



**IPCC WGII
Fourth Assessment Report
Climate Change Impacts, Adaptation and Vulnerability
*Government and Expert Review of Second Order Draft***

Specific Comments

GOVERNMENT REVIEW COMMENTS

Chapter 15

August 2006

Discussion of Government 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 Govt 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**.

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Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Notes of the writing team
G-15-1	A	0				We would also like to point to the seemingly lack in balance between the various sections in Chapter 15.4. We note in particular the long discussion related to terrestrial ecosystems compared to the relative compact text on marine ecosystems. Consider more balance. (Government of Norway)	We believe that the text has to reflect the balance in science. The current balance between terrestrial ecosystems and marine ecosystems reflects the progress made since the TAR. Additional information about ocean acidification has been added to achieve further balance and to strengthen this important marine issue. (HM will add it to the text).
G-15-2	A	0				We concur with the fact that impacts of climate change on the indigenous populations of the north is an important issue, and we believe that this is appropriately reflected in the text. However there seems to be a skew towards references relating to indigenous subsistence communities in North America. We would like to note also, that while the indigenous issues are covered to a large degree, there seems to be limited consideration of impacts on Arctic populations in general. Considering that more than 90 % of the Arctic populations are non-indigenous, we suggest a careful consideration of balance and appropriate discussion of impacts of climate change on Arctic societies as a whole. (Government of Norway)	We believe that the largest and most significant developments in understanding in the human dimensions since the TAR have focused on Indigenous Peoples and this is appropriately reflected in the emphasis of the chapter.
G-15-3	A	0				We are pleased to note that a number of the authors involved in the Arctic Council's Arctic Climate Impact Assessment process (ACIA 2005) also are authors of Chapter 15 on the Polar Regions. This has ensured that the findings of ACIA are generally reflected in the draft text and that ACIA is used as a primary reference source for this work. We believe the ACIA-report provides the best up-to-date consolidation of information on climate change and impacts of this in the Arctic per today, and should provide an important foundation for the IPCC fourth assessment report. (Government of Norway)	No response required
G-15-4	A	0				The term sovereignty is mentioned in the TS but apart from the ES of this chapter, does not appear in any of subsets mentioned on line 39 of page 40 of the TS. (Government of Canada)	The sovereignty issue is no longer included in the chapter
G-15-5	A	0				The divide in the cited literature and the assessment provided between the Northern Hemisphere and Southern Hemisphere polar regions, in this Chapter is the most stark in the WG2 report.	We acknowledge that there is a imbalance between the assessment in Arctic and Antarctic regions and the number of cited publications. This reflects the

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						The authors should include information as to why this is the case. If it is due to a lack of research in Antarctica this should be made clear, and/or if it is due to greater potential impacts in the Arctic, this should be expressed. (Government of Australia)	greater diversity of human and biophysical regimes in the Arctic compared to the Antarctic. This will be explained in the text.
G-15-6	A	0				The chapter is slightly inconsistent in its choice of technical terms to define for the reader, and those to leave undefined. For example, why aren't "thermokarst" and "brash" defined? (Government of Canada)	We have made additional checks and the technical terms like "thermokarst" have either been defined in the text or in the glossary.
G-15-7	A	0				The Arctic is generally described in a too uniform manner. The Arctic constitutes a number of unique regions with distinct characteristics. Recent warming has been more dramatic in some areas than others and local features of the natural world and societies also create differences in what impacts will occur and which will be most significant in each sub-region. In the ACIA process, the Arctic was subdivided into four sub-regions to reflect this diversity (cf. ACIA, 2005). Consideration should be given to reference such regional differences in more detail also in this report. The diversity of the region gives basis for a varied impact framework, and the differences in impact will be especially important in context of adaptation measures. (Government of Norway)	Space allocated to this chapter (which is to cover Arctic and Antarctic) does not allow for a regional treatment, especially as different regions might be chosen for discussion of impacts on, terrestrial ecology, society and physical environment. We are pleased to cite the success of ACIA as a source of such regional information. Where substantial regional differences occur within the Arctic these are discussed in the text.
G-15-8	A	0				Maintain consistency on capitalization of the word "Arctic" throughout the chapter. (Government of Canada)	The word "Arctic" on all occasions is capitalized.
G-15-9	A	0				Lines 11-13 on page 3 summarize the entire problem with this assessment and this is further emphasized in section 15.8. All the bullet points in 15.8 point towards severe lacks of knowledge that will require tremendous effort if this kind of assessment ever will have confidence levels that can convince the unconvinced. The need for balanced wording is as necessary as ever since the document will lead to renewed heated debate regarding if it is biased or not and whether the findings merit any response by society at all.	Acknowledged and covered in the "Uncertainties" section. A useful comment that the authors will bear in mind.

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						(Government of Norway)	
G-15-10	A	0				Lack information (proxi data etc) on past global change, past 20 000 years BP and older (Government of Sweden)	Relevant post-TAR information on climate change impacts that has been obtained using proxy data is included. More detailed progress in using proxy data is covered in WG-1.
G-15-11	A	0				In chapter 15.4 (especially related to freshwater systems and terrestrial ecosystems), there seems to be no references to future impacts and vulnerabilities in Antarctica. Although extensive text is likely not necessary, consideration should be given to include some discussion on Antarctica. We note the separate chapter on Antarctic marine systems. (Government of Norway)	The relevant currently available literature is extremely limited and precludes a separate section on Antarctic future impacts and vulnerabilities. Some aspects of vulnerability are covered in section 15.2.2.
G-15-12	A	0				General comments. The chapter is too long and repeats similar informations in different context. It is specifically related to permafrost warming and increase of thickness of the active layer. Similarly There also some other examples listed in my comments. I would like to stress two important gaps. First of all, processes in polar regions could affect potentially not only c. 4 million of residents of the Arctic but due to general ocean level rise millions over the world. It is a result of an other very weakly sketched problem of response of the West Antarctic Ice Sheet to slow increase of the sea level generated by faster melting of glaciers, ice caps and the Greenland Ice Sheet in the Arctic (the problem is mentioned shortly and not clearly enough in sub-chapter 15.3.4, page 18). Such problem is the real challenge. An other general remark: tourism is mentioned only once (page 9, line 28) in the context of the Antarctic area, while hundreds of thousands of tourists are visiting attractive places in the Arctic giving income to Inuits. There are very strong disproportions particular areas as Greenland, Iceland, Svalbard, Alaska and Russian Arctic. Editorial remark: sentences are in generally very long. (Government of Poland)	The prescribed section-headings which were agreed prior to writing, enforce some repetition of information, however every effort will be made to minimize repetitions and reduce chapter length. This issue is thoroughly discussed in the chapters of WGI and so is not reworked in this chapter. We believe that adequate reference to the WGI chapters is provided. Case study 15.6.3 addresses some of these issues. Additional information about the tourism in the Arctic is added. Some reference to tourism and eco-tourism is now included.
G-15-	A	0				General comment: "Indigenous Peoples" should be written in	This chapter employs the capitalization used by the

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13						lower case (i.e. as “indigenous peoples”). (Government of Norway)	Arctic Council.
G-15-14	A	0				Deglaciation of the West-Antarctic Ice sheet is seen throughout the report as a key vulnerability to climate change, however, the significance of this treatment is not reflected in the Chapter 15 discussion of the WAI. The authors should ensure a consistent treatment of the WAI throughout the report. (Government of Australia)	This issue is one that is extensively covered in the chapters of WG-I. We have taken the view that an expanded discussion in Ch15 would still not give the same level of detail which is there in WG-I and so would be repetitious
G-15-15	A	0				Consider adding more graphs - perhaps photographs to illustrate such things as coastal erosion and glacier retreat (and to break up long stretches of text)? (Government of Canada)	This cannot be achieved because of insufficient space.
G-15-16	A	0				Chapter 15.4.6 (esp. 15.4.6.1) seems somewhat out of context when the discussion does not consider more fully that the overall societal changes (increased welfare, etc) that have occurred in the Arctic over the last century have been formidable and likely have had more dramatic effects on health and human well-being than climate change effects alone have and will have. (Government of Norway)	The multiple stresses that face Arctic societies is one that is highlighted in the chapter, and it is the interplay between CC and these other stresses which is the central theme of CH15. THIS CONTEXT IS EXPLICITLY DISCUSSED IN TERMS OF MULTIPLE STRESSORS ON COMMUNITY AND HUMAN HEALTH IN 15.4.6.2
G-15-17	A	0				Although the focus of the IPCC report of course is the climate change that is currently being experienced as well as future trends, there seems to be a tendency to over-emphasize the dramatic changes occurring now, not putting it in a context of an always dynamic (changing) climate system. Great care should be given to ensure an appropriate balance in the text. (Government of Norway)	Distinguishing between the natural variability and the climate change is a very important issue, which is addressed in detail in WG-1. We accept the spirit of the comment, and do not wish to under-emphasise the influence of past natural climate changes, but without devoting sections of text to this issue it is not easy to stress without repetitious qualification.
G-15-18	A	0				Although included in the text, it is challenging to easily see what is new since TAR. We would find it useful if the main chapters included a section which in an succinct manner (bullet points) summarizes “what’s new since the TAR”. (Government of Norway)	Material presented in this document from 15.2 onwards is new since the TAR and this is reflected in the recent nature of most references. A further clarification about this given in the section preceding 15.1.
G-15-19	A	1		40		There is no a systematic system of handling the names of different species, some have only the english name, some have both the english and scientific name, which should be used at least when	Species are generally well-known and where they are note, a reference is provided for

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						the species is mentioned for the first time (Government of Finland)	further clarification. Overall a policy will be applied at the editorial stage for the complete volume.
G-15-20	A	3	12			The term "additive multiple stressor" is confusing because the concept of "multiple stressors" already includes an implicit notion that interactions between different stressors can add further stress to a system or unit. (Government of Norway)	The wording "additive multiple stressor" appears only once in the text and is changed to "multiple stressor"
G-15-21	A	3	23	3	35	The last sentence of this dot point should be separated to form its own dot point, as it refers to future warming impacts rather than current observed warming. (Government of Australia)	We do not agree, separation of the sentences under this bullet would require, insertion of new text to make it clear, and so is to be avoided.
G-15-22	A	3	44	3	45	Change to ".....on many ice-dependent marine mammals and seabirds" (Government of Norway)	This will be fixed during the final text editing.
G-15-23	A	4	0			Melting of sea-ice (e.g. east of Svalbard) will make new areas accessible for increased human activity (increased tourism and drilling activity close to the ice border in the Barents Sea). (Government of Norway)	This is true and in accord with what the text of the chapter says. Increased potential for the tourism and drilling activity will be noted.
G-15-24	A	4	1		3	Ice as a water resource should be mentioned, (Government of USA)	Text relevant to this no longer exists in the Executive Summary.
G-15-25	A	4	15	4	19	To many factors mixed together. These sentences are not clearly understandable. I suggest to remove all or rephrase the second sentence. (Government of Poland)	This is, unfortunately, a complex issue and so all the factors are important. We have revised the text to make it simpler.
G-15-26	A	4	15	4	16	Increased melting of snow/ice/seaice will also increase the contaminant exposure to the freshwater, terrestrial and marine ecosystems (see AMAP Pathway report, The Influence of Global Change on Contaminant Pathways to, within, and from the Arctic. Arctic Monitoring and Assessment Programme (AMAP), Oslo, Norway. xi+65 pp., AMAP, 2003. AMAP Assessment 2002. (Government of Norway)	The Executive Summary has been re-written and reference to contaminants has been removed so this comment is no longer applicable.
G-15-27	A	5	5	5	35	I think that it should be mentioned that half of the Arctic human population is living in Barents Region (Government of Finland)	This is too much detail.

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G-15-28	A	5	10		10	Different than what? Each other? The rest of the world? This should be made clear. (Government of USA)	Sentence has been reworded.
G-15-29	A	5	14	5	15	"The warming of water flowing into Arctic Ocean, and the reduction of salinity of the mixed layer in the Beaufort Sea" should be added to the key findings in executive summary p.3 line 19 (Government of Germany)	This is a WGI issue.
G-15-30	A	5	32	5	32	Better is to finish sentence: "in both polar regions" instead of both poles. (Government of Poland)	Changed as suggested.
G-15-31	A	5	48	5	49	Please add the confidence level for this effect. (Government of Germany)	Added "high confidence".
G-15-32	A	6	1	6	45	At least one place name used in the text (Scotia Sea - p.28, lines 43/44) is not shown on the Antarctic map (Government of Canada)	Thanks for pointing this out. All placenames used in the final text now appear on the map.
G-15-33	A	7	13	7	16	The "greenhouse signature" mentioned after the quoted paper is still debatable. (Government of Poland)	Paragraph has been deleted per suggestion of Expert Reviewer comment E-15-67.
G-15-34	A	7	16	7	16	"...and that the marine [?] Arctic..." - for clarity (Government of Canada)	"marine" has been inserted as suggested.
G-15-35	A	7	29	7	29	After quoting McBean et al.. 2005, I suggest to add: "and due to difficulty in methods of measurements of rain and snow falls in very windy polar areas. Comment: Majority of meteo stations are located close to coast and error in measurements of precipitation at them depends how frequent and strong winds are. (Government of Poland)	Suggested addition has been made.
G-15-36	A	7	31		32	There are some very good surface mass balance models for Greenland that calculate precipitation (Hanna et al., 2004, JGR; Box et al., 2006 J. of Climate). These should be mentioned. (Government of USA)	This is a WGI issue.
G-15-37	A	7	33	7	33	"...with changes in temperature..." (Government of Canada)	Line 34 now says "with changes in temperature".
G-15-38	A	7	33		33	Changes "in" temperature (Government of USA)	"in" has been inserted.
G-15-39	A	7	48			Change the text to: "Broader ecosystem impacts of climate change in the polar regions and elsewhere are summarized by Walther et al. (2002) and in ACIA (2005)". Comment: To us it	TVC: agreed and fixed

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						seems like an omission not to mention ACIA as an important source of consolidated information on impacts of climate change. (Government of Norway)	
G-15-40	A	7	50	8	3	<p>There is necessary to add recent studies or fast retreat of large outlet tidewater glaciers of the Greenland Ice Sheet (e.g. L. Stearns, G. Hamilton, 2006: Dynamics of Large Tidewater Glaciers in East Greenland: Recent Results From Satellite Remote Sensing and Fieldwork. The Mass Budget Of ArcticGlaciers. Extended Abstracts. Institute for Marine and Atmospheric Research, Utrecht University, Utrecht, pp. 102-104).</p> <p>It is most probably dynamic response of tidewater glaciers for thinning (due to increased melting). Mechanism is a bit complicated and not completely understand. In simplification: more melt waters penetrate to the glacier bed - glacier is flowing faster due to increase of basal sliding - glacier ice ice is drained from upstream of the ice sheet area - fast flow generate intense calving and retreat of the glacier front. Similar fast retreat is observed for Columbia Glacier Alaska. Such type of processes in many glaciated areas of the Arctic are leading to dynamic decrease of thicknes of glaciers and their retreat. Acceleration of Greenland outlet glaciers are mentioned in the sub-chapter 15.3.4 - page 17, but no explored as important projected changes. See below. (Government of Poland)</p>	<p>The most important references in this subject area have been cited.</p> <p>This mechanism is no more than a hypothesis and cannot be proven to be the active one, in this case (DGV). This area is more completely covered in chapters in WGI.</p>
G-15-41	A	8	1	8	2	Change the sentence to: ".....around the periphery of Greenland ice sheet, where maximum surface-melt area has increased during the past 20 years (Abdalati and Steffen, 2001; Walsh et al., 2005), while...." (Government of Norway)	Noted
G-15-42	A	8	35			In the context of pointing to the importance of the Arctic in global politics and economies it might be worth mentioning the fact that it has been indicated that around 25% of the world's yet to be discovered petroleum resources are expected to be located in the Arctic, according to USGS estimates. (Government of Norway)	<p>Such information as well as the short discussion on the consequences for economic development and environmental impacts will be added to the text.</p> <p>Reference and text added to include this on pg8</p>
G-15-43	A	8	40	8	40	"See box, 15.6.3" - I can not find any box in 15.6.3. (Government of Germany)	Noted

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G-15-44	A	9	1	9	9	Comment: to long and unclear sentences. I suggest to reduce sentences related to pre-satellite data and to quote Fig. 15.3 (Government of Poland)	Text changed.
G-15-45	A	9	15	9	16	sentence beginning "Experimental studies..." needs to be simplified. (Government of Canada)	Text changed.
G-15-46	A	9	15	9	17	Penultimate sentence is difficult to understand as written. (Government of Australia)	Text changed.
G-15-47	A	9	20	9	22	This sentence is excessively sweeping, when taking into account that it is based on data from a single cruise in the Ross Sea. Diatoms in general do not like highly stratified waters and many models indicate that they will decrease in more stratified oceans. I suggest that this paragraph be reviewed. There is much information on phytoplankton distribution in the Southern Ocean that could help to clarify the issue. (Government of Spain)	Text changed.
G-15-48	A	9	24	9	26	This sentence is grammatically incorrect and thus its meaning is unclear. (Government of Canada)	Text changed.
G-15-49	A	9	24	9	26	The sentence "Since the draw-down....." seems to be incomplete? (Government of Norway)	Text changed.
G-15-50	A	9	24		26	Should this sentence actually read "Because the draw-down of CO2 and the rate of new production are actually lower with diatoms than with Phaeocystis, the increased stratification...."? (Government of USA)	Text changed.
G-15-51	A	9	28	9	30	Suggestion: to add tourism as real nowadays and potential source of income of Inuits in the Arctic (see my general comments) (Government of Poland)	Text already exists to discuss tourism as opportunity for economic development in arctic (in section on implications for sustainable development)
G-15-52	A	9	28	9	29	Nearly 30,000 tourists now visit Antarctica each year and the industry is growing". [Comment: Note tourism statistics for 2005-2006 (www.iaato.org)]. (Government of Norway)	Text changed.
G-15-53	A	9	37	9	38	Although illegal fishing is in its own right a major sustainability issue, is there enough depth in the scientific literature to support	We believe that there is good reason to believe that illegal fishing could act with CC to cause impacts,

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						this point twinning climate change and illegal fishing issues? (Government of Australia)	and this is reflected in the text.
G-15-54	A	9	43	9	45	Is it appropriate to use the reference to McCarthy's definition of the vulnerability of coupled human-environment systems here? (Government of Norway)	TVC: yes, it is not specific to human-environment systems.
G-15-55	A	9	43	9	45	I suggest to remove this sentence. (Government of Poland)	Will consider at final revision
G-15-56	A	10	1	10	39	Maps could be larger on the Fig. 15.2. Therefore, more clear. (Government of Poland)	The maps are designed to fill one column. Enlarging them to fill two columns would exceed the prescribed chapter length.
G-15-57	A	11	49	11	49	"Also shown ... extent for September 2002 [?] and..." (Government of Canada)	Noted
G-15-58	A	12	1	12	20	Fig. 15.3: The same comment as above. (Government of Poland)	The maps are designed to fill one column. Enlarging them to fill two columns would exceed the prescribed chapter length.
G-15-59	A	13	12	15	31	These sections on freshwater polar systems are very well done. Each section starts with a short consensus paragraph by the authors, which is followed by the supporting analysis based on specific literature. This is a good model for other TAR chapters. (Government of USA)	Thanks for the plaudit.
G-15-60	A	13	13	13	18	I suggest to remove both sentences. Content of both of them is repeated later in this sub-chapter (Government of Poland)	TVC: some repetitions have been omitted whereas other apparent repetitions fall under different categories such as biodiversity changes and consequences of biodiversity changes.
G-15-61	A	13	22	13	23	"(e.g., complete loss of ice cover)". I do not understand of what kind of ice is written? (Government of Poland)	Accepted: we should always be specific about what type of ice is being discussed. Adjective "freshwater" has been added. TDP
G-15-62	A	13	45	13	47	Very similar sentence and data on the Dry Valleys are on page 6, line47-48. I suggest to shorten and rephrase it. (Government of Poland)	Noted
G-15-63	A	13	51	13	51	rearrange words to read "... the annual open water period ..." (Government of Canada)	Noted
G-15-64	A	14	12	14	12	If the definition of permafrost is necessary in the report, I suggest to add also definition of frequently used "active layer" in here and remove from page 17, line 49. (Government of Poland)	Both are now in glossary

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G-15-65	A	14	14	14	17	suggest breaking sentence in two, starting at "Here" on line 15; or use semi-colon (Government of Canada)	Noted
G-15-66	A	14	32	15	31	The whole chapter deals with the vulnerability of indigenous people, what about the rest 90 % of the population in the Arctic? (Government of Finland)	We agree, however there is an orientation towards the population identified as being most vulnerable to projected climatic changes in the chapter (Indigenous populations) and which are covered in significantly more detail in the literature. Little exists with regards to climate impacts and adaptive capacity of the general Arctic population living in larger centres today. A note to mention the lack of data on non-Indigenous populations has been added to highlight this limitation. Additionally, many sections that refer to Arctic peoples refer to ALL Arctic populations and not only Indigenous Peoples, this has been verified throughout the chapter by removing "Indigenous" in some locations to be more inclusive. However, sub-groups (such as IPs) are highlighted though because of specific vulnerability.
G-15-67	A	14	32	15	31	Broaden the consideration of Arctic peoples to include LOCAL residents, not only indigenous peoples. It is important to note that the Arctic also contains non-indigenous peoples. (Government of Norway)	See comment above
G-15-68	A	14	34	14	35	break sentence in two, starting at "For the most..."; or use semi-colon (Government of Canada)	Noted
G-15-69	A	14	39	14	40	I suggest to remove sentence: "In contrast, the archaeological record ... (Pavlov et al., 2001)" (Government of Poland)	Rewritten
G-15-70	A	14	40	14	42	The sentence "Arctic Indigenous Peoples have historically lived with a high degree of environmental variability and the capacity to adapt has been part of their culture" holds true for all people, and we question whether it adds anything to the text. Consider deleting for brevities sake. Cf. also our general comments pt. 4. (Government of Norway)	We agree with this comment, the text has been changed.
G-15-	A	15	18	15	18	Delete ", constrain or reduce"	Noted

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71						(Government of Netherlands)	
G-15-72	A	15	30		30	The Watt-Cloutier reference is missing from the reference list. (Government of USA)	Reference added
G-15-73	A	15	34	16	15	Section 15.3.1 is important in illustrating the complex feedbacks in polar areas that may have impacts globally. This should be more clearly highlighted in the Executive Summary. This comment also applies to section 15.4.3.2 (page 24). (Government of Australia)	The executive summary and relevant text have been rewritten, efforts have been made to better highlight these points.
G-15-74	A	15	36			Section 15.3.1: A bullet point regarding the uncertainty of the Arctic ocean carbon cycle alterations due to changed water column stability, altered nutrient availability at the ocean surface due to altered mixing and altered air-sea exchange from changes in ice-cover as well as wind is equally warranted here. (Government of Norway)	Insufficient new evidence has emerged since the TAR to warrant inclusion of this point.
G-15-75	A	15	38	16	15	Freshwater ice and sea ice should be treated by two separate bullets. (Government of USA)	Sea ice is not included in the freshwater bullet (p. 15, lines 45-49).
G-15-76	A	15	40	15	40	Suggestion to rephrase: "Reflectivity of Snow and Ice: Snow, glacier ice and sea ice...." (Government of Poland)	Suggested change sounds redundant and unnecessary.
G-15-77	A	15	45	15	46	In this point the term " Cryospheric retreat". It means nothing in this context and seems to be a mistake. I strongly suggest replace by: "Retreat of glaciers and ice sheets, freshwater runoff...". One more correction: more important than mountain glaciers in the Arctic are ice caps. Best way might be:"Retreat of glaciers in the Arctic...." (Government of Poland)	Suggested changes have been made.
G-15-78	A	15	45		49	There is no comment on the impacts of glacier and ice sheet change on sea level. Also in addition to the rapid melting of Greenland's edges, the enhanced discharge (associated with that melt) is an important change that should be discussed in this paragraph. (Government of USA)	This is primarily a WGI issue (and is especially appropriate for Chapter 4 of the WGI report).
G-15-79	A	16	1		1	The strength of methane as a greenhouse gas (compared to CO2) should be mentioned here (it is mentioned later, but here would be appropriate). Also, methane is a form of carbon, so the reason for the reference to both is not clear. Include references to models	Fixed.

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						and conclusions contained in the first sentence of the bullet. (Government of USA)	
G-15-80	A	16	8	8	12	There are some measurements already published for instance by the EU Cost 627-programme (Government of Finland)	This is an inappropriate level of detail in this short bullet.
G-15-81	A	16	12	16	12	"... warming influence of ..." (Government of Canada)	Changed as suggested.
G-15-82	A	16	14	16	14	can the word "alter" be changed to either "increase" or "decrease"; or is the outcome not yet known? (Government of Canada)	HM – do we know the direction of change?
G-15-83	A	16	20		20	Over what time frame is the 2 to 9°C temperature rise predicted for? (Government of USA)	Have inserted “by the year 2100”.
G-15-84	A	16	21	16	21	"autumn and winter", which season? Northern or Southern hemisphere autumn and winter? (Government of Netherlands)	Have inserted “northern”.
G-15-85	A	16	37	16	37	"...in the range 15 to 30%..." (Government of Canada)	Changed to “15-30%”.
G-15-86	A	16	49	16	50	Comment. Reduction of sea ice area is not considered as an important impact calving rates of tidewater glaciers. See my explanation above page 7-8. (Government of Poland)	Comment too unclear for response
G-15-87	A	17	2	17	3	Does the prediction for potential complete loss of sea-ice in Antarctica relate to the summer season, or complete loss also in winter season? Consider specifying. (Government of Norway)	Paragraph has been deleted in response to Expert Reviewer comments.
G-15-88	A	17	2		2	The Parkinson paper is in press, not “submitted” as indicated in the text. (Government of USA)	Paragraph has been deleted in response to Expert Reviewer comments.
G-15-89	A	17	8		12	Some statement should be added that indicates that the ice sheet discharge that the models are not currently capturing can be quite large (e.g. Ilullisat or Kangerdlugssuaq). (Government of USA)	Have inserted “quite large” prior to “ice discharge (calving rates)”.
G-15-90	A	17	34	17	41	I would suggest to rephrase the first sentence: "...across Arctic glaciated areas". Moreover, as commented to page 7-8, projection of such processes has to be consider as additional source of fresh water in the sea from melting icebergs.	Noted

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Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Notes of the writing team
						(Government of Poland)	
G-15-91	A	17	50	17	50	Delete "either" (Government of Netherlands)	Noted
G-15-92	A	18	2		2	Revise to clarify the references involving northern and southern. (Government of USA)	OAA - done
G-15-93	A	18	7	18	7	"Antarctica" is used here, whereas elsewhere "Antarctic" is used as a heading (Government of Canada)	Fixed
G-15-94	A	18	11	18	25	I am glad to read this text. Considerations on possible importance of behaviour the West Antarctic Ice Sheet - dynamic instability via Ross Ice Shelf. Such important possible process with consequence for relatively rapid ocean rise should be included to the sub-chapter 15.8 "Key unertainties" - page 39 as one of short points. (Government of Poland)	This issue is within the new key unvcertainties
G-15-95	A	18	25		25	The Zwally et al and the Velicogna and Wahr don't really contradict the Davis et al result. Zwally et al also get growth and Velicogna and Wahr have a significantly high uncertainty such that the Davis et al result are not outside the limits of uncertainty. (Government of USA)	Noted and text modified
G-15-96	A	18	51	18	51	I find the units "km3/yr" meaningless for river flow. Can the increase be expressed as a proportion? See for example p.20 lines 17-18 (Government of Canada)	Text has been modified to also include a reference to the equivalent % change. TDP
G-15-97	A	19	1	19	5	Permafrost thaw is first mentioned as being eliminated as responsible for the increase in river runoff and later it is "possibly linked" to interannual variations in runoff production. This seems to be inconsistent. (Government of Netherlands)	The elimination as being responsible is because of its small mass contribution. The effect on interannual variations is because of changes in flow pathways and delivery times. To clarify, in this case, the text has been revised to read "ice melt from permafrost". To further help, some preceding text about interannual variations has been modified to read "Seasonal precipitation-runoff responses could be further obscured by the effects of permafrost thaw and related alterations to flow pathways and transfer times" TDP

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G-15-98	A	20	19		20	Include ice sheets in addition to ice caps and glaciers. (Government of USA)	Suggested change has been made.
G-15-99	A	21	21			Suggested new sentence: "For example, the navigation season for the Northern Sea Route is projected to increase from the current 20-30 days per year to 90-100 days by 2080" [Comment: cf. ACIA, esp. Instances et al.] (Government of Norway)	Page 21 (middle para., containing line 21) is about nutrient, carbon and sediment loadings. The suggested sentence about changes in the navigation season length does not seem to fit at all.
G-15-100	A	21	24			Suggested new last sentence: Sea ice changes could, however, also make the northern sea routes less predictable for shipping, especially in the Canadian Arctic Archipelago [Comment: cf. ACIA, esp. Instances et al.] (Government of Norway)	DAVID AND OLEG: PAGE AND REFERENCE DO NOT MATCH...NOT IN THE FRESHWATER SECTION.....TDP?? - Comment is unclear
G-15-101	A	22	31	25	27	In many places of the text one can reduce repetitions on consequences of changing winter snow conditions, repeated informations on thawing permafrost and migration of shrubs and tree line toward N (e.g. page 24 - see below) (Government of Poland)	TVC: some of the repetition has been reduced
G-15-102	A	22	51	23	2	This is a misleading statement. Lemmings cycles have not broken down, in fact there have been major outbreaks in 1997, 2001 and 2004-05 along Scandian mountains. It is true that vole cycles have disappeared in northern Fennoscandia, but it cannot be said yet that changing snow conditions are the cause. There are alternative explanations, e.g. the change in landscape due to intensive forestry - e.g. Henttonen and Wallgren (2001) refer to forestry, not so much to snow. In addition, Yoccoz and Ims (1999) discuss the introduced local <i>Microtus</i> population on Svalbard, which is a very special case to generalize. (Government of Finland)	TVC: fixed
G-15-103	A	23	2			The Ivory gull also show a dramatic decline in the Canadian Arctic. From 1985 to 2002-2004 the population declined by 80 %. Reference to: Gilchrist, G.H. & Mallory, M.L. submitted. Declines in abundance and distribution of the ivory gull (<i>Pagophila eburnea</i>) in arctic Canada. (Government of Norway)	TVC: the general feature is covered in the text but there is no space for detail. Also we cannot include manuscripts that are at the "submitted" stage
G-15-104	A	23	27	23	31	This sentence is both complicated and grammatically incorrect, making its meaning unclear. It needs another verb, at least, and	TVC: the paragraph has been re-written

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						possibly to be rewritten entirely or split up into two sentences. (Government of Canada)	
G-15-105	A	23	35	23	41	should there not be some mention of limitations imposed by soil type, or lack of soil in some areas? (Government of Canada)	TVC: text modified
G-15-106	A	23	42	23	42	what are "knock-on" effects? (Government of Canada)	TVC: the phrase is well known – no change
G-15-107	A	23	48	24	1	The phrase "During climate change" is unhelpful - perhaps substitute "As a result of projected climate changes..."? Also, this sentence is also grammatically incorrect - it breaks down in line 51 in between the weedy southern plant species and the "expand timing of bird migrations". What does this mean? (Government of Canada)	TVC: both points have been attended to.
G-15-108	A	24	14	24	16	the bracketed section is quite lengthy and would be better dealt with as a sentence on its own (Government of Canada)	TVC: the text has been re-written
G-15-109	A	24	38	24	41	Comment: Information on such consequences on reflectivity of climatic warming are in other places of the text. (Government of Poland)	TVC: the reference to snow has been removed to reduce repetition
G-15-110	A	24	46	24	46	for readability, start new sentence at "however"; or use semi-colon (Government of Canada)	TVC: the sentence has been modified
G-15-111	A	26	5	26	6	"...expansion of agriculture and forestry where soils permit." (Government of Canada)	TVC: agreed – text modified
G-15-112	A	26	20			Consider removing the word "massive" from the sentence, as some fish stocks have rightly been massively over-exploited, but others not. (Government of Norway)	HV REMOVED
G-15-113	A	26	28	26	30	It is a bit unclear what this sentence refers back to, and in fact there seems to be two points included here: i) that reduced sea-ice is likely to have serious consequences for animals associated with sea-ice (dependent on sea-ice habitat for travel, birth, etc.) and ii) that reduced abundance of organisms (eg. crustacean and fish) at the sea ice edge due to sea-ice reduction will impact predators depending on them. Consider rewriting to make this clearer. (Government of Norway)	HV GOOD COMMENT; HAS BEEN CLARIFIED
G-15-	A	26	28	26	29predators associated with sea ice including seals, seabirds and	HV DONE

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114						polar bears.... Reference to: Sakshaug et al. 1993 (Government of Norway)	
G-15-115	A	26	32	26	38	no reference is offered for this paragraph (Government of Canada)	HV DONE
G-15-116	A	27	15		18	Suggest rewriting such as “showed very cold conditions until temperatures warmed suddenly around 1920, and maintained high levels until they dropped suddenly in the late 1960s.” (Government of USA)	HV DONE
G-15-117	A	27	20		21	Not sure that the data prove that cod abundance depends principally on water temperatures. (Government of USA)	HV IT DOES IN MARGINAL AREAS E.G. GREENLAND
G-15-118	A	27	47	27	50	This sentence (“Finally, management practices.....”) is a bit skewed relative to the two important points made in ACIA by Vilhjalmsson et al. (2005), which was more along the line that i) “the total effect of climate change on fish stocks is probably going to be of less importance than the effects of fisheries policies and their enforcement, and the significant factor in determining the future of fisheries is sound resource management practices” and ii) “changes in distribution of commercial stocks (due to climate warming) may lead to conflicts between nations over distribution of fishing opportunities and could require tough negotiations to generate viable solutions regarding international cooperation in fisheries management”. The text should be adjusted to take these to messages into account. (Government of Norway)	HV GOOD COMMENT; DONE
G-15-119	A	28	1		19	A “Draft” map stamped with a bold “to be revised” at the Governmental review stage of an IPCC report is not acceptable. (Government of USA)	<i>NEW AND IMPROVED MAP DONE</i>
G-15-120	A	28	15	28	19	The red line in the figure is not explained in the text (Government of Netherlands)	<i>NEW AND IMPROVED MAP WITH PROPER EXPLANATIONS OF DETAIL now provided</i>
G-15-121	A	28	22	28	22	This is the first section of 15.4 that deals with the Antarctic, is there no information on the Antarctic with regard to the previous sections? (Government of Netherlands)	The current balance between terrestrial ecosystems and marine ecosystems reflects the progress made since the TAR. Additional information about ocean acidification has been added to achieve further balance and to strengthen this important marine issue. (HM will add it to the text).

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G-15-122	A	28	24			Change to: "Over the last 200 years, some seal and whale species (eg. Antarctic fur seals, blue whale, fin whale) were exploited almost to extinction...." (Government of Norway)	Noted
G-15-123	A	28	28	28	29	Include the word System as: "The Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR), part of the Antarctic Treaty System, was designed....." (Government of Norway)	Noted
G-15-124	A	29	12	29	12	"... changes in patterns of ocean..." (Government of Canada)	Noted
G-15-125	A	29	16	29	16	"And here it is important to note that the impact of changes in these..." (Government of Canada)	Noted
G-15-126	A	29	16		16	It "is" important.....changes "to" these (Government of USA)	Noted
G-15-127	A	29	27	29	33	More references are required in this section -- using only Hamilton (2003) is not very convincing. In addition, Hamilton is not included in the reference list at the end of the chapter. (Government of Norway)	CF – reference has been changed to ACIA health chapter which is more appropriate ref for this statement
G-15-128	A	29	49	29	51	The sentence "The frequency of injuries such as....." is a quite obvious statement, and could be removed for brevities sake. (Government of Norway)	CF-Has been generalized
G-15-129	A	29	49	29	50	Is it necessary to state that frostbite and hypothermia are associated with cold exposure? What one could do here is to point out more emphatically the positive consequence of less extreme cold weather, especially given the stats on cold-related deaths vs. other causes of death cited for Finland. (Government of Canada)	CF-opening statement has been generalized
G-15-130	A	29	51	29	51	What are the 2000-3000 "extra deaths" in Finland during the cold season in addition to? Does this mean that the predicted number of deaths is increased by that much due to frostbite, hypothermia, etc.? Clarify, please... (Government of Canada)	CF-has been reworded – speaks of deaths from cold-related diseases and injuries
G-15-131	A	30	0	31		Impacts of climate on the health of Arctic resident references should also be given to the AMAP report "Persistent Toxic Substances, Food Security and Indigenous Peoples of the Russian North". 2004,2, 192 pages. References should also be	CF-in fact these reports speak only to contaminant exposure and not climate. Reference to AMAP has been made when speaking of human health and contaminants and climate and to a paper

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						given to the report; Human Health in the Arctic. Arctic Monitoring and Assessment Programme (AMAP), Oslo, Norway. AMAP Assessment 2002, xiii+137. pp, AMAP 2003. (Government of Norway)	specifically reviewing this topic in IJCH (Kraemer et al 2005)
G-15-132	A	30	14			Chapter 15.4.6.2 [Comment: "Anecdotal evidence" is a sensitive term. Evidence is normally used in the context of something that can be tested/re-examined. Consider using "anecdotal information that indicated an increase...." instead.] (Government of Norway)	Edited to say "information suggests"
G-15-133	A	30	24	30	24	Reference in list: Change name spelling from Lindgern to "Lindgren" (Government of Sweden)	Done
G-15-134	A	30	27			Tularemia in the Arctic is very typically a rodent borne disease. Reservoir is in the rodents, and e.g. mountain hares always die due to the infection. Using "rabbits" here may be misleading. In the north, tularemia is a mosquito transmitted disease, and therefore sensitive to climate change. Animal movements here may not be so relevant. (Government of Finland)	CF-Evidence from Arctic Canada suggests that it has been transmitted by rabbits. Have adapted text to include this relationship though
G-15-135	A	30	29	30	47	It's premature and perhaps wrong to imply or state that the northward spread of West Nile virus is one example of warming-related migration. Evidence has not been put forth (and may not exist) supporting this hypothesis, beyond the correlation of warming with WNV's northward spread. The wording of this section is thus misleading. In addition, the three maps allegedly drawn from Warren et al., 2005 are actually not to be found in that paper. Also, the role of migratory birds in spreading WNV could be discussed. (Government of Canada)	Text and figure have been deleted. CF-this was a misreference for the paper and source, and for brevity the material has been deleted.
G-15-136	A	30	47	30	47	time frame is 2000-2003 but maps begin 2001 (Government of Canada)	Material is deleted
G-15-137	A	31	12	31	12	What are "these activities"? (Government of Canada)	CF-reworded to say "traditional resource harvesting"
G-15-138	A	31	30	31	30	The cause for increased contaminant levels is not obvious to me. (Government of Canada)	CF-has been clarified (bacterial contamination)
G-15-139	A	31	37	31	38	The phrase "combined forces acting on Arctic communities and individuals today" is insufficiently explanatory - maybe add a few	Has been edited to identify socio-cultural, economic, political and environmental focused on

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						adjectives in between combined and forces? (Government of Canada)	and within communities
G-15-140	A	32	9		37	Nice, concise summary about coastal impacts, should cross reference coastal chapter? (Government of USA)	Thanks
G-15-141	A	32	11	32	21	First sentence is not necessary. Rest of the section one can easily shorten. (Government of Poland)	Noted
G-15-142	A	32	13		13	"ground ice" should be "land ice" (Government of USA)	Noted
G-15-143	A	32	24	32	24	Some elaboration on the link between industrial activity and erosion would be helpful. (Government of Canada)	Note has been taken in rewrite
G-15-144	A	33	20	33	20	delete "this" to have "in which it exists" (Government of Canada)	Noted
G-15-145	A	33	38	33	38	"environmental areas" is vague. Maybe "representative ecological areas" or "areas of ecological significance"? (Government of Canada)	Noted
G-15-146	A	33	50	33	51	"Although arctic communities show great resilience and ability to change in many regions, some responses have been influenced by socio-political change". (Government of Norway)	Noted
G-15-147	A	34	2	34	3	The sentence "Such diversity also means that local...." is a quite obvious statement, and could be removed for brevities sake. (Government of Norway)	Noted
G-15-148	A	34	3	34	6	In the sentence beginning with "Currently, little is known..." and ending with "...mitigating negative change", the word "they" should be added between "how" and "use". (Government of Canada)	Noted
G-15-149	A	34	33	34	40	Additional and better references are needed here to support the discussion on local knowledge (in addition to Riedlinger, 2001b) (Government of Norway)	CF-done – the 2002 book (largest work on this topic from several circumpolar countries) is referenced now
G-15-150	A	34		35		Chapter 15.6.1. [Comment: Seems reasonable to adjust text somewhat to put this issue (case study) in the context that this relates to a small percentage (10%) of the Arctic population. Cf. also our general comments, pt. 4]. (Government of Norway)	CF-done with small editing at opening of case study

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G-15-151	A	36	20	36	21	Probably WRONG! Antarctica had its climatic optimum 3000-4000 years BP, when it probably was warmer than today (see Ingólfsson, Ó., Hjort, C., Berkman, P., Björck, S., Colhoun, E., Goodwin, I.D., Hall, B., Hirakawa, K., Melles, M., Möller, P. & Prentice, M. (1998). Antarctic glacial history since the Last Glacial Maximum: an overview of the record on land. Antarctic Science, 10, 326-344. AND Ingólfsson, Ó., Hjort, C., Humlum, O. (2003). Glacial and climate history of the Antarctic Peninsula since the last glacial maximum. Arctic, Antarctic, and Alpine Research, 35 (2), p. 175-186) (Government of Sweden)	The evidence from Domack et al., taken at face value superceeds the suggested papers and so, if confirmed, should change the prevailing view. However, we accept the outside possibility that Domack is wrong and this explains the use of "probably" to qualify the Domack conclusion. There is no more space for discussion of this issue.
G-15-152	A	36	41		44	Should the final two sentences be reversed in order for clarity? (Government of USA)	Rewritten
G-15-153	A	37	1	37	1	Can the word "changing" be changed to either "increasing" or "decreasing"? (Government of Canada)	Noted
G-15-154	A	37	5	37	9	Sea level should be included as part of the global significance of the Antarctic peninsula (Government of USA)	This is a good point and may be included for the final version - The extensive treatment of the sea-level contribution of Antarctica in WG-I means that any discussion would be superfluous here.
G-15-155	A	37	5	37	9	Missing the notion that the Antarctic ice sheet is an archive of the historical climate and therefore extremely valuable for our understanding of the climate system and historic climate change. (Government of Netherlands)	The Antarctic Peninsula is not, actually, the best archive of climate from ice cores, due to warm temperatures (which smear out climate signals) and high accumulation (which implies short records).
G-15-156	A	38	2	38	3	include Arctic Ocean as potential disrupter of the regional carbon balance. (Government of Norway)	The carbon balance is considered in detail in WG-1 chapters 2 and 10. We are not going to add any new text on that because of the space limits, however reference to WG-1 report will be added.
G-15-157	A	38	20	38	25	The Antarctic may also become more accessible and used. There is an increase in tourism, both to Antarctica and Arctic (e.g. Svalbard). Since the east of Svalbard is ice-free more ships and tourists visit these areas. (Government of Norway)	Noted
G-15-	A	38	20	38	24	I am glad to find short section on tourism and geo-eco-tourism in	Noted

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158						the Arctic in the future. Tourism business activity is already working on relatively large scale in the Arctic, but increase possibility of a navigable NW Passage will probably a chance for further rapid development. We have remember also on the Russian Arctic and commercial services for tourists. (Government of Poland)	
G-15-159	A	38	26	38	28	This sentence's last clause ("make this task is enormous") seems to be from an earlier version that was edited into grammatical incorrectness. (Government of Canada)	Thanks
G-15-160	A	38	27		28	This is not grammatically correct (the "with" and the "make" don't go together) (Government of USA)	Again thanks
G-15-161	A	38	28	38	32	The sentence beginning with "These impacts..." should also be carefully rewritten with respect to tense, subject-verb agreement, comprehensibility, etc. (Government of Canada)	And again thanks
G-15-162	A	38	30		31	"and changing fish stocks and ecosystems (Government of USA)	Noted
G-15-163	A	38	35	38	42	Please give some additional information about the meaning of the term "sustainability" in this context, so that this sentence can not be misunderstood. (Government of Germany)	The definition of "sustainable development" is now in the WG-2 glossary. The text was changed to employ only the term "sustainable development"
G-15-164	A	38	48	38	48	Suggest starting new sentence after "community". (Government of Canada)	This has been re-written
G-15-165	A	38				The increase in oil activity i.a. in the Barents Seam have an influence on the communities in the Arctic. Change in the sea-ice condition make it possible to drill further north as well as extend the season for drilling activity. (Government of Norway)	This has been re-written
G-15-166	A	39	0			Is a climate assessment of the Antarctic (similar to ACIA) also a missing element? (Government of Netherlands)	This has been re-written
G-15-167	A	39	1		20	Move the "of" from in front of each bullet to the top line (line 1); There should be a bullet in t his section that speaks to the implications of change in the polar regions to the rest of the Earth system, e.g. ocean circulation and sea level. There are hints of	This has been re-written

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						this, and it is addressed in the text, but it should be explicitly stated in a bullet; The last bullet hints at abrupt climate change, but this is one of the aspects that should probably be stated in this section. (Government of USA)	
G-15-168	A	39	7	39	11	Suggest that the third bullet should be made the first one in the list, given the fundamental point it makes (Government of Canada)	This has been re-written
G-15-169	A	39	8	39	8	Recent rates "of" warming (Government of USA)	This has been re-written
G-15-170	A	44	21	44	22	Einarsson, 2004 should be changed to Arctic Human development Report, 2004. (Government of Norway)	Noted
G-15-171	A	48	30	48	34	The references Krupnik 2002a and 2002b are the same. (Government of Norway)	Noted
G-15-172	A	49	12	49	12	Reference in text: Change name spelling from Lindgern to "Lindgren" (Government of Sweden)	Noted
G-15-173	A	49	48	50	2	The references McCarthy 2005a and 2005b are the same (Government of Norway)	Noted