctic) deal with all the issues in much more detail. (iv) On a more "technical" note, it is obvious that many of the observations and findings for the different "compartments" of the Arctic and Antarctic system are similar. Thus, one keeps reading, e.g., about species migration or the increase in pests and diseases in terrestrial and marine ecosystems. While this -as well- is understandable and a consequence of the chapter design, I would suggest to create some sort of summary figure and/or table that groups the major impacts into a limited number of "generic" impacts and than lists, where these impacts are being found. In this way, the reader would gian an immediate insight into the major impacts of climate change on the polar regions. (Manfred Lange, University of Muenster)	Others have said that the balance is now correct. (The chapter title is not flexible) See numerous previous comments on this topic. Nice idea but space does not permit.
E-15-12	A	1		57		The current version of the chapter does a nice job at identifying climate changes and both unfavorable and favorable consequences. Congratulations on pulling together so much information into a readable and informative text. (Claire Parkinson, NASA Goddard Space Flight Center)	No response required
E-15-13	A	3	0	4		there are some points made in the Executive Summary Key findings which then receive little subsequent coverage which appears unbalanced e.g. local impacts of glacier loss such as increased iceberg hazard and hydropower potential; contaminant capture and issues of pollution; adverse effects of sea ice retreat in the Arctic on ice-dependent mammals; there is also repetition of the points about changing species/ranges/abundances etc	Executive Summmary has been re-writen and referenced to the text.

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						(Fiona Cawkwell, University College Cork)	
E-15-14	A	3	1	4	45	Executive Summary loses impacts because of its length. It needs fewer bullets so that the reader can retain the key points. (Jean Palutikof, Met Office)	ES has been rewritten
E-15-15	A	3	1			COMMENT EXECUTIVE SUMMARY: This would benefit from a brief summary of the projected climate changes for the polar regions (William Hare, Potsdam Institute for Climate Impact Research (PIK))	ES has been rewritten. Given that (1) we are already over length and (2) WGI addresses projections of change, we cannot justify the implementation of this suggestion.
E-15-16	A	3	1			COMMENT EXECUTIVE SUMMARY: Language use to describe impacts is often not clear as to direction and significance eg what does it mean to "affect" ecosystems. Some effort needs to go into making clear where it is possible the magnitude and significance of changes (William Hare, Potsdam Institute for Climate Impact Research (PIK))	"Affect" etc, are used to avoid value judgements about the detrimental etc nature of impacts.
E-15-17	A	3	3	6	4	These changes were observed over the last 5 years? Is the statement meant to imply that long-term changes (i.e. occurring over the last few decades etc.) have now been documented rather than those occurring since publication of TAR -- the statement should be clarified. (Sharon Smith, Natural Resources Canada)	Text has been re-written and clarified.
E-15-18	A	3	6			Delete "the" polar regions (Robert Jefferies, University of Toronto)	Re-written
E-15-19	A	3	13	3	17	There is a need to clarify how impact is being defined here - impact on natural? human systems? This is important for comparison between regions as there is a rather substantial difference in population density etc. It would seem that the potential economic impacts are greater (and also more obvious) for the Arctic compared to the Antarctic. There are numerous settlements in the Arctic as well as resource development etc. This is not really the case for the Antarctic. While changes in the biophysical environment may occur in the Antarctic that may have far reaching impacts, i.e. impact regions outside the Antarctic, it would seem that the socio-economic impacts within the Antarctic itself would be somewhat limited or negligible. It is not clear in this summary if the climate change impacts and associated adaptation etc. discussed in this chapter should be limited to those that are experienced by the region itself. (Sharon Smith, Natural Resources Canada)	1. Climate impacts on natural and human systems are defined in the glossary. 2. The rewritten Executive Summary considers both types of such impacts. 3. The contrasts between the Arctic and the Antarctic are discussed further in the text.
E-15-20	A	3	21	3	21	This is purely an editorial point – the word 'confidence' sometimes comes with a capital 'C' and sometimes with a lower case 'c'. I suggest that the lower case version is used throughout the summary. (Michael Usher, University of Stirling)	Noted

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Notes of the writing team
E-15-21	A	3	21			Add: However "globally", areas in both... (or some equivalent, as it is not clear you are discussing global events) (Robert Jefferies, University of Toronto)	Noted
E-15-22	A	3	23	3	25	From the literature, the likelihood of global feedbacks is already a reality (ACIA key finding 2: Arctic warming and its consequences have worldwide implications). Therefore the confidence of this statement should be very high, or you might want to consider the phrase "The impacts of climate change in the polar regions are increasingly producing feedbacks..." in place of "The impacts of future climate change in the polar regions will produce feedbacks...". The simplest / most direct example of this is the polar amplification and the albedo effect of sea ice (and snow) - a positive feedback that is already under way. (John Streicker, Yukon College)	There is still significant uncertainty remaining in the understanding the effect THC changes and several other mechanisms may have on the radiative forcing, which is why we feel more comportable to keep the uncertainty level as it is now.
E-15-23	A	3	24			Delete:... change in "the" polar regions... (Robert Jefferies, University of Toronto)	No
E-15-24	A	3	25	3	25	This is purely an editorial point – the word 'confidence' sometimes comes with a capital 'C' and sometimes with a lower case 'c'. I suggest that the lower case version is used throughout the summary. (Michael Usher, University of Stirling)	Check "confidence" appears only with lower-case c.
E-15-25	A	3	26	3	30	The impression of this bullet is that climate change will have a quite positive impact on the Arctic - it that the authors' intention (Gordon McBean, Institute for Catastrophic Loss Reduction, University of West. Ontario)	Most of the impacts have both negative and positive components depending on particular perspectives. Here we focus on objective scientific findings.
E-15-26	A	3	26			Add: greenness of the "southern" (?) Arctic.... (Robert Jefferies, University of Toronto)	TVC. Fixed
E-15-27	A	3	30	3	30	This is purely an editorial point – the word 'confidence' sometimes comes with a capital 'C' and sometimes with a lower case 'c'. I suggest that the lower case version is used throughout the summary. (Michael Usher, University of Stirling)	Repeated comment
E-15-28	A	3	30			I think that the term "vegetation zone relocation" is somewhat misleading as the evidence to date is based on local changes, primarily in the sub-Arctic and also individual species will show relocation rather than intact vegetative zones. (Robert Jefferies, University of Toronto)	TVC. "Vegetation zone" is used carefully as a unit that models what will move. "Communities" will not move en bloc so this word was not used. In addition, the Executive Summary has been re-written and some of the above revisions or comments may no longer be applicable.

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E-15-29	A	3	30			I have just come across a recent paper by Tape, Sturm and Racini in Global Change Biology, 12, 686-702 that provides much stronger evidence for shrub advancement in Arctic regions. There is also an additional paper by Sturm, Douglas and Racine that should be referenced as well on this issue of shrub expansion and that is in the Journal of Geophysical Research, 110, 1-13, doi 10.1029/2005JG000013. Together, they strengthen considerably the statements that are being made. In the same issue of Global Change Biology there is a paper by Euskirchen et al. (2006) Global Change Biology, 12, 731-750 on the importance of recent shifts in soil thermal dynamics on the growing season length, productivity and carbon sequestration that should be included. (Robert Jefferies, University of Toronto)	TVC: references added but the papers do not strengthen the case outside Alaska as the evidence is weak. Also, the Euskirchen et al paper has not been cited as this models recent changes and we focus on observed changes
E-15-30	A	3	31	3	35	Not clear if this point is about plants and animals or about climate. Better to have more on plants and animals. (Jean Palutikof, Met Office)	Noted
E-15-31	A	3	33	3	33	This is purely an editorial point – the word 'confidence' sometimes comes with a capital 'C' and sometimes with a lower case 'c'. I suggest that the lower case version is used throughout the summary. (Michael Usher, University of Stirling)	Repeated comment
E-15-32	A	3	36			Quantify the increase in discharge (Robert Jefferies, University of Toronto)	Text has been modified to read "The combined discharge of the six largest Eurasian rivers draining into the Arctic Ocean shows an increase since the mid-1930s of approximately 7%, largely consistent….
E-15-33	A	3	37			add a comma after precipitation (Robert Jefferies, University of Toronto)	Noted
E-15-34	A	3	42	3	42	TAR comes out of the blue. Should be written "Third Assessment Report (TAR)" (David Malcolm, Arctic Energy Alliance)	Editorial point for TSU
E-15-35	A	3	45	3	45	"mammals" could be changed to "animals", since several seabird species are similarly dependent on sea ice - and fish too. (Hans Meltofte, National Environmental Research Institute)	TVC: agreed and done
E-15-36	A	3				ES doesn't have source notes in. Please add them as they are very useful. (Paul van der Linden, Met Office)	Noted and completed
E-15-37	A	4	6	4	6	change "are due to" to "may be due to" (Annika Hofgaard, Norwegian Institute for Nature Research)	No change – statements are made baldly, then qualified using the stated confidence.
E-15-38	A	4	9	4	14	This paragraph does not seem to actually say anything - but it is of high confidence. (Gordon McBean, Institute for Catastrophic Loss Reduction, University of West.	Do not agree, but have removed reference to capelin/polar cod in Hudson Bay

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						Ontario)	
E-15-39	A	4	11	4	12	This example of the replacement of Arctic Cod by Capelin in the Hudson Bay is not discussed further in the main body of the text. As this is a key finding there should be some discussion of the change. (Robert Jefferies, University of Toronto)	Have removed reference to capelin/polar cod in Hudson Bay. I know of no examples of actual displacements, but more southern species have been spreading north.
E-15-40	A	4	11			lower case "s" for species (Robert Jefferies, University of Toronto)	noted
E-15-41	A	4	16	4	17	What is meant by timing and rate of thaw of permafrost? Is the statement referring to timing and rate of active layer thaw? The paragraph would appear to be concerned with seasonal processes and if that is the case then it is the changes in active layer thaw that will be important. (Sharon Smith, Natural Resources Canada)	ES was rewritten
E-15-42	A	4	20	4	24	I am uneasy about this statement as I think that it is an overstatement and it is too simplistic. I do not quarrel with the principle, but I feel the evidence largely comes from sub-Arctic or even the boreal for invading species and for animal-transmitted diseases (Robert Jefferies, University of Toronto)	The Executive Summary has been re-written and some of the above revisions or comments may no longer be applicable.
E-15-43	A	4	21	4	21	invading species: this may, as strongly, be related to human activity level as to changes in climate regimes (Annika Hofgaard, Norwegian Institute for Nature Research)	TVC: agreed, but too specific for the bullets. The text appears later in the chapter. No action
E-15-44	A	4	29	4	31	It could be added that the ability to adabt to climate changes may be weakened through these stressors (Annika Hofgaard, Norwegian Institute for Nature Research)	TVC: agreed, this is already stated in the words “challenge this adaptive ability”
E-15-45	A	4	32	4	37	decreased albedo per se contributes to climate warming (e.g. through increased shrubiness) (Annika Hofgaard, Norwegian Institute for Nature Research)	TVC: agreed – text modified
E-15-46	A	4	36			Add: methane emissions "from melting permafrost" mean.... (Robert Jefferies, University of Toronto)	TVC: agreed, text modified: ES was rewritten
E-15-47	A	4	38	4	41	The statement should indicate that it is the warming and thawing of ice-rich permafrost that is important. The impact will also depend on the design of the structure. In addition, the expected life-time of the structure also needs to be considered and whether impacts of climate change will have an adverse effect on the structure during its lifetime as many structures have been designed to tolerate a certain amount of thaw. Some structures may require substantial investment for adaptation not all of them. Is this more of a short-term cost, ie. remedial action required for some structures but problem will become less as new structures are buillt which take climate change into account. Rewording of the paragraph is	ES was rewritten

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						suggested: "Warming and thawing of ice-rich permafrost may have a detrimental impact on many Arctic structures including critical community infrastructure. Substantial investments may be needed to adapt or relocate communities and structures in response to these changes." (Sharon Smith, Natural Resources Canada)	
E-15-48	A	4	44			I am uncertain what the evidence is for increasing agricultural and forestry opportunities in sub-Arctic and Low Arctic regions. In Canada, shield soils do not offer much scope for agriculture and with increasing paludification and fire-generated tundra the forestry opportunities may not be as large as they seem? (Robert Jefferies, University of Toronto)	TVC: text modified to include “in some areas”
E-15-49	A	5	1	5	1	Replace "TAR" in title with "Third Assessment Report" (could put TAR in brackets) (David Malcolm, Arctic Energy Alliance)	TSU to apply consistent usage
E-15-50	A	5	13	5	13	What is meant by slight warming? Less than 1°C?, 0.1°C? Is the trend significant? The statement should be more quantitative. (Sharon Smith, Natural Resources Canada)	Wording changed to “weaker warming”, meaning less than the 5°C warming over land noted earlier in the sentence.
E-15-51	A	5	17	5	18	Generally, GCMs results and observations are in agreement that there was warming in the Arctic during the 20th Century and this warming was generally larger in the Arctic if compared with the global average. However, GCMs predict the largest warming in the higher Arctic while the measurements show that in the 20th Century a major warming has occurred in the low Arctic and Sub-Arctic (Vladimir Romanovsky, University of Alaska Fairbanks)	Reviewer is correct, but this is more appropriate for WGI.
E-15-52	A	5	20	5	21	Explain what is meant by "not ubiquitous". (Gordon McBean, Institute for Catastrophic Loss Reduction, University of West. Ontario)	Sentence has been reworded.
E-15-53	A	5	20	5	20	Change "Elsewhere warming was not ubiquitous" to "Elsewhere in Antarctica, warming has occurred in some areas but cooling in others." (Claire Parkinson, NASA Goddard Space Flight Center)	Changed as suggested.
E-15-54	A	5	21	5	21	Change "1973-1996" to "1978-1996", to reflect the satellite record, which shows little overall change in Antarctic sea ice extent over the period 1978-1996, when the record is quite good, but suggests an overall decrease for the longer period 1973-1996, when adding in the lesser quality record from the 1970s. (Claire Parkinson, NASA Goddard Space Flight Center)	Changed as suggested.
E-15-55	A	5	23	5	23	The time period over which these changes might occur should be given. (Sharon Smith, Natural Resources Canada)	Added “over the 21st century”.
E-15-56	A	5	28		29	exposure of bare ground is not unique to the Antarctic Peninsula but across the polar regions e.g. in the Queen Elizabeth Islands of Arctic Canada	Agreed but the key concern relates to the Antarctic Peninsula, where ecological change

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						(Fiona Cawkwell, University College Cork)	is likely.
E-15-57	A	5	32	5	32	The sea ice is not lost at the poles but in both polar regions. (Gordon McBean, Institute for Catastrophic Loss Reduction, University of West. Ontario)	Changed as suggested
E-15-58	A	5	32	5	32	Change "sea ice at both poles" to "sea ice in both polar regions". (There is no sea ice at or near the South Pole, which is instead surrounded by land ice.) (Claire Parkinson, NASA Goddard Space Flight Center)	Repeated comment
E-15-59	A	5	33	5	36	The term "near-surface permafrost" is not a very good one to use and it is unclear what is meant by this statement. Is the intent to say that there will be complete thawing of thin permafrost in the southern discontinuous permafrost zone? OR is the intent to say that increases in thaw depth and degradation of permafrost are expected? The term "near-surface permafrost" is very ambiguous. (Sharon Smith, Natural Resources Canada)	It was changed to “permafrost”.
E-15-60	A	5	33	5	36	Changes in permafrost conditions will not necessarily lead to alteration of landscape and damage to infrastructure (i.e. impacts will not be the same everywhere). The impacts on landscapes and infrastructure related to thawing of permafrost will largely depend on the ground ice conditions and also the design of the infrastructures. In some areas there may be negligible impacts on landscape or infrastructure and the statement should reflect this. Rewording is suggested to indicate that these projected changes in permafrost conditions "may" lead to altered landscapes etc. (Sharon Smith, Natural Resources Canada)	Reworded to read “may”.
E-15-61	A	5	49			I would suggest adding the word "extent" to the end of this sentence (Vladimir Romanovsky, University of Alaska Fairbanks)	Noted
E-15-62	A	5	49			Add: of the "sea/land"surface, which will in turn... (Robert Jefferies, University of Toronto)	Noted
E-15-63	A	6	1	6	45	The Figure legend for 15.1 indicates that place names used in the text are shown on the map. Missing is the location of Hudson Bay. Also I believe that the word "Nunavut" appears where Quebec or Ungava is located. The North-West Territories should be located further to the north-west. At present, the name appears where Nunavut is located. (Robert Jefferies, University of Toronto)	Figure revisered
E-15-64	A	6	1			Figure 15.1 - Suggest that in addition to the maps, there is a statement that clearly indcates the area that is considered to be Polar, i.e. north and south of what latitude. (Sharon Smith, Natural Resources Canada)	No, there is no simple definition that works for all sectors, and so the boundary cannot be drawn
E-15-	A	6	41			Figure 1 takes a lot of space for a location map. Could the geographic info not be	No – the diagram is only one column and less

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65						given in any of the other maps? I only picked up one reference in the text to this figure, likewise the feature of 'polar front' is only mentioned once in the text – but with no ref to Fig. 1. (Paul van der Linden, Met Office)	that one page. A lack of familirity with polar regions requires inclusion. Every placename is, effectively, a reference to the map.
E-15-66	A	7	5	15	31	Section 15.2 is long and leisurely. It would benefit from the use of summarizing tables. (Jean Palutikof, Met Office)	Section 15.2 has been reduced.
E-15-67	A	7	13	7	16	This is such an important statement and conclusion that I think you should give the key pieces of evidence to support the statement. (Robert Jefferies, University of Toronto)	Sentence has been added (although this issue belongs more to WGI than WGII).
E-15-68	A	7	13	7	16	The sentence is somewhat unclear. It starts with attribution of recent changes to natural variability and anthropogenic forcing, but the conclusions were made in terms of a relative importance of the circulation-driven changes and changes related to greenhouse warming. The problem is that we cannot strongly relate circulation-driven changes with natural variability or greenhouse warming with anthropogenic forcing. There is always a mix of both. (Vladimir Romanovsky, University of Alaska Fairbanks)	This is a WGI issue. The sentence in question makes no claims about the reasons for the circulation-driven changes, and such claims would be inappropriate here, especially since length constraints do not allow an additional discussion of this complex issue.
E-15-69	A	7	16	7	16	It seems inappropriate to say that the Arctic is "in the early stages of a manifestation of the greenhouse signature" when the greenhouse effect has been an integral component of the Earth's climate for at least a billion years. Probably what was meant here was: "in the early stages of a manifestation of the human-enhanced greenhouse signature." That would make more sense. (Claire Parkinson, NASA Goddard Space Flight Center)	Changed as suggested.
E-15-70	A	7	18	7	20	This is an over-statement. Not all regions of the Arctic have warmed during this period which is implied by the statement. Mention should be made of the anomalous cooling in late winter and early spring in the Ungava, Baffin, west Greenland region that occurred in the 80.s and early 90's and this cooling has now ameliorated. (Robert Jefferies, University of Toronto)	Wording has been changed to indicate that warming occurred in "much of the Arctic". Since the regions mentioned by the reviewer have warmed in the past 5-10 years, the reviewer seems to support the validity of our statement.
E-15-71	A	7	18	7	18	"spring and winter" should read "winter and spring". First it makes sense in terms of the seasonal cycle and second it makes sense since the highest shifts have been in winter. (John Streicker, Yukon College)	Changed as suggested.
E-15-72	A	7	18		20	would be helpful to put some values on 'strongest' and 'smallest' for comparative purposes (Fiona Cawkwell, University College Cork)	Added "nearly 1°C per decade".
E-15-	A	7	18			Not clear why only "1980-present" period is mentioned. The same is also true for	Any mention of temperature changes needs to

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73						the 1950-2000 period (Vladimir Romanovsky, University of Alaska Fairbanks)	be referenced to the specific period of the changes.
E-15-74	A	7	29			precipitation _measurement_ network (Fiona Cawkwell, University College Cork)	Changed as suggested.
E-15-75	A	7	30	7	30	"although coastal vulnerability…" should read "and coastal vulnerability…" (John Streicker, Yukon College)	We desagree. The message is that the coastal vulnerability to storms is increasing with less sea ice, however there is no evidence of increasing storm frquency.
E-15-76	A	7	32			Explain what is meant by irregular in this context and link it with the summary statement on Page 3 line 36. (Robert Jefferies, University of Toronto)	"irregular" has been deleted, so text is now consistent with p. 3, line 36.
E-15-77	A	7	33	7	33	replace "changes temperature" with "changes in temperature" (Manfred Lange, University of Muenster)	Changed as suggested.
E-15-78	A	7	33	7	33	"with changes temperature..." missing a word? Should read "with changes to temperature…" (John Streicker, Yukon College)	Reworded as "changes in temperature" (cf. comment E-15-77).
E-15-79	A	7	34			there should also be some reference to cloud cover - the fact that little is currently known about the frequency and type of cloud cover across the Arctic, that it represents one of, if not the greatest uncertainty remaining in climate modelling, but that it plays a large role in controlling the radiative balance at the surface and thus melt of snow and ice as well as being closely tied to precipitation (Fiona Cawkwell, University College Cork)	This is a WGI issue. We do not wish to tread on WGI's turf.
E-15-80	A	7	34			the role of macro oscillatory systems such as NAO and AO should also be mentioned, the prevailing recent mode and the effect changes in mode have on climate, changes in upper air pressure and their association to surface change (Fiona Cawkwell, University College Cork)	This is also a WGI issue.
E-15-81	A	7	36	7	36	Instead of an "in prep" reference for the reductions of Arctic sea ice and glaciers, add Parkinson and Cavalieri 2002 and Stroeve et al. 2005 as references for the sea ice reductions and Arendt et al. 2002 and Abdalati et al. 2004 as references for the glacier reductions. The full references are: Parkinson, C. L., and D. J. Cavalieri, 2002, A 21 year record of Arctic sea-ice extents and their regional, seasonal and monthly variability and trends, Annals of Glaciology, 34, 441-446; Stroeve, J. C., M. C. Serreze, F. Fetterer, T. Arbetter, W. Meier, J. Maslanik, and K. Knowles, 2005, Tracking the	Noted

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						Arctic's shrinking ice cover: Another extreme September minimum in 2004, Geophysical Research Letters, 32, L04501, doi:10.1029/2004GL02180; Arendt, A. A., K. A. Echelmeyer, W. D. Harrison, C. S. Lingle, and V. B. Valentine, 2002, Rapid wastage of Alaska glaciers and their contribution to rising sea level, Science, 297 (5580), 382-386; and Abdalati, W., W. Krabill, E. Frederick, S. Manizade, C. Martin, J. Sonntag, R. Swift, R. Thomas, J. Yungel, and R. Koerner, 2004, Elevation changes of ice caps in the Canadian Arctic Archipelago, Journal of Geophysical Research, 109, F04007, doi:10.1029/2003JF000045. (Claire Parkinson, NASA Goddard Space Flight Center)	
E-15-82	A	7	36			a summary of the amount of sea ice/glaciated area loss is needed in this paragraph (Fiona Cawkwell, University College Cork)	A simple summary number is not possible in this case, and would be repeating material in WGI, which is cited here anyway.
E-15-83	A	7	40	7	40	Over what time period is this degradation observed? Some studies have examined changes over more than a century. It would also be useful to indicate which regions. (Sharon Smith, Natural Resources Canada)	Here we use the general statement with a reference to WG-1 report, which addresses this problem in more details. The word "recent" has been added before "degrdation".
E-15-84	A	7	43			I do not think Sturm et al. (2001) are referring to the entire North American Arctic just the Seward Peninsula. (Robert Jefferies, University of Toronto)	TVC: text modified and reference added
E-15-85	A	8	3			this phenomenon of increased thickening in the interior and thinning at the margins is also evident in the Canadian Arctic (Abdalati et al, 2004 JGR 109) comparing laser altimetry surveys over the period 1995-2000, and also from unpublished (Cawkwell) data comparing 2003 IceSat data over the Devon icecap with elevation data derived from 1960 aerial photography (Fiona Cawkwell, University College Cork)	The Greenland example is included since it is the most signficant and high-profile example. Unpublished work has no real place in the report.
E-15-86	A	8	7	8	7	The percentage of indigenous peoples varies consdierably across the Arctic. (Gordon McBean, Institute for Catastrophic Loss Reduction, University of West. Ontario)	This may be true, but the 10% value is a useful indicator
E-15-87	A	8	10	8	10	replace "Bogloyavlenskiy, 2004" with "Bogloyavlenskiy and Siggner, 2004" (Manfred Lange, University of Muenster)	Noted
E-15-88	A	8	11	8	14	I do not find it reasonable to mention the negative impacts of people living in larger settlements first. The encouragement for indigenous people to live in settlements with all kinds of facilities has improved the living conditions considerably including health care and social security. As in all transition cultures, this has also involved social problems, but these are minor as compared to the huge improvements mentioned in the following sentences. I therefore suggest that the	We believe the existing statement should stand as is

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						statement on negative effects is moved down below the superior statements on improvements. See further below. (Hans Meltofte, National Environmental Research Institute)	
E-15-89	A	8	24	8	24	Since all 3 of Canada's Northern Territories now have formalized land claims in place, why single out Nunavut? Better to say Northern Canada. (John Streicker, Yukon College)	CF-agree, changed to reflect suggestion
E-15-90	A	8	29			Add the reference of Bruce Forbes (2006) who has just edited one of the Springer Verlag Ecological Studies books on reindeer husbandry in northern Europe. (Robert Jefferies, University of Toronto)	CF-done
E-15-91	A	8	30			A new paragraph is suggested, perhaps fitting on this page, informing about the Arctic as a source area for carriers of the avian influenza, picked up from domestic birds (waterfowl) mainly in E Asia during southboumd migration. This is a rather recent research field (medical orhothology), and the impacts of climate change on migration routes and numbers of migrating arctic breeding waterfowl are not yet assessed (= gap of knowledge). (Ulf Molau, Göteborg University)	CF-lack of space does not permit additions, although we agree this new area is of interest
E-15-92	A	8	50			A new synthesis volume of climate change impacts across the Antarctic and sub-Antarctic in terms of terrestrial biology will be available in Sept 2006: Trends in Antarctic Terrestrial and Limnetic Ecosystems, eds. Bergstrom, D.M, Convey, P. & Huiskes, A.H.L. Springer, Dordrecht. Amongst other aspects, chapters in this volume document the impacts of drying (in particular) and warming on some sub-Antarctic islands. (Peter Convey, British Antarctic Survey)	Not available at the time of writing.
E-15-93	A	9	11	9	26	These two paragraphs lack clarity of the processes that are taking place, especially the second paragraph. They should be re-written. (Robert Jefferies, University of Toronto)	Noted
E-15-94	A	9	11	9	11	Change "atmospheric concentrations" to "atmospheric CO2 concentrations". (Claire Parkinson, NASA Goddard Space Flight Center)	Noted
E-15-95	A	9	21			when in a species name, "antarctica" does not require capitalisation (Peter Convey, British Antarctic Survey)	Noted
E-15-96	A	9	28			tourism numbers are now over 30,000 - see Frenot et al Biol Rev 2005 (ref given previously); cf previous comment at this point in my earlier review, I suggest reference should be made here to the likelihood of introduction of non-indigenous species associated with human visitation. (Peter Convey, British Antarctic Survey)	This is now included
E-15-97	A	9	45	9	45	This reference should be to at least McCarthy and Martello - same error occurrs other places.	Done

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						(Gordon McBean, Institute for Catastrophic Loss Reduction, University of West. Ontario)	
E-15-98	A	9	49	9	49	Polar species are "specialised" - are you sure you can generalize like this? Many (especially plants) have very broad ranges and are found in many environments, suggesting the opposite (Konrad Gajewski, University of Ottawa)	TVC: the statement comments that "*Many* polar species are specialised. No change.
E-15-99	A	9	49	10	5	This para would benefit from inclusion of ref to Frenot et al 2005 (above) and to the Bergstrom et al book, both of which document the impacts of introduced or alien species on indigenous communities, and particularly highlight the consequences of indigenous species and communities being vulnerable to the impacts of introduced and better competitors and predators (Peter Convey, British Antarctic Survey)	This issue is now dealt with
E-15-100	A	10	9	10	10	"biodiversity is low in general" must refer to species richness. In terms of genetic diversity, the levels in the Arctic are higher than in comparable ecosystems at lower latitudes (Molau 2004, Ambio, Special Report 13: 24–28). (Ulf Molau, Göteborg University)	TVC: fixed
E-15-101	A	10	14			Wrong heading type. (Jean Palutikof, Met Office)	This is now sorted out – but the requirement for "Antarctic" and "Arctic" sub-sub heads remains
E-15-102	A	10	15	10	15	"low adaptive potential" is a misleading characterization, as most arctic and alpine vascular plants are high-ploid and a single individual may contain the genetic diversity typical of a small population (C. Brochmann, several papers; Molau 2004). (Ulf Molau, Göteborg University)	TVC: text modified to focus on species
E-15-103	A	10	21	10	22	But surely relocation is a form of adaptation. (Jean Palutikof, Met Office)	TVC: yes, relocation is an existing adaptation to a specific environment. The problem is inability to adapt in situ to new environments. Text slightly clarified
E-15-104	A	10	24	10	37	why is there such an explicite reference to commercial firsheries only in a section dealing with "Vulnerability and adaptive capacity", which goes far beyond the commercial/economical realm? (Manfred Lange, University of Muenster)	In the Fourth Assessment, emphasis is on commercial fisheries. Space prevents discussion of all issues.
E-15-105	A	10	24	10	37	This paragraph belongs in Section 15.2.1 (Jean Palutikof, Met Office)	Paragraph deleted.
E-15-106	A	10	24	10	34	No references, and lines 14-22 only have one, which is pre-TAR. (Jean Palutikof, Met Office)	Paragraph deleted

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E-15-107	A	10	32	10	34	See also Boertmann et al. 2006, Brit. Birds 99: 282-298 for wintering of 3.5-5.5 mio. seabirds off SW Greenland. (Hans Meltofte, National Environmental Research Institute)	Paragraph deleted
E-15-108	A	10	48			Insert 'of fish'. Make clear these figures apply over total Arctic. (Jean Palutikof, Met Office)	Done
E-15-109	A	11	1	11	51	Figure 15.2 As in the ACIA document, I find this graphic somewhat misleading for ice extent. It shows September 2002, and September is an ice minima. The area described as predicted ice extent in 2070-2090 is, I believe, the annual ice average. (John Streicker, Yukon College)	Reviewer inference is incorrect. The projected ice extent for 2070-2090 is for summer.
E-15-110	A	11	40			In the FOD there was a figure on Permafrost and sea ice in the Arctic up to 2090 which has been removed from the SOD. Some of the info it contained is now in the SOD fig 15.2, but a lot has been lost. Could we have the missing bits back, please (sea ice 2010-30, 2040-60; current permafrost boundary, projected permafrost boundary) Also include which scenarios/models were used in the projections. (Paul van der Linden, Met Office)	No. See earlier responses
E-15-111	A	11	49			"sea ice extent for and projected" Something is wrong with the text in this figure heading (for Figure 15.2) (Tavi Murray, Swansea University)	Noted
E-15-112	A	11				I note that the extent of ice cover in Greenland does not change (as far as I can see) in this figure, which is misleading. Perhaps a comment to this end could be added in the figure heading. (Tavi Murray, Swansea University)	Noted – some changes are visble in the figure
E-15-113	A	12	22			Figure heading to 15.3 "Parkinson (Parkinson, 2002)" - can you delete one of the "Parkinson"s? (Tavi Murray, Swansea University)	Noted
E-15-114	A	12	37	46		Convey chapter in Bergstrom et al vol provides an up to date review of terrestrial biological consequences in the Antarctic (Peter Convey, British Antarctic Survey)	This has been noted
E-15-115	A	12	46			change not changes (Robert Jefferies, University of Toronto)	Noted
E-15-116	A	13	8			Frenot et al revew is a more pertinent reference here (Peter Convey, British Antarctic Survey)	Noted
E-15-117	A	13	24	13	27	"Historically, Arctic freshwater ecosystems have responded…" Surely, this statement is not correct. There is so little information in the paleo literature about rapid changes that it would be premature to make such a statement. Most paleo records are samples at low resolution, so we dont know how rapid responses can be. At treeline, it has been shown that vegetation responds quite rapidly to climate	Wording has been changed to indicate that freshwater ecosystems have “adapted” rather than simply responded to large variations in climate over long transitional period.

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						variations. We have an MSc thesis that will show rapid changes of diatoms to climate variations during the Holocene. So I would not make a statement such as this. (Konrad Gajewski, University of Ottawa)	
E-15-118	A	13	26			"…in the next century…" - not clear what century is meant, the 21st or the 22nd? (Vladimir Romanovsky, University of Alaska Fairbanks)	"Century" has been replaced with "hundred years"
E-15-119	A	13	30			"highly vulnerable is too strong giving the uncertainty of the projections. I suggest ...are vulnerable... (Robert Jefferies, University of Toronto)	"highly vulnerable" has been changed to "vulnerable"
E-15-120	A	13	32	13	39	Use of rivers as transporation routes appears to be largely ignored in this section with the only comment related to transportation being ice road construction. The Mackenzie River for example is a major transporation route in the western Canadian Arctic and changes in water levels or length of ice free season may occur in response to climate change with potential for postive and negative impacts. (Sharon Smith, Natural Resources Canada)	Section has been reworded to inlcude comment about "open-water transportation" as one of the examples of modified resource use. Unfortuatnely, unsufficient space precludes the inlcusion of details regarding specific river systems that will be affected (e.g., the Makcenzie River or, even more so, the large Russian rivers that currently have extensive ice-breaking operations to extend the freshwater transporation season. TP
E-15-121	A	13	51	13	51	replace "period open water" with "period of open water" (Manfred Lange, University of Muenster)	Noted
E-15-122	A	13	51			...annual period "of" open water... (Robert Jefferies, University of Toronto)	Noted
E-15-123	A	14	3	5		fur seals - not sure how easy it will be to make clear here, but the Signy fur seal explosion does not represent a breeding population, but is virtually completely a resting/moulting one as an overspill from South Georgia - a large subject, but also indicative of wider links between human impacts (whaling, sealing, climate) across the Southern Ocean (Peter Convey, British Antarctic Survey)	This is too much detail to include here.
E-15-124	A	14	6			Suggest density replaces concentration (Robert Jefferies, University of Toronto)	Noted
E-15-125	A	14	7			Suggest "composition of microbial communities" (Robert Jefferies, University of Toronto)	Noted
E-15-126	A	14	14			Permafrost is also probably widespread under the glaciers and under the ice sheet in Antarctica (Vladimir Romanovsky, University of Alaska Fairbanks)	From the perspective of change this is irrelevant at all but the extremely long time sales.
E-15-	A	14	19	14	22	Rapid warming is not observed everywhere within the regions mentioned. Ch 4	Text changed to indicate that many (not all)

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127						WG1 comments on the variability in the rate of temperature change and this section should also reflect that. In warmer permafrost such as in the southern Mackenzie valley or discontinuous permafrost of Alaska, there has been very little or no change in temperature over the last 2 decades. For Canada, Smith et al. 2005 is a better reference to cite than Beilman et al 2001 (see below for further comment) as it provides a better picture of recent changes in permafrost temperatures across Canada not just one region and also comments on the variability. While significant increases in permafrost temperature have been observed in the central and northern Mackenzie region (western Canada), these changes have been greater and occurred over a longer period than those in the eastern or high Canadian Arctic. (Smith, S.L., Burgess, M.M., Riseborough, D. and Nixon, F.M. 2005. Recent trends from Canadian permafrost thermal monitoring network sites. Permafrost and Periglacial Processes 16: 19-30). (Sharon Smith, Natural Resources Canada)	parts of the Arctic are getting warmer. Reference added.
E-15-128	A	14	21	14	21	Beilman et al. 2001 is not a very good reference with respect to information on trends in Canadian permafrost conditions as it only investigates western peatlands (specifically northern Praires), is not representative of conditions across Canada and does not provide observations of permafrost temperatures. It is also not cited in Ch. 4 WG1 in the discussion of changes in permafrost temperature across Canada. A better reference which examines trends in permafrost temperature across the Canadian Arctic is Smith et al. 2005 (Smith, S.L., Burgess, M.M., Riseborough, D. and Nixon, F.M. 2005. Recent trends from Canadian permafrost thermal monitoring network sites. Permafrost and Periglacial Processes 16: 19-30). (Sharon Smith, Natural Resources Canada)	Reference added.
E-15-129	A	14	22	14	23	What is meant by removal of snow cover? Human induced?, removal by wind? - clarification is required. Removal of snow cover may not necessarily result in warming as greater cooling can occur in the winter with an overall lowering of ground temperature. (Sharon Smith, Natural Resources Canada)	Text was changed.
E-15-130	A	14	22	14	23	Any removal of the snow cover during the winter will produce cooling in permafrost, not warming. However, it is not clear what kind of “removal of snowcover” is meant here. (Vladimir Romanovsky, University of Alaska Fairbanks)	Text was changed.
E-15-131	A	14	27	14	30	Changes to moisture fluxes and surface and subsurface hydrology, drainage etc. will also be important. To some extent these changes to the hydrological system will be important factors influencing the changes in carbon sources and sinks and feedbacks to the climate system. Changes in moisture fluxes will also have	These important changes are discussed in the section devoted to hydrology.

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						feebacks to the climate system. Terrestrial and aquatic ecosystems may also be affected by changes in hydrologic system that can occur in response to changes in permafrost conditions. Brown et al (2004) discuss the linkages between changes in permafrost conditions (as well as all cryospheric components) and the hydrologic system in a chapter published in a document produced by Environment Canada on Threats to Water Available in Canada. The chapter may also provide information relevant to other sections which discuss links between the cryosphere and hydrologic system and impacts of climate change (Brown, R.D., Demuth, M.N., Goodison, B.E., Marsh, P., Prowse, T.D., Smith, S.L. and Woo, M.-K. 2004. Climate Variability & Change - Cryosphere. Chapter 14 in Threats to Water Availability in Canada; NWRI Scientific Assessment Report Series No. 3 and ACSD Science Assessment Series No. 1, National Water Research Institute, Meteorological Service of Canada, Environment Canada, p. 107-116.) (Sharon Smith, Natural Resources Canada)	We believe that the most important issues have ben referred to in the existing text.
E-15-132	A	14	34			sub-Antarctic islands (Robert Jefferies, University of Toronto)	Noted
E-15-133	A	15	8	15	12	This short paragraph in "15.3 Assumptions about future trends" is the only mention of "methane hydrates" yet says that if dissociation of these hydrates occur "whether these emissions reach the atmosphere as methane or carbon dioxide is very important" given that "methane has more than 20 times the warming influence that carbon dioxide" (note that the sentence is chopped off by the way and needs to be edited by the author). Surely if methane hydrates are considered "very important" to climate change there should be some review of their contribution elsewhere in the report. Also, even in this short paragraph, there should be reference to key papers and "the hydrate gun hypothesis" that could cause a runaway effect for global warming (e.g., E. Dendy Sloan Jr, "Fundamental principles and applications of natural gas hydrates", NATURE, 426, 353-359, 2003, and A. Pecher, "Gas hydrates on the brink," NATURE, 420, 622-623, 2002, and the many references therein). Also the literature sources indicate a best guess that there are fromt twice to an order of magnitude increase of the amount of hydrocarbon energy trapped in methane hydrate form than all other global hydrocarbon sources combined. Surely gas hydrates need to be written up in the report -- the fact that they were ignored in the ACIA report is no excuse to continue to ignore them in this update report. I would gladly provide a summary of the methane hydrate literature pertaining to climate change upon request to david.malcolm@ualberta.ca. (David Malcolm, Arctic Energy Alliance)	New references added although Methane hydrates are extremely well covered in chapter 7 of the IPCC WG-1 report. We will add reference to this chapter.
E-15-	A	15	9			...sharing "of" mechanisms (It is not clear what mechanisms are being talked	CF – “of” has been deleted to refer to sharing

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134						about?) (Robert Jefferies, University of Toronto)	mechanisms (social networks)
E-15-135	A	15	11			replace communities' with communities (Robert Jefferies, University of Toronto)	CF-done
E-15-136	A	15	15	24		Although not my expertise, I retain a concern that the issue of indigenous community "development" is being ducked here - the emphasis to the reader is on the threat to the "lifestyle and culture" of indigenous communities. However this in itself is not a static concept - these communities adopt new technologies and lifestyle elements as part of the very flexibility that is characteristic of their history. However, these new technologies (particularly in transport and hunting) themselves pose a new or increased impact or threat to their environment. I can't help but feel the current wording and thrust of this section is avoiding the issue of whether such communities can "pick and choose" - it is ok for new elements to be absorbed if the community wants it, but the line of "threat to culture" is rolled out in response to more inconvenient changes. This is a political issue, but not to recognise it takes away from the objective nature of a report such as IPCC, and also smacks to some extent of hypocrisy. These concerns are also relevant to p25 l31 on. (Peter Convey, British Antarctic Survey)	CF-sentence added to increase explicit nature of the impact of internal trends in communities on adaptive capacity as well (both positive and negative)
E-15-137	A	15	17	15	19	Again, I find this rather unbalanced. Before arctic communities became members of modern society, they died out again and again during periods of famine. Today, they enjoy the social security and all kinds of other advantages offered by modern nations. Nobody will be allowed to starve to death due to climate perturbations, and arctic communities' access to modern societies opens a lot of opportunities under all kinds of climate situations, which may occur in a foreseeable future. In most respects, living conditions in the Arctic have never in human history been more favourable - in spite of all problems. (Hans Meltofte, National Environmental Research Institute)	CF-The reader is interpreting the sentence as solely negative when in fact “affect” can be positive or negative and hence the statement is currently inclusive to capture some essence of the comment here, that connections and modernity have brough improvement as well to communities.
E-15-138	A	15	23			"required to adapt" does not make sense-rewrite please (Robert Jefferies, University of Toronto)	CF-edited to make sense
E-15-139	A	15	30	15	31	What are these thresholds? and "the limits to adaptive capacity" is unclear. Rewrite the entire sentence please. (Robert Jefferies, University of Toronto)	CF-edited to simplify.
E-15-140	A	15	38	15	39	What about polar amplification itself? Holland and Bitz, 2003 indicate that there is a strong correlation between sea ice / albedo and positive feedback. In your first bullet you qualify this as "may be leading...". In any case the polar amplification is being observed and it does have consequences for the global climate. (John Streicker, Yukon College)	This is a WGI issue; we do not have the space to delve into a discussion of it.

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E-15-141	A	15	39			Suggest... implications linked to the following processes... (Robert Jefferies, University of Toronto)	Noted
E-15-142	A	15	40	15	44	I am surprised that a WGII chapter has a paragraph on reflectivity and its global importance. (Gordon McBean, Institute for Catastrophic Loss Reduction, University of West. Ontario)	There is a tricky split between WGI and WGII in this area, but we believe it is important to summarise this issue here, although it could do with reference to the WGI treatment which will have greater depth.
E-15-143	A	15	41			Suggest..... system, as a consequence of albedo and insulation effects (Robert Jefferies, University of Toronto)	Noted
E-15-144	A	15	42	15	42	Mention is made here of the more rapid disappearance of both snow and sea ice cover in some areas, yet in the parentheses, both areas given as examples are land areas, relevant to the snow cover changes but not the sea ice changes. I recommend adding "the Greenland Sea" to "Siberia, Alaska". (Claire Parkinson, NASA Goddard Space Flight Center)	Changed as suggested.
E-15-145	A	15	44			A review on the ecology of snowbeds and snowbed ecosystems in arctic and alpine areas (the tundra biome) is to appear in Arctic, Antarctic and Alpine Research (R. Björk & U. Molau, inpress). (Ulf Molau, Göteborg University)	The publication was not published at the time of writing.
E-15-146	A	15	45			and line 50 -- odd capitalisation of titles (Tavi Murray, Swansea University)	Noted
E-15-147	A	15	50	16	2	Should it be methane and carbon dioxide (rather than methane and carbon)? Are the impacts on the carbon cycle somewhat complex? Doesn't the changes in carbon sources and sinks and whether either methane or CO2 is released depend on drainage, revegetation etc.? (Sharon Smith, Natural Resources Canada)	TVC: yes, “dioxide” added to text. Yes, the impacts on the carbon cycle are complex and dealt with in the text. Here we denote this by the words “uncertainty is high”. Some extra clarification has been added
E-15-148	A	16	3	16	7	This bullet-point can be stressed even stronger: as permafrost degrades and tundra pools drain out, this will lead to vanishment of the breeding habitat of up to 70 % of the worldwide waterfowl populations (ACIA 2004, although not particularly outspoken). (Ulf Molau, Göteborg University)	TVC: the point has been strengthened.
E-15-149	A	16	8	16	12	A reference is required for these statements. It is important to consider over what time period carbon from these sources may be released. In some cases (such as on the Beaufort Shelf) hydrates are at depths below 200m as they formed during periods of lower sea level when the sediments were exposed to lower temperatures - It takes considerable time for warming to reach these depths (lag effects etc.). It is also important to note that in these areas that were formerly sub aerial, there has been a long-term warming due to sea level rise associated with deglaciation - the	See response to E-15-133. Methane hydrates are extremely well covered in chapter 7 of the IPCC WG-1 report. Added reference to this chapter.

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						degradation of hydrate in this case may have very little to do with recent or future climate warming but is a response to changes at the sea bed which occurred several millenia ago.The statement could be more specific and indicate whether reference is being made to hydrates that occur beneath deeper water depths (and may largely be present due to higher pressures rather than colder conditions) and were not areas that have become innundated following deglaciation. Does the statement refer to terrestrial hydrates? -- These are also found at great depth (>200m) so it would take some time for warming to reach these depths. (Sharon Smith, Natural Resources Canada)	
E-15-150	A	16	16			There should be an additional bullet-point highlighting the probability of future terrestrial ecosystem successions friven by climate change. (Ulf Molau, Göteborg University)	TVC: a separate bullet point on succession is not warrented as this is merely a mechanism for vegetation change and vegetation change is covered. Reflectivity of vegetation has been flagged for bullet point 1.
E-15-151	A	16	20	16	20	Over what time period is this warming to occur? (Sharon Smith, Natural Resources Canada)	Noted
E-15-152	A	16	20			The time period of these changes needs to be specified. (Vladimir Romanovsky, University of Alaska Fairbanks)	Repeated comment
E-15-153	A	16	20		23	presumably this is in reference to Arctic regions - need to say so; also, over what time period is this warming predicted, 100 years? What are respective summer and winter values, given tht summer temperatures drive a lot of the melt related glacier retreat these are the most significant values (Fiona Cawkwell, University College Cork)	Repeated comment
E-15-154	A	16	25		28	what is the range of values produced by all these models - how much is warming amplified by in the Southern Ocean strip? (Fiona Cawkwell, University College Cork)	We do not have the space to expand on this point.
E-15-155	A	16	30			Unclear. Do you mean 'by 10-20%'? (Jean Palutikof, Met Office)	Changed as suggested to “10-20%”.
E-15-156	A	16	31		32	even though spatial patterns are varied can anything be said about seasonal trends in precipitation? (Fiona Cawkwell, University College Cork)	Added “the seasonality” in sentence about across-model differences.
E-15-157	A	16	33	16	34	The partitioning among snow and rain will have important implications for hydrologic systems (as well as terrestrial and aquatic ecosystems) but this is not really mentioned in this paragraph. Perhaps this is discussed elsewhere in more detailed discussions of impacts of these projected atmospheric changes. (Sharon Smith, Natural Resources Canada)	Added mention of effects on terrestrial ecosystems.
E-15-	A	16	33	16	34	Some explanation is required here. How would the partitioning of snow and rain	We added a sentence in response to this

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158						change? Would it be the same everywhere? How will the change in partitioning affect snow loads? Will it be the same everywhere? The link between partioning of snow and rain and snow loads is not clear. Would there be more snow in the high Arctic (which is basically a desert at present) in the winter under warmer conditions and would this lead to increased snow loads? In the southern portion of the polar regions, would there be less winter snow and therefore lower snow loads? (Sharon Smith, Natural Resources Canada)	comment, but we do not have the space for an expanded discussion.
E-15-159	A	16	37			is this really 15.30 or 15-30? (2dp cannot be justified if it is not a typo) (Fiona Cawkwell, University College Cork)	Typo has been corrected.
E-15-160	A	16	37			Insert 'in runoff' (Jean Palutikof, Met Office)	"in runoff" has been inserted.
E-15-161	A	16	39			need to say something about uncertainty of cloud cover change in polar regions - this will impact on surface radiation budgets and hence many of the other components of the cryosphere/biosphere system under discussion - it is also one of the main reasons different climate models give such different predictions (Fiona Cawkwell, University College Cork)	This is a WGI issue.
E-15-162	A	16	42	16	42	Section 15.3.3 Has no discussion of wind on the transport and mixing of ocean waters as a result of sea ice loss. (John Streicker, Yukon College)	Sentence has been added, but we do not have the space for an expanded discussion.
E-15-163	A	16	42	16	42	I was surprised that there was no mention here about the possible effects of changes in the thermohaline circulation in the Atlantic Ocean (the North Atlantic Drift or Gulf Stream) because a result of the increasing freshwater input to the Arctic Ocean. Thus, at least one of the two polar regions could have a huge impact well beyond the Arctic. If reference is made to the slowing of the currant here, then it might be appropriate to include a sentence about this in the summary, at page 2, possibly between lines 9 and 14. (Michael Usher, University of Stirling)	Sentence has been added, but this is primarily a WGI issue.
E-15-164	A	16	45			It is not at all clear what areas A2 etc refer to. Figure 15.2 is not forthcoming on the matter. (Robert Jefferies, University of Toronto)	Reference to Fig. 15.2 hs been deleted. The cited paper by Zhang describes the different scenarios (A2, A1B, B1).
E-15-165	A	16	45			I assume this relates to the Arctic Ocean - need to say so (Fiona Cawkwell, University College Cork)	Have inserted "in the Arctic".
E-15-166	A	16	46	16	48	Sentence too complicated for target audience. What is 'first-year ice'? Can probably delete without too much loss. (Jean Palutikof, Met Office)	Sentence has been reworded; "first-year" and "multiyear" have been eliminated.
E-15-167	A	16	48	17	12	This discussion of calving seems inconsistent between these two sections (Gordon McBean, Institute for Catastrophic Loss Reduction, University of West.	DGV – I don't see an inconsistency, calving rates are though to be likely to increase, but

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						Ontario)	simulations do not include these effects.
E-15-168	A	17	1	17	18	This section is not well integrated. It reads as a series of non-linking statements. Rewrite please. (Robert Jefferies, University of Toronto)	First and third paragraphs have been deleted – see following two reviewer comments.
E-15-169	A	17	1	17	18	The material here seems appropriate for WGI, not WGII. (Gordon McBean, Institute for Catastrophic Loss Reduction, University of West. Ontario)	First and third paragraphs have been deleted.
E-15-170	A	17	1	17	6	Delete (Jean Palutikof, Met Office)	Done.
E-15-171	A	17	2	17	2	The "Parkinson et al., Submitted" article referenced here has now been published, and hence "Submitted" should be replaced by "2006". The full reference is: Parkinson, C. L., K. Y. Vinnikov, and D. J. Cavalieri, 2006: Evaluation of the simulation of the annual cycle of Arctic and Antarctic sea ice coverages by 11 major global climate models. Journal of Geophysical Research, 111 (C7), C07012, doi:10.1029/2005JC003408. (Claire Parkinson, NASA Goddard Space Flight Center)	Per preceding reviewer comments, this paragraph gas been deleted.
E-15-172	A	17	2			the huge range in predictions for Antarctic sea ice emphasises just how much uncertainty there is in the models and the need for care in extrapolating results from them - a few error margins would not go amiss on some of these results and also serve to highlight the uncertainty in many of these values and estimates (Fiona Cawkwell, University College Cork)	Paragraph has been deleted in response to preceding reviewer comments.
E-15-173	A	17	8	17	18	Page 17, lines 8 to 18: IPCC do not run models or have modelling centres! Either delete or reduce these two paragraphs, if the latter just talk about models assessed by the IPCC. (Paul van der Linden, Met Office)	Text has been reworded so that it refers only to “simulations in the IPCC archives”.
E-15-174	A	17	9	17	35	The greenland ice discussion is split in two sections on same page and does not seem fully consistent in details and the impression left on the reader. (Gordon McBean, Institute for Catastrophic Loss Reduction, University of West. Ontario)	DGV – disagree one section is about the impact on the oceans and the other on land ice.
E-15-175	A	17	9			Freshening of the ocean surface in northern high latitudes does not require “negative mass balance of Greenland”. Just increase in Greenland ice melt will be enough. (Vladimir Romanovsky, University of Alaska Fairbanks)	Fixed
E-15-176	A	17	15	17	18	Text can be deleted from 'for example'. (Jean Palutikof, Met Office)	Fixed
E-15-177	A	17	24	17	25	The effect would be on the ground thermal regime (assume this is what is being referred to)	No response required

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						(Sharon Smith, Natural Resources Canada)	
E-15-178	A	17	25	17	28	Are these rates for the polar regions or for entire continents? Are they representative of polar regions. (Sharon Smith, Natural Resources Canada)	These are for the snow-covered areas, including polar regions.
E-15-179	A	17	27	17	29	It is not clear what kind of impacts “for the insulation of permafrost” the earlier spring snowmelt will have. (Vladimir Romanovsky, University of Alaska Fairbanks)	Text was changed.
E-15-180	A	17	28	17	30	How will insulation of permafrost be affected - some explanation is required (assume that the response of permafrost is complex) (Sharon Smith, Natural Resources Canada)	Text was changed.
E-15-181	A	17	38			the important thing is not just that the ice sheet is growing in height but that its volume is remaining unchanged, and thus the contribution of melting ice to global sea levels is potentially not as significant (Fiona Cawkwell, University College Cork)	This is not the view of the most up to date assessments
E-15-182	A	17	41			more needs to be made of changes in the terrestrial cryosphere e.g. loss of glaciated areas in Canada, Alaska; changes in snow melt patterns in Canada and Greenland with earlier thawing and later freeze-up which has meant enhanced melt run-off etc (Fiona Cawkwell, University College Cork)	Material covered in WGI – CH4
E-15-183	A	17	45	17	49	Rewording is suggested: "….thawing of permafrost in the southern portions of the sporadic and discontinuous zones ……." (Sharon Smith, Natural Resources Canada)	Text changed as suggested
E-15-184	A	17	48			It needs to be more carefully explained the patchiness of what will be increasing in the continuous permafrost areas. (Vladimir Romanovsky, University of Alaska Fairbanks)	The message is that part of continuous permafrost will become discontinuous.
E-15-185	A	17	49	18	3	It is important to state clearly that the rate of change in thaw depth will be variable and will depend on a number of factors. While there is some indcation that there is spatial variability which could be interpreted as a latitudinal variation, there will also be variability due to soil (including ice content) and vegetation conditions. Is there a figure/map (included in Anisimov and Belolutskaia 2004? which is cited) that could be presented that would illustrate the spatial variability in projected changes in thaw depth throughout the northern hemisphere. The only figure that illustrates anything related to permafrost is fig 15.4 which shows lakes that have disappeared over time. One could argue that a figure showing projected changes in thaw depth for entire northern hemisphere would be useful in illustrating where impacts on communities and infrastructure may be greater. (Sharon Smith, Natural Resources Canada)	This is exactly what the paper (Anisimov and Belolutskaia, 2004) is about. This paper has maps with projected changed of the seasonal thaw depth. Similar maps were included in the ACIA report, reference to it was added.
E-15-	A	17	49	18	3	As the thaw depth continues to increase over time, the top of permafrost and base	This is obvious for those who understand the

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186						of the active layer will (at some point) not be the same (i.e. the entire thawed layer will not freeze back each winter) - degrading conditions will exist. Perhaps this point should be made. (Sharon Smith, Natural Resources Canada)	process. Due to page limits we can not geet into such level of details, it is more appropriate for WG-1.
E-15-187	A	18	8		8	Here you specifically mention that the Antarctic ice sheet is discussed in detail elsewhere - I presume this is also the case for the Greenland ice sheet. If so it would be worth also flagging that in the Arctic section on P17 or do you feel this repetative with section 15.3.3? (Tavi Murray, Swansea University)	Reference to ch4 added
E-15-188	A	18	23		23	"which might be related to increase in" -- should read "increases" (Tavi Murray, Swansea University)	Fixed
E-15-189	A	18	25	18	25	The fact that Davis++, Zwally++ and in particular Velicogna & Wahr adopted different approaches needs to be signalled a bit more explcitly. (Richard Hindmarsh, British Antarctic Survey)	Noted
E-15-190	A	18	37		39	Line 38 -- "These include" -- the "These" is ambiguous and the reader cannot tell whether it refers to those wholly in the Arctic or those fed by rivers and lakes further south. (Tavi Murray, Swansea University)	To clarify, the text has been modifed to read "The latter includes give of …." TDP
E-15-191	A	18	51	19	16	This para important but not very clear - needs work. Should cite 'Detection of a direct carbon dioxide effect in continental river runoff records.' Gedney N, Cox PM, Betts RA, Boucher O, Huntingford C, Stott PA. Nature, 439 (7078): 835-838. (Jean Palutikof, Met Office)	Paragraph has been modifed to improve clarity and flow. Gedney et al. reference that focusses on global runoff and role of suppression of plant transpiration due to C)2-induced stomal closure is already considered and cited on p. 20, line 12-13, which deals explicity with this issue. TDP
E-15-192	A	18	51			What percentage change is this? (Gordon McBean, Institute for Catastrophic Loss Reduction, University of West. Ontario)	The percentage equivalent of approximately 7% has been included in the text and an insertionmade that it is the largest 6 Eurasian rivers. TDP
E-15-193	A	19	7			Ob not Ob' (Robert Jefferies, University of Toronto)	Spelling of Ob corrected. TDP
E-15-194	A	19	28	19	32	Are there any examples from North America that could be given (any reports of studies by Duguay, Hinzman?) (Sharon Smith, Natural Resources Canada)	Hinzman is an author of the cited Smith et al. paper. He is also referenced elsewhere (i.e., Hinzman et al. 2005) and this reference has again been inserted here. Unfortunately, space limitations preclude an extensive listing

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							of regional examples dealing with permafrost effects on lentic systems.
E-15-195	A	21	17	21	34	All the material on DOC is very difficult to follow and may not be of interest to the WG2 target readers. Its necessary to shorten and simplify. (Jean Palutikof, Met Office)	Two sentences with some of the DOC material has been eliminated. TDP
E-15-196	A	22	0	22		Here and elsewhere there are many references to unpublished papers, moist by authros fo this section. It would be preferable to have literature from other authors. (Gordon McBean, Institute for Catastrophic Loss Reduction, University of West. Ontario)	All papers not published or in press have been removed
E-15-197	A	22	3	22	7	Permafrost is also an important factor in the integrity of these containment structures, pipelines etc. (Sharon Smith, Natural Resources Canada)	Noted
E-15-198	A	22	15	22	23	Some clarification on results from Beilman and Robinson (2003) which show upt to 50 % of permafrost in peat plateaus has degraded --- Beilman and Robinson report on 9 sites in the discontinuous permafrost zone in western Canada. Their results are not for the enitre discontinuous permafrost zone of northern Canada as this statement would imply. While it is correct to say up to 50%, it would be better if the statement was 10-50% as was given in the paper. (note these comments assume that the statement related to Canadian peatlands are only attributable to Beilman and Robinson, not Malmer et al 2005). Payette et al (2004) might also be consulted for information on degradation of permafrost in subarctic peatlands in Northern Quebec, on eastern coast of Hudson Bay (Payette, S. et al. 2004 Accelerated thawing of subarctic peatland over the last 50 years, Geophysical Res Let. 31, L18208). (Sharon Smith, Natural Resources Canada)	OAA – this text has been rewritten
E-15-199	A	22	15	22	17	It would be useful to indicate what coastal communities will have a problem with sea-water contamination of groundwater reserves as one would expect in the permafrost regions, use of groundwater is limited (in many instances it may be of poor quality) - important to indicate the magnitude of the problem and where it may be a problem. What places are dependent on groundwater for water source? It is this reviewer's understanding that In Canada groundwater use in polar regions is limited. (Sharon Smith, Natural Resources Canada)	CF-as an assessment of all communities has not been conducted specific communities are not known
E-15-200	A	22	15	22	23	Is information related to Canadian peatlands found in Malmer et al (2005)? (Sharon Smith, Natural Resources Canada)	Don't understand why the question was asked!
E-15-201	A	22	19	22	28	Do you mean 'fish'? If so, say so. (Jean Palutikof, Met Office)	TP – The term used is more precise and concise

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E-15-202	A	22	22		22	paleolimnological (Tavi Murray, Swansea University)	Noted
E-15-203	A	22	31	26	9	This section of text very dense and difficult to follow - it needs re-writing. (Jean Palutikof, Met Office)	TVC: clarity has been improved as some parts have been re-written
E-15-204	A	22	38	22	40	Are you sure about this? In North America, there was not all that much tundra during full glacial (note the reference (Callaghan) is a secondary source and does not contain data about this). There was only a small strip of tundra south of the ice sheet, and except for Alaska (and here the nature of the vegetation is still under dispute) and perhaps the mountains, there was little tundra. Perhaps in Eurasia this is the case; if so, this should be specified. (Konrad Gajewski, University of Ottawa)	TVC: Eurasia specified
E-15-205	A	23	5	23	6	This statement is much too undifferentiated. In historical times, goose populations of the Western Palearctic and North America have never been larger (e.g Madsen et al. 1999: Goose Populations of the Western Palearctic. Wetlands International & National Environmental Research Institute, Denmark), and there are indications that most arctic and sub-arctic wader populations of the East Atlantic flyway are doing well or even are increasing (Meltofte et al. 2006, Wader Study Group Bull. 109: 83-87). This is not so for waders in North America and waterbirds in general in East Asia, but here, problems outside the Arctic are probably more important. In accordance with this, 30 arctic wader specialists gathered at a workshop in Denmark a few years ago reached the conclusion that in general, arctic waders initially are likely to benefit from climate amelioration due to earlier snow melt and increased invertebrate food availability both to the adult breeding birds during the first period after arrival and to the chicks after hatch in July (Meltofte et al. 2004, Climate Change in the Arctic, Extended Abstracts, AMAP Report 2004:4, and in prep.). However, in the longer term all arctic birds are most likely to suffer large range contractions due to overgrowing of tundra habitat with scrubs and trees. Here the high-arctic populations will probably suffer most, since much of the very limited high-arctic tundra may be taken over by higher growth typical of low-arctic tundra. (Hans Meltofte, National Environmental Research Institute)	TVC: text modified to slightly weaken the extent of population decline, but there is insufficient space for more detail.
E-15-206	A	23	6			climate change not climate changes (Robert Jefferies, University of Toronto)	TVC: fixed
E-15-207	A	23	8			Delete 'formerly' (Jean Palutikof, Met Office)	TVC: text deleted
E-15-208	A	23	9	22	12	What are the actual climate effects? (Gordon McBean, Institute for Catastrophic Loss Reduction, University of West.	TVC: text modified to focus on climate effects

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						Ontario)	
E-15-209	A	23	11	23	12	What does this sentence about icing events mean? Do their antlers ice up so they topple over? Needs clarifying. (Jean Palutikof, Met Office)	TVC: explanation added
E-15-210	A	23	11	23	12	See also Forchhammer & Boertmann 1993, Ecography 16: 299-308. (Hans Meltofte, National Environmental Research Institute)	TVC: reference added
E-15-211	A	23	11			typo ",." (Tavi Murray, Swansea University)	TVC: fixed
E-15-212	A	23	14	23	31	Written in note form - needs revision. (Jean Palutikof, Met Office)	TVC: now revised
E-15-213	A	23	14	23	15	Too what extent do the Seward Peninsula or the Swedish sub-Arctic represent the Arctic? See comments above (p7 line 43) and the Executive Summary. (Robert Jefferies, University of Toronto)	TVC:locations of tree-line and shrub advance have been specified
E-15-214	A	23	14	25		This subject matter is also reviewed by Walther et al 2002, referred to elsewhere in the chapter (Peter Convey, British Antarctic Survey)	TVC: more recent primary data are cited. No change
E-15-215	A	23	16	23	17	the text need some change as the cited paper show stable or possibly retreating treeline positions in northern Scandinavia (correspondance to climate; snow) and somewhat advancing in the south (corresponding to browsing and climate) (Annika Hofgaard, Norwegian Institute for Nature Research)	TVC: text modified
E-15-216	A	23	17			Should start a new sentence with Although as these are different thoughts. (Gordon McBean, Institute for Catastrophic Loss Reduction, University of West. Ontario)	TVC: text modified
E-15-217	A	23	19			On what time scale did these former changes take place? What did you learn from these results, if anyhting, in this context? (Gordon McBean, Institute for Catastrophic Loss Reduction, University of West. Ontario)	TVC: rates of change are listed below this part of the text. The reader is now directed to this.
E-15-218	A	23	24	23	25	Should this information not be with the freshwater stuff? (Gordon McBean, Institute for Catastrophic Loss Reduction, University of West. Ontario)	TVC: yes, text modified
E-15-219	A	23	27	23	31	One sentence paragraph, and the sentence isn't grammatically correct. (Jean Palutikof, Met Office)	TVC: text re-written
E-15-220	A	23	27	23	31	increase in NDVI and primary production is somewhat mixed here. These two variables may not be comparable due to landscape scale grazing/browsing pressure (Annika Hofgaard, Norwegian Institute for Nature Research)	TVC: text modified
E-15-221	A	23	27	23	31	I do not know what or how I am to interpret from this paragraph. (Gordon McBean, Institute for Catastrophic Loss Reduction, University of West.	TVC: text re-written

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						Ontario)	
E-15-222	A	23	35	23	51	Words like 'trophic level structure' and 'genotype' won't be readily accessible to your readership. Is it possible to simplify this paragraph? (Jean Palutikof, Met Office)	TVC: As far as it is possible we have removed technical terms. Those that remain are defined in the glossary. Paragraph has been simplified
E-15-223	A	23	37	23	38	"Arctic species will extend their ranges northwards and upwards" - no way! There is not much land available fo such moves; many species will be trapped. (Ulf Molau, Göteborg University)	TVC: text modified
E-15-224	A	23	38	23	39	This seems the same as lines 18-19 above on same page. (Gordon McBean, Institute for Catastrophic Loss Reduction, University of West. Ontario)	TVC: lines 18-19 were about observed changes whereas lines 38 to 39 are projected changes: the headings denote this difference. No change.
E-15-225	A	23	41	23	41	"simple" - change to "relatively simple" (Ulf Molau, Göteborg University)	TVC: done
E-15-226	A	23	47	23	48	Compare this with p. 22, lines 46-49 - are they consistent? (Gordon McBean, Institute for Catastrophic Loss Reduction, University of West. Ontario)	TVC: the texts are not inconsistent and this interpretation depends on the missing magnitude of new species on lines 18 and 19. this has now been fixed.
E-15-227	A	23	51	23	51	Something has been lost in the text here. I suspect that it should read "…to expend. The timing of bird …". (Michael Usher, University of Stirling)	TVC: fixed
E-15-228	A	23	51			Missing full stop (Jean Palutikof, Met Office)	TVC: fixed
E-15-229	A	24	9	24	10	What sort of effects? This statement isn't helpful to the readers. (Jean Palutikof, Met Office)	TVC: text modified
E-15-230	A	24	13	24	16	very difficult sentence. (Jean Palutikof, Met Office)	TVC: fixed
E-15-231	A	24	13		16	this sentence is very confusing (Fiona Cawkwell, University College Cork)	TVC: fixed
E-15-232	A	24	15			km2 superscript (Robert Jefferies, University of Toronto)	TVC: fixed
E-15-233	A	24	15		15	"km2" should be superscipted. (Tavi Murray, Swansea University)	TVC: fixed
E-15-234	A	24	25	24	27	Missing from ACIA key finding 3: forest fires are projected to increase (in frequency and extent) (John Streicker, Yukon College)	TVC: text modified
E-15-	A	24	40	24	41	Too many pr-TAR references.	TVC: one old reference deleted, one new one

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235						(Jean Palutikof, Met Office)	added
E-15-236	A	24	43	24	51	You may wish to add the recent review in Nature by Chapin and Zimov on permafrost and methane release? (Robert Jefferies, University of Toronto)	TVC: reference added
E-15-237	A	24	43	25	27	Considering the measurements of methane release into the atmosphere, mention should be made of recent advances in satellite remote sensing, e.g., C. Frankenberg, J.F. Meirink, M. van Weele, U. Platt & T. Wagner, "Assessing Methane Emissions from Global Space-Borne Observations," Sciencexpress/www.sciencexpress.org/17March 2005/Pages 1-4/10.1126/science.1106644. (David Malcolm, Arctic Energy Alliance)	TVC: this is a methodological paper dealing mainly with the tropics. A reference to it has not been added
E-15-238	A	24	47			What does 'overlap zero' mean? (Jean Palutikof, Met Office)	TVC: text modified
E-15-239	A	25	5	25	7	What do 'source status' and 'sink status' mean? (Jean Palutikof, Met Office)	TVC: explanation given and these terms are defined in the glossary
E-15-240	A	25	12	25	13	Further comment is needed to know what to make of this sentence. (Gordon McBean, Institute for Catastrophic Loss Reduction, University of West. Ontario)	This paragraph was deleted
E-15-241	A	25	15	25	22	Should this be in a WGII report? Is the methane included in the statement on carbon? (Gordon McBean, Institute for Catastrophic Loss Reduction, University of West. Ontario)	TVC: yes, biogenic proceses in polar regions belong here whereas consequences for radiative forcing are the focus of WGI. The statememnt on carbon has been clarified This paragraph was deleted
E-15-242	A	25	15			there is a lot of repetition here (Fiona Cawkwell, University College Cork)	TVC: there is not repetition: the paragraph starting on page 24, line 43 is about *current* conditions, tht on page 25, line 15 about *projected* conditions: no change This paragraph was deleted
E-15-243	A	25	22			Subarctic conifer forest (e.g., interior Alaska) is undergoing "browning" due to increasing summer drought. (Ulf Molau, Göteborg University)	TVC: the comment is not relevant to this section: no change
E-15-244	A	25	24	25	27	As it stands, this paragraph is weakly presented. (Ulf Molau, Göteborg University)	TVC: paragraph strengthened
E-15-245	A	25	34			presumably $200M per year - need to emphasise time frame (Fiona Cawkwell, University College Cork)	CF-correct, edited to state per year
E-15-246	A	25	42	25	42	The statement should be more specific about where these sources of energy are used. There are many communities in the north that use diesel etc. as a major	Noted

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						energy source. (Sharon Smith, Natural Resources Canada)	
E-15-247	A	25	50	25	51	Are poor soil conditions also an issue? (Sharon Smith, Natural Resources Canada)	This is not the most significant factor and is not mentioned
E-15-248	A	26	2			Metric is irrelevant. We just need to know about the change. (Jean Palutikof, Met Office)	The description of the metric helps understand the reason it is not easy to project, and the specific nature of the climate sensistivity
E-15-249	A	26	4	26	9	What about changes in Canada, Alaska, and Scandinavia? This paragraph also mixes issues - are the soils okay or markets availabelt o make use of this expanded agriculture? (Gordon McBean, Institute for Catastrophic Loss Reduction, University of West. Ontario)	CF-added stipulation re: where markets exist or infrastructure can be developed to clarify
E-15-250	A	26	6		6	"and forestry . And while, " Oddly phrased and punctuated two sentences. (Tavi Murray, Swansea University)	CF-edited
E-15-251	A	26	42	26	45	Ocean models include T, S, and currents; which parameters are you referring to? (Gordon McBean, Institute for Catastrophic Loss Reduction, University of West. Ontario)	Fixed – text deleted.
E-15-252	A	27	5	27	50	How is 'overall effect' (line 9) quite different when both regions end up with depleted fisk stocks? This box could be reduced by half in length (and should be moved to Section 15.6). (Jean Palutikof, Met Office)	Fixed – text in box re-written
E-15-253	A	27	12	27	34	Since the West greenland fish are very close to the Labrador fish, there should be a connection made between these examples (Gordon McBean, Institute for Catastrophic Loss Reduction, University of West. Ontario)	There were extensive investigations in the Greenland/Labrador area in the 1960s (Northland Series). Cod may drift across the Davis Strait to Labrador, but such driftts could hardly restore the 'northern cod' complex.
E-15-254	A	27	12	27	25	It is important to connect these two paragraphs to understand the time changes. (Gordon McBean, Institute for Catastrophic Loss Reduction, University of West. Ontario)	Done
E-15-255	A	28	24			The focus obviously is on climate change consequences, but to be objective greater reference to the interaction with ecosystem changes related to the "recovery" from previous and drastic overexploitation is required - as with all ecosystems, it is far from clear what the trajectory of change/recovery is likely to be - there is no automatic assumption of a return to a pre-existing state - and in the Southern Ocean it is clear that many of the population or ecosystem trends currently being seen involve complex and very poorly understood interactions between "climate change" and various responses to previous human economic exploitation.	I agree wholeheartedly with this excellent comment. The only special remark I want to make is that while there can br no general guarantee for reversal to a previous, let alonr pristine, state is that if commercial marine stocls can be managed correctly, they can yield much more than at present so long as warming – or cooling for that matter – does

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						(Peter Convey, British Antarctic Survey)	not go haywire. Otherwise there are two prerquisites for this, i.e. increased scientific knowledge and understanding (should come in recommendations) and managers willing to enter fair negotiations. The latter are almost nion existing today. This is allured to in 15.4.3.3 and in the Text Box
E-15-256	A	29	12			patterns of ocean circulation (Robert Jefferies, University of Toronto)	Fixed – word inserted
E-15-257	A	29	16		16	"And here it important to note" (Tavi Murray, Swansea University)	Fixed – word inserted
E-15-258	A	29	43	29	44	What does this mean? (Jean Palutikof, Met Office)	CF – has been simplified
E-15-259	A	29	45			What is 'northern cardiomyopathia'? Is it necessary to confuse your readers with these technical terms? It just obscures your message. (Jean Palutikof, Met Office)	CF – it has been simplified
E-15-260	A	29	49			Are unintended injuries the same as accidents? (Gordon McBean, Institute for Catastrophic Loss Reduction, University of West. Ontario)	CF – yes but this is the proper health community terminology (has been changed for more general audience)
E-15-261	A	30	1	30	2	This text needs to be clarified. (Gordon McBean, Institute for Catastrophic Loss Reduction, University of West. Ontario)	CF-has been reworded
E-15-262	A	30	19	30	19	This should be refered to as climate variability. (Gordon McBean, Institute for Catastrophic Loss Reduction, University of West. Ontario)	CF-edited to reflect comment
E-15-263	A	30	19			El Nino needs the stroke above the "n" (Robert Jefferies, University of Toronto)	CF – Done
E-15-264	A	30	27			Define 'zoonotic'. Can be done at line 22. (Jean Palutikof, Met Office)	CF, DGV to check for how we are to deal with in text definitions of words that are in the glossary
E-15-265	A	30	33			I'm not entirely convinced by 3 years worth of data for W N virus - how much natural variability is there, and between 2002-3 there is not that much difference in the area where positive tests were recorded (Fiona Cawkwell, University College Cork)	CF –has been deleted
E-15-266	A	30	36	30	47	This data set of West Nile needs to be updated to the present. Also it is not clear how much the change in range is due to climatic events per se. I suggest a more cautious statement is needed.	CF-has been deleted

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						(Robert Jefferies, University of Toronto)	
E-15-267	A	31	29	31	30	Which communities would be subject to saltwater intrusion (assume this is related to groundwater contamination) - the communities given in the preceeding sentence? As mentioned in an earlier comment, presence of permafrost often limits the use of ground water as a freshwater resource. (Sharon Smith, Natural Resources Canada)	CF-currently no assessment done to cite location specific examples
E-15-268	A	31	32	31	33	How will sewage lagoons be damaged and how is this related to climate change? Some explanation is required. Is this the result of loss of containment due to permafrost thaw for example? (Sharon Smith, Natural Resources Canada)	CF-has been edited to state reservoir or sewage lagoon containment, yes
E-15-269	A	32	7	32	43	Section can be shortened, needs reference to sea level change. (Jean Palutikof, Met Office)	Text was changed.
E-15-270	A	32	7			There is text on coastal erosion due to changes in permafrost and sea ice (15.4.7), but nowhere did I see this linked to rising sea levels and what that would do to amplify the effect in future. [Unless it is implicit in this statement from section 15.7 on page 37: Despite discrepancies in details, by the mid-21st Century, all IPCC scenarios yield a discontinuous high-risk zone around the Arctic Ocean, indicating a high potential for coastal erosion.] (Paul van der Linden, Met Office)	Sea level is listed as one of the factors governing the coastal errosion, however here emphasis is made on the effect of permafrost degradation.
E-15-271	A	32	23	32	27	I assume that it is the impacts related to disturbance of the ground surface etc. that are being referred to when human activity is mentioned or industrial activity. Perhaps clarification is required (Sharon Smith, Natural Resources Canada)	Yes, this is what we were trying to say.
E-15-272	A	32	46	34	11	This section very general and could be substantially shortened - much of it relates to adaptation in general and is not really specific to Polar Regions, e.g., 33 lines 20-33. (Jean Palutikof, Met Office)	This section is a required one, and this is the best and most specific text that we feel can be written under it.
E-15-273	A	32	46	34	11	Heavy overharvest of many populations of birds and mammals by arctic people already necessitates considerable changes in many arctic peoples' way of living. It is evident that many slow reproducing populations have been severely reduced following human population growth and the introduction of shotguns and speed boats, and that they no longer can sustain hunting harvest - with of without climate change (see e.g. the debate book by Hansen, K. 2002: A Farewell to Greenland's Wildlife. Gads Forlag, Copenhagen). (Hans Meltofte, National Environmental Research Institute)	Fixed. A relevant sentence has been added on page 38 line 30 regarding the implications of wildlife harvesting on Sustainable Development.
E-15-274	A	32	48	32	51	Are the emissions of entire nations considered even if only a portion of the nation is considered Arctic? The US is one of the largest emittors but only a small portion of	CF: Clarification of “extra-Arctic” contributions to the quoted 40% level has been

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						the country (and its population) would be considered Arctic. While a rather large portion (about half) of Canada may be considered arctic, only a small proportion of the population is in the arctic. These statements need to be clarified. (Sharon Smith, Natural Resources Canada)	addressed by a bracketed qualifying statement, i.e., (mainly from areas outside the Arctic). have added words to clarify
E-15-275	A	32	48			Although the countries may emit 40%, the Arctic regions of these countries emit a small percentage. While on the global basis, there is discussion of the north affecting the south (developed countries affecting developing countries), in this context, it is the southern, usually more decvleoped parts of these countreis affecting the northern (usually less developed) parts of the countries. (Gordon McBean, Institute for Catastrophic Loss Reduction, University of West. Ontario)	Repeated comment
E-15-276	A	32	50	32	50	"there is a need to concurrently consider both mitigation and adaptation…" See note below (John Streicker, Yukon College)	Not necessary
E-15-277	A	33	1	33	1	The polar amplification is not only projected, it is observed. I suggest "magnified by the current and projected amplification…" (John Streicker, Yukon College)	Text changed as suggested
E-15-278	A	33	25	33	26	It would seem that some changes in local environments would increase human vulnerability whereas other changes could decrease vulnerability. Hence I would change "increases human vulnerability" to "can increase human vulnerability." (Claire Parkinson, NASA Goddard Space Flight Center)	Text changed as suggested
E-15-279	A	33	35	33	37	Again, a more cautious statement is required on "high latitude agriculture" (see previous comment). (Robert Jefferies, University of Toronto)	Here we talk about the opportunities for high latitude agriculture, and these are increasing.
E-15-280	A	33	42	33	43	The IPCC FAR should be careful not to decouple adaptation from mitigation. Adaptive strategies which refocus economic growth to industrial processes which contribute heavily to greenhouse gas production are ultimately mal-adaptive. (John Streicker, Yukon College)	Noted. Too general to cause any specific action.
E-15-281	A	33	50			Although Arctic communities.... (Robert Jefferies, University of Toronto)	Changed
E-15-282	A	34	6	34	6	The effectiveness of adaptation strategies is certainly enhanced when local community members are involved in the decision making process. (John Streicker, Yukon College)	Agreed, this is implicit
E-15-283	A	34	11			among all Arctic residents (Robert Jefferies, University of Toronto)	Changed
E-15-284	A	34	14	37	9	Case Studies need tightening to provide more hard fact and less waffle. .	

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Notes of the writing team
						The first, Traditional Knowledge, needs more concrete examples. It starts to be interesting at line 42. Megadeltas would be improved by the addition of a map of the Lena delta. The Antarctic Peninsula case study is OK but rather too long. I suggest some text is lost from the first and third principally, and some from the second (but a map needs adding). Total net loss could be one page from this section even when the map is added. (Jean Palutikof, Met Office)	Examples have been added with an additional reference Consideration will be given to including satellite images of one or two northern deltas under varying hydrologic conditions as controlled by cryospheric processes (i.e., sea and river ice) DGV – I defend the length of this, as one of the few Antarctic sections that stands out, I will take specific comments for shortening but would like to maintain, one full page on this issue. Colletively the LAs agree that the case study is important to include but should be reduced to one page or less. It has now been noted by the TSU that the cross-chapter case studies do not count in the overall page limits for this chapter and hence, signficiant savings from the two cross-chapter boxes have already been made (i.e., ~1.25 p). Further savings will be made by shrinkage of the Antarctic Peninsula case study (i.e., ~0.25 p) . Total ~ 1.5 p saving.
E-15-285	A	34	16	35	5	The overall impression of this section that may be left with the reader is that traditional knowledge for adaptation makes climate change a relatively small issue for northern peoples - this is not the impression that I think is appropriate - so the authors may wish to re-examine the text in this context. (Gordon McBean, Institute for Catastrophic Loss Reduction, University of West. Ontario)	CF
E-15-286	A	34	33	34	40	Climate change may (probably will) push the climate beyond the limits of TEK. (Gordon McBean, Institute for Catastrophic Loss Reduction, University of West. Ontario)	CF
E-15-287	A	35	32			indicate not indicates (Robert Jefferies, University of Toronto)	TVC: fixed

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Notes of the writing team
E-15-288	A	36	12	36	16	This text should be checked against whatis in WGI. Is there a question that summer warming will continue? There is also need for editing because some words seem to be missing. (Gordon McBean, Institute for Catastrophic Loss Reduction, University of West. Ontario)	Text has been tidied-up. There is a question over whether summer warming will continue therefore text is correct.
E-15-289	A	36	18	36	31	The atmospheric warming/ocean warming controversy could be signalled a bit more clearly - this has significance for timescales and response (Richard Hindmarsh, British Antarctic Survey)	This is not a level of detail that can be discussed here.
E-15-290	A	36	29	36	31	Is this text consistent with WGI? How rapid is rapid warming? Is there really little basis for projecting climate in this area? (Gordon McBean, Institute for Catastrophic Loss Reduction, University of West. Ontario)	The region under discussion is probably too small to be resolved by WG-I, and projecting a continued increase is given as a hypothetical here.
E-15-291	A	36	33	44		Reference to the Bergstrom et al 2006 volume would be pertinent here (Peter Convey, British Antarctic Survey)	Noted
E-15-292	A	37	12	38	42	Authors need to think carefully about this section. This heading may only merit one paragraph in this chapter, since Sustainable Development and Antarctica, at least, are generally recognized as oxymoronic. To have 2 pages on permafrost really isn't appropriate under this section heading, and gives avery strange impression. (Jean Palutikof, Met Office)	permafrost material was condenced. CF has previously supplied material on Sustainable Development (beyond that incuded in this version) that could “round out” the remainder of this section. All provided material, however, will be edited down to a total page length of only 1p. DGV has done final integration.
E-15-293	A	37	12	38	18	Almost the entire section does not really deal with "Implications for sustainable development", but is devoted much more specifically to permafrost thawing and ist effects; therefore the section should be retitled to "Impacts of thawing permafrost on northern communities and infrastructure". However, in this case, it does not belong here but should be moved to chapter 15.4 (Manfred Lange, University of Muenster)	See response to comment 292
E-15-294	A	37	14	38	57	You spend 5 paragraphs discussing the complicated nature of permafrost and influences from climate change and direct human activity. A more straitforward case with respect to economic activity and infrastructure that you don't mention is ice roads. These seasonal roads have a decreasing window of operation due to later freeze-up and earlier spring-thaw. They are used to transport goods at a fraction of the cost of air-frieght to remote communities and camps. At COP 11 a group from the Northwest Territories, Canada was proposing to pursue renewable energy	See respopnse to comment 292 CF and TP have provided additional material on ice roads. More material is required on mineral development for final integration into material as discussed in #292.

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						sources rather than rely on diesel power generation. Thus they would mitigate GHG emissions and adapt to a shorter ice road season by reducing the need to transport fuel. (John Streicker, Yukon College)	
E-15-295	A	37	14			Section 15.7.1 -- Monitoring of integrity of structures as well as the ground thermal regime, thaw settlement and other parameters will also be essential in both the mitigation of climate change impacts and also to provide further information to aid in the design of future infrastructure. Some examples of monitoring programs could possibly be presented. A permafrost and terrain monitoring program has been conducted for 20 years along the Norman Wells pipeline (see for eg. Burgess and Smith 2003 - citation provided earlier) and this has investigated changes in the ground thermal regime, thaw depth, thaw settlement etc (both on and off the right-of-way), pipe movements etc. and has provided information to increase understanding of impacts of climate change and northern development which is useful for future project design. Other examples related to pipelines (Alaska), railways, major buildings etc. in other regions could probably be given as well. (Sharon Smith, Natural Resources Canada)	Insufficient space for this level of deatail.
E-15-296	A	37	14			Section 15.7.1 - As mentioned in earlier comments, there will be a need for good information on the ground materials (ice content, temperature) to aid in site selection and also to determine how climate change may influence design of future structures or potential impacts for existing structures (as well as information on foundation characteristics etc.). Couture et al. 2000, 2001 and Chartrand et al 2002 (all are cited in ref. list) describe a pilot study carried out in two communities in the Mackenzie valley in which available geotechnical information and an inventory of infrastructure (and its characteristics) were compiled in order to develop tools that could be used by communities to determine which structures may encounter problems due to climate warming and to also facilitate future landuse planning. This approach could be mentioned to illustrate techniques that can be used to facilitate development of adaptation strategies. (Sharon Smith, Natural Resources Canada)	Insufficient space precludes such a detailed discussion but, as noted in #295, some aspects of monitoring will be included regarding future recommendatons.
E-15-297	A	37	16	37	20	There are also important concerns related to mining such as contaminant containment. Permafrost is often relied on for containment either as foundation for frozen core dams (or other retaining structures) of tailing ponds or encapsulation of tailing piles. (Sharon Smith, Natural Resources Canada)	Text was changed.
E-15-298	A	37	22			Is it pertinent to mention in this paragraph the influence than continued rapid rise in world oil prices will have on pressures to exploit regions that are currently	This is more relevant to WG III.

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						considered too difficult to exploit economically in the Arctic and Antarctic? (Peter Convey, British Antarctic Survey)	
E-15-299	A	37	29	37	29	The Ouranos group in Montreal has undertaken studies on this in Canada. (Gordon McBean, Institute for Catastrophic Loss Reduction, University of West. Ontario)	Research background has been noted and material employed as necessary during major re-write of this section.
E-15-300	A	37	33	37	33	It would be better to say "Substanial investment may be necessary …" as the impacts on infrastructure will depend on the ground ice conditions as well as the design of the structure. (Sharon Smith, Natural Resources Canada)	Concern noted and Section 15.7 will receive a major revision.
E-15-301	A	37	36	37	37	While this is a good point (and definitely needs to be made), we also need to consider that the actual impact will also depend on the engineering design -- will climate change result in a significant impact on the structure during its lifetime, beyond the design values etc. (Sharon Smith, Natural Resources Canada)	Concern noted and Section 15.7 will receive a major revision.
E-15-302	A	37	36	37	44	This section makes an important point in that it points out that not all damage to infrastructure related to permafrost thaw can be attributed to climate change and that quite often these impacts are related to the construction and operation of the structure itself (this is particularly true where engineering design has failed to consider permafrost conditions as was the case in many older structures). Unfortunately, other chapters in the WG2 report (see individual comments on specific chapters for details) have made statements that unequivocally link infrastructure damage to climate change (and this also shows up in SPM and TS). The authors of Chapter 15 may wish to consult with the authors of these other chapters to make sure that there is consistency in the statements that are made. (Sharon Smith, Natural Resources Canada)	Concern noted and Section 15.7 will receive a major revision. A useful reference to detailed material on permafrost in the ACIA will also be made.
E-15-303	A	37	37	37	41	While it is true that a number of reports have made unequivocal statements implying that climate change is responsible for widespread damage to infrastructure, the way the sentence is written it implies that all the reports cited might be making this type of statement which is not the case. While the 3 reports which appear to be media reports (Zernova, Gribchatov and Vailieva) may make these statements, Smith et al and Couture et al (which are the scientific papers) do not. Smith et al. (2001) is mainly a review of the challenges permafrost presents to northern development in Canada and while it does comment on the impacts thawing permafrost may have on infrastructure (as well as effects development may have on permafrost) and provides a number of examples, it does not attribute them to climate change. Couture et al. 2003, also presents some examples of impacts related to permafrost thaw but does not attribute the observed damage to climate	Concern noted and Section 15.7 will receive a major revision.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Notes of the writing team
						change (the paper also comments that disturbance can result in permafrost degradation and damage to infrastructure). To be fair, the scientific papers that do not make statements linking all permafrost thaw in development areas or observed damage to climate change should be separated from these more alarmist views. It is also important to note that the damage to infrastructure for the most part which is described in Smith et al and Couture et al is related to older infrastructure for which engineering design was not appropriate for permafrost conditions and was similar to that used in the south. In the latter half of the 20th century the presence of permafrost was taken into account in design and damage was reduced. (Sharon Smith, Natural Resources Canada)	
E-15-304	A	37	41	37	44	The effect of heated buildings and urban heat island effects are not the only causes of permafrost thaw related to development. The disturbance to the ground surface such as that caused by removal of the vegatation cover and the organic layer can also result in changes to the ground thermal regime - for a number of types of infrasturcture this will be the main cause of permafrost thaw rather than the ones mentioned in this paragraph (eg. disturbance of the ground surface related to clearing of right-of-ways for pipeline or road construction). Imapcts related to right-of-way clearing associated with Norman Wells pipeline in the Mackenzie valley and documentation of changes in thaw depth in disturbed and undisturbed terrain are provided in Burgess and Smith (2003) (Burgess, M.M. and Smith, S.L. 2003. 17 years of thaw penetration and surface settlement observations in permafrost terrain along the Norman Wells pipeline, Northwest Territories, Canada; Proceedings of 8th International Conference on Permafrost, July 2003, Zurich Switzerland, p. 107-112.) (Sharon Smith, Natural Resources Canada)	Concern noted and Section 15.7 will receive a major revision.
E-15-305	A	37	46	37	51	This section raises an important point in that it mentions that inappropriate position and construction practices have been used and one assumes that this may be largely responsible for permafrost thaw and any related damage to buildings etc. Perhaps a further point could be made which highlights the importance of site selection (avoidance of thaw sensitive material etc.), knowledge of condition of underlying materials and use of designs appropriate to permafrost conditions as these are essential for maintaining structural integrity under both stable and changing climates. (Sharon Smith, Natural Resources Canada)	Concern noted and Section 15.7 will receive a major revision.
E-15-306	A	38	4	38	5	The quote from Couture et al. (2000, 2002 actually it should be 2001 - my mistake in comments on FOD) may be a bit innaccurate. Couture et al (2000) stated that geotechnical problems are anticipated to be more common leading to serious and	Concern noted and Section 15.7 will receive a major revision.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Notes of the writing team
						costly problems or maintenance requirements for northern communities and infrastructure. Whether it is overwhelming would depend on a lot of other factors including the economic situation of the communities etc. Couture et al (2001) indicated that climate change related impacts could initiate greater economic costs. Note that in comments on FOD, the reviewer had made a similar comment but also suggested that a more important contribution of Couture et al. (2000) (and also Couture et al 2001, and Chartrand et al 2002 which were not cited in FOD) was that it discussed the need to understand the conditions of the underlying material and to provide databases that could be used by communities in their landuse planning. (Sharon Smith, Natural Resources Canada)	
E-15-307	A	38	4	38	18	It would be good to mention that climate change has been considered recently in design of major structures and there are a number of Canadian examples such as containment dams for Ekati diamond mine, large buildings (EBA 1995; Hayley 2004). It is also important to mention that adaptation techniques for dealing with warming and thawing of permafrost do already exist to some extent as construction (including surface disturbance etc.) and operation of various structures can result in permafrost thaw under a stable climate. Special techniques are utilized in the design of northern infrastructure to deal with these changes in permafrost conditions and can also be used to adapt to climate change. Refs: EBA Engineering Consultants, 1995. Tailings Management Plan and Preliminary Design of Retention Structures. Submitted to BHP Diamonds, Dec. 1995 Hayley, D. W. 2004. Climate change – an adaptation challenge for northern engineers. The PEGG, Newspaper of the APEGGA, January 2004 (I believe this may already be in the reference list) (Sharon Smith, Natural Resources Canada)	DGV:Concern noted and Section 15.7 will receive a major revision.
E-15-308	A	38	4	38	5	Chartrand et al. (2002) presents a geotechnical database for Norman Wells and Tuktoyaktuk and does not make any statements regarding the cost of rehabilitating community infrastructure. It should therefore be removed from this sentence. (Sharon Smith, Natural Resources Canada)	Concern noted and Section 15.7 will receive a major revision.
E-15-309	A	38	4	38	18	As mentioned in preceeding comment, adaptation techniques for dealing with climate change do to some extent already exist (adjustable foundation, use of insulation, piles, use of thermosyphons etc) and that what is required is to incorporate additional thaw into design of new infrastructure. There is not much discussion of the adaptation techniques that could be utilized to deal with consequences of permafrost thaw. (Sharon Smith, Natural Resources Canada)	Concern noted and Section 15.7 will receive a major revision.
E-15-310	A	38	20	38	24	With these changes will come incresed risk of envrionmental damage to sensitive ecosystems.	Valid point and a brief comment will be included about such related effects.

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						(Gordon McBean, Institute for Catastrophic Loss Reduction, University of West. Ontario)	
E-15-311	A	38	28	38	28	(Minor) I recommend toning down "this task is enormous" to: 'this task is increased even further." (Claire Parkinson, NASA Goddard Space Flight Center)	Proposed text change will be used.
E-15-312	A	38	34	28	42	This whole part of the paragraph addresses the Arctic Council; I fail to see why it has been placed here. If at all, it should be positioned in the introduction of this chapter. (Manfred Lange, University of Muenster)	Text will be reduced and re-organized in major revision of this section.
E-15-313	A	38	47			Need something/more on research needs at the end of the chapter. (Paul van der Linden, Met Office)	Research recommendations have been added in 15.8
E-15-314	A	38	50	38	50	Could add a sentence: "Some of these gaps will be addressed by research currently underway during the International Polar Year." (John Streicker, Yukon College)	Regarding research recommendations, a reference has been made to ICARPII research plans and IPY.
E-15-315	A	39	0			other uncertainties which should be mentioned include a) the impact of changes outside the polar regions, e.g. in ocean currents, global winds, climatic teleconnections; b) there are often insufficient records to be able to defintively determine whether current trends and rates of change are extreme, new... (e.g. in climate a 30 year record is desired before true change can be distinguished from noise) (Fiona Cawkwell, University College Cork)	Covered in new Key Uncertainties and Recommendations section.
E-15-316	A	39	1	39	20	The impression left is that we do not know anything. (Gordon McBean, Institute for Catastrophic Loss Reduction, University of West. Ontario)	This section has been re-written with advances explicit
E-15-317	A	39	2	39	3	It is unclear in this bullet which "climate warming" is meant. It would be nice to make it more explicit, e.g., changing it to "recent climate warming" or "expected future climate warming" or "recent and expected future climate warming". (Claire Parkinson, NASA Goddard Space Flight Center)	Text has been rewritten.
E-15-318	A	39	7	39	7	Expand "spatial variability" to "spatial and temporal variability". (Claire Parkinson, NASA Goddard Space Flight Center)	Text has been rewritten.
E-15-319	A	39	8	39	8	Have "whether rapid recent rates warming…" Should read "whether rapid recent warming rates…"? (John Streicker, Yukon College)	Text has been rewritten.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Notes of the writing team
E-15-320	A	39	11	39	11	Could add this clause to the end of this bullet: "to assist communities to develop reasonable environmental assessments, resource management plans and adaptation strategies;" (John Streicker, Yukon College)	Text has been rewritten.
E-15-321	A	39	20	39	20	Have "adaptation capacity of natural…" Should read "adaptive capacity of natural…"? (John Streicker, Yukon College)	Text has been rewritten.
E-15-322	A	40	1	57		There are numerous changes that are needed to the References. They cannot be checked fully at this stage (Robert Jefferies, University of Toronto)	Noted
E-15-323	A	40	1	57	50	There are many errors in the references, including: double entries fo several references, some with in press and the other as printed; many page numbers missing; etc. (Gordon McBean, Institute for Catastrophic Loss Reduction, University of West. Ontario)	Noted
E-15-324	A	40	8	40	8	Reference to add: Abdalati, W., W. Krabill, E. Frederick, S. Manizade, C. Martin, J. Sonntag, R. Swift, R. Thomas, J. Yungel, and R. Koerner, 2004, Elevation changes of ice caps in the Canadian Arctic Archipelago, Journal of Geophysical Research, 109, F04007, doi:10.1029/2003JF000045. (Claire Parkinson, NASA Goddard Space Flight Center)	Noted
E-15-325	A	40	45	40	45	Reference to add: Arendt, A. A., K. A. Echelmeyer, W. D. Harrison, C. S. Lingle, and V. B. Valentine, 2002, Rapid wastage of Alaska glaciers and their contribution to rising sea level, Science, 297 (5580), 382-386. (Claire Parkinson, NASA Goddard Space Flight Center)	Noted
E-15-326	A	42	10	42	17	Callaghan et al. 2005a & b are identical (?) (Annika Hofgaard, Norwegian Institute for Nature Research)	Noted
E-15-327	A	49	12	49	12	"Lindgern" should be "Lindgren" (Ulf Molau, Göteborg University)	Noted
E-15-328	A	51	22	51	22	Reference to add: Parkinson, C. L., and D. J. Cavalieri, 2002, A 21 year record of Arctic sea-ice extents and their regional, seasonal and monthly variability and trends, Annals of Glaciology, 34, 441-446. (Claire Parkinson, NASA Goddard Space Flight Center)	Noted
E-15-329	A	51	24	51	26	This reference has now been published and should be updated to: Parkinson, C. L., K. Y. Vinnikov, and D. J. Cavalieri, 2006: Evaluation of the simulation of the annual cycle of Arctic and Antarctic sea ice coverages by 11 major global climate models. Journal of Geophysical Research, 111 (C7), C07012, doi:10.1029/2005JC003408.	Noted

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						(Claire Parkinson, NASA Goddard Space Flight Center)	
E-15-330	A	55	4	55	4	Reference to add: Stroeve, J. C., M. C. Serreze, F. Fetterer, T. Arbetter, W. Meier, J. Maslanik, and K. Knowles, 2005, Tracking the Arctic's shrinking ice cover: Another extreme September minimum in 2004, Geophysical Research Letters, 32, L04501, doi:10.1029/2004GL02180. (Claire Parkinson, NASA Goddard Space Flight Center)	Noted

This part contains LATE EXPERT comments for chapter 15

CHAPTER 15

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15-1	LATE	0				Make sure it does not come across with too much hyperbole or "shrillness", e.g. avoid adjectives such as "dramatic" and "extreme". I think the air of impartial observer begins to dissipate if it seems like we are pushing a climate change impacts position too hard. (David Atkinson, University of Alaska)	This is a rather stylistic comment, but is noted and the general spirit accepted.
15-2	LATE	1	6	1	14	Adjective "dramatic" appears twice. This word can be removed in both cases without loss of meaning. (David Atkinson, University of Alaska)	Noted – addressed in final editing
15-3	LATE	3	20	4	45	Various occurrences of "confidence" that has been capitallized. (in one case "Medium" was capitallized) (David Atkinson, University of Alaska)	Noted – addressed in final editing
15-4	LATE	3	24	3	24	Replace "will" with "could". Our understanding of feedbacks is not clear enough to use such definate term as "will produce". (David Atkinson, University of Alaska)	Noted
15-5	LATE	3	32	3	32	Replace "as a" with "in". (David Atkinson, University of Alaska)	Noted – addressed in final editing
15-6	LATE	3	40	3	40	Will the executives know what "riparian" means? (David Atkinson, University of Alaska)	We have requested that the term should appear in the glossary
15-7	LATE	3	43	3	43	Insert "damaging" between "increased" and "coastal". (David Atkinson, University of Alaska)	Considered – but this is a generally loaded term and will be avoided if possible
15-8	LATE	3	44	3	44	Replace "together with" with "as well as". (David Atkinson, University of Alaska)	Purely stylistic - will consider in final revision
15-9	LATE	4	9	4	14	Some repetition with bullet on page 4, lines 20-24. (David Atkinson, University of Alaska)	Noted
15-10	LATE	4	11	4	11	Replace "emergence" with "the appearance". (David Atkinson, University of Alaska)	Noted
15-11	LATE	4	35	4	35	Replace "will be" with "will act as". (David Atkinson, University of Alaska)	Noted
15-12	LATE	4	38	4	38	Insert between "permafrost" and "will" the phrase "and accelerated coastal erosion".	Noted

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Notes of the writing team
						(David Atkinson, University of Alaska)	
15-13	LATE	7	1	7	2	Replace "the Southern Ocean's uptake of CO2 emissions" with "the uptake of CO2 emissions by the Southen Oceans". (David Atkinson, University of Alaska)	Noted
15-14	LATE	7	16	7	16	Replace "the greenhouse" with "a greenhouse". (David Atkinson, University of Alaska)	Stylistic - not accepted
15-15	LATE	7	30	7	30	Replace "Arctic" with "circum-Arctic coastal margins". (David Atkinson, University of Alaska)	Too wordy
15-16	LATE	8	27	8	27	Insert between "support" and "play" the word "now". (David Atkinson, University of Alaska)	Noted
15-17	LATE	8	27	8	27	Drop "Nowadays". (David Atkinson, University of Alaska)	Stylistic - not accepted
15-18	LATE	9	3	9	4	Replace "So for the period before satellite observation only" with "Thus, for the period before satellite observation, only". (David Atkinson, University of Alaska)	Stylistic - not accepted
15-19	LATE	9	32	9	32	Replace "still" with "yet". (David Atkinson, University of Alaska)	Stylistic - not accepted
15-20	LATE	9	37	9	37	Replace "numbers following their taking bait" with "numbers when they take". (David Atkinson, University of Alaska)	Noted –accepted
15-21	LATE	13	17	13	17	Define "Cascading effects" with an e.g. (David Atkinson, University of Alaska)	Suggestion accepted - will consider if space permits
15-22	LATE	14	25	14	25	Replace "are, however, important considerations that must be taken into account." with "are important local-scale considerations that must also be taken into account.". (David Atkinson, University of Alaska)	Stylistic - not accepted
15-23	LATE	14	34	14	34	Put a semicolon after "populations", not a comma. (David Atkinson, University of Alaska)	Noted
15-24	LATE	15	6	15	6	Insert a comma after "2002)". (David Atkinson, University of Alaska)	Noted
15-25	LATE	15	6	15	6	Drop the comma between"regimes" and "and". (David Atkinson, University of Alaska)	Noted
15-26	LATE	15	7	15	7	Insert a comma after "activities)". (David Atkinson, University of Alaska)	Noted
15-27	LATE	15	11	15	11	Drop the apostrophe on "communities"'. (David Atkinson, University of Alaska)	Stylistic - not accepted
15-28	LATE	15	12	15	12	Replace "decreased" with "decreases" to match the verb tense established previously in the sentence.	Noted

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Notes of the writing team
						(David Atkinson, University of Alaska)	
15-29	LATE	15	12	15	12	Insert between "individuals" and "to" the word "available". (David Atkinson, University of Alaska)	Noted
15-30	LATE	15	40	15	40	Drop the comma after "sea ice". (David Atkinson, University of Alaska)	Noted
15-31	LATE	15	49	15	49	Insert between "with" and "global" the word "attendant". (David Atkinson, University of Alaska)	Noted
15-32	LATE	16	37	16	37	The number "15.30 %" - I assume this is a range and should be written "15 - 30 %" or "15 to 30 %". If not the ".30" should be dropped. (David Atkinson, University of Alaska)	Noted
15-33	LATE	17	2	17	2	Change capital "S" on "Submitted" to lower case. (David Atkinson, University of Alaska)	Stylistic – to be homogenised by TSU
15-34	LATE	17	29	17	30	I did not understand this line, especially "insulation of permafrost for the timing of spring melt-water pulses". This should be clarified. (David Atkinson, University of Alaska)	Noted – change made
15-35	LATE	17	34	17	34	Replace "across" with "for most". (David Atkinson, University of Alaska)	Noted
15-36	LATE	17	34	17	34	Drop "of glaciers". (David Atkinson, University of Alaska)	Stylistic - not accepted
15-37	LATE	18	5	18	5	Insert a comma between "gases" and "are". (David Atkinson, University of Alaska)	Noted
15-38	LATE	18	8	18	8	After "Antarctic ice sheet" drop the comma and replace "is" with "are". (David Atkinson, University of Alaska)	Noted
15-39	LATE	18	9	18	9	Drop the comma after "prep-a)". (David Atkinson, University of Alaska)	Noted
15-40	LATE	18	10	18	11	Replace "theories over the causes still prevent confidence in prediction of future changes." with "theories concerning causes of observed change limit predictive capacity.". (David Atkinson, University of Alaska)	Stylistic - not accepted
15-41	LATE	18	12	18	12	Replace "probably alone in" with "the only ice sheet in the Antarctic". (David Atkinson, University of Alaska)	Noted
15-42	LATE	18	19	18	19	Insert a comma between "period" and "is". (David Atkinson, University of Alaska)	Noted
15-43	LATE	18	20	18	20	Drop the comma after "change". (David Atkinson, University of Alaska)	Noted
15-44	LATE	18	20	18	20	Change "have" to "has". (David Atkinson, University of Alaska)	Noted

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Notes of the writing team
15-45	LATE	18	21	18	21	Change "century" to "centennial." (David Atkinson, University of Alaska)	Stylistic - not accepted
15-46	LATE	18	23	18	23	Change "12 years which might be related to increase" to "12 years. This might be related to an increase". (David Atkinson, University of Alaska)	Stylistic - not accepted
15-47	LATE	18	46	18	47	The word "effect" appears three times in this part - perhaps change the second "effect" to "cycles". (David Atkinson, University of Alaska)	Noted
15-48	LATE	20	36	20	36	Change "transformations and also erosion events" to "transformations, erosion events". (David Atkinson, University of Alaska)	Stylistic - not accepted
15-49	LATE	32	13	32	13	Drop the comma after "infrastructure". (David Atkinson, University of Alaska)	Stylistic - not accepted