



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

Specific Comments

Chapter 19

December 5, 2005

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 DECEMBER

Substantive comments

- The chapter writing team should discuss all substantive expert review comments, by email and/or at Merida.
- 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)

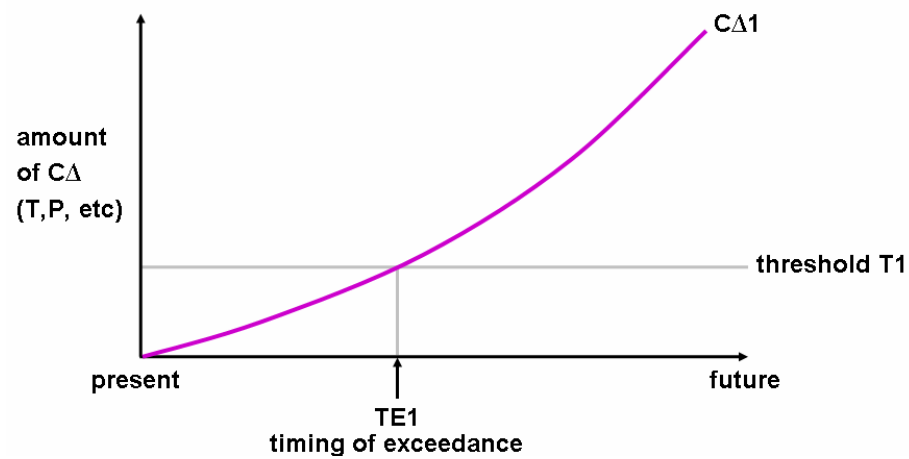
General

- The record can be kept electronically, or with pen-and-paper.
- 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 **28th February 2006**.

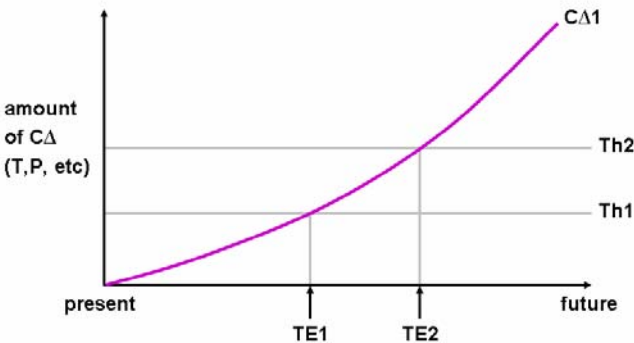
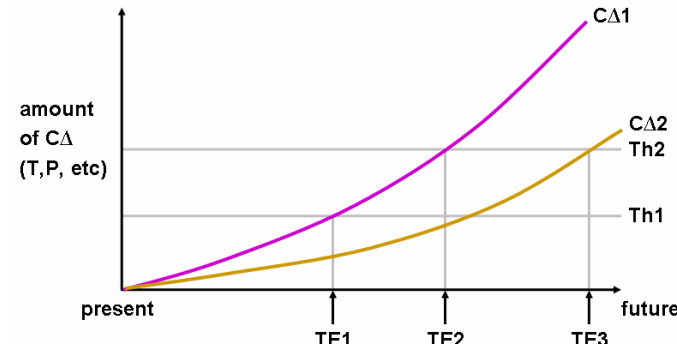
IPCC WGII AR4 FOD Expert Review Comments

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Notes of the writing team
19-0	A	0				<p>Co-chair and TSU comments</p> <p>General comments; Very substantial condensing is needed, which will help to focus on the essentials. Text is currently 65 pp of Word (41 pp printed) needs reducing to 20 pp printed.</p> <p>Suggest you start with sections 19.1.3 and 4 and 5; then follow with 19.1.2 then 1. NB this is not a chapter about Art 2, but about much wider sets of important impacts; and Art 2 is one example of a target. Starting with current 19.1.1 may well provoke negative misunderstanding by some readers; and NB in 3, even 1 years time, Art 2 may have been replaced by another policy target.</p> <p>Global vulnerabilites should start with global aggregate assessments of 'IPCC' scenarios of projected T and P change (not the extreme low-prob scenarios). The former are the basis of the rest of the report and should be so also in this chapter. The global KV part of this chapter should assess KVs (for example) in the context of i) aggregate global costs (eg Nordhaus, etc) asking for example where is the point of inflexion between global net gain and global net cost, is this significant or not,), ii) aggregate global econ-soc but non monetary estimates (eg the millions at risk analysis; and migration analyses), and iii) aggregate non econ estimates (see Millenium Asst).</p> <p>Then, continue (in much condensed revision) with discontinuity scenarios. Anyway actually have almost no modelled impact assessments for these.</p> <p>The assessment of exceedance avoided by a) mitigation and b)</p>	<p>Agree—done</p> <p>Article 1 is part of our charge and is thus addressed, but it is only one of many aspects of the purpose of the chapter—all of which are now combined into sect 19.1, so hopefully, this is better balanced.</p> <p>Most of our authors are very skeptical of neoclassical economics aggregation approaches—in fact we will have major caveats when we cite them—and Chapter 20 gives only low confidence to such aggregate estimates. We do early on now summarize our conclusions linked to increasing levels of GMT.</p> <p>Have condensed and mention singularity issues in several places, including opening of the chapter--to extent literature permits, of course.</p> <p>We have cast this into two new tables that will be explicit in changing vulnerability with</p>

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						<p>adaptation is very weak. There should be much more on this and the previous sections should be condensed substantially. A) Mitigation: There should be analysis of impacts for different ppm concn pathways (see for example, the global millions at risk for Hadley 550 and 750 (Arnell et al 2001); and see same for the SRES scenarios (Parry et al 2004), from which ppm equivalents can be inferred with A1B=750; B2=650 and B1=550 (Swart, Mitchell, Morita and Raper GEC, 2002). There have now been several impact assessments for various mitigation/stabilisation pathways. And B) Adaptation: there should be assessment of how much adaptation can avoid KVs (by either avoiding exceedance [raising tolerable ceiling] or delaying exceedance). SEE THE SEQUENCE OF 3 FIGS HERE:</p> <p>A</p>  <p>M.Parry, SBSTA, May 2005</p>	<p>increasing GMT.</p> <p>We have problems with using ppms—requires pdf of climate sensitivity—do that briefly at end on integrated assessment section to conform with our Plenary outline, but don't wish to take on too much of the WG 1 job here, by mapping ppm to temperature trends—except, as noted, in one section that assesses integrated assessment literature, and drips with caveats.</p>

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						<p>B</p>  <p>amount of CΔ (T,P, etc)</p> <p>present TE1 TE2 future</p> <p>Th1 Th2 CΔ1</p> <p>Increase resilience of system / sector (i.e. adapt) = raise threshold = delay time of exceedance</p> <p>M.Parry, SBSTA, May 2005</p> <p>C</p>  <p>amount of CΔ (T,P, etc)</p> <p>present TE1 TE2 TE3 future</p> <p>Th1 Th2 CΔ1 CΔ2</p> <p>Increase resilience AND reduce emissions</p> <p>Q: How far can Adaptation buy time for mitigation?</p>	<p>We have figures on this, but do not believe we could fashion a quantitative graph like this credibly from existing literature. We are concerned with any framing of the problem based on single values of any aspects as over precise---but we agree that the issues need to be raised and do it via framework based on probabilistic approaches and risk management.</p>

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						<p>The question this chapter must address is: how sensitive are KVs (their avoidance or their delay of occurrence) to elasticities in mitigation and/or adaptation.</p> <p>You do not analyse the impact literature to see whether there is any clustering of effects at certain times as forcing increases. Surely this is a key aspect of KVs. An example I worked on is given in a report on UK agric I sent you a while ago [Parry, et al., (2002) Investigation of thresholds of impact of climate change on agriculture in England and Wales. Jackson Env't Inst, Research Report 4, Univ of East Anglia, U.K.]. The impact literature will tell you (or you need to ask other authors) about whether there is any 'lumping together' of important effects with certain amounts of C change (but less so between these amounts), i.e. where effects are triggered non-linearly or step-wise.</p> <p>Why not use sectoral or regional burning embers diagrams, such as in Ch4 (ecos) or ch 11 (Australia)</p> <p>There needs to be a summary table of the effects expected under different amounts of ppm The literature on this is now extensive. Much of it is summarised in the Rachel Warren/Hare papers from Exeter and in the OECD Benefits project (eg Hitz and Smith, et al)</p> <p>Key next step is to draw conclusions: You urgently need to go through all core chapters to pull out KVs for each sector and region (and assess whether there is any lumping of these which might lead to macro-region KVs or multi--sector KVs or global KVs))</p> <p>Below is copy of comment by M. Parry on ZERO-ORDER DRAFT in Jan 2005 [with note on whether comments have been addressed in</p>	<p>Can't fashion very many credible elasticities, but we do summarize ranges and pdfs available in the literature.</p> <p>Have not explicitly performed a clustering analysis—don't think it would be very credible given that we are not attempting a comprehensive summary of impacts—that is in sectoral and regional chapters. Nevertheless, our new table does do this implicitly, even if not comprehensively.</p> <p>Considering it—but big aggregation problems and uncertainties in the science.</p> <p>Will do it by GMT, not ppm (except for direct CO2 effects, terrestrial biota and ocean acidification) Can' do KVs for "each sector and region"—our tables would be 22 pages long! We pick a selection of key ones deemed by chapter authors to make illustrative points.</p> <p>Section 19.2 now very short—dealing</p>

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						<p>the FOD]:</p> <p>General comments:</p> <p>1) suggest section 2 be reduced to about half its current length, to allow more emphasis on conclusions rather than methods. [FOD is even longer]</p> <p>2) Much of the richness from the Buenos Aires meeting is not captured in the paper (see the set of ppt from the meeting) eg the 3 approaches suggested by T.R.Carter regarding identification of thresholds at regional levels; and eg Cofee -Morlot's criticisms of various of these. [FOD is better but still misses much; FOD remains too obsessed with a) Art2; b) global extreme scenarios c) probability of the event rather than of the impact flowing from it]</p> <p>3) S 19.3: Why only physical system thresholds at global level? Why not economic: eg global food supply; global water; global political security (NB even if the conclusion is that these global systems are NOT threatened by climate change, this is still a valid part of the assessment, viz where there are systems that are apparently resilient. [this criticism not answered at all in FOD]</p> <p>4) S 19.3.2 regional is missing: presumably much info can now be obtained from regional chapter ZoD drafts [FOD now better on this]</p> <p>5) S 19.3.3. sectoral thresholds: subsection treatment is very uneven here and there is not a clear conclusion about where the key vulnerabilities are. The literature is very much more extensive than has been cited. Excess attention to lakes and wetlands. [FOD is better on this but fails to address clustering of impacts]</p>	<p>primarily with defining KVs.</p> <p>FOD comments,--here, ,nevertheless, our response is that we added Cofee-Morlopt as CA and have negotiated a balance of these among the Ch 19 team. Cannot cover all the issues in remotely the amount of space allocated to Ch 19.</p> <p>New tables 19.1/2 do much of this.</p> <p>Language will be added to clarify distinction between KVs and “dangerous”</p> <p>We have mined the literature and other chapters to identify these, and have found: Global health effects, Lakes, e.g.—see new tables.</p> <p>Text reduced, tables added</p> <p>This is not straightforward—big disputes in the literature—reflected in chapter author dialogues. We summarize various positions</p>

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						<p>6) S 19.3.4 use diagrams and table to illustrate conclusions and reduce text length</p> <p>7) S 19.4 adaptation: no obvious conclusions drawn here, yet. What is/can adaptation do regarding key vulnerabilities/thresholds: a) avoid their exceedance; b) delay their exceedance. Use diagrammatic examples of this. [FOD still does not address this]</p> <p>8) Section 19.5 risk of triggering key vulnerabilities, proposed in LA outline is missing completely (dropped?)</p> <p>9) No clear conclusions are reached about where/what/when are the the key vulnerabilities; too much space is spent on method and insufficient on current knowledge about how this can inform policy.</p> <p>10) Suggest next stape is to quarry the draft regional and sectoral ZoD drafts for substance on system and regional key vulnerabilities.</p> <p>11) At the end of the chapter the reader needs some balanced evaluation of where current knowledge indicates the main key vulnerabilities to be: what regions, what systems, at what levels of forcing, at what points in time, at what rates (NB there is relatively little consideration of rates of change (rather than levels) as thresholds) . The TAR ducked prioritising the vulnerabilities (eg indicating where these are) but the AR4 should not. And, of course, to indicate where there are apparently NOT thresholds is just as valid (and useful) a set of conclusions; or where the current information is not adequate to discriminate them. [this FOD chapter yet has to develop its conclusions]</p>	<p>and give specific examples. Can't give high confidence to what isn't high confidence analysis. Few diagrams would be generalizable, so we explore this with specific cases.</p> <p>Can't tell people what is key except in normative framework. We explicitly raise the various views in many examples.</p> <p>We have added conclusions related to differential potential of biophysical, biological, social, economic systems to adapt (different sectors as well).</p> <p>See tables (need to consider how to address timing), We identify triggering thresholds where possible. But as we stress, prioritizing is a deeply normative exercise and we are not in the policy prescription business. We do make explicit some of the trade-offs involved. See tables</p> <p>Table 2 addresses</p> <p>All represented in SOD.</p>

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						<p>19. Assessing Key Vulnerabilities and the Risk from Climate Change</p> <ul style="list-style-type: none"> • Methods and concepts: issues relating to Article 2 of the UNFCCC; reasons for concern; measuring damage; identifying key impacts and vulnerabilities, and their risk of occurrence • Approaches to determining levels of climate change for key impacts • Assessing key global risks • Assessing key risks for regions and sectors • Assessment of response strategies to avoid occurrence: stabilisation scenarios; mitigation/adaptation strategies; avoiding irreversibilities; role of sustainable development; treatment of uncertainty • Uncertainties, unknowns, priorities for research (Martin Parry) 	<p>MORE RESPONSES ON ABOVE: We do assess the adaptation potential in our “key” table in Section 19.3.4!</p> <p>We discuss this risk in connection with the KVs itself rather than in an “artificial” separate section.</p> <p>We cannot reach “clear conclusions” about all that because of the need for value judgements and because of scientific uncertainty.</p>

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19-1	A	0				<p>General Comments on Chapter 19: Chapter 19 is a well written summary of the key vulnerabilities conceivable in the context of global climate change. It provides a generally comprehensive assessment of the state of knowledge in this field, is well structured, does not contain doubtful arguments, and is of appropriate length. My comments are mostly restricted to recent developments concerning the tolerable windows approach and its application to possible instabilities in thermohaline circulation. I have also made some suggestions that should increase the readability of the chapter, especially to an interdisciplinary audience.</p> <p>I very much appreciate the strong emphasis on the need to make a clear distinction between scientific analysis and inevitable value judgments. This clarification is a considerable step forward with respect to the Third Assessment Report.</p> <p>With a view to future assessment reports, one should refrain from expressing global mean temperature change with respect to “current” levels. This would imply a continuously shifting benchmark as time goes by. I would instead recommend that mean temperature change be expressed with respect to the pre-industrial temperature.</p> <p>(Thomas Bruckner, Technical University of Berlin)</p>	<p>Thanks!</p> <p>Agree—need WG 2 wide decision on this I think? If not we will make our own—so far it is warming above 1990, chosen to have some already discernible observed effects in our tables.</p>
19-2	A	0				<p>The authors have done a good job of focusing attention on the main risks, although at times the relative magnitudes of the various kinds of risks are not presented as clearly as they might be. I urge that an effort be made in the Summary for Policymakers or elsewhere in the Fourth Assessment to emphasize more strongly the most serious risks. I will refer to page and line numbers in the specific comments that follow. As will be obvious, some of my comments are substantive</p>	<p>Thanks!</p>

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						<p>and some are purely typographical. References: DeCanio, Stephen J., 2003. Economic Models of Climate Change: A Critique. New York: Palgrave Macmillan. Forum on Religion and Ecology, 2004. "Statements." http://environment.harvard.edu/religion/publications/statements/index.html (accessed 8-15-05). Hall, Darwin C., and Richard J. Behl, forthcoming. "Integrating economic analysis and the science of climate instability," Ecological Economics (accepted 5 May 2005). Krause, Florentin, Stephen J. DeCanio, J. Andrew Hoerner, and Paul Baer, 2002. "Cutting Carbon Emissions at a Profit (Part I): Opportunities for the U.S." Contemporary Economic Policy, Vol. 20, No. 4: 339-365. MacIntyre, Alasdair, 1981 [1984]. After Virtue. Notre Dame, IN: University of Notre Dame Press, Second Edition. Nordhaus, William D., and Joseph G. Boyer, 2000. Warming the World: Economic Models of Global Warming. Cambridge, MA: M.I.T. Press. Shlyakhter, Alexander I., and Daniel M. Kammen, 1992. "Sea-level rise or fall?" Nature, Vol. 357 (7 May): 25. (Stephen De Canio, University of California, Santa Barbara)</p>	<p>The references don't seem to be crucial for our chapter.</p>
19-3	A	0				<p>Several comments are in order here. First, Venus is not Earth, and Venus-like conditions (with surface temperatures hotter than the melting point of lead) are not required to threaten civilization as we know it or even the habitability of Earth. Hence, the possibilities of major positive warming feedbacks associated with terrestrial and/or oceanic methane releases are much more serious than is suggested by saying that the Earth will not become like Venus. Second, it should be made clear that the assertion about "no support in the literature" for the possibility of a runaway greenhouse effect applies (if it does) to the models including land carbon storage only. Third, the phrase "no support in the literature" sounds as though this issue (the possibility of a runaway greenhouse effect) has been extensively examined in the literature. Is that the case? In other words, are there numerous modeling studies on the appropriate time scale (and including both terrestrial and oceanic methane sinks) that have looked for a possible runaway greenhouse effect and found none? Fourth, it needs to be emphasized that health and civilization can be severely threatened from positive warming feedbacks caused by methane releases even if they do not produce a "runaway greenhouse effect". Fifth, on pp. 20-21 there is only a placeholder for "melting of permafrost peat soils, which store large amounts of methane" (lines 50 on p. 20 and 1 on p. 21). Presumably, this means that the permafrost methane sink has not been included in any of the</p>	<p>Not the primary job for WG 2—we'll recheck our language to see if it is problematic. Don't agree there is any palpable chance of runaway greenhouse effect on earth, though—we have enough pioneers in climate science to be very confident of this assessment.</p>

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						<p>previous discussion (including the statement about “no support in the literature” for a runaway greenhouse effect).</p> <p>My suggestion is that this section (19.2.1.1) be rewritten to (1) make clear which studies refer to which conclusions, and (2) be much less complacent about the consequences of positive feedbacks from methane release (Stephen De Canio, University of California, Santa Barbara)</p>	<p>We do not ignore feedbacks, positive and negative, neither are we WG 1 whose task is to summarize all—we just give illustrations and important selections.</p>
19-4	A	0				<p>Most of contents are one viewpoint, e.g. 2-3 as a thresholds, not involve other view points in published literatures, e.g. key vulnerability is not thresholds, adaptation can delay or avoid dangerous climate in some period. 19.3 needs more aggregated works. 19.4 needs more quantitative assessments.</p> <p>19.3.2 change into sectoral key vulnerability; 19.3.3 change into regional key vulnerability; 19.3.5 not very clear, please revise it; suggest to exchange 19.4.1 and 19.4.</p> <p>(Lin Erda, Chinese Academy of Agricultural Sciences)</p>	<p>Will do it in three temp blocks in SODt version, but still must cite literature like EU target along with other suggestions.</p>
19-5	A	0				<p>The FOD of chapter 19 is a vast improvement over the ZOD. The chapter has a well designed structure and proceeds in a logical order. For me, the writing is very clear, yet sufficiently sophisticated and comprehensible. The FOD of chapter 19 is fairly comprehensive and nearly complete. Having reviewed the ZOD with its numerous deficiencies, I applaud the writing team for preparing this FOD.</p> <p>As acknowledged by the writing team, the sections on sectoral and regional impacts have so far not been able to absorb the material produced in the FOD's of the specific chapters of AR4. As regards my own specific expertise and interests, very little of the current FOD dealing with agriculture, fisheries, forestry and respective vulnerabilities (chapter 5) can be found in 19.3 of this FOD.</p> <p>(Günther Fischer, International Institute for Applied Systems Analysis)</p>	<p>Thanks!</p> <p>Will have cited current info from other parts of the AR4 Contrasts with comment 19-0</p>
19-6	A	0				<p>Well documented and organized. It is a good approach to classify impacts vs. scale, ie. global, regional, and sectorial scale. However, the assessment of response strategies to avoid key vulnerabilities is still difficult to implement unless the research gap is overcome. Therefore the section on "Priorities for research" should be completed</p> <p>(Savitri Garivait, The Joint Graduate School of Energy and Environment (JGSEE))</p>	<p>Thanks</p> <p>Priorities for research now added to SOD.</p>

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19-7	A	0				General comment. There is general tendency in this chapter to equate "sensitivity" to "vulnerability". I would vet each use of "vulnerable" and its derivatives. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Whole issue has been carefully reworded based on many comments. This "tendency" reflects a "tendency" in the climate change literature in general. Adaptation is and must be considered.
19-8	A	0				General comment on this chapter: This chapter seems to be oblivious to the fact that in the future adaptive capacities should be greater than they are currently if the SRES' assumptions are borne out, particularly for the developing world because those scenarios assume that they will grow more rapidly. Moreover, since technology is constantly accreting, there should be more technological options available (all else being equal) [See Goklany (2005c), "Integrated Strategies to Reduce Vulnerability and Advance Adaptation, Mitigation, and Sustainable Development," accepted by Mitigation and Adaptation Strategies for Global Change.] As a result, future impacts should be lower than can be expected based only on the basis of CC, and "thresholds" at which some "vulnerabilities" (especially with respect to human systems) become key under today's adaptive capacity may be raised in the future as that capacity advances. I recommend working this concept in at various junctures in this chapter. See also comments 67, 68. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	We do agree that we did not phrase it as well as we should have or deal with this topic of the limits to adaptation as clearly as we could, so this issue has been revisited for clarity. Not clear how technology and organization will alter future adaptive capacity—we cite opposing literature and draw from Chapter 17. Adaptive potential in developing countries is often high, but will it be realized is more speculative and not at all automatic. All this is now explicitly stated in SOD. We did consider potential future changes in adaptive capacity in our chapter. However, not all KVs can be avoided by adaptation, the SRES projections of economic growth in poor countries are controversial, and even a high (average) GDP is no guarantee for low impacts: The effects of Hurricane Katrina have been termed as "A Third World problem occurring in a First World country". Counter-adaptive trends are also evident, and may increase with wealth. Moreover adaptation has costs, usually including greater energy consumption.
19-9	A	0				A truly excellent summary, with admirable focus and a commendable attention to uncertainty. (Chris Hope, Judge Business School)	Thanks!
19-10	A	0				Multiple Stresses (Note this comment may apply to the volume as a whole and should be passed on to WG II chairs). The FAR clearly intends that multiple stresses be taken into account and this should include environmental and socio-economic stresses. The importance of multiple stresses has been long recognized. For example extreme climate events of the 1930s in the US, drought and floods, had much greater impact because of the simultaneous occurrence of the economic depression. Many studies such as	

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						<p>Diamond (2005) study of collapse show that societal collapse often involves climate change but such is never sufficient to alone account for the collapse. And recent studies of vulnerability such as the two article by Turner et. Al. 2005 (not cited in Chapter 19) in PNAS all emphasize multiple social and natural stresses. But Chapter 19 while specifically mentioning multiple stresses has no assessment except for a few scattered references from other WG II chapters such as population growth exacerbating coastal system impacts. Even Chapter 20, which specifically sets out to examine multiple stresses limits this primarily to other environmental stresses.</p> <p>A good starting point for serious examination of multiple stresses is to ask what other socio-economic and environmental trends are likely to take place over the next 50-100 years to parallel projections of climate change and to ask how these will interact together either to increase or decrease vulnerability. For as source of major candidate trends see: Kates, Robert W. and Thomas M. Parris, “Long-Term Trends and a Sustainability Transition,” Proceedings of the National Academy of Sciences, 2003, 100(14):8062-8067</p> <p>The Chapter is obviously too long and will grow longer with FOD’s with more detail and citation replacing ZODs placeholders and if such serious under addressed areas as multiple stresses and adaptation are addressed and the two sections on research and conclusions are written. The current 90 page text thus need to be cut in half, even if a reasonable case should be made to expand a bit beyond the allotted 25 printed pages give the synthetic role of the chapter.</p> <p>I see two general places where cuts could readily be made. First, there is an excess of methodological and conceptual discussion in 19.1, 19.2, and 19.4. Indeed some of it reads as if the authors were writing methodological reviews rather than simply stating the methods actually used (as opposed to could be used) to identify key vulnerabilities and response to them. Second, if one takes as a sample the key Table 19.1 and worked backwards from it to the global, sect oral, and regional summaries, then some of these summary discussions could be abandoned by referral to the chapters from which they came. The text would then contain the minimal needed to justify the authors assessment of the key vulnerabilities in Table 19 using the six criteria for choosing them</p> <p>Identifying key vulnerabilities</p> <p>I do like the attempt at synthesis and conclusion embodied in Table 19 with one suggested change (see below). But neither in Table 19 or in the global, sectoral, and regional summaries is there any apparent ordering of key vulnerabilities. Within any one section, key vulnerabilities appear to be ordered either randomly or with a</p>	<p>We now address the multiple stresses and baseline of development status issue more explicitly in opening paragraphs. However, we believe that the main issue for us is the marginal consequences of various climatic scenarios on a variety of metrics of human well being and the natural system, and that how various baseline scenarios changes human well-being is not our primary task, but rather marginal climatic impacts. Of course we often mention baselines and the relative sensitivity of marginal climatic impacts to development baseline for clarity at the outset and is tables, and draw from Chapter 20.</p> <p>In short, regardless of whether development baseline trends represent more impacts than climate change is not our charge—rather it is to assess how the climate component affects societies/nature. Marginal climate impacts will ride along with baseline changes, and must be weighed versus efforts to mitigate climate changes that impose impacts. The main role of baselines for us is how it affects adaptive capacity—and thus vulnerability in specific cases.</p>

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						<p>bias to listing singularities first. I suggest the coherence of the chapter would be strengthened if in each of the global, sectoral, and regional summaries the identified key vulnerabilities were ordered consistently with reference to one or more of the six criteria for assessing key vulnerabilities. My own preference would be to order key vulnerabilities by relative certitude and confidence, and the for equal certitude either by magnitude (so readers would think about big items first) or by timing (so readers would consider vulnerabilities already being experienced first).</p> <p>Missing from the key vulnerabilities is one addressing extreme events. These events: storms, floods, droughts, wildfires etc. are included but scattered in all the sectoral and regional summaries. But increasingly, stakeholders and decisionmakers are becoming aware of these, the potential for increases in both frequency and intensity and the potentials for adaptation as a whole and it would be remiss to fail to acknowledge this in its global context</p> <p>Related to this issue is the lack of consistent use of the suggested language for qualitative or quantitative measures of likelihood and confidence. As the authors note this is still under discussion and will be applied in the SOD. But there are so many uses of words such as “uncertain” that do not fit into these measures yet they seem to substitute for “speculative” which to scientists has a pejorative value. In any event standard usage is badly needed.</p> <p>Assessment of response strategies</p> <p>The authors’ decisions to address adaptation as a brief and speculative column in Table 19 and then devote almost ten pages to mitigation seems unjustified. They use the existence of Chapter 17 to minimize their analysis of adaptation but ignore the existence of an entire volume on mitigation WG III to engage in a methodological review that surely should be in that volume.</p> <p>There should be equal time for adaptation and mitigation although not necessarily in the same place. As a first step, there should be an added column on mitigation potential in Table 19. It too should address specific key vulnerabilities not assessing mitigation in general but linked to key thresholds identified for key vulnerabilities. But as mitigation is local in implementation but global in impact, supporting material could be found in the global summary or in 19.4. Likewise supporting material for adaptation should be included in the regional and sectoral summaries where most appropriate give its more local character or in 19.4.</p> <p>Indeed the effort to dichotomize adaptation literature into optimist and pessimist camps or elsewhere into planned vs. invisible hand camps may reflect some literature but is not really helpful. One can be a thoughtful optimist in believing that industrialized farmers can readily adapt but a thoughtful pessimist in believing</p>	<p>Now ordered by reasons for concern in table 1 and by sectors versus amounts of GMT change in table 2.</p> <p>As said several times, ordering of KVs is normative and how to reach a clear consensus not yet clear</p> <p>Dealt with outside of Chapter 19—we just briefly summarize. Will update to be consistent with latest guidance memo on uncertainties—will not invent new terminology or framework for uncertainties.</p> <p>Much more balance in the SOD, we believe.</p>

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						<p>that malaria sufferers cannot. It is not clear whether the adaptation potential or the mitigation potential has been actually used in assessing key vulnerabilities. Have any potential vulnerabilities been removed from the "key" list because of adaptation or mitigation potential? (Bob Kates, 0)</p>	<p>Agree—it is dropped from revised tables</p>
19-11	A	0				<p>There is fundamental error running right through this chapter. This concerns the treatment of adaptation capacities of human societies to climate change which might occur over the next century. In many places, reference is made to the limited ability of Developing Countries in particular to adapt to change. Yet this possible change is being driven by accumulation of GHGs as the result of emissions scenarios which see substantial economic development in such countries, such that they will enjoy standards of economic welfare broadly comparable with OECD countries presently. This tendency to downplay human adaptive capacity pervades the chapter, and results in a substantial exaggeration of the likely impacts of climate change on human societies. Impacts as malaria or dengue fever, for example, depend crucially on socio-economic factors, such that their existing distributions have more to do with these than with climate. This flaw seriously weakens the chapter as currently written - to the extent that I would recommend against publication were this a paper submitted for publication. A further problem is that there is a tendency to downplay existing variability, against which anthropogenic climate change must be assessed (see comment re p4 line 42 below). Finally, the chapter reflects a particular interpretation of FCCC Article 2 regarding the adaptability of natural systems which is not contained within the text of Art 2. (see the comment re pp4-5 below). (Aynsley Kellow, University of Tasmania)</p>	<p>Do not agree that we downplay adaptive capacity--but take a realistic look. We have tried to make this debate clearer in revision. Certainly it is not an "error" to summarize the opposing sides in the adaptation debate—the "error" is to assert that only one of these views is "true" given current state of the literature. Since this comment is repeated so many times by certain reviewers, we will put here what is now said about adaptive capacity right up front in the Executive Summary of the SOD: "Planned adaptation can significantly reduce many potentially dangerous impacts of climate change and reduce the risk from many key vulnerabilities. However, the technical, financial, and institutional capacity and the political motivation necessary for planning and implementing effective adaptations are currently quite limited in many regions. In addition, the risk-reducing potential of planned adaptation is either very limited or very costly for some key vulnerabilities, such as loss of biodiversity, melting of mountain glaciers or disintegration of major ice sheets. On the other hand, especially in developed countries, the capacity to implement coastal protection, agricultural crop changes or irrigation systems may be much higher.</p> <p>The literature presents a wide range of views on the potential for adaptation to reduce the</p>

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							risks from climate change. However, it is consistent in suggesting that it will be much more difficult for both human and natural systems to adapt to larger magnitudes of global mean temperature change than to smaller ones, and that adaptation will be more difficult and/or costly for faster warming rates than for a slower warming.”
19-12	A	0				<p>The authors use the term mainly "MOC" but also mention "THC". I think this needs to be standardized. My, limited, understanding is that THC refers to the whole global ocean "conveyor belt" whereas the term MOC is used to refer to the overturning in a particular ocean basin.</p> <p>The authors have done an excellent job on this FOD. I found the chapter (despite the noted lack of full information from the preceding chapters) presents a lucid, understandable and "value-added" description/interpretation of a complex literature despite the many uncertainties (which are clearly noted). I look forward to seeing the SOD with the Priorities for Research & Conclusions.</p> <p>(Janice Lough, Australian Institute of Marine Science)</p>	<p>Will clarify and be consistent with wg 1</p> <p>Thanks</p> <p>Us too! I think that the term MOC is now preferred by ocean scientists..</p> <p>A big laud.</p>
19-13	A	0				<p>The chapter is not always clear about whether it is referring to global average temperature changes or local temperature changes (e.g., over Greenland). It would help in a number of cases to actually give indications of both--so when one says 5 C over Greenland, indicate that this means something like 2 C global average. What is important is to make sure that comparisons of apples and apples can be done. Where this arises, it will be mentioned in the specific comments.</p> <p>(Michael MacCracken, Climate Institute)</p>	<p>Have clarified this—use gmt in tables but mention the heterogeneity problem more explicitly. We should be always be clear about our reference – but uncertainties do not allow for a one-to-one correspondence between global and regional temperature change. I. Now we even have a Box on this to make sure nobody misunderstands us!</p>
19-14	A	0				<p>Chapter as a whole: Overall, this chapter is very well done, and quite readable and understandable. Compliments to the authors.</p> <p>General comment on chapter: I was rather surprised to find so little about how the rise in the CO2 concentration alone would lead to an acidification of the oceans that</p>	<p>Thanks!</p>

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						could seriously endanger marine life (Ken Caldiera gave an interesting talk on this recently at a symposium sponsored by the Norwegian embassy in Washington DC). It might even be argued that the risk being taken in this area alone would be enough to justify action. I was also surprised to see how far into the chapter it took to get to mention of the likely loss of so many coral ecosystems to the rise in CO2 and to climate change--this is a very serious issue for many locations and deserves early mention as being important in itself, not as it is now as part of how biogeochemical cycles are affected. (Michael MacCracken, Climate Institute)	Agree—have gotten more from relevant chapters. Summaries in beginning now.
19-15	A	0				This should be the most significant chapter of the AR4, but at the start it tends to get bogged down in semantics. Some words, like likelihood and threshold, seem to be given confusing meanings. (Michael Manton, Bureau of Meteorology Research Centre)	Will revisit this languHas been rewritten with clarity in mind.
19-16	A	0				Congrats for putting such a great key chapter together. (Malte Meinshausen, NCAR, National Center for Atmospheric Research)	Thanks!
19-17	A	0				The chapter as it stands is about 54 printed pages and certain sections are yet to be developed. The authors need to cut down considerably to the 30 page limit. The chapter has not addressed the role of sustainable development in reducing key vulnerabilities, with particular respect to Article 2 of the UNFCCC. The developing countries, while supporting the need to set stabilization targets, also think that sustainable development could help reduce greenhouse gas emission as well as help in adaptation. I think this link needs to be addressed. See Adil Najam, Saleemul Huq and Youba Sokona (2003. Climate negotiations beyond Kyoto: Developing countries concerns and interests. Climate Policy, 3:221-231. Several references have conflicting dates in the text and in the references section. (Anthony Nyong, University of Jos)	
19-18	A	0				A general comment on the whole chapter. The section structure needs careful attention. Revisions to the current structure are needed. Basic concepts and methods sections in the beginning are all right but it would be better to divide the core of assessment to greater number of sections (global systems impacts, sectoral impacts, regional impacts, and a synthesis) than has been done in the first order draft. A general comment on the flow of argumentation in the chapter. More effort is needed to justify and rationalise the ordering of sections / material / analysis in the chapter. At the moment, the impact assessment matter and risk & response matter do not sit easily together. Also, the continuity and flow of argumentation within the impact assessment matter is unnecessarily weak while the risk and response matter does not generate easily identifiable lessons or observations as highlights.	Some of these points taken in revision, but space imitations have loomed at every step. Some already done in intro to give a better

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						<p>A general comment on the chapter. There is a need to discuss explicitly and to a greater extent what impact categories are relevant in different parts of the analysis. The "global key vulnerabilities" section clearly and justifiably focuses on physical impacts on key earth systems but it does not explicitly discuss or justify this choice. In sections on sectoral and regional impacts, there is a greater need to be transparent on what impacts are considered. Is climate change causing impacts on water resources or increasing flooding or causing economic / property damage or impairing health or all of the above? Overall, the draft chapter pays far less attention to economic or monetised impacts than its predecessor, which is clearly a weakness. This is not to say that present analysis should be replaced by economic considerations. Best practice would probably be to discuss in sectoral and regional chapters first physical impacts (e.g. crop reductions, health impacts) and enrich the text by discussing estimates of monetized impacts where they are available and add insight. There is scope to increase discussion on economic impacts substantially from the present.</p> <p>A general comment on the chapter. Present ordering of subsections in the impact assessment part of the chapter and the treatment of subject matter in them give most likely unintended emphasis on the impacts on non-human systems instead of on impacts on human systems. Revisions to orderings and handling of substance matter should be made to increase emphasis placed on impacts on humans. (Jouni Paavola, University of East Anglia)</p>	<p>roadmap.</p> <p>We have little confidence in monetized impact studies—in fact the authors of Chapter 20 are assigning low confidence to their own assessment of aggregate impacts on GDP. Nevertheless, we now bring it in in tables and text explicitly. Added economic system discussion and table entries, but generally do not assign high confidence to them, consistent with Chapter 20.</p>
19-19	A	0				<p>OVERALL COMMENT: the chapter appears to be biased towards studies that employ methodologies that can (in theory) provide 'global' or 'large-scale,' and quantitative assessments of vulnerability. However, there is an increasing call for local-scale, quantitative or qualitative vulnerability assessments, and I feel that such assessments can provide at least as much value to our knowledge of climate risk and vulnerabilities as the global-scale assessments. See, for example: Polsky, C., Schröter, D., Patt, A., Gaffin, S., Martello, M.L., Neff, R., Pulsipher, A. and Selin, H., 2003. Assessing Vulnerabilities to the Effects of Global Change: An Eight-Step Approach. Research and Assessment Systems for Sustainability Program</p>	<p>We agree more on local impacts and vulnerabilities need to be discussed, and attempt this in our tables and accompanying text.</p>

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						Discussion Paper 2003-05. Environment and Natural Resources Program, Belfer Center for Science and International Affairs, Kennedy School of Government, Harvard University, Cambridge, Massachusetts. http://ksgnotes1.harvard.edu/BCSIA/sust.nsf/pubs/pub75 . Note that this paper will soon be published formally: Schröter, D., Polsky, C. and Patt, A., 2005. Assessing Vulnerabilities to the Effects of Global Change: An Eight Step Approach. Mitigation and Adaptation Strategies for Global Change(Winter). (Colin Polsky, Clark University)	If the regional chapters have reviewed these studies, they will hopefully make it into our chapter through this channel. The studies we review explicitly in our chapter are generally those that are unlikely to receive attention in the other chapters due to their cross-sectoral and/or cross-regional scope.
19-20	A	0				This chapter seems to be already in quite good shape. (Klaus Radunsky, Umweltbundesamt GmbH)	Thanks!
19-21	A	0				The bias mentioned above is exacerbated by selection inclusion of topics and papers, and by selected quotation from papers. (Richard S.J. Tol, Uni. Hamburg)	Nothing specific mentioned—can't respond without reviewer giving detailed reference to text to deal with.
19-22	A	0				Much of the text in the chapter may be redundant in light of the info provided in Table 19.1. Perhaps remove the redundant material. (James S. Wang, Environmental Defense)	Will shorten table and make text more streamlined. Have eid to reduce unnecessary redundancies, though not a perfect job we suspect.
19-23	A	1	0	5		no discuss sustainable development (Lin Erda, Chinese Academy of Agricultural Sciences)	There is some, but a bit more has been added and cross refs to other chapters
19-24	A	1	0			Following twelve references are not provided within comments (most are available from my homepage): 1. Goklany, IM. 1995. "Strategies to Enhance Adaptability: Technological Change, Economic Growth and Free Trade." Climatic Change 30: 427-449. 2. Goklany, IM. 1998. "Saving Habitat and Conserving Biodiversity on a Crowded Planet." BioScience 48 : 941-953. 3. Goklany, IM. 1999. "Richer is More Resilient: Dealing With Climate Change and More Urgent Environmental Problems." In R. Bailey, ed., Earth Report 2000, Revisiting the True State of the Planet (New York, NY: McGraw-Hill), pp. 155-187. 4. Goklany, IM. 1999a. "The Future of the Industrial System." Invited Paper. International Conference on Industrial Ecology and Sustainability, University of Technology of Troyes, Troyes, France, September 22-25, 1999. Also available in: D. Bourg and S. Erkman (eds). 2003. Perspectives on Industrial Ecology (Sheffield, UK: Greenleaf Publishing), pp. 194-222.	Have used a few now, especially in adaptation section.

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						<p>5. Goklany, IM. 2000. "Potential Consequences of Increasing Atmospheric CO2 Concentration Compared to Other Environmental Problems." <i>Technology 7S</i>: 189-213.</p> <p>6. Goklany, IM. 2001. <i>The Precautionary Principle: A Critical Appraisal of Environmental Risk Assessment</i> (Cato Institute, Washington, DC).</p> <p>7. Goklany, IM. 2002. "Comparing 20th Century Trends in U.S. and Global Agricultural Land and Water Use." <i>Water International 27</i>: 321-329.</p> <p>8. Goklany, IM. 2002b. "The Globalization of Human Well-being." <i>Policy Analysis</i>, No. 447 (Washington, DC: Cato Institute, August 22, 2002).</p> <p>9. Goklany, IM. 2003. "Relative Contributions of Global Warming to Various Climate Sensitive Risks, and Their Implications for Adaptation and Mitigation," <i>Energy & Environment 14</i>: 797-822.</p> <p>10. Goklany, IM. 2005. "A Climate Policy for the Short and Medium Term: Stabilization or Adaptation?" <i>Energy & Environment 16</i>: 667-680.</p> <p>11. Goklany, IM. 2005a. "Is a Richer-but-warmer World Better than Poorer-but-cooler Worlds?" 25th Annual North American Conference of the US Association for Energy Economics/International Association of Energy Economics, September 21-23, 2005.</p> <p>12. Goklany, IM. 2005b. "Integrated Strategies to Reduce Vulnerability and Advance Adaptation, Mitigation, and Sustainable Development," accepted by <i>Mitigation and Adaptation Strategies for Global Change</i>. .</p> <p>(Indur Goklany, Office of Policy Analysis, Department of the Interior)</p>	
19-25	A	1	1	75	50	<p>The large number of comments included here are mainly about details. I thought the overall structure of the chapter worked very well.</p> <p>(Rachel Warren, Tyndall Centre)</p>	Had great trouble locating comments due to wrong pagination. May have missed some due to this.
19-26	A	1	1	75	50	<p>Overall I liked this chapter very much. Very large sections of it are very well written. I particularly liked the first 2 pages, and the discussion of criteria for key vulnerabilities (section 19.2). I also liked the discussion at the end on studies which have tried to identify how to avoid DAI.</p> <p>(Rachel Warren, Tyndall Centre)</p>	Thanks
19-27	A	1	3			<p>The wording of the title of the chapter needs to be reconsidered because it includes a notion of "vulnerability" which is problematic for the reasons outlined in greater detail in comment No. 2. The substance of the chapter would be better caught by a straightforward wording such as "Climate Change Impacts, Risks and Reasons for</p>	Impossible—assigned to us by Plenary. Maybe good idea but not allowed at this stage by us.

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						Concern". (Jouni Paavola, University of East Anglia)	
19-28	A	1	10	1	10	First bullet suggest reword to "interpretations of the concept of key vulnerabilities and the criteria for their identification" or at least insert comman between "for" and "identifying" (Rachel Warren, Tyndall Centre)	Whole section has been reworded.
19-29	A	1	14	1	16	The number of contributing authors seems small, especially for the scope of material covered. (Michael Manton, Bureau of Meteorology Research Centre)	
19-30	A	1	38	1	44	Second set of bullets: is it obvious which are objective and which subjective? (Rachel Warren, Tyndall Centre)	
19-31	A	2	25	2	30	need assess initial condition for key vulnerability (Lin Erda, Chinese Academy of Agricultural Sciences)	Do not understand comment
19-32	A	3	0	5		The executive summary (ES) makes confusing and mostly unnecessary use of the term "vulnerability", which is also symptomatic of the title of the chapter and the rest of the chapter. The problem with the use of the term in the ES is that it is used as a synonym of "impact" or "outcome" or "consequence". This is a problem because a) the meaning is not clarified in the ES; 2) the meaning assigned to the term deviates from the widely established meaning of the term; and 3) it is not necessary to use the term at all in the ES or elsewhere in the chapter in the sense it is currently used. I suggest that the ES is revised so that references to "vulnerability" or "vulnerabilities" in the sense of "key outcomes or "key consequences" are eliminated and replaced with the more straightforward "impacts", "outcomes" and "key concerns", which is in line with the language of the WG2 chapter on the same theme in TAR. (Jouni Paavola, University of East Anglia)	We revised the framing of vulnerability, but without contradicting the WG 2 glossary definition that is used across wg 2. Consistency across the AR 4 may have to be addressed further by bureau and co-chairs. There is an issue re usage, but par. 3 does define vulnerability.
19-33	A	3	1	3	50	References could be inserted in the section perhaps to other places in WGII (Rachel Warren, Tyndall Centre)	Will cross-ref a lot and include a representative sample of primary refernces, particularly when not as thoroughly covered in other chapters since they are dealing with x-cutting issues—like integrated assessment..
19-34	A	3	4			“pre-industrial temperature” There are two definitions of “pre-industrial” i.e. around 1750 or around 1850 in recent research papers. Basic information regarding stabilization issues should be described in a box or somewhere in the tex (Hideo Harasawa, National Institute for Environmental Studies)	We will be explicit in our chapter and help negotiate a standard for WG 2 if possible at next author’s meeting.

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19-35	A	3	10	3	15	A realistic approach to DAI (Michael Manton, Bureau of Meteorology Research Centre)	Thanks
19-36	A	3	12			'... the definition of 'dangerous anthropogenic interference with the climate system' (DAI) cannot be based on scientific arguments alone ..' Why not, please specify the reasons. (Hans H.J. Labohm, Netherlands Institute of International Relations 'Clingendael')	They were, but we reworked the language to make it more explicit.
19-37	A	3	14	3	14	Why "a political process"? Why not many, repeated processes? (Richard S.J. Tol, Uni. Hamburg)	It is both repeated processes and normative valuations—those are part of political processes, not just scientific processes.
19-38	A	3	17	3	24	Replace the word 'product' with 'function'. The mathematical relationship has not been defined (William Kininmonth, Australasian Climate Research)	Agree
19-39	A	3	20			Assessment of key vulnerabilities (should be assessment of what are the key concerns) is defined here so that it ignores the need to account for the level and distribution of adaptive capacity. Yet the level and distribution of adaptive capacity clearly need to be examined, which forms a distinct exercise from the assessment of distribution of impacts (which is included into the list). This addition is also warranted by the inclusion of "potential for adaptation" in the bulleted list in line 29. (Jouni Paavola, University of East Anglia)	Cannot rewrite our mission from Plenary, but can make clear the concern/vulnerability confusion with explanatory language at the beginning. We think we did this now.
19-40	A	3	23	3	30	Which are objective and which are subjective criteria? (Marko Scholze, University of Bristol)	
19-41	A	3	28	3	36	Suggest after "to date" "with climatic warming being greatest at the poles". Does the fact that, in spite of the fact that warming is greatest at the poles, impacts are most serious at lower latitudes. Except for in Arctic, where effects might be more severe than at lower latitudes. In fact, suggest edit to read that low latitude less developed areas AND the Arctic are generally at greatest risk. (Rachel Warren, Tyndall Centre)	These sections have been rewritten, and hopefully some of these issues dealt with sufficiently.
19-42	A	3	46	4	5	In my opinion, two additional points could be added as robust general conclusions. First, it is a robust (and plausible) finding across many studies that both exposure to impacts and adaptation capacity strongly depend on future socio-economic development paths. Second, what may constitute a key vulnerability is not only defined by the magnitude of climate change and level of human development but also by the speed of climate change. (Günther Fischer, International Institute for Applied Systems Analysis)	We addressed baseline point, as noted in response to 19-10.
19-43	A	3	47	3	47	There are several literatures to argue that the threshold of collapse of THC will be	We try to be consistent with WG 1 and

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						above 4 degree centigrade (stocker and schmittner, 1997). Therefore the expression of "range from 1.5 to 4 degree centigrade above" should be revised as "range from 1.5 to <4 degree centigrade above". (Mitsutsune Yamaguchi, Teikyo University)	literature, but it must be recognized there is some disagreement in lit. Needs expert judgement which we give and label as such.
19-44	A	4	1	4	2	'Some impacts of climate change ...' and '... studies as key vulnerabilities.' In what sense – vulnerabilities for whom, what? This is a sentence that is confusing and seems to occur thru out the chapter ...ensure that a distinction is made between 'impacts' and 'vulnerabilitie' (Coleen Vogel, University of the Witwatersrand)	Have clarified vulnerabilities issues in many places
19-45	A	4	3			Change "increases" to "changes in". This would be more accurate. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	We disagree, but have revised most of our language.
19-46	A	4	3			'increases in severity of extreme events': please specify how global warming, whatever its origin, affects this increase (mechanism). (Hans H.J. Labohm, Netherlands Institute of International Relations 'Clingendael')	Will be made consistent with wg 1
19-47	A	4	3	4	3	Add: ...and threats to coastal infrastructure. (David Major, Columbia University)	Agree
19-48	A	4	4	4	5	As a general proposition, this is not true. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Controversial, but we agree it needs to be rethought—some added discussion in latest.
19-49	A	4	4	4	5	The opposite may be true. It could be argued that countries with high natural climate variability will manage climate change en passant. Countries with benign climates may notice the impacts first. (Michael Manton, Bureau of Meteorology Research Centre)	Ditto above response Few general rules that apply everywhere—we've said that regional and ssectoral heterogeneity to be expected.
19-50	A	4	5			"in the near future"; ambiguous expression. (Hideo Harasawa, National Institute for Environmental Studies)	
19-51	A	4	6			"CO2 stabilization level" When we consider stabilization level, Greenhouse gas concentration stabilizarion is more important. So Chapter 12 should make clear the following points. a. GHG or CO2 only. In case of GHG, which gases are included. For examples, Kyoto 6 gases, CFCs, SO2 as cooling agents, so on. b. start year of temperature increase (pre-industrial revolution (around 1750), pre- industrial level (around 1850), or 1990 (Reference year of UNFCCC and Kyoto Protocol); c. Global mean or regional mean temperature. d. Time of stabilization of GHGs and temperature; 4) Some references sited in the text are not listed in reference list. For example, "Gardiner, 2005" (P15, L 5), "AMAP, 2005" (P15, L5), "Harvey and Huan , JGR, 1995", and so on. (Hideo Harasawa, National Institute for Environmental Studies)	Have addressed mapping of emissions to concentrations to GMT in integrated assessment sections by summarizing the literature, but do not plan to map ghg concentrations against key vulnerabilities—rather GMT—would need to decrease confidence as the uncertainties cascade—that is a WG 1 job primarily, except in the integrated assessment literature. See response to 19-0.
19-52	A	4	10	4	11	It is very important that Planned adaptation can significantly reduce many	

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						potentially dangerous impacts of climate change and reduce the risk from many key vulnerabilities, please give more description (Lin Erda, Chinese Academy of Agricultural Sciences)	Have made this issue more explicit, as discussed in response to 19-8 and 19-11.
19-53	A	4	10			Modify the beginning of the sentence to read: "Planned or EVEN UNPLANNED, I.E., SPONTANEOUS, adaptation (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Rewritten.
19-54	A	4	10	4	22	Developed countries have a better capacity for adaptation than developing countries, however developing countries have large low cost mitigation potential. It might be easier to generate adaptation money in developing countries if these funds are linked to mitigation. (Alexander Golub, Environmental Defense)	Not really our remit, but adaptation discussion entirely revised.
19-55	A	4	10	4	11	This statement applies only to certain classes of human systems and usually not to ecosystems and biodiversity and this needs to be made clear at the beginning. (William Hare, PIK)	Agreed and stated so.
19-56	A	4	10		16	In particular, this passage needs to be substantially rewritten to reflect the likelihood that technical, financial and political resources in Developing Countries are likely to develop substantially as GHG emisisions grow and climate change emerges. (Aynsley Kellow, University of Tasmania)	See 19-8/11 response
19-57	A	4	10	4	47	Suggest that the strategies section of this chapter be rewritten to address risk management under deep uncertainty as opposed to the sole focus on idealized frameworks or methodologies. A general comment to the strategies section of this draft chapter is that it does not seem to bring onboard the central role of risk management when dealing with the deep uncertainties inherent in climate change risk. Risk management is mentioned on line 31 as being most appropriate, and then not discussed? Instead a variety of idealized methodologies are considered. In particular, given the uncertainties, it is clear that we are dealing with a sequential decision making problem. Given the currently unknown outcomes, maintaining flexibility and resilience has value. Improving understanding and the development of options and technologies will also has value. Analyses of stabilization outcomes makes it clear that uncertainty is paramount in attempts to define a GHG level that would avoid DAI. (Haroon Kheshgi, ExxonMobil Research and Engineering Company)	Risk-mgmt approach is central to the SOD. Agree, and this emerges in integrated assessment sections.
19-58	A	4	13			Extend the end of the sentence to read as follows: "...in developing countries, ALTHOUGH THEIR ADAPTIVE CAPACITY SHOULD BE ENHANCED IF THE FUTURE UNFOLDS PER THE SRES SCENARIOS." (Indur Goklany, Office of Policy Analysis, Department of the Interior)	See 19-8/11 response

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19-59	A	4	13	4	16	It is unclear what "risk-reducing potential of planned adaptation" means. It would seem e.g. that adaptation could greatly reduce the impacts of ice sheet disintegration if that disintegration occurs on a timescale of multiple centuries or millennia. (Brian O'Neill, IIASA and Brown University)	Revised language.
19-60	A	4	14	4	16	In line 14, I would change "very limited" to "somewhat limited". First, it is possible to attenuate pressures of CC on biodiversity by reducing other pressures (such as loss of terrestrial and freshwater habitat) which might be greater (at least for the next several decades. This would also help increase the likelihood that "migration corridors" and the like are conserved [see Goklany 1995: 430-31, 2000, 2003, 2005: 672]. Second, while glaciers, once frozen may not be recreated, adaptation can indeed address some (perhaps most) of the impacts of that on human systems (e.g., changes in availability of water during different seasons, etc.). Third, similarly, given that the rise in sea level due to "disintegration" of ice sheets will be a centuries-long process, it seems quite plausible that, once again, human systems should be able to adapt. Also if one compares the historical rate of sea level rise since the ice age ended [~120 m over 20K yrs, with most of that occurring between 20K and 6K yrs before the present], it seems that nature itself can, and has, adapted. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	agree not so clear—see 19-8/11 supposition, we cite range of literature.
19-61	A	4	14	4	14	This is not just true for some but most ecological hazards and very many human systems, hence "some" needs to be changed to "many". (William Hare, PIK)	Section rewritten.
19-62	A	4	15			I would insert "potential" ahead of "loss of biodiversity." Changes in distribution and abundance of various species do not necessarily constitute "loss." (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Disagree—climate change will not speed up evolution appreciably, but climatic stresses will increase endangerment is the overwhelming conclusion of the literature. So the net effect cannot be positive from the biodiversity loss perspective, though individual species or ecosystems may prosper in some anthropomorphized definitions of "improvement".
19-63	A	4	17			Add human health to the list of effects that developed countries have a higher capacity to cope with. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Depends on implementation of potential—we say that often and in tables as well.
19-64	A	4	18			It's not clear what "obstacles" refers to - the apparent reference is to various forms	Language revised.

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						of lack of capacity which appear in context to be focused on developing countries, as indicated by the transition "on the other hand". (Paul Baer, Stanford University)	
19-65	A	4	18	4	18	Which obstacles are exactly ment here? (Marko Scholze, University of Bristol)	Ditto
19-66	A	4	19	4	22	It is very interesting that The literature is divided into more and less favourable views of the potential for adaptation to abate key vulnerabilities, though it is consistent in suggesting that it will be much more difficult to adapt to climatic warming above a few degrees than less than a few degrees, and that adaptation will be more difficult and expensive for fast warming rates than for a slower warming. (Lin Erda, Chinese Academy of Agricultural Sciences)	Agree, and say so often.
19-67	A	4	20	4	21	'.....climatic warming above a few degrees' expand and explain why an important statement being made but not well substantiated. (Coleen Vogel, University of the Witwatersrand)	Will cross ref appropriate chapters
19-68	A	4	21			"a few" degrees is much too vague to be used in this context. "A few" could easily be four, and it's not clear that it would be any easier to adapt to an increase of 3.5° than 4.5°. (Paul Baer, Stanford University)	Language revised.
19-69	A	4	24		29	Assessment of what are key concerns (instead of vulnerabilities) would also need to account for lack of adaptive capacity and its distribution. Therefore, the list of methodological categories would need to be amended so as to encompass this area of assessment. None of the listed methodological categories can be argued to encompass lack of adaptive capacity and its distribution adequately. (Jouni Paavola, University of East Anglia)	See response to 19-39
19-70	A	4	26	4	28	Suggest that this chapter identify analyses that manage the risk of DAI rather than solely examine stablilization pathways. The central methodology is sequential decision making. All strategies will be taken in the context of development priorities. Improving understanding of climate change, increasing resiliane to risks generally and climate specifically, reducing emissions cost effectively, creating technology options, and cooperation are all key elements to managing risk. Suggest that discussion be broadened to address all of these key elements. (Haroon Kheshgi, ExxonMobil Research and Engineering Company)	Primarily a WG 3 job to specify specific strategies, but we do address this framework and cite Lempert papers.
19-71	A	4	26	4	28	Why is cost-benefit analysis ignored? There is a large literature, with papers published in the best journals. (Richard S.J. Tol, Uni. Hamburg)	Not our charge—chapter 20 and WG 3. Nevertheless, we mention it as one of the frameworks for analysis, though Chapter 20 assigns only low confidence to market metrics, which are the core of C/B analysis.

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19-72	A	4	27			The “guardrail” analysis (or better, guardrail approach) is now well accepted and should be written without quotation marks. The same comment applies to Table 19.2. (Thomas Bruckner, Technical University of Berlin)	Section revised.
19-73	A	4	27			In the light of the aforementioned substitution (integrated assessment -> cost-benefit analysis), the term “integrated assessment” in line 27 should be replaced by “cost-benefit analysis”. (Thomas Bruckner, Technical University of Berlin)	Section revised, but we may have more general meaning than narrow C/B literature.
19-74	A	4	30	4	34	This rather effusive focus on uncertainties, particularly on line 34, plays right into the hands of those who will say we have too little information to take action--whether we like it or not or think it rational or not, this has been the approach of the US in the climate area. In the IPCC assessment, great care needs to be taken not to make open-ended comments about uncertainties--there will always be uncertainties and in some context they will always be seen as large (or too large). Alternative wording needs to be found--or at least the text needs to be qualified so that such phrases cannot be taken out of context. For example, the last sentence might be rewritten to say "However, quite often the range of probabilities that can be assigned is quite broad because of the complexities of the impacts and the variety of situations that may arise." I would urge the authors actually to make a really strong effort throughout the chapter to express their thoughts without using the word "uncertainty"--I think it is actually possible and would be more helpful to the reader to do as "uncertainties" is almost a meaningless expression without suitable context. (Michael MacCracken, Climate Institute)	Will use the uncertainties guidance memo language, but cannot agree to frame the chapter in anticipation of polemical misuse. We strive to tell the story straight as we see the literature, regardless of potential for abuse by special interests on the outside.
19-75	A	4	35			"risk of key vulnerabilities" is a grammatical mismatch: vulnerabilities are a form of potential and already exist, it is the whether they will actually be realized that is uncertain, and thus a risk. (Paul Baer, Stanford University)	See 19-32/19-39
19-76	A	4	35			Modify this line to read: "Reductions in greenhouse gas emissions will OVER TIME reduce the risk of key vulnerabilities..." The effects of mitigation will be gradual, and that ought to be noted here. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Time issue well represented in many places— even has its own figure: 19-3.
19-77	A	4	35	4	40	Replace 'will' by 'may' in the first sentence; delete ',in contrast,' from the second sentence. The certainty of the first sentence is in contradiction to the sentiments of uncertainty about climate sensitivity in the previous bullet point. (William Kininmonth, Australasian Climate Research)	We disagree—virtually all the burning embers charts in TAR and AR4 to date show more damages with more GMT, especially after a few degrees warming.
19-78	A	4	35	4	40	The conclusion on the effect of postponement of emissions reductions on the risk of	

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						DAI is not well supported by the chapter. In particular, the text mentioning dependence on mitigation cost reductions via technological learning are not discussed anywhere else in the chapter and therefore it does not seem appropriate to highlight it in the executive summary. And in general, while I would agree that all else equal delay raises risks of DAI, there is also an argument that delaying reduction may reduce risks because it will cause a focus on short term reduction strategies at the expense of investing in technological development for long-term solutions that could make the large emissions reductions necessary to really avoid DAI. I am not personally convinced of this argument but it cannot be ignored and is not discussed in this chapter. (Brian O'Neill, IIASA and Brown University)	True we do little on this WG 3 issue other than to flag it in "cost-effectiveness section.
19-79	A	4	35	4	36	Please clarify the wording "key vulnerabilities and DAI." (Klaus Radunsky, Umweltbundesamt GmbH)	Rephrased.
19-80	A	4	36	4	38	Expand when using acronyms DAI and GHG for the first time. (Coleen Vogel, University of the Witwatersrand)	Agree
19-81	A	4	37			Not sure the cost of mitigation scenarios is relevant to this chapter. (Chris Hope, Judge Business School)	Why we don't push C/B very far—but small mention is needed
19-82	A	4	37	4	39	Delete the following sentences as those should be discussed in WG3. "--- depending on the rate of learning that brings down costs of low-GHG emitting technologies, makes achievement of the lower range of stabilization targets (e.g., less than 500 ppm CO ₂ -equivalent) increasingly expensive or infeasible (except via overshoot scenarios)". (Mitsutsune Yamaguchi, Teikyo University)	We are not replicating WG 3, but our Plenary outline calls for some discussion of mitigation—we keep it to minimum needed for context.
19-83	A	4	41			After the bullet on lines 35 to 40, I would add the following new bullet: "On the other hand, the risk of key vulnerabilities and DAI can also be reduced or postponed through adaptation, particularly through efforts to reduce society's risk to climate-sensitive hazards that might be exacerbated by climate change and through broad efforts to increase adaptive capacity. Among other things, such an approach allows the world to buy time to improve and/or develop more cost-effective mitigation technologies and to get a firmer grasp of the science and economics of climate change and climate change policies." See Goklany (1999, 2000, 2003, 2005). (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Already too long and this will be dealt with earlier: see response to 19-8/11.
19-84	A	4	41	4	47	Examples of 'Some large-scale singularities' must be given, otherwise this is unsubstantiated rhetoric. To be included in the Executive Summary the statement must refer to material in the body of the chapter. (William Kininmonth, Australasian Climate Research)	Agree

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19-85	A	4	42			Delete the expression 'no longer'. Some abrupt or irreversible changes have surely always been possible and unavoidable by human agency. This wording conveys the false impression that only human agency is likely to cause such. (Aynsley Kellow, University of Tasmania)	Agree it is mis-phrased—should have said “be avoided from anthropogenic Climate changes”, but that is not the context of the places this appears.
19-86	A	4	44	4	47	The IPCC TAR states that stabilization at 450 ppm would require global emissions to peak by 2020 at 9 GtC/yr, and would ultimately lead to a temperature rise of 1.5 – 3.9 °C. Stabilization at 550 ppm would require global emissions to peak by 2030 at 11 GtC/yr, and would ultimately lead to a temperature rise of 2.0 – 5.0 °C. These candidate targets pose an unprecedented global challenge. Only a profound infrastructural transition would enable global emissions to peak at 9 GtC/yr by 2020 (to meet the 450 ppm target), or even at 11 GtC/yr by 2030 (to meet the 550 ppm target). Even then, the estimates of warming cited by the TAR are now being revised upward (owing to improved understanding of sulphate aerosols, black carbon aerosols, and soil carbon releases), these ranges are decidedly optimistic. These stabilization targets would therefore inevitably lead to significant damages, and they carry the risk of severe damages. I think that based on these, the thresholds that are set for major vulnerabilities in the manuscript may be somewhat optimistic than what may obtain in reality. (Anthony Nyong, University of Jos)	Indeed, but we will focus on vulnerability to various levels of warming and integrated assessment section briefly discuss stabilization levels
19-87	A	4	45			Why the emphasis on CO2? Options such as the Hansen Alternative Scenario draw attention to the fact that CO2 stabilization is not necessarily the preferred mitigation response, yet the use of CO2 privileges particular policy options. This would at least be better stated in terms of CO2 equivalents, using GWP numbers, or forcings in w/m2. (Aynsley Kellow, University of Tasmania)	Article 2 focus, but other possibilities are indeed part of tool kit—cross referenced to WG 3 discussions—but all studies show in long term CO2 is the big driver
19-88	A	4	49	5	50	The list of "reasons of concern" has been slightly revised from TAR, in terms of ordering. But both original and revised orderings leave something to desire - the logic of orderings is not transparently evident. The revised ordering is probably based on the assessment of likely probability of occurrence. If this is so, it should be stated and justified. Alternatively, the ordering could be revised to: aggregate impacts, distribution of impacts, extreme events, unique and threatened systems, and singular events. This ordering would be justifiable because the attention moves from more general to more specific issues, adding detail and specificity to assessment while being able to rest on what has been already covered. (Jouni Paavola, University of East Anglia)	Need it to be increasing with GMT—why we ordered it as shown—section revised in any case.
19-89	A	4	50	5	9	In this passage, reference is made to particular ecosystems which might be	

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						vulnerable, but then both 'biodiversity hotspots' and 'unique and threatened species'. Art. 2 (which is reprinted in the next page) makes no reference to either biodiversity or threatened species, but to a stabilization level within a time frame sufficient 'to allow ecosystems to adapt naturally to climate change.' Natural adaptation to climate change has seemingly frequently involved changes to the distributions and even distributions of species. Biodiversity preservation and protection of endangered species might be good things in themselves, but they are not implicit in Art.2 and - indeed - might even be jeopardised if the objectives of Art. 2 are to be realized. (Aynsley Kellow, University of Tasmania)	That is not “adaptation”, but response—adaptation, as we define it, is capacity of existing system to be resistant to stresses, not a redefinition of the system after climate change. Migration within the system, genetic change and human intervention to produce suitable habitat are examples of adaptation, but whatever happens is not. This just defines the problem away. We clarify our language and logic to prevent misinterpretation.
19-90	A	5	1	5	50	There are two instances of "value judgement about the acceptability (or unacceptability of potential) risks " on this page (Rachel Warren, Tyndall Centre)	Section rewritten.
19-91	A	5	3	5	9	Strike "adversely" and "adverse" where they occur in this para. Being "affected" is not necessarily the same as "adversely affected." Not all changes are negative. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Disagree—our focus is vulnerability, not full range of species’ responses—what is threatened is what needs to be of concern. Nevertheless, we do believe that climatic change and synergism with habitat fragmentation is overwhelmingly threatening rather than favorable to biodiversity preservation—but not all species, of course, some of which would do “better” in some scenarios.
19-92	A	5	3	5	3	Add to this list coral reefs and ecosystems with highly restricted ranges (eg Fynbos) (William Hare, PIK)	Agree
19-93	A	5	4	5	4	What does "current" mean: be consistent eg above 1990 or above PI. Some systems appear at main risk for 0.5oC above 1990 so it would be best to express the range as 0.5-1.5oC range above 1990 as many of the systems referred to are identified at high risk for <2oC GMT above PI. (William Hare, PIK)	Do this now in our tables.
19-94	A	5	5			Strike "significant", for the same reason as offered above. Moreover, it is "significant" compared to what? Goklany (2005) suggests that through 2085 at least, with regard to biodiversity, habitat loss due to non-climate change related factors may be more significantly more significant (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Disagree—it is significant in both statistical and generic meaning of the word—just read the literature and one finds an overwhelming concern about biodiversity loss from climate stresses.

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19-95	A	5	8	5	9	It is not sure that there is now high confidence that a warming of 1-2oC would have adverse impacts on many unique and vulnerable systems. Which and where? (Lin Erda, Chinese Academy of Agricultural Sciences)	The tables now do that along with discussion of the entries
19-96	A	5	8			Please provide here the definition of “high confidence” (reading the executive summary should not require going to table 19.2) (Ha-Duong Minh, CNRS)	Will fit new guidance memo on uncertainties
19-97	A	5	8	5	8	It is proposed to specify 1-2°C above 1990 levels (as above). (Klaus Radunsky, Umweltbundesamt GmbH)	Ditto
19-98	A	5	11	5	15	Should note that: [1] the cumulative deaths and death rates due to extreme weather events has declined since the 1930s. [Goklany (2005a). Is Climate Change the 21st Century’s Most Urgent Environmental Problem?. Lindenwood Economic Policy Lecture, Series 7, Lindenwood University, St. Charles, MO, available at http://www.junkscience.com/may05/Goklany_Final_Publication.pdf . Also forthcoming in Society (Transaction Publications). [2] At least in the US losses are rising because more property is at risk, see Pielke et al. (1998); Goklany (2000); Mary W. Downton, J. Zoe Barnard Miller, and Roger A. Pielke Jr. 2005 Reanalysis of U.S. National Weather Service Flood Loss Database. Natural Hazards Review. February 2005: 13-22. [3] Trends in deaths, death rates and property losses suggest that socio-economic factors may be more important in terms of determining the human impact of extreme events than climate (or climate change). (Indur Goklany, Office of Policy Analysis, Department of the Interior)	This is the baseline issue—see discussion in 19-10. There is not just one factor, despite this citation. We summarize recent literature, which collectively suggests multiple causation of losses.
19-99	A	5	11	5	16	Delete "Recent". Such extreme events have been causing loss of life and property damage through recorded history. (William Kininmonth, Australasian Climate Research)	Should say “recent extreme events have demonstrated continuing vulnerability”, rather than current phrasing
19-100	A	5	11	5	11	‘Recent extreme climate events...’ (e.g. floods, droughts – give examples) (Coleen Vogel, University of the Witwatersrand)	See 19-99
19-101	A	5	13	5	15	How is "human influence" defined? This is unclear whether the authors are suggesting either (a) that human influence on climate caused extreme weather events, or (b) that human influence on people's vulnerability (poverty, settlement patterns, etc.) are leading to more extreme events. Given the massive literature on natural disasters that show the human dimensions of disaster and argue that "natural" disasters are more social than natural, I think this section needs clarification and needs to address the interplay between, on the one hand, societal circumstances that exacerbate vulnerability and, on the other hand, environmental or climatological conditions that cause problems for human societies. (Mark Carey, University of California, Berkeley)	Agree that non-climatic literature on vulnerability needs more emphasis—per 19-32 as well.—major revision in this regard in the SOD.
19-102	A	5	13	5	15	The issue of whether or not extreme events have intensified "significantly" is best	Disagree—very relevant to WG2, but we

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						left to WGI. I'd strike this sentence. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	agree we should x-ref relevant sections of wg 1—now done.
19-103	A	5	13			Sources? (Hans H.J. Labohm, Netherlands Institute of International Relations 'Clingendael')	This is an executive summary—sources later on in chapter, put in relevant sections in SOD
19-104	A	5	15	5	15	Add drought to this short list as this has a high impact on many already vulnerable regions (see eg Wang, G. (2005). "Agricultural drought in a future climate: results from 15 global climate models participating in the IPCC 4th assessment." Climate Dynamics: 1-15.) (William Hare, PIK)	Section rewritten
19-105	A	5	15	5	15	Droughts and flooding should be mentioned here explicitly as well. (Marko Scholze, University of Bristol)	Ditto
19-106	A	5	15	5	15	The recent increase in tropical cyclone intensity is not well understood yet. (James S. Wang, Environmental Defense)	True, but pretty clear statistics—will ref WG 1 discussion of very recent literature.
19-107	A	5	17	5	23	The paragraph implies racial discrimination and neglect of indigenous peoples in developed countries. This is not demonstrated in the body of the chapter and cannot be included as a summary statement. (William Kininmonth, Australasian Climate Research)	Totally disagree—no racial discrimination implied—but, if race is correlated with vulnerable coastal dwellers or the Arctic peoples, that is the nature of the system. The inequity implications, if any, would be a major reason to consider such vulnerabilities “key” by our definitions. We report European 2003 heat wave deaths—mostly Caucasians—is that implicit racial discrimination? The question of inequitable distribution of impacts is very relevant to our charge, and is explicit in our SOD.
19-108	A	5	17	5	23	While developing countries likely have less adaptive capacity than developed nations, the developed nations have a huge investment in infrastructure along their coasts—from huge metropolitan areas to particular facilities—that are going to be very, very costly to move, and that will therefore likely not be moved until they are overwhelmed by a storm surge, making the costs of relocation even higher. I think that playing down this huge vulnerability is allowing the developed nations to continue to think that climate change is not really as important for them as I think it will be. (Michael MacCracken, Climate Institute)	Agree—section has been revised.
19-109	A	5	17		23	Here vulnerability is used in its generally accepted sense. The term's use should be restricted to this sense to prevent confusion and to preserve terminological clarity.	See 19-32

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						(Jouni Paavola, University of East Anglia)	
19-110	A	5	17	5	17	'... that the distribution....' The distribution of what?... this is not clear. (Coleen Vogel, University of the Witwatersrand)	Section revised.
19-111	A	5	18	5	18	How does "low latitude less developed" match with marginal environments mentioned earlier? (Glenn McGregor, King's College London)	Ditto
19-112	A	5	21			I would modify to read: "...some population groups in developed countries COULD BE, IN THE ABSENCE OF ADAPTATION MEASURES, highly vulnerable..." (Indur Goklany, Office of Policy Analysis, Department of the Interior)	See 19-8
19-113	A	5	22			Strike "adverse." See comment no. 10. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Disagree
19-114	A	5	25	5	39	The treatment of aggregate impacts is not satisfactory here. The term "aggregate" does not have to be equated with "monetized". An assessment of aggregate impacts can perfectly well be based on multiple "numeraires" and there are also compelling reasons to use this kind of non-commensurated approach for conveying an estimate of aggregate impacts. In line with this, the paragraph should present a more substantive statement on aggregate impacts instead of emphasising difficulties. For example, there ought to be estimates of aggregate health impacts in other chapters as well as estimates of crop losses and pecuniary losses. For conceptual justifications of this view, see Paavola, J. (2002) Rethinking the Choice and Performance of Environmental Policies. In D. Bromley and J. Paavola (eds) Economics, Ethics, and Environmental Policy: Contested Choices. Malden, MA: Blackwell. Pp. 87-102, as well as other contributions in this volume. For a climate change application, see Paavola, J. and Adger, W. N. (2006). Fair Adaptation to Climate Change. Ecological Economics, in press, available online. See also Schneider's (2006) contribution on the "five numeraires" to Adger, W. N., Paavola, J., Huq, S., and Mace, M. J., eds. (2006), Fairness in Adaptation to Climate Change. Cambridge, MA: The MIT Press, in press. (Jouni Paavola, University of East Anglia)	agree Agree—our revised table reflects this and it is now made consistent in the exec summary here.
19-115	A	5	29	5	29	'smooth temperature increases' give an example....expand on what is being intended here! (Coleen Vogel, University of the Witwatersrand)	Section revised
19-116	A	5	30	5	30	I would replace "flood" by "flood or pest" (Michael MacCracken, Climate Institute)	ditto
19-117	A	5	31	5	31	Add "tropical" before "cyclone" (Janice Lough, Australian Institute of Marine Science)	Agreed

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19-118	A	5	33	5	35	I would urge the authors not to use the vague word "may" and to instead substitute words drawn from the IPCC lexicon. Here are the first two of quite a number of locations (not always mentioned) where this need arises. (Michael MacCracken, Climate Institute)	Rewritten
19-119	A	5	36			I would add a sentence here that would say: "If economic development and technological change grow as assumed in the SRES scenarios, adaptive capacity around the world should increase significantly over time." See previous comment. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	See 19-8/11
19-120	A	5	36	5	39	Close the sentence after 'TAR'. This is a biased statement given the generally agreed reduction in estimated sea level rise from anthropogenic global warming. (William Kininmonth, Australasian Climate Research)	Disagree—the lowering of SL estimates is from revised thermal expansion, but recent literature suggests higher likelihood of disintegration of GIS and WAIS—though the big SL rises could be delayed a few centuries. This is explicit in DOD.
19-121	A	5	36			Sources? (Hans H.J. Labohm, Netherlands Institute of International Relations 'Clingendael')	Not in exec summary—but in sections—will x-ref
19-122	A	5	37	5	39	The statement, "... in particular, there is greater uncertainty in estimates that show aggregated benefits from climate change below a few degrees of warming" , implies that benefits might be lower than previously estimated. But given that increases in adaptive capacity over time are downplayed in most impacts studies, and the SRES scenario projections/assumptions of significant economic growth and technological change, I am not sure how one can say that. In fact, noting that the SRES scenarios were not used for pre-TAR impacts assessments, I would argue the converse, i.e., [See Goklany (2005a). "Is a Richer-but-warmer World Better than Poorer-but-cooler Worlds?" 25th Annual North American Conference of the US Association for Energy Economics/International Association of Energy Economics, September 21-23, 2005.]. I recommend dropping this statement. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	This is not a cost/benefit framework we were assigned by Plenary, but a vulnerabilities analysis. Also, we do not automatically accept that future adaptation necessarily fully offsets all reasonable climate scenarios—see 19-8/11.
19-123	A	5	37	5	39	Again vague – can one cite a referenced case. (Coleen Vogel, University of the Witwatersrand)	Citations later on—just x-refs here
19-124	A	5	38	5	39	The main issue in the aggregated studies is mid and high lat agricultural production increases: if these are not realized then there is large uncertainty in aggregated benefits at less than 2.3oC above PI. (William Hare, PIK)	agree
19-125	A	5	41	5	47	The sequence of this paragraph, here and where it reoccurs later, is weird - it focuses on WAIS, which (while perhaps lower than the TAR estimate) still is only	These points resent in rewrite in several

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						vulnerable at 2° to 4° above current levels, while the Greenland ice sheet may be vulnerable as low as 1°C above present. The latter would certainly change where the yellow/orange/red thresholds should be on the fifth bar. (Paul Baer, Stanford University)	places.
19-126	A	5	41	5	44	I would note what this means in terms of magnitude and rate of sea level, and the ability to adapt -- see comment no. 5. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Issue discussed in SOD.
19-127	A	5	41	5	50	Further comments in the body of the chapter. Need to ensure consistency between the summary and what is in the text. (William Kininmonth, Australasian Climate Research)	Agree—and x-refs too
19-128	A	5	41	5	50	I would have thought that the dire situation facing coral reefs would have been mentioned here, as part of a more general mention of ocean acidification. (Michael MacCracken, Climate Institute)	Agreed and done.
19-129	A	5	41	5	50	According to the most recent model evaluation at WG1, most models does not show the collapse of the THC under SRES A1B scenario, though THC itself will be weakening. It would be better to describe this point (WG1 AR4, section 10.3.4; Box 10.1 in section 10.7). (Mitsutsune Yamaguchi, Teikyo University)	Text revised to be consistent with literature and WG 1.
19-130	A	5	43	5	45	It is important that some studies indicate that a 2 to 4°C global warming above current levels could begin WAIS deglaciation (low to medium confidence). Why we use the lower confidence as an evidence? (Lin Erda, Chinese Academy of Agricultural Sciences)	Confidence is an author judgement based on a broad and sometimes contradictory literature.
19-131	A	5	43	5	43	This range needs to be expanded eg to 1.5-4°C above 1990: formation of summer melt ponds on the Ross Ice Shelf could occur with a global mean warming of ca 2°C above PI depending on whose model one believes - if this is the critical threshold for ice shelf collapse then the lower temp applies. (William Hare, PIK)	Section rewritten based on recent literature and WG 1.
19-132	A	5	44	5	47	WAIS and GMT appear to lack prior definitions. (Thomas Bruckner, Technical University of Berlin)	Will fix
19-133	A	5	44			Please define “low to medium confidence” (Ha-Duong Minh, CNRS)	Will summarize recent guidance
19-134	A	5	44	5	44	WAIS – Acronyms again - either explain in full here or have an expanded acronym list. (Coleen Vogel, University of the Witwatersrand)	
19-135	A	5	45	5	47	The IPCC WG I section on Greenland during the 21st century has a much lower estimate of the likelihood of a rapid deterioration. In my review comments of that chapter I suggested that a major problem with that analysis was that the modeling	We summarize literature and Wg 1.

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						approaches used to make the projection likely significantly underestimate the sea level rise in the 20th century, and so there must be shortcomings in the approach of depending almost solely on model results. (Michael MacCracken, Climate Institute)	
19-136	A	5	48	6	50	There are five burning embers, but only four reason of concern. Please read the chapter. (Richard S.J. Tol, Uni. Hamburg)	Author of original agrees with current language.
19-137	A	5	49	5	49	Instead of: is not reporting, use: has not reported (David Major, Columbia University)	Corrected.
19-138	A	6	1	6	50	Figure 19.1 is very interesting but do we need this detail here? The word "vulnerability" does not appear in the diagram so link to text needs improving if it is retained. (Rachel Warren, Tyndall Centre)	This figure has been dropped.
19-139	A	6	15	6	16	Similarly, it is incorrect to say that "it requires a normative evaluation of which impacts are important enough to constitute, individually or in combination, 'dangerous anthropogenic interference'". It may be that governments take the position that they are willing to run the risks that are entailed in various emissions paths (including business as usual), but decision-makers should be held to the standard of admitting that they are deliberately incurring those risks, not that they have simply made a "normative evaluation" of what constitutes "dangerous anthropogenic interference". (Stephen De Canio, University of California, Santa Barbara)	We modified the text to make clear that it refer to the interpretation of UNFCCC Article 2. According to the Vienna Convention on the Law of (International) Treaties, the interpretation of a particular Treaty is up to its parties unless the Treaty provides for a different mechanism.
19-140	A	6	15	6	15	"normative" needs definition at this early stage as is used widely throughout the chapter. Ensure that definition is consistent throughout (Glenn McGregor, King's College London)	Definition added.
19-141	A	6	27	6	30	some comment on the fact that the time horizons for these three endpoints are vastly different is warranted. Further the endpoints are likely to achieved at different times in the future (Glenn McGregor, King's College London)	Box 19.1 simply cites Article 2 UNFCCC. Issues of time scales are discussed elsewhere.
19-142	A	6	39	6	40	The meaning of "vulnerabilities" for the purposes of this chapter is defined here. As indicated above, this definition is problematic for a number of reasons. This issue should be addressed by not using the term "vulnerabilities" when referring to "key concerns" or "outcomes". Vulnerability is a term which should be used more narrowly to refer to the characteristics of social groups which make them sensitive to climate change impacts. This definitional issue should also receive due consideration because "vulnerability" is used differently in different draft chapters of the WG2 contribution. The established meaning of "vulnerability" is defined in	The definition of "vulnerabilities" is largely prescribed by the IPCC plenary that agreed on the title of Chapter 19. We added a cross-ref to Chapter 17.

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						the draft of WG2 Chapter 17, around p. 3. This text also provides ample references to the relevant scientific literature where the established definition has been put forward and mobilised in scientific research. (Jouni Paavola, University of East Anglia)	
19-143	A	6	40	40	40	“key vulnerabilities” – Vulnerabilities are usually different to impacts – one needs to explain why they are conflated here. (Coleen Vogel, University of the Witwatersrand)	This sentence has been dropped.
19-144	A	7	1	7	1	Add Greenland Ice Sheet also. (Rachel Warren, Tyndall Centre)	Reference not clear.
19-145	A	7	4	7	4	Very good setting of context or ‘frame’ for what is to come. (Coleen Vogel, University of the Witwatersrand)	No action required.
19-146	A	7	6		41	These two paragraphs can be substantially reduced. (Ha-Duong Minh, CNRS)	Addressed
19-147	A	7	6	7	41	This section of text makes a strong contrast between "scientific analysis" and "value judgements" which not unproblematic. It considers that value judgements emerge from existential experiences which may differ radically between different individuals and groups, and that these value judgements are then "negotiated" in the political process to come up with collectively agreed-upon value judgements. This reifies experience as the authentic source value judgements, and omits that people apply theories and philosophies to reflect on objects of value judgements. That is, value judgements are not devoid of "science" and the question is which science informs those judgements. The reverse argument for science involving value judgements can also be made. Secondly, and perhaps more importantly, subjective valuations, equity and normative issues are not solely issues of value judgement: they can be and are approached scientifically. Alternative normative standpoints and the consequences of adopting them can be examined with scientific rigor and impartiality, just like the risks are proposed to be examined in the draft chapter, to assist decision-makers to make informed choices. (Jouni Paavola, University of East Anglia)	We refer to the scientific studies of certain value judgements (e.g., risk perception) elsewhere in our chapter.
19-148	A	7	9			I would suggest using the term "values" rather than the economic term "preferences." (Paul Baer, Stanford University)	Addressed.
19-149	A	7	9		17	You may add another consideration to this long list of factors to be considered: (unintended) side-effects and feedbacks caused by mitigation and adaptation efforts. (Günther Fischer, International Institute for Applied Systems Analysis)	Addressed.
19-150	A	7	9			Add at the end of the sentence: "...about social preferences AND	The importance of adaptation is mentioned in

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						SPONTANEOUS AND PLANNED RESPONSES AND ADAPTATIONS." (Indur Goklany, Office of Policy Analysis, Department of the Interior)	the following sentence.
19-151	A	7	14	7	15	The phrase, “value judgments about the acceptability or unacceptability of potential risks” connotes a degree of arbitrariness about “value judgments” that may not accurately represent the true state of affairs. The term “value judgments” is associated with a particular emotivist philosophical stance that separates assertions about “facts” from “value judgments”. The former are supposedly true or false while the latter are more or less arbitrary and subjective. Yet citizens and governments come to their conclusions through complex cognitive and social processes that cannot be so easily reduced to “value judgments”. These processes include social interactions, debate and discussion, reliance on philosophical principles that some claim are universal, adherence to major cultural and religious traditions (which may have common themes), etc. The reference to the TAR in the following paragraph on p. 7 alludes to this complexity, while still referring to the policy decisions as “value judgments”. I believe it would be useful for the IPCC to be more philosophically sophisticated than to refer to moral and ethical decisions merely as “value judgments”. One example of the development of this type of sophistication is given by MacIntyre (1981) and the literature in which it is embedded. A useful compilation of the ways in which the major religious traditions of the world bear on these issues can be found in the Forum on Religion and Ecology (2004). I am not suggesting that the IPCC should take up this huge area of inquiry (which of course extends beyond the realm of natural science), only that it be more sensitive in avoiding the philosophical presumptions inherent in the use of the “value judgment” terminology. (Stephen De Canio, University of California, Santa Barbara)	One sentence and references added.
19-152	A	7	17			Replace "addressed" with "illuminated" (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Done.
19-153	A	7	17			I am not aware of any principle stating that uncertainties can be resolved by additional scientific research in a timely maneer that will make it clear what is the optimal course of action. Additional research may confirm the chaotic or otherwise unpredictable nature of the problem, and/or come too late. (Ha-Duong Minh, CNRS)	We are not aware of such a “principle” either.
19-154	A	7	21			19.1.2, the value judgments should be taken by policy makes rather than IPCC, IPCC should only provide evidences or options (Lin Erda, Chinese Academy of Agricultural Sciences)	We share this view.
19-155	A	7	29	7	29	...the same time, climate decisions involve value... (David Major, Columbia University)	Our citation of the TAR is correct.

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19-156	A	7	33	7	33	The impacts and consequence are not all or even "socially determined": Key vulnerabilities are. (William Hare, PIK)	This sentence has been dropped.
19-157	A	7	37			The distinction between risk and uncertainty goes back 70 years, and is an important one. Climate change as a problem inevitably involves a high degree of uncertainty, rather than being an area where the probability of particular hazards occurring is known with any great certainty. Adams (in the 'References', but not referred to at any stage) discusses what he terms 'virtual risk' under these conditions. This is an important concept, because under conditions of virtual risk the cultural disposition to risk of observers is particularly important. The chapter should incorporate some discussion of this point, because it has important ramifications for approaches such as Delphi exercises, which are relied upon later (pp18, p21, eg). For the results of Delphi exercises to have any validity, we need to know something about the cultural dispositions to risk of the participants, and would probably prefer that we had a mix which included those sceptical about the possibility of the risk under consideration. Without this assurance, the results of Delphi exercises cannot be regarded as reliable, since they are possibly no more than the results of 'groupthink' (in Irving Janis's expression). Reliance on results of Delphi exercises later in the chapter is thus misplaced, unless this point is dealt with explicitly, and some evidence provided as to the characteristics of the participants. (Aynsley Kellow, University of Tasmania)	The reference to Adams was dropped. The revised text no longer refers to Delphi exercises.
19-158	A	7	46	9	11	In light of comments 2 and 8 in particular, I suggest that the text of section 19.1.2. is redrafted so that it avoids using "vulnerabilities" to refer to "key concerns" or "outcomes", and instead uses straightforwardly the latter kind of terms. This would be more in line with Ch 19 of TAR and draft chapters of WG2 contribution to FAR. But the causal chain from climate change to impacts, risks, vulnerability in its ordinary meaning and outcomes would need to be discussed and defined here in somewhat greater detail than is currently the case. (Jouni Paavola, University of East Anglia)	See response to comment 19-142.
19-159	A	8	3	8	34	The figure 19.1 which is given as illustrative of vulnerability studies in the natural hazards literature is not the best possible one, because it gives little attention to group / social attributes that create vulnerability. Some alternatives can be found from the first 20 pages of the Proceedings of the International Workshop in Vulnerability and Global Environmental change held in Stockholm Environment Institute in 2001, available on-line at http://www.sei.se/dload/2002/Vulnerability%20report2.PDF , and from publications listed in the references of WG2 draft chapter 17.	This figure has been dropped.

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						(Jouni Paavola, University of East Anglia)	
19-160	A	8	6			As Figure 19.1 is currently quite complex, either some more discussion should be in the text or it should be simplified. The text would even flow well without figure 19.1. (Günther Fischer, International Institute for Applied Systems Analysis)	This figure has been dropped.
19-161	A	8	9	8	34	The diagram is difficult to read. (Alexander Golub, Environmental Defense)	This figure has been dropped.
19-162	A	8	34	8	34	Page of figure needs to be inserted. (Coleen Vogel, University of the Witwatersrand)	This figure has been dropped.
19-163	A	8	37	8	49	New analysis of WAIS collapse (Nicholls et al (2005)) at http://www.uni-hamburg.de/Wiss/FB/15/Sustainability/waisglobalwp.pdf (This paper is in review for Climatic Change) (Robert Nicholls, University of Southampton)	We don't think that this working paper fundamentally changes the conclusions of our review of the literature.
19-164	A	8	38			"knock-on effects" is british jargon which isn't clear to readers of US english. (Paul Baer, Stanford University)	Addressed.
19-165	A	8	38	8	41	Need to quantify what is meant by 'large' and 'substantial' to give the statement context. Such magnitudes are provided elsewhere. (William Kininmonth, Australasian Climate Research)	This paragraph has been dropped.
19-166	A	8	38	8	38	Instead of knock-on, which is too colloquial, use "follow-on" (David Major, Columbia University)	Addressed.
19-167	A	8	38			Suggest replacing "cascade" by "network". (Ha-Duong Minh, CNRS)	This paragraph has been dropped.
19-168	A	8	48	8	49	In many cases its simply not known whether thresholds are involved; and where they are presumed to exist, "where they are" is highly uncertain. (Paul Baer, Stanford University)	This paragraph has been dropped.
19-169	A	8	48	8	49	Also on this page line 48/49 a vague statement...can you expand again (Coleen Vogel, University of the Witwatersrand)	This paragraph has been dropped.
19-170	A	8				Figure 19.1. not helpful as it is illustrates a different definition of vulnerability (Chris Hope, Judge Business School)	This figure has been dropped.
19-171	A	8				Figure 19.1 is not vital to the discussion (Michael Manton, Bureau of Meteorology Research Centre)	This figure has been dropped.
19-172	A	9	3	9	5	The necessary distinction between scientific analysis and normative positions makes it difficult to define a meaning for the word "key" in the context of "key vulnerabilities". This is because particular vulnerabilities might be considered "key" relative to "dangerous anthropogenic interference with the climate system" only for some policy makers. This problem is highlighted in the sentence "The identification of 'key	We state at several instances that while the identification of "key vulnerabilities" in this chapter reflects the pertinent literature and is based on the criteria discussed in Section 19.2.1, individual decision-makers have the liberty to either accept our classification or

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						<p>vulnerabilities’ is intended to provide guidance for identifying levels and rates of climate change that may or may not be considered ‘dangerous’ by different sets of decision-makers”. Perhaps one could reduce the ambiguity by stating that “The identification of ‘key vulnerabilities’ is intended to provide a set of potentially significantly impacted regions and sectors as well as conceivable large-scale discontinuities that are clear candidates for consideration as markers for “dangerous anthropogenic interference with the climate system” — at least by some subset of climate change decision makers.”</p> <p>(Thomas Bruckner, Technical University of Berlin)</p>	not.
19-173	A	9	4	9	5	<p>"may or not be considered dangerous by different decision-makers" is tautologically true. "May be considered dangerous by some stakeholders (or decisionmakers) and not by others" is perhaps better...</p> <p>(Paul Baer, Stanford University)</p>	Addressed.
19-174	A	9	8	9	11	<p>It is very important that It should also be noted that the list here of “key” vulnerabilities is not intended to be exhaustive, nor does it constitute a list of “dangerous” impacts. Key vulnerabilities may or may not be regarded by different decision makers as leading to dangerous impacts. The judgement as to what is dangerous is another value judgement.</p> <p>(Lin Erda, Chinese Academy of Agricultural Sciences)</p>	We think these points are clear from our text.
19-175	A	9	9	9	11	<p>It is inaccurate to say that “[t]he judgement [sic] as to what is dangerous is another value judgement [sic]”. The concept of “dangerous” has an objective component; it is not purely a matter of a “value judgment”. Playing Russian Roulette with a six-cylinder revolver is “dangerous” under any meaningful definition of the word “danger”. Some people may still wish to play Russian Roulette, but they do so not because they have made a “value judgment” that it is not “dangerous”. So too with climate change; some of the possibilities for large-scale, irreversible singularities referred to in the Chapter (i.e., release of terrestrial and oceanic sinks of methane, deglaciation of the West Antarctic and Greenland ice sheets, shutdown of the Meridional Overturning Circulation) surely are “dangerous”. It may be that government authorities are unwilling to take steps to mitigate these risks, but the “danger” posed by a threat of such events or processes is an objective fact. This is not just a semantic point, because it has to do with the meaning of one of the key parts of the UNFCCC: to “prevent dangerous anthropogenic interference with the climate system”.</p> <p>(Stephen De Canio, University of California, Santa Barbara)</p>	The key question here is “how dangerous, and to whom”. It is primarily upon the parties to the UNFCCC, not the IPCC, to decide which dangers from climate change merit particular attention in the formulation of climate policies. See also our response to comment 19-139.
19-176	A	9	14	10	12	<p>Much of this section is summarising policy actions rather than scientific activities.</p>	This section has been dropped.

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						(Michael Manton, Bureau of Meteorology Research Centre)	
19-177	A	9	14			Section 19.1.4 identifies a few international environmental agreements or policy processes relevant to climate change but does not draw any specific conclusions on the ways in which they might matter to identifying or evaluating key vulnerabilities. Rather, the section reads like a short list. E.g., it is pointed out the WSSD developed the WEHAB initiative. What is the reader to make of this regarding its connect to key vulnerabilities? Also, the MDGs are noted, but there is no conclusion on whether they suggest anything specific regarding types of key vulnerabilities, etc. (Brian O'Neill, IIASA and Brown University)	This section has been dropped.
19-178	A	9	14	10	25	This subsection's text does not tie in well with what is said above. Either a transition is needed to justify the presentation of the material, or the material ought to be removed and the issues discussed elsewhere. The latter alternative appears more justified. For example, conclusions could reflect on the steps taken in the light of assessed reasons for concern. (Jouni Paavola, University of East Anglia)	This section has been dropped.
19-179	A	9	21	9	21	I would urge a bit of amplification here, as events don't always have to be quite so extreme--sometime just an anomalous event can be catapulted into an extreme impact due to such factors as fire, coastal erosion, storm surges, etc.--events might be rare without being extreme. (Michael MacCracken, Climate Institute)	This section has been dropped.
19-180	A	9	35			MEA is an acronym for 'Multilateral Environmental Agreement'. It is not the same as a 'regime', which might or might not include an agreement but can also include norms, customs, etc. (Aynsley Kellow, University of Tasmania)	This section has been dropped.
19-181	A	9	35	9	35	To clarify remove comma after "internal" and add one after "external" (Rachel Warren, Tyndall Centre)	Reference not clear.
19-182	A	9	40	9	40	Johannesburg, South Africa (David Major, Columbia University)	This section has been dropped.
19-183	A	10	11	10	12	What is meant by 'conventional' here? Add (et al) to reference – see references at end of chapter. (Agrawala et al) – reference – no title of paper or context (Coleen Vogel, University of the Witwatersrand)	This section has been dropped.
19-184	A	10	14	10	25	I would recommend including the 8-nation Arctic Climate Impact Assessment as a regional example here, just to give another dimension to the types of assessments being done.	This section has been dropped.

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						(Michael MacCracken, Climate Institute)	
19-185	A	10	25	10	25	Convention on.....(not of) (David Major, Columbia University)	This section has been dropped.
19-186	A	10	25	10	25	Suggest a brief set of examples of key vulnerabilities from these assessments e.g. MEA etc (Coleen Vogel, University of the Witwatersrand)	This section has been dropped.
19-187	A	10	28	10	29	This title is frivolous: try "Outline of chapter". Indeed why does the chapter need an outline, esp after 10 pages? (Michael Manton, Bureau of Meteorology Research Centre)	This section has been renamed and moved to the beginning of the chapter.
19-188	A	11	3	11	3	Different date in reference pg – please check (Coleen Vogel, University of the Witwatersrand)	Corrected.
19-189	A	11	5	11	9	European Union Heads of Government adopted in March 2005, following consideration of the IPCC TAR and other analyses, the goal of limiting GMT warming to 2oC above PI, confirming the views of EU environment Ministers adopted in 1996 following consideration of the IPCC SAR, Hence at least one major regional group does consider it possible to define limits hence this sentence needs to be reworded to include this fact, without losing the sense on line 8-9. (William Hare, PIK)	Addressed.
19-190	A	11	5	11	9	This statement as it is framed could be very contentious. The 2°C target is almost a heuristic device and certainly does not have any basis through the forward projection of risk (climate hazard, impact, outcome). As the text earlier suggests its choice is normative and depends on being highly risk averse in the area of potential impacts while, some would argue, jettisoning other normative concerns (e.g. the short-term economy, especially with it heavy dependence on fossil fuels). I think this chapter has to be at arms length from the 2°C figure – there is no general consensus that has any solid scientific basis, thus changing a heuristic device from one level to another on the basis of risk perception is, I think, something that the IPCC itself has to avoid, though of course it must be assessed. This target – whose target? – might be changed – by whom? I think this target has as much justification as do the numbers in the Kyoto Protocol, therefore needs to be treated very circumspectly. The following section adds support to this point. (Roger Jones, CSIRO)	We now state explicitly that the 2°C target was adopted by governments not scientists.
19-191	A	11	5	11	9	Citing a specific threshold for global mean temperature change that could be dangerous seems inappropriate at this point in the chapter. No review or assessment has yet occurred and you already are using 2 C preferentially as an example. I would suggest cutting the phrase that refers to this specific target. (Brian O'Neill, IIASA and Brown University)	We now state explicitly that the 2°C target was adopted by governments not scientists.

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19-192	A	11	7	11	8	The 2 degrees number is not a scientifically- or economically-determined target. In fact, the UK conference in Exeter, "Avoiding Dangerous Climate Change" avoided taking a stance on this. If anything, this is a politically created "target." I would, therefore, not mention it at all. The alternative would be to discuss its pros and cons at length, which I would not recommend. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	We now state explicitly that the 2°C target was adopted by governments not scientists.
19-193	A	11	7	11	8	Remove the clause 'a global mean temperature increase of 2C over pre-industrial levels is often cited in the literature' from the sentence and include it in a new sentence that points out that there is no rigorous basis for the estimate as a trigger for DAI. (William Kininmonth, Australasian Climate Research)	We now state explicitly that the 2°C target was adopted by governments not scientists.
19-194	A	11	7	11	7	It might be useful to indicate here that a 2 C rise over preindustrial on a global average basis could be 5 C or more in high latitudes. (Michael MacCracken, Climate Institute)	We do not think that this point is crucial here.
19-195	A	11	7	11	8	Why list 2 C as a threshold without a sound reference? (Michael Manton, Bureau of Meteorology Research Centre)	Reference added.
19-196	A	11	7	11	8	What is the reason for a 2 deg C increase being a threshold and where does it come from (reference)? (Marko Scholze, University of Bristol)	Reference added.
19-197	A	11	7	11	8	The two degree target is often mentioned because it is the only target around, not because it has any scientific validity or much political support. You perpetuate the myth. (Richard S.J. Tol, Uni. Hamburg)	We now state explicitly that the 2°C target was adopted by governments not scientists.
19-198	A	11	13			Comment on entire section 19.2.1. For what it's worth, these criteria parallel a set of criteria developed to apply the precautionary principle using a "risk-risk framework". [See Goklany 2002. From precautionary principle to risk-risk analysis. Nature Biotechnology 20 (November): 1075.] (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Reference added.
19-199	A	11	13	15	8	19.2.1. Is it possible for the chapter to operationalise criteria in a structured (but not objective) assessment? (E.g. to set up the criteria for what is Table 19.1) (Roger Jones, CSIRO)	Not clear.
19-200	A	11	13	15	8	I was surprised that this section did not seem to mention the issue of linkages between countries and how impacts could come in across borders--for example, if a migrating species is affected, if a key import is impacted, if a key market is impacted, from health effects via two-way travel, etc. The issues here tend to not play up the issue of linkages across nations and regions. (Michael MacCracken, Climate Institute)	This section focuses on outcomes rather than pathways.

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19-201	A	11	13			There may be another relevant criterion for "key" (additional to the criteria listed in this section): In structural analysis a key variable is defined as a variable with many pathways of direct or indirect impact on other variables (see e.g. the work of Michel Godet). (Ortwin Renn, University of Stuttgart)	This section focuses on outcomes rather than intermediate variables.
19-202	A	11	22	11	22	DEFRA,2005 – does this refer to proceedings or can one access texts off the web (Coleen Vogel, University of the Witwatersrand)	Reference corrected.
19-203	A	11	24	11	36	It is not clear why 'dangerous' is being discussed here. (Michael Manton, Bureau of Meteorology Research Centre)	Because the criteria for identifying a vulnerability as “key” are guided by the goal of providing information about potentially “dangerous” climate change.
19-204	A	11	24	11	26	"factual and normative with "external" and "internal", or subjective". Subjective is related to which of the previous terms here. This is a confusing sentence (Glenn McGregor, King's College London)	Addressed.
19-205	A	11	24		26	Please clarify this sentence. (Ha-Duong Minh, CNRS)	Addressed.
19-206	A	11	25	11	26	'external, internal or subjective' – give examples. Here one may wish to include (Chambers, 1989) seminar piece on vulnerability in a broader sense (Coleen Vogel, University of the Witwatersrand)	We give examples in the following sentence.
19-207	A	11	27	11	29	Replace from "more" at line 27 to "relationship" in line 29 by the following: "more objective criteria for the harmful impact include, a- scale & intensity, b- timing, c- persistence, d-potential for adaptation, e- importance of vulnerable system." (Mohamed El-Shahawy, Faculty of Science- Cairo University - Giza -Egypt)	We do not consider the importance of the vulnerable system an objective criterion.
19-208	A	11	27		28	Objective criteria...level of confidence is an oxymoron (Ha-Duong Minh, CNRS)	Addressed.
19-209	A	11	28	11	28	"and the level of confidence" questionable whether this can be considered "objective" (Glenn McGregor, King's College London)	The level of confidence is, in principle, a scientific criterion even though estimates may vary considerably across different people.
19-210	A	11	31	11	36	While “socially-mediated perceptions of risk” can be “culturally and socially context specific”, the degree of risk aversion can in some circumstances be quantified. There is a large literature in macroeconomics and elsewhere that relies on estimates of the degree of relative risk aversion in consumption (which is strongly related to the intertemporal elasticity of substitution in consumption) exhibited by economic agents (see DeCanio 2003, pp. 89-92 and the references therein). It may not be possible to measure or estimate with any accuracy the level of risk aversion that informed citizens would express in confronting climate change scenarios, but calculations based on such estimates can be found in the literature	We are not convinced “that risk aversion has an objective reality deeply rooted in human consciousness”. For instance, economic agents show very different risk attitudes when buying insurance policies and when gambling.

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						(my recollection is that one set of such calculations is given in Nordhaus and Boyer (2000), although I do not have access to that volume at the moment so this should be checked by Chapter 19's authors). There can be no doubt that risk aversion has an objective reality deeply rooted in human consciousness. (Stephen De Canio, University of California, Santa Barbara)	
19-211	A	11	38	11	42	A brief version of this should be in the Executive Summary: "There are differing views on what constitutes a 'vulnerable system'. Some hold that human systems are the only ones that should be classified as 'vulnerable', while others would consider a species of no clear utility to human societies--but whose survival is threatened by climate change--as legitimately part of the definition of a 'vulnerable system'". (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Due to space limitations, we did follow this suggestion to expand the executive summary.
19-212	A	11	39	12	9	Words like dichotomize, explication and even normative (while precise) don't help the reading. (Michael Manton, Bureau of Meteorology Research Centre)	Addressed.
19-213	A	11	43	11	45	This is not a good example for two reasons: GIS decay has immediate and proximate interests to anthropocentrists and not one that "might eventually" have some relationship to impact (why not just say this rather than refer to "social utility" as no one to has claimed a benefit from this?, secondly there is not a debate about this as far as can be seen from the literature eg no one has argued to leep the GIS from a nature-centric point of view. A better example might be loss of endemic Alpine flora, where there is a debate: does it matter if the entire Alpine flora of Australian and New Zealand are eliminated not? (William Hare, PIK)	We followed this suggestion.
19-214	A	12	1	12	5	To what extent is the drought in some parts of Africa attributed to aerosol pollution (commonly referred to as "global dimming") and to what extent is it attributed to climate change? (Rachel Warren, Tyndall Centre)	Reference not clear.
19-215	A	12	3	12	3	...for the explication... (David Major, Columbia University)	Addressed.
19-216	A	12	3	12	3	"explication" Word usage ? (Glenn McGregor, King's College London)	Addressed.
19-217	A	12	7	12	10	THC breakdown is not always irreversible (Rachel Warren, Tyndall Centre)	Reference not clear.
19-218	A	12	8	12	9	The phrase "we discuss the most important of these criteria" is jarring, since it immediately follows a discussion (echoing several previous discussions in the chapter) of the subjectiveness of identifying criteria for key vulnerabilities. Then the text immediately, and without explanation, implies authors have already made	This sentence has been dropped.

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						their own judgment of which criteria are the most important. (Brian O'Neill, IIASA and Brown University)	
19-219	A	12	11	12	11	Replace the word "magnitude" by " a- Scale & Intensity (Mohamed El-Shahawy, Faculty of Science- Cairo University - Giza -Egypt)	We explain that scale and intensity are the main dimensions of magnitude.
19-220	A	12	11	13	7	Comment on subsection on "Magnitude": This subsection addresses measures of magnitudes in terms of absolute changes due to CC. This, however, is only part of the story. These changes have to be placed in their broader context, because without a context every number looms large. For example, some papers note that some studies indicate that many millions more will be at risk of, say, malaria, in the future because of CC (see, eg., Parry et al. 1999; King 2004). That is true, but they fail to note that the same studies also show that many more millions will be at risk even if there is no CC. Providing this context is important so that policymakers know how much of a dent reducing CC would make on the aggregate population at risk (PAR) for malaria, and make informed choices regarding the most effective and most economic strategies to reduce malaria. This is especially the case if the primary goal is to advance sustainable development, and not merely to reduce the impacts of CC. [For a detailed discussion, and the implications of providing a context, see Goklany (2003) and Goklany and King (2004). [Comment continued in the following entry.] (Indur Goklany, Office of Policy Analysis, Department of the Interior)	We agree that impacts of changes in non-climatic conditions should not be attributed to climate change. However, we do not think that this is an appropriate place to discuss the weaknesses of "some studies" identified by "some papers" that may not have done that.
19-221	A	12	11	48		[Previous comment continued.] Insert a new para at line 48 to read:"It is also important to view the problem of CC in the broader context of other problems such as (lack of) sustainable development. Accordingly, if one is concerned about, say, malaria, hunger, coastal flooding or other climate-sensitive hazards, it is important to furnish information not only on the additional PAR due to CC alone, but also the total PAR due to both CC and non-CC related factors. Providing both sets of information would allow policymakers and the public to have a better understanding of the effect of GHG emission reductions on the overall PAR for these hazards, and to make informed choices regarding the most effective and most economic strategies to reduce these hazards. This is particularly the case if the primary goal is to reduce these hazards, thereby advancing sustainable development, rather than merely reducing the impacts of CC (Goklany 2000, 2003, 2005). In fact, since advancing sustainable development also should advance adaptive capacity that should help society cope with the impacts of CC, as and when they occur (Goklany 2005b)" (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Context is important, but we are concerned about marginal impact of climate change and especially any synergies, including exceeding thresholds which may involve highly non-linear impacts with small increments in stress.
19-222	A	12	12	12	14	Global synchronization of effects such as drought or boreal forest wilting or	Good point. Isolated changes can be dealt with

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						increases in extreme events is key to the "scale" issue here and should be mentioned. (William Hare, PIK)	much easier through outside help than widespread simultaneous changes/stresses.
19-223	A	12	16	12	24	The melting of the Greenland and West Antarctic Ice Sheets will have a large negative impact on climate because of the very large extraction of heat necessary to melt the ice masses. A change in the location (formation and trajectory) of tropical cyclones can be as important as changes in intensity, as witnessed during El Nino events. (William Kininmonth, Australasian Climate Research)	This sentence has been dropped.
19-224	A	12	17		23	If these impacts are well-known, maybe save space and improve readability by dropping all citations but a blanket (TAR WGI) in the end. (Ha-Duong Minh, CNRS)	This sentence has been dropped.
19-225	A	12	23	12	23	Replace normal modes by major modes. (Michael Manton, Bureau of Meteorology Research Centre)	Addressed.
19-226	A	12	26	12	26	'people' – e.g. site some cases in southern Africa (Coleen Vogel, University of the Witwatersrand)	We are not referring to specific regions here.
19-227	A	12	31	12	33	It is not convincing that the examples don't imply priorities in some sense: I wonder what they are. (Michael Manton, Bureau of Meteorology Research Centre)	This sentence has been dropped.
19-228	A	12	38	12	38	Comment: contingent valuation methods have been subjected to forceful criticism:perhaps it would be appropriate to qualify this reference here. (David Major, Columbia University)	In this section, we simply state the metrics used rather than criticizing particular approaches.
19-229	A	12	49	12	49	I think it needs to explicitly be said that "appropriate" can cover a lot of ground--that is, while there are some types of impacts that indeed cannot be measured quantitatively and so a qualitative evaluation is more appropriate, those making choices make them for many reasons (e.g., equity, biodiversity preservation, national security, etc.) and so they may choose qualitative metrics because they are more appropriate for their perspective even if in some cases quantitative metrics might exist. (Michael MacCracken, Climate Institute)	We think that the current text is consistent with these arguments.
19-230	A	13	2	13	7	Magnitude of impacts from the viewpoint of justice (distribution) is NOT value-laden. The text should be revised here to avoid conveying to the reader that all issues of justice and equity are value-laden by their nature, because this is clearly not true. For example, the incidence of beneficial and adverse consequences (both monetary and non-monetary) of climate change impacts globally and within each nation-state is a matter of facts and not values. The question what do do about them is of course value-laden and contentious, but this does not prevent objective	Addressed.

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						scientific study of incidence of impacts. (Jouni Paavola, University of East Anglia)	
19-231	A	13	9	13	9	Add " b- " before the word "Timing" (Mohamed El-Shahawy, Faculty of Science- Cairo University - Giza -Egypt)	Why?
19-232	A	13	9	13	37	I would think that the "Timing" point should be generalized a bit to also include proximity and familiarity (or maybe those should be a separate point)--we often care about what we are closest to, or have visited, so that too can make a major difference. (Michael MacCracken, Climate Institute)	These aspects are better considered in "importance" than in "timing".
19-233	A	13	10	13	10	Add the following before the word " A harmful" : "Timing parameter could be regarded in terms of; a-the period (Short range that expected to happen soon and long range that projected to happen after decade or more), b- Rate at which the impact occurs (i- Suddenly, ii- Gradually, iii- Very rapidly in non linear systems)." (Mohamed El-Shahawy, Faculty of Science- Cairo University - Giza -Egypt)	Addressed later in this paragraph.
19-234	A	13	10	13	15	I would have thought the Arctic impacts occurring now would have been a prime example here--the world being told about them through the Arctic assessment is, for example, stirring up quite a storm. So, while fine to talk about future impacts, the chapter should also be mentioning ones occurring NOW. (Michael MacCracken, Climate Institute)	We added a sentence.
19-235	A	13	11	13	15	Effects of deglaciation on water supplies remains a complicated issue. Recent work on Tanzania's Mt. Kilimanjaro (Kaser and Molg: see publications link at http://geowww.uibk.ac.at/glacio/), as well as literature on Peru's glacier-hydrology relations (Kaser and Juen; Mark and Seltzer: see http://geog-www.sbs.ohio-state.edu/faculty/bmark/), suggest that deglaciation does not cause instant loss to water reserves. This should be clarified in this report so that it is not assumed that glacier retreat and water loss are perfectly correlated. (Mark Carey, University of California, Berkeley)	Addressed.
19-236	A	13	11	13	11	"far distant" is far necessary here? (Glenn McGregor, King's College London)	Addressed.
19-237	A	13	13			surprise is used appropriately, suggest dropping the " " (Ha-Duong Minh, CNRS)	Addressed.
19-238	A	13	17	13	17	This point needs to be expanded beyond "triggered" and "events" to include the idea of commitments to future change from present or near future levels of radiative forcing: eg long term steric sea level rise could threaten small island states, even if CO2 is reduced in the future. (William Hare, PIK)	Addressed.
19-239	A	13	18	13	18	Disintegration is most likely not on the cards for Greenland ice sheet and further	We changed the text according to this

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						more the effects of a deglaciation of Greenland could be up 0.5m/century and hence would be clearly observable on time frames of several decades, and in addition is most likely reversible unless the ice sheet loses to much altitude (eg can be considered reversible in principle of CO2 concentrations are reduced from peak levels withing a few centuries. The West Antarctic Ice sheet is the example to use here, with the caveat that observable effects may be seen on multi decadal time scales eg if the present acceleration of the main discharge ice streams from the Amundsen sea basins continues, effects will be observed in decades not centuries, but that that there is a likelihood of irreversible dynamic collapse. (William Hare, PIK)	suggestion.
19-240	A	13	18	13	20	This is a poor example. Sea level rise will take place as the Greenland ice sheet melts. What is the basis for the delayed action? (William Kininmonth, Australasian Climate Research)	See comment 19-239.
19-241	A	13	18	13	20	Regarding the timing criterion as applied to the Greenland ice sheet, it would be useful to distinguish when the irreversibility takes hold: is it within the next few decades, when the disintegration is "triggered", or is it in the "longer term" after the disintegration begins (as implied by the current text)? (Brian O'Neill, IIASA and Brown University)	See comment 19-239.
19-242	A	13	19			Replace "but produce" with "if it produces" (Indur Goklany, Office of Policy Analysis, Department of the Interior)	This term has been dropped.
19-243	A	13	20	13	21	"Delayed irreversibility" is a lousy term. The irreversibility isn't delayed, only the consequence of concern. If you're going to use this term (which is new to me in any case) a citation would be good. (Paul Baer, Stanford University)	This term has been dropped.
19-244	A	13	20	13	21	Is there not a better term than delayed irreversibility? The irreversibility is not delayed, the observable impact is. It is more a tipping point with a delayed impact. The irreversibility occurs at the tipping point not later. For some systems may experience a similar dynamic and where recover is possible, that recovery is asymptotic, requiring a shift to conditions far more stable than those at which the tipping point occurred. (Roger Jones, CSIRO)	This term has been dropped.
19-245	A	13	22			Cross refer also to WG III chapter 2 (Ha-Duong Minh, CNRS)	This term has been dropped.
19-246	A	13	22	13	24	"--- but ---- may be severe". The things are not so simple. This sentence is subjective and this is one of lead authors' view. This is against IPCC writing rule. Either delete or should include both literatures for and against the idea of discounting.	This sentence has been dropped.

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						(Mitsutsune Yamaguchi, Teikyo University)	
19-247	A	13	23	13	27	Discussion on discount rate should be elaborated here or at the end of the chapter. (Alexander Golub, Environmental Defense)	This sentence has been dropped.
19-248	A	13	24	13	27	Yohe (2003) More trouble with cost-benefit analysis is relevant here. Yohe, G., 2003: "More trouble for cost-benefit analysis", Climatic Change 56: 235-244. (Roger Jones, CSIRO)	This sentence has been dropped.
19-249	A	13	24	13	27	The statement that deglaciation of a major ice sheet would "likely induce significant economic and ecological damages" should be supported. What is the basis for the judgment of likelihood? I can imagine that inundation by definition would mean ecological damages, but whether economic damages would be substantial so far in the future from a process occurring over at least several centuries at least is not obviously true. (Brian O'Neill, IIASA and Brown University)	This sentence has been dropped.
19-250	A	13	25	13	27	The Atlantis Project results indicate major problems in responding to this threat see eg Nicholls, R. J., R. S. J. Tol, et al. (2004). "GLOBAL ESTIMATES OF THE IMPACT OF A COLLAPSE OF THE WEST ANTARCTIC ICE SHEET." Submitted. And also the policy makers summary "The pessimistic results of the three case studies are partly contradicted by the results of a global impact model of sea level rise. This model is driven by a cost-benefit analysis of coastal protection, rather than a political analysis as in the case studies. The model suggests that it would be worthwhile to defend the coastline in developed countries, which will be richer still in the future. Protection costs would soar, but be bearable. In poorer countries, land losses would be dramatic. The model foresees mass migration, but does not include the impacts of that. Even though the model results are less pessimistic than are the case study results, they do cause concern." http://www.uni-hamburg.de/Wiss/FB/15/Sustainability/atlas.htm (William Hare, PIK)	This sentence has been dropped.
19-251	A	13	29			Insert "adverse" ahead of "impacts" ... since no one would be worried if they were otherwise. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Addressed.
19-252	A	13	29	13	37	Time attributes of impacts and adaptation can have more complex relationships than is portrayed in this paragraph. From the viewpoint of elementary economic theorizing, a sudden, one-off impact provides complete information to actors for adaptation. Therefore, in theory agents could attain "perfect" adaptation despite the fact that the "magnitude" of adaptation might be greater in this instance than in gradual change. Gradual or recurring change may, in turn, leave agents uncertain	The statement that a sudden impact (e.g., a transition to a new climate regime) "provides complete information to actors for adaptation" assumes that this impact can either be projected with certainty or that reactive adaptation is sufficient and the one-off impact

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						about the end state of the system and result in sub-optimal adaptation. The text should be revised here to reflect awareness of the more complex relationships of adaptation decisions to the time attributes of climate change impacts. (Jouni Paavola, University of East Anglia)	eliminates any uncertainty about subsequent climate change. Neither of these assumptions appears to be realistic.
19-253	A	13	35			Insert "Lack of" preceding the new sentence. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	This sentence has been dropped.
19-254	A	13	35		37	It is inappropriate to mention the 2004 tsunamis in the context of climate change hazards. (Aynsley Kellow, University of Tasmania)	This sentence has been dropped.
19-255	A	13	35	13	37	This is not a climate related example and should be omitted. Understanding, preparation, early warning and emergency response are tried and tested measures for addressing climate hazards. Tropical cyclones and bushfires are no less surprises than are tsunamis. (William Kininmonth, Australasian Climate Research)	This sentence has been dropped.
19-256	A	13	35	13	37	It is not clear that using tsunamis as an example of surprise events and the value of early warning is relevant, and it is perhaps misleading. Would probably be better to choose a climate-related impact as an example instead, e.g. warnings for hurricane landfall. (Brian O'Neill, IIASA and Brown University)	This sentence has been dropped.
19-257	A	13	35	13	37	Tsunamis are a bad example here, they are not directly linked to climate change! (Marko Scholze, University of Bristol)	This sentence has been dropped.
19-258	A	13	39	13	39	Add "c- " before the word "Persistence" (Mohamed El-Shahawy, Faculty of Science- Cairo University - Giza -Egypt)	Not clear why.
19-259	A	13	41			Insert "could" ahead of "become" (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Addressed.
19-260	A	13	44			Need a reference for Lal (2002) (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Reference needed
19-261	A	14	5	14	17	In English likelihood and confidence are similar. Here likelihood is defined as an expectation or maximum likelihood. Such semantics can lead to an understatement of the real point at issue. (Michael Manton, Bureau of Meteorology Research Centre)	We disagree with this comment and think that our definitions of likelihood and confidence are consistent.
19-262	A	14	5	14	17	I think this section on "likelihood and confidence" needs to carefully distinguish between the likelihood of particular levels and rates of climate change, and the likelihood of impacts conditional on those changes. If talking about the latter, then I agree with the text that all else equal, an impact with high likelihood is more apt to be seen as key (e.g., if we are sure the THC is going to shut down with 3 C warming in 100 years, that elevates its importance compared to if this event is	We believe that the IPCC mandate requires us to report large-scale adverse impacts of climate change independent of our assessment whether it is (still) feasible to avoid them. The question how to react, e.g., to impacts of an impending significant impact is then up to

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						possible but unlikely). If talking about the former, the reverse could well be true. Those climate changes (and associated impacts) that are very likely because they are unavoidable are least likely to be seen as key because there is nothing one can do about it other than adapt. For example, if it turns out that there is essentially nothing that can be done to avoid widespread damage to coral reefs because this occurs at a very low level of climate change, then this impact is not a very useful one in determining dangerous levels of climate change. This raises the possibility that a criterion more directly related to "avoidability" could be useful. Since avoidance is the principal motivation of Article 2, it might make sense to distinguish this characteristic of vulnerabilities. A separate but related point: the last sentence of this section is not very helpful, since it mixes likelihood and magnitude in a way that does not clarify much the role of likelihood. (Brian O'Neill, IIASA and Brown University)	society. The last sentence was reformulated..
19-263	A	14	5	14	17	the following citations should be considered for this section: Patt, A. and Dessai, S., 2005. Communicating uncertainty: lessons learned and suggestions for climate change assessment. Comptes Rendus Geosciences.; Patt, A. and Schrag, D., 2003. Using specific language to describe risk and probability. Climatic Change, 61: 17-30.; Patt, A.G., 2001. Understanding uncertainty: forecasting seasonal climate for farmers in Zimbabwe. Risk Decision and Policy, 6: 105-119. (Colin Polsky, Clark University)	We value these publications about risk communication but we believe they do not add to the points made here.
19-264	A	14	6	14	17	An issue here is the proximity of the stakeholder to the effects of the damage: it is not just a matter of relative risk aversion. (William Hare, PIK)	Proximity and other determinants are covered in the term "Everything else being equal".
19-265	A	14	6	14	7	Here is another place where "uncertainty " seems to be overemphasized-- "substantial" compared to what--no context is given. At least out to 2050, there is a quite small range of possibilities--the phrasing here is very misleading and plays into the hands of those who want to keep delaying facing up to the issue. (Michael MacCracken, Climate Institute)	This sentence has been dropped.
19-266	A	14	7	14	7	The phrase "though the occurrence of some climate change is highly likely" greatly understates what the science indicates. There is no way to avoid "some" climate change. I would urge changing the word "some" to "significant" or "globally significant" or something similar here. The current phrasing is much too restrained. (Michael MacCracken, Climate Institute)	This sentence has been dropped.
19-267	A	14	7			Define "highly likely". Check cross reference (Ha-Duong Minh, CNRS)	This sentence has been dropped.
19-268	A	14	9	14	12	This dichotomy doesn't do justice to the level of uncertainty. The confidence in a subjective estimate is not merely the spread, but the uncertainty in the spread. This	We are aware that there are multi-dimensional characterizations of uncertain parameters (e.g.,

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						isn't an idle point in this context, since the spread of the climate sensitivity is perhaps one of the most important uncertainties at the present time. It doesn't help that in this reference, which refers to expert surveys, "the probability distribution" is ambiguous whether it means any individual PDF, or some "collective" PDF. (Paul Baer, Stanford University)	the NUSAP framework by Funtowicz and Ravetz). We believe, however, that the two-dimensional characterization suggested here is a reasonable compromise between comprehensiveness and comprehensibility.
19-269	A	14	9		12	It is not clear which probability distribution is alluded to line 11. The text suggests that the expert elicitations referred to yield one well defined "aggregate" probability distribution. I would think that Morgan and Keith did not aggregate. (Ha-Duong Minh, CNRS)	The text was changed and new references added.
19-270	A	14	12	14	12	The assertion that confidence is reflected by the "spread" of a distribution is misleading. In the special case of estimating the probability of a single well defined event then a wide spread of estimates (say from a range of experts) may be indicative of low confidence. However, for continuous variables, the variance (spread) of a distribution can be an indication of natural variability. We may have very high confidence that the probability distribution of a given quantity (the daily rainfall in the city of Newcastle) has a large variance. In this sense "spread" may be thought of as being a property of nature and has nothing to do with confidence. This is to do with the distinction between aleatory and epistemic uncertainties, which is discussed quite well in box 19.2. I suggest however, that p14, line 12 is tightened up. (Jim Hall, University of Newcastle upon Tyne)	The revised text explicitly refers to well-defined events and parameters with a "true" value. Hence, natural variability is not relevant here. We reformulated the text to clarify the inverse relationship between confidence and spread.
19-271	A	14	14	14	17	Unfortunately, however, Alaska and the Arctic are changing dramatically--will soon be highly damaging--and the response hardly matches the level of impact. (Michael MacCracken, Climate Institute)	We emphasize with this personal view.
19-272	A	14	16			No major stakeholders are likely to be risk-prone for impacts of these magnitudes. Better to discuss how the degree of risk aversion affects decisions. (Chris Hope, Judge Business School)	This sentence has been dropped.
19-273	A	14	16			Risk-tolerant. I'm risk prone but that's just clumsiness, not through any particular preference. (Roger Jones, CSIRO)	This sentence has been dropped.
19-274	A	14	19	14	19	Add "d- " before the word "Potential" (Mohamed El-Shahawy, Faculty of Science- Cairo University - Giza -Egypt)	Not clear why.
19-275	A	14	19	14	44	hope it be written that adaptation can reduce or avoid dangerous climate change (Lin Erda, Chinese Academy of Agricultural Sciences)	There is a whole subsection on the potential of adaptation to address key vulnerabilities.
19-276	A	14	19	14	44	this section has no citations. Why? Consider reviewing the debate about the Ricardian climate change impacts methodology: see Polsky, C., 2004. Putting	These and other citations were added.

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						Space and Time in Ricardian Climate Change Impact Studies: The Case of Agriculture in the U.S. Great Plains. <i>Annals of the Association of American Geographers</i> , 94(3): 549-564.; Polsky, C. and Easterling, W.E., 2001. Adaptation To Climate Variability and Change in the US Great Plains: A Multi-Scale Analysis of Ricardian Climate Sensitivities. <i>Agriculture, Ecosystems, and Environment</i> , 85(1-3): 133-144.; Hanemann, W.M., 2000. Adaptation and its Measurement: An Editorial Comment. <i>Climatic Change</i> , 45: 571-581.; Kaufmann, R., 1998. Commentary: The Impact of Climate Change on US Agriculture: A Response to Mendelsohn et al. (1994). <i>Ecological Economics</i> , 26: 113-119.; Mendelsohn, R., Nordhaus, W. and Shaw, D., 1994. The Impact of Global Warming on Agriculture: A Ricardian Analysis. <i>American Economic Review</i> , 84(4): 753-771.; Mendelsohn, R. and Nordhaus, W., 1996. The Impact of Global Warming on Agriculture: Reply. <i>American Economic Review</i> , 86(5): 1312-1315.; Cline, W.R., 1996. The Impact of Global Warming on Agriculture: Comment. <i>American Economic Review</i> , 86(5): 1309-1311. (Colin Polsky, Clark University)	
19-277	A	14	28			I would modify the sentence to read: "There is considerable scope for adaptation in agriculture and in some other sectors in which technical and social instruments are available to be deployed to reduce impacts. It is generally thought that there is less scope for adaptation in the case of some impacts of sea-level rise and biodiversity preservtion, although Goklany (2000, 2003, 2005: 672, 2005b) argues that by addressing major current threats to biodiversity (i.e., loss of terrestrial and freshwater habitat to agriculture, in particular), that would aid natural systems cope with the impacts of climate change." (Indur Goklany, Office of Policy Analysis, Department of the Interior)	We added many citations to literature discussing the potential for adaptation in agriculture.
19-278	A	14	29	14	33	Adaptation potential varies within sectors such as agriculture and health depending on where they are geographically and socially and economically and these variations are often more important differences between sectors. On biodiversity, it is not just a matter of "less scope"; basically the options are just not there. (William Hare, PIK)	Suggestions incorporated.
19-279	A	14	30	14	40	Suggest alter to say aggregation is theoretically useful, for the reasons stated, but in practise the problems of value judgements and metric choices underlying aggregate methods (stated) reduce the practical use of such results. (Rachel Warren, Tyndall Centre)	Reference not clear.
19-280	A	14	34			Insert the following para at this point: "If future worlds are consistent with the SRES scenarios, then they should all be wealthier, more technologically advanced, and possess greater quantities of human and social capital. Therefore, their adaptive	This section critically reviews the published literature rather than evaluating particular scenarios or making suggestions for other

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						capacities should be greater than they are today, and impacts studies should take that into consideration." (Indur Goklany, Office of Policy Analysis, Department of the Interior)	studies.
19-281	A	14	40	14	40	"options those" should be "options than those" (Glenn McGregor, King's College London)	This text has been dropped.
19-282	A	14	46	14	46	Add "e- " before the word "Importance" (Mohamed El-Shahawy, Faculty of Science- Cairo University - Giza -Egypt)	Not clear why.
19-283	A	14	46	15	8	I would think that it would help to also mention that there might be "keystone" species or systems that could be impacted. Examples might be migrating species or coral or some similar situation. Also, some mention should be made of the impacts that can be created by invasive species, fire, etc. I would urge some additional text be added, but at a minimum, on page 15, line 1, change "charismatic" to "charismatic or keystone" and somewhere mention invasive species, pests, etc. (Michael MacCracken, Climate Institute)	The text was modified to clarify that we are not referring to individual species here.
19-284	A	15	0	16		19.2.2 not clear describe the relations and different between key vulnerability and DA (Lin Erda, Chinese Academy of Agricultural Sciences)	This text has been rewritten and moved to Section 19.1.2.2.
19-285	A	15	10	15	10	Suggest explain location of Capensis to non-expert reader (Rachel Warren, Tyndall Centre)	Addressed.
19-286	A	15	11	16	22	There is one aspect that has been either forgotten or intentionally been omitted, the question of fairness. Both within countries as well as across countries it seems fairly clear by now that there is often a large discrepancy between the amounts contributed to emissions (and climate change) and the likely exposure to future adverse impacts. While I can see that you would touch upon a sensitive issue I nevertheless think that your thoughtful presentation should also address this question. (Günther Fischer, International Institute for Applied Systems Analysis)	A separate paragraph on (unfair) distribution of impacts has been added.
19-287	A	15	21	15	33	All the discussion suggests that all impacts are negative. In fact, over certain periods, it is likely that there will be clear winners and losers, not just relative losers. (Michael Manton, Bureau of Meteorology Research Centre)	This paragraph has been dropped.
19-288	A	15	21	15	33	This paragraph omits the consideration of levels and distribution of adaptive capacities (social vulnerability) as a step in the determination of DAI. The text should be revised to include it. (Jouni Paavola, University of East Anglia)	This paragraph has been dropped.
19-289	A	15	25	15	25	Suggest explain that type II threshold is a systemic threshold (Rachel Warren, Tyndall Centre)	Addressed.

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19-290	A	15	26			based on the definition, “one should be delete, because only more or some key vulnerabilities can as DAI (Lin Erda, Chinese Academy of Agricultural Sciences)	We believe that decision-makers may judge climate change as “dangerous” based on a single key vulnerability, such as disintegration of WAIS.
19-291	A	15	27			Modify the sentence that ends on that line as follows: "...may, TO SOME STAKEHOLDERS, constitute DAI by themselves." (Indur Goklany, Office of Policy Analysis, Department of the Interior)	This paragraph has been dropped.
19-292	A	15	30	15	33	Seems that there is too much focus on impacts and not vulnerabilities... Can one not say ‘key vulnerabilities’ that exacerbate impacts?? Again the apparent misuse of the terms that pervades through-out much of this Chapter (Coleen Vogel, University of the Witwatersrand)	This paragraph has been dropped.
19-293	A	15	38	15	38	"generically" Word usage? (Glenn McGregor, King's College London)	Addressed.
19-294	A	15	38	15	38	‘today’s poor’ – Poverty is not related always to, neither directly equated with/to vulnerability – not all who are poor are vulnerable! Need to avoid perpetuating this stereotype. (Coleen Vogel, University of the Witwatersrand)	This sentence has been dropped.
19-295	A	15	41	15	41	The citation Gardiner, 2005 is mssing in the references. (Marko Scholze, University of Bristol)	Reference needed.
19-296	A	15	42	15	42	‘on aggregate impacts’ – aggregating vulnerabilities tricky – the vulnerable are usually highly differentiated. Such classifications, while useful in some cases, are problematic. One should not over-interpret these aggregated indicators.....much of what is tough in ‘vulnerability’ science is the disaggregated ‘stuff’, the differentials etc..... (Coleen Vogel, University of the Witwatersrand)	We are simply reporting the literature here.
19-297	A	15	48	16	10	The attempt to equate and then show that poverty and vulnerability are different leads to a curious but not very illuminating discussion. (Michael Manton, Bureau of Meteorology Research Centre)	The “equating” statement has been dropped.
19-298	A	15	48	16	10	It is not only the distinction between rich (developed) and poor (developing) countries, it is also the distribution of income which makes the people vulnerable, e.g. Katarina in the US. (Marko Scholze, University of Bristol)	We agree, and we believe our text is consistent with this view.
19-299	A	16	0	17		19.2.3 there should be one or two paragraphs to discuss what is different between	We do not believe that discussing the

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						key vulnerabilities and Thresholds? Why IPCC plenary decide use key vulnerability rather than thresholds as the title of the chapter (Lin Erda, Chinese Academy of Agricultural Sciences)	motivation of specific decisions in the IPCC plenary is part of our mandate.
19-300	A	16	1	16	10	The list of references on social vulnerability is not very representative or exhaustive. One established way to looking at the issues is provided in Wisner, B., P. Blaikie, T. Cannon, and I. Davis. 2004. At Risk: Natural Hazards, People's Vulnerability and Disasters, 2nd edition. London: Routledge. Other references could be found from the first order draft of WG2 Chapter 17. (Jouni Paavola, University of East Anglia)	We replaced the references.
19-301	A	16	1	16	50	Mention something here about rates of change as thresholds whatever the reference point. (Rachel Warren, Tyndall Centre)	Reference not clear.
19-302	A	16	3	16	4	(Schoon, 2005) – this reference is missing from the reference list. 'Poverty' is not always equated with vulnerability". – see previous comment. (Coleen Vogel, University of the Witwatersrand)	We replaced this reference.
19-303	A	16	7			Insert a new sentence that reads: "Another factor that could increase vulnerability is the reluctance or inability to use available technologies., for whatever reason. For example, the resurgence of malaria in many parts of the world was partly due to a cessation of the use of DDT (Goklany 2001: 15-20). What makes this example even more remarkable is that indoor residual spraying with DDT is very cheap, easy to implement, and has little if any collateral environmental damage. Similarly, inhibitions regarding GM technology could and, as Zambia and Zimbabwe's response to GM corn sent by the US as aid during their recent famines indicates, compromised the ability to deal with hunger and malnutrition (Goklany 2001: 29-56; 1999c: 123). As another example, consider that the Norse colonists of Greenland would not employ technologies used by neighboring cultures, which made it harder to cope with climate change (Goklany 1995)." (Indur Goklany, Office of Policy Analysis, Department of the Interior)	We have mentioned this point under the topic "Potential for adaptation".
19-304	A	16	8	16	8	UKCIPS, 2004 is not in the reference list. (Jim Hall, University of Newcastle upon Tyne)	Reference needed.
19-305	A	16	8	16	9	2004 should be "2003" (Glenn McGregor, King's College London)	Corrected.
19-306	A	16	9	16	9	2003 heatwave (William Hare, PIK)	Corrected.
19-307	A	16	12	16	22	Classification doesn't seem to be discussed (Michael Manton, Bureau of Meteorology Research Centre)	We dropped this term.

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19-308	A	16	12	16	22	I would like to see some more details here, esp on the different methods of aggregation. (Marko Scholze, University of Bristol)	A more detailed treatment is not possible due to space limitations.
19-309	A	16	13			“Well known systematic threshold is the melting point of ice at 0oC” I feel the melting point of ice is just transition point of substance between solid and liquid. It seems this example is not adequate in this section. (Hideo Harasawa, National Institute for Environmental Studies)	Addressed.
19-310	A	16	20	16	20	Where does 1990 sit? 1990 is referred to later in the chapter. (Rachel Warren, Tyndall Centre)	Reference not clear.
19-311	A	16	23			I would add a new sub-heading under Sec. 19.2.2 titled, "Establishing the Relative Importance of Climate Change," which would contain the following text: "Since CC might exacerbate existing climate-related problems thereby increasing vulnerability to those problems, it is useful for policy-making purposes to identify the contribution of climate change to these problems now and in the future. Goklany (2003, 2005) has used this approach to evaluate the effectiveness of various mitigation and adaptation schemes to reduce vulnerability to malaria, hunger, coastal flooding, water shortage and certain forms of habitat loss through 2085." (Indur Goklany, Office of Policy Analysis, Department of the Interior)	We refer to the importance of non-climatic conditions throughout the text.
19-312	A	16	37	16	37	processes' is abit misleading here, thresholds can also be defined by reference to variability which isn't considered as a process usually. (Marko Scholze, University of Bristol)	Addressed.
19-313	A	16	44	16	46	It's not clear where these examples come from - there are enough proposed critical limits with real citations that taking these two (from where?) seems unnecessary. (Paul Baer, Stanford University)	We replaced the illustrative thresholds with examples from the published literature.
19-314	A	16	44	16	46	Replace the sentence with the following: "Based on this, critical impact limits may be formulated in terms of, for instance, limiting sea-level rise until 2200 to a certain amount above present levels or limiting the extinction of species in, say, the Capensis floral kingdom to specific fraction of endemic plant species. Development of critical levels may involve considerations of other factors that might affect the problems being evaluated. For example, with respect to the above species extinction example, one of the factors considered ought ot be the other (non-CC related) threats to the species" (Indur Goklany, Office of Policy Analysis, Department of the Interior)	The respective sentence has been dropped.
19-315	A	16	44	16	46	The examples of "critical impact limits" are given without reference. Why might these be good examples of critical limits? (Jim Hall, University of Newcastle upon Tyne)	We replaced the illustrative thresholds with examples from the published literature.

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19-316	A	16	44	16	44	critical "normative" limits (William Hare, PIK)	Addressed.
19-317	A	16	46	16	46	Add "of South Africa" after "kingdom" (Janice Lough, Australian Institute of Marine Science)	The respective sentence has been dropped.
19-318	A	16	46	16	46	What is "Capensis floral kingdom"--this will need to be explained to the non-biology reader. (Michael MacCracken, Climate Institute)	The respective sentence has been dropped.
19-319	A	16	48	17	14	The discussion of thresholds seems to miss the point. Consider a graph of forcing vs impact. A threshold is reached when the impact exceeds a certain value. When the impact changes smoothly with forcing, one has type I threshold. Type II occurs when the impact curve changes rapidly for a given change in forcing. (Michael Manton, Bureau of Meteorology Research Centre)	These paragraphs have been completely reformulated.
19-320	A	17	7			I don't think that the fact that these are politically negotiable makes them "socio-economic", but then, I don't have a better term. (Paul Baer, Stanford University)	These paragraphs have been completely reformulated.
19-321	A	18	0			Box 19.2 Confidence levels described here is different from those adopted in the 2nd LA meeting. (Hideo Harasawa, National Institute for Environmental Studies)	True. Need to change these.
19-322	A	18	1	18	14	Should this section be contained within a box? (Anthony Nyong, University of Jos)	Confused me too.
19-323	A	18	1	32	50	Somewhere in this chapter there needs to be a discussion of the future commitments to sea level rise that exist, the problem of the dynamics of this. However, this may be covered in WGI? If so, it could be referred to in this chapter. (Rachel Warren, Tyndall Centre)	Not sure what lines this refers to, but general point is correct. One KV is the long lasting commitment to SLR long after stabilisation of GHG concentrations
19-324	A	18	1	18	20	Does "respiration" refer to soil or plant respiration? I have always thought of CO2 fertilisation as a negative feedback and soil respiration as a positive feedback and it is not clear from the text how these relate to the story told in this paragraph. (Rachel Warren, Tyndall Centre)	Refers to total respiration of biosphere, as is common use.
19-325	A	18	2	18	13	It is generally accepted that the 2000 increase in temperature over pre-industrial levels was 0.6C (TAR). Given the uncertainty of the recent trend (1998 was the warmest year and GMT since have been quite variable) it is inappropriate to suggest that GMT has risen 0.1C between 2000 and 2006. (William Kininmonth, Australasian Climate Research)	Cross-reference to WGI to be inserted.
19-326	A	18	13			Add at the end of the last line: ".. and is consistent with the notion that systems currently expect to and are, in that respect, geared to dealing with 'present' climate" (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Relevance of comment unclear. If he means that systems are adapted to present warmed temperature, that is not clear, with substantial references to stressed and changing systems in

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							WGII chapter 1.
19-327	A	18	17			Comments on Box 19.2: The heading "Quantitative Assessment of Confidence Levels" should be modified to more accurately portray how these levels are established. Accordingly, it should be change to "Subjective Quantitative Assessment of Confidence Levels." The box, on line 30, should also emphasize that: "at best, it reflects the collective judgement of the CLAs and lead authors and not necessarily of anyone else, nor does it represent a consensus view of the scientific community." Finally, I note that as a reviewer, since I do not know exactly how the levels were arrived in each case, I certainly can't endorse them lock, stock and barrel. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	This point will be discussed with the entire WG.
19-328	A	18	17			Box 19.2The definitions of low and very low confidence need to be thought about carefully. As they stand at present, to say that there is low confidence in any result is to imply it is more likely to be wrong (67 – 95% chance) than right (5-33% chance). Eg on p20line1, the assigning of a low confidence implies that the increase in methane releases is more likely to be outside the range of 10-25% than inside it. Is that what you want to convey? (Chris Hope, Judge Business School)	Yes
19-329	A	18	17			box 19.2 should address the disucssion in Patt, A. and Dessai, S., 2005. Communicating uncertainty: lessons learned and suggestions for climate change assessment. Comptes Rendus Geosciences.; Patt, A. and Schrag, D., 2003. Using specific language to describe risk and probability. Climatic Change, 61: 17-30. (Colin Polsky, Clark University)	We are obliged to follow IPCC uncertainty guidance, and we do so.
19-330	A	18	19	18	29	How 'quantative' is the collective expert judgment of observational evidence? (Marko Scholze, University of Bristol)	Same as above.
19-331	A	18	20	18	20	The referent of "the report" is not clear here. Do you mean TAR, or AR4? (David Major, Columbia University)	AR4
19-332	A	18	20	18	30	I suggest that this now standard IPCC indicator be re-thought, or at least, more carefully explained. Linking the verbal confidence levels (very high) etc to probabilities, leads to the question of just what do the probabilities mean? A very logical conclusion is that if the authors assess that they have low confidence in a statement then I am to read that they associate a probablity 5% or less to it. Does this mean that they believe that the statement has only a 5% chance of being correct? Thus anything assessed as low or very low is more likley to not be correct than correct. I have argued before (un-successfully) that the probablity scale, if it is used, should start from a minimum of 50% (eg very low might be associated with an assessment that there is a 50 to 55 % probability that the statement is true - ie it	Same as above.

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						is only just marginally more likely true than not true). I have been asked on several occasions by negotiators and readers of the report to explain this scale to them, but nowhere can I find a clear explanation. (Ian Noble, The World Bank)	
19-333	A	18	21	18	21	If it is not possible to assign probabilities other than 'a degree of belief among the authors' then the exercise should be abandoned. (William Kininmonth, Australasian Climate Research)	Experts do have expertise and their judgement is worth a lot—why the governments asked IPCC to address these issues in the first place.
19-334	A	18	25	18	29	I do hope the IPCC chooses to use similar terminology (and cut-offs) across its WGs, or this will all be pretty confusing. Personally, as my input to the IPCC uncertainty conference made clear, I hope IPCC chooses not to claim it can differentiate as finely as two significant figures, as the listing here does, and basically uses an odds-type approach (e.g., less than about one chance in 10, less than about one chance in 3, about even odds, greater than about 2 chances in 3, greater than about 9 chances in 10--or something similar). (Michael MacCracken, Climate Institute)	Same point as above.
19-335	A	18	25	18	29	attaching percentages to this ordinal scale does not make this quantitative (Glenn McGregor, King's College London)	See above points.
19-336	A	18	27	18	27	Sets up the reader's curiosity as to what was different on Venus. I doubt if there is room to explain? (Rachel Warren, Tyndall Centre)	p.19, line 37. It is a distraction.
19-337	A	18	31	18	49	"well established" is used five times subsequently to this box but none of the other terms appear even once. Thus this whole second half of the box is largely irrelevant. I understand that per the note on page 19, these terms are likely to change, but if you're going to use the TAR terms as placeholders you should put them in places where you will need them as placeholders. (Paul Baer, Stanford University)	Language will be sharpened in subsequent drafts but discussion within entire WG is needed to get uniformity.
19-338	A	18	34	18	34	"o agreement" should be "of agreement" (Glenn McGregor, King's College London)	Accepted.
19-339	A	18	36		37	It would be inappropriate to regard as 'well-established' knowledge which is 'consistent with models'. This would place in the same category astronomical observations and observations of highly uncertain climate processes. The test of the latter (as with science generally) should be agreement between predictions based on theories/models and observations in the future (or not known at the time the prediction was made). The test proposed here sets the bar very low. For example, whether any of the models predict the recent finding of net mass being added to the Greenland ice-sheet (by Johannessen et al, 2005 - assuming their findings prove robust) is more important than whether models account for past observations, yet	Should be "Observations are consistent with model predictions..."

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						this criterion would bnot allow us ot distinguish the two, (Aynsley Kellow, University of Tasmania)	
19-340	A	18	37			Suggest adding “converge to” before “support the finding” (Ha-Duong Minh, CNRS)	Could do, but not essential (is implicit).
19-341	A	18	38	18	44	The bullet defining "established but incomplete" is overly long, repetitive, and confusing. (Brian O'Neill, IIASA and Brown University)	Agree.
19-342	A	18	41	18	43	Remove duplicate part of sentence from "although....." to "processes". (Janice Lough, Australian Institute of Marine Science)	Yes.
19-343	A	18	45	18	45	Spelling: "competing" (David Major, Columbia University)	Yes.
19-344	A	18	45	18	45	"Competiting" Spelling? (Glenn McGregor, King's College London)	Ditto
19-345	A	18	48	18	48	after "other calcifiers" explain "including plankton called coccolithiphores which are at the base of the food chain" (Rachel Warren, Tyndall Centre)	p.19, line 7? Maybe, but length?
19-346	A	19	0	20		The recent Royal Society report on ocean acidification (available on-line at http://www.royalsoc.ac.uk/document.asp?tip=0&id=3249) is an authoritative reference. (Jim Hall, University of Newcastle upon Tyne)	Yes, and Turley at al., 2006 in “Avoiding Dangerous Climate Change”, Chapter.8. Accepted and in latest draft.
19-347	A	19	0	20		No mention is made of the effect of ocean surface warming leading to increase ocean stratification. Stronger stratification would effectively reduce the volume of the ocean available for CO2 uptake from the atmosphere and the flow of carbon between surface and deep waters. More intense stratification would also reduce the flow of new nutrients from deeper waters required for primary production in the sun lit surface layer of the oceans and ultimately reduce ocean primary production and the biological fixation of carbon by marine organisms. Moreover, CO2 is less soluble in warmer water. (Jim Hall, University of Newcastle upon Tyne)	Some of these processes are taken into account in carbon cycle models that are the basis of AR4 concentration projections, and do not need to be handle separately by Ch19 unless we see a risk that models do not present the full range of risk. Other processes are not quantified yet in a way that Ch 19 can use them.
19-348	A	19	11	20		(on p. 19) to 2 (on page 20): This discussion seems misleading. In the first paragraph (p. 19, lines 22-23), it appears that the models being compared are “coupled climate-dynamic global vegetation models”. The next paragraph after that makes the claim that “no runaway greenhouse effect is obtained in any of the model simulations. A runaway greenhouse (such as on Venus) would imply a continuously amplifying positive feedback effect leading to drastic warming and a fundamental change in the chemical state of the atmosphere, a condition that has no support in the literature” (lines 36-40). But the paragraph after that (lines 42-50 on	Discussion of “runaway” is eliminated. Reference to permafrost now included.

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						<p>p. 19 and 1-2 on p. 20) discusses destabilization of methane gas hydrates in marine sediments, which presumably is not included in the “global vegetation” and “land carbon storage” models of the previous two paragraphs. The paragraph on destabilization of methane gas hydrates (lines 42-50) says that “[t]he likelihood of destabilization and its effect on future climate remain very uncertain”, then cites one study estimating that “methane releases increase distant future temperature by 10-25% over a range of scenarios”. This paragraph concludes by saying that “[t]o date, there is only low confidence in any quantitative conclusions”.</p> <p>Several comments are in order here. First, Venus is not Earth, and Venus-like conditions (with surface temperatures hotter than the melting point of lead) are not required to threaten civilization as we know it or even the habitability of Earth. Hence, the possibilities of major positive warming feedbacks associated with terrestrial and/or oceanic methane releases are much more serious than is suggested by saying that the Earth will not become like Venus. Second, it should be made clear that the assertion about “no support in the literature” for the possibility of a runaway greenhouse effect applies (if it does) to the models including land carbon storage only. Third, the phrase “no support in the literature” sounds as though this issue (the possibility of a runaway greenhouse effect) has been extensively examined in the literature. Is that the case? In other words, are there numerous modeling studies on the appropriate time scale (and including both terrestrial and oceanic methane sinks) that have looked for a possible runaway greenhouse effect and found none? Fourth, it needs to be emphasized that health and civilization can be severely threatened from positive warming feedbacks caused by methane releases even if they do not produce a “runaway greenhouse effect”. Fifth, on pp. 20-21 there is only a placeholder for “melting of permafrost peat soils, which store large amounts of methane” (lines 50 on p. 20 and 1 on p. 21). Presumably, this means that the permafrost methane sink has not been included in any of the previous discussion (including the statement about “no support in the literature” for a runaway greenhouse effect).</p> <p>(Stephen De Canio, University of California, Santa Barbara)</p>	
19-349	A	19	11	25	40	<p>I was surprised there was no subsection on extreme events, hurricane intensification, etc. This is a key issue.</p> <p>(Michael MacCracken, Climate Institute)</p>	Subsection on extremes added
19-350	A	19	11	25	40	<p>The discussion of confidence and likelihood is not really picked up properly in this section. One can assign a probability to a value or known threshold. However, most of the section is focused on the probability that the feature is real; ie that the sign of the impact is correct.</p>	Language has been made consistent with IPCC uncertainty guidance. We see no problem with assigning probability to a

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						(Michael Manton, Bureau of Meteorology Research Centre)	change of sign.
19-351	A	19	11	19	11	It would be better for this detailed discussion of science issues to be in WG1. These must be key science issue now that the basic science is accepted. (Michael Manton, Bureau of Meteorology Research Centre)	Science discussion has been reduced significantly and reference made instead to WGI at appropriate points.
19-352	A	19	11	25	40	19.3.1 Various key vulnerabilities (KV) are discussed in a systematic fashion which leaves the reader with the sense that some may not be interlinked. Would it be possible to present a schematic summarizing the possible links between the KVs ? (Glenn McGregor, King's College London)	Linkage of KVs figure under consideration.
19-353	A	19	11	25	40	Isn't the global hydrological cycle a global key vulnerability as well, esp in terms of changes in precipitation and runoff patterns and therefor increases in droughts and floods? This is of course different (but still linked) to the aspect of fresh water availability. (Marko Scholze, University of Bristol)	Covered in extreme events and water supply. Hydrological cycle as a KV is also discussed in terms of regional impacts.
19-354	A	19	15	19	40	No probability is assigned to carbon release over land. (Michael Manton, Bureau of Meteorology Research Centre)	Line 30 indicates "likely" for probability of change of sign of terrestrial sink.
19-355	A	19	15	21	1	Section 19.3.1.1. on global biogeochemical cycles gets less attention and space than deglaciation, ocean circulation and modes of climate variability. Recent research results which indicate that increasing CO2 levels and temperatures are likely to result in reduced CO2 sequestration or to turn soils into net contributors to atmospheric CO2 concentrations would appear to need more discussion. See e.g. Heath et al, (2005), Rising Atmospheric CO2 Reduces Sequestration of Root-Derived Carbon, Science 309: 1711-1713; Korner et al (2005) Carbon Flux and Growth in Mature Deciduous Forest Trees, Science 309, 1360-62; Powlson (2005) Will Soil Amplify Climate Change? Nature 433: 204-205.; Knorr et al. (2005) Long term sensitivity of soil carbon turnover to warming, Nature 433: 298-301; Domisch, T. et al., (2005) Decomposition and nitrogen dynamics of litter in peat soils from two climatic regions under different temperature regimes. European Journal of Soil Biology, in press, available online. (Jouni Paavola, University of East Anglia)	Proportion of ice sheet discussion to be reduced. References to be listed or indicated by reference to WGI section.
19-356	A	19	20		22	There is a rather comprehensive discussion of CO2 fertilization in chapter 5 which could be used here. For perennial plantations down-regulation (acclimation) has been observed in recent experiments and is expected to reduce CO2 fertilization benefits. (Günther Fischer, International Institute for Applied Systems Analysis)	We handle this by reference to WGI.
19-357	A	19	21			Add "or may not" after "may", since it's not clear what the outcome will be.	

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						(Indur Goklany, Office of Policy Analysis, Department of the Interior)	Sentence eliminated.
19-358	A	19	22			Add at the end of the sentence that ends on that line the following: ", although, all else being equal, carbon fertilization may dampen the effects of air pollution {References: [1] Agrawal, M. and Deepak, S.S. 2003. Physiological and biochemical responses of two cultivars of wheat to elevated levels of CO2 and SO2, singly and in combination. Environmental Pollution 121: 189-197. [2] Reid, C.D. and Fiscus, E.L. 1998. Effects of elevated [CO2] and/or ozone on limitations to CO2 assimilation in soybean (Glycine max). Journal of Experimental Botany 18: 885-895. [3] [Tiedemann, A.V. and Firsching, K.H. 2000. Interactive effects of elevated ozone and carbon dioxide on growth and yield of leaf rust-infected versus non-infected wheat. Environmental Pollution 108: 357-363. [4] Vilhena-Cardoso, J. and Barnes, J. 2001. Does nitrogen supply affect the response of wheat (Triticum aestivum cv. Hanno) to the combination of elevated CO2 and O3? Journal of Experimental Botany 52: 1901-1911.} (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Sentence eliminated. Detailed referencing left to WGI.
19-359	A	19	22	19	22	air pollution' is a poor example, especially when dealing with natural ecosystems away from urban areas. Changing patterns of cloudiness and rainfall associated with climate change would be expected to have a more limiting impact in many locations. (William Kininmonth, Australasian Climate Research)	Sentence eliminated.
19-360	A	19	22	19	23	The models are 'coupled climate carbon-cycle models' and not 'coupled climate-dynamic global vegetation models'; not all of the 7 models include a dynamic vegetation model. (Marko Scholze, University of Bristol)	Material eliminated.
19-361	A	19	30	19	32	Before one can use words like "likely" and attach "moderate confidence" to a time-specific prediction, one needs to evaluate how good the models are, and how much credence can/should be placed in them. In the absence of that, I would change the sentence to read: "These results suggest that, possibly, positive feedbacks on the carbon cycle from warming would exceed negative feedbacks in the longer term, i.e., some time beyond the middle of this century), increasing atmospheric carbon dioxide concentrations, and further enhancing warming." (Indur Goklany, Office of Policy Analysis, Department of the Interior)	The weaknesses of the models are most likely in under-estimating the likelihood of reversal from sequestration to emissions due to inadequate account of drought, fire and other stresses. We are asked to render judgment on probabilities in specific IPCC uncertainty language. Based on WGI discussion of models mentioned, this what we have done. The suggested language is not in accord with the guidance.
19-362	A	19	30	19	32	Reference should be made to the observation since CO2 measurements commenced that the annual amplitude of CO2 variation has increased as well as the annual	see earlier comments for references to observations showing that drought and fire

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						mean concentration. This points to a positive response of the biosphere (William Kininmonth, Australasian Climate Research)	lead to episodic reversal already. Check latest trends in annual amplitude. The understanding that there is currently a positive carbon cycle response to warming and to enhanced CO2 is incorporated in both WGI and WGII discussions.
19-363	A	19	30	19	30	likely' seems to be a bit too weak here, all 7 out of the 7 models show a positive feedback, that is an important feat here! (Marko Scholze, University of Bristol)	We use "likely" to acknowledge model uncertainties. "Very likely" would be too strong.
19-364	A	19	33	19	34	Suspect that fire has been observed to increase in N America and former Soviet Union? (Rachel Warren, Tyndall Centre)	The point a bout fire has been left general; not region specific.
19-365	A	19	36	19	37	One of the consequence of a feedback is that increases the level of abatement needed for any given target. See eg Matthews, H. D. (2005), Decrease of emissions required to stabilize atmospheric CO2 due to positive carbon cycle-climate feedbacks, Geophys. Res. Lett., 32, L21707, doi:10.1029/2005GL023435. (William Hare, PIK)	This is implicit in the language, as revised.
19-366	A	19	37	19	40	This is correct but is this the main issue here? It depend on what is meant by a large or drastic additional warming: once could argue the Cox et al scale feedbacks with additional warming of several degrees is large and drastic. Perhaps this issue should be emphasized here rather than a runaway effect which no one has talked about for many years. (William Hare, PIK)	We now use the word "extremely high" to describe concentrations from the risk of a Cox-like outcome.
19-367	A	19	37	19	40	Mentioning runaway greenhouse is provocative. (Michael Manton, Bureau of Meteorology Research Centre)	Deleted
19-368	A	19	42	20	2	With respect to the authors quoted, this section is illogical. The ocean is highly stratified and the mixing of heat through the thermocline is limited. Near freezing water forms over polar regions and spreads across the ocean deeps. Warming is only of the thin surface lens due to solar radiation. Any destabilisation of methane gas hydrates in the ocean sediments will only come about as a consequence of geological activity, not climate. (William Kininmonth, Australasian Climate Research)	Warming does penetrate to depths locally where overturning or subduction occurs. It has been observed. It is only necessary for it to happen locally if there are methane hydrates there to create an emission. This assertion contradicts literature cited. Reviewer gives no reference.
19-369	A	19	42		50	Suggest a qualitative assessment of the state of knowledge (Ha-Duong Minh, CNRS)	We believe that a qualitative assessment is appropriate for the context here.
19-370	A	19	45	19	47	Unless I misunderstand the physics, only sea-level rise due to ice melt contributes to an increase in eustatic pressure; and since sea-level rise due to thermal expansion	We have clarified this point.

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						is likely to dominate in the next few decades, this distinction is probably worth making. (Paul Baer, Stanford University)	
19-371	A	19	49	20	2	Another recent estimate indicates substantial long term warming commitments from even low levels of fossil fuel emissions (see eg Archer, D. and B. Buffett (2005). "Time-dependent response of the global ocean clathrate reservoir to climatic and anthropogenic forcing." <i>Geochemistry Geophysics Geosystems</i> 6.) and also note that the Harvey et al results are not insignificant: if one is interested in limiting warming to 2oC then the size of the feedback they describe could render this very difficult to achieve. (William Hare, PIK)	. Archer and Buffet reference included. We do not indicate that Harvey is "insignificant".
19-372	A	20	1	21	50	Oppenheimer and Alley 2004 is variously quoted for 2C or 4C or 2-4C threshold for WAIS collapse and is this not with respect to preindustrial temperatures? (Rachel Warren, Tyndall Centre)	Chapter now uses recent (1990) temperature uniformly.
19-373	A	20	4	20	14	This paragraph does not accord with reality. The carbonate compensation depth separates the ocean into the surface carbonate rich layer and the deep carbonate poor layer. Limestones have been laid down in the shallower (less than 3 km depth) waters for millions of years, even when CO2 concentrations were much in excess of current and projected levels. Should be deleted or explained more realistically. (William Kininmonth, Australasian Climate Research)	This argument contradicts literature cited on increasing ocean pH, and no literature supporting its relevance to ocean pH is given.
19-374	A	20	4	20	4	Add "absorption by the oceans of" after "due to". (Janice Lough, Australian Institute of Marine Science)	Sentences correct and clear as is, and space for words is at a premium so we prefer to not include this edit.
19-375	A	20	4	20	14	This issue of ocean acidification and its impact on marine life and coral is a huge issue in itself. It should not be just a small part of a topic on biogeochemical cycling--and the issue should be mentioned much earlier in the chapter. In terms of policymakers, certainly, this issue of the impact of ocean acidification on the carbon cycle is much less important than the impact on marine life and coral. (Michael MacCracken, Climate Institute)	Placement of this issue under "Global" section does not reduce its salience, but merely reflects the lack of region-specific studies of its impact. Acidification gets is treated with about 25% of words in carbon cycle section, which is substantial.
19-376	A	20	4	20	42	More impacts than vulnerabilities.....not clear where the 'vulnerable' System is the 'agent of change' ...again see previous comments...reads Much like a set of 'impacts'. (Coleen Vogel, University of the Witwatersrand)	Point accepted. Section rewritten to focus on why certain vulnerabilities are key.
19-377	A	20	4	20	4	Feely et al. (2004) (in journal <i>Science</i>) suggest that the threshold for dangerous direct impacts of CO2 on marine ecosystems is > 800 ppm CO2, so this may be	Reviewer has misread the reference. There is

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						much higher than the threshold for dangerous warming impacts. (James S. Wang, Environmental Defense)	no threshold for dissolution.
19-378	A	20	5			which Article 2? (Lin Erda, Chinese Academy of Agricultural Sciences)	Context of UNFCCC clear at beginning of chapter. Can't repeat it with every use.
19-379	A	20	7	20	7	Add following reference after "Hughes et al": The Royal Society (2005). Ocean Acidification due to increasing atmospheric carbon dioxide. (see www.royalsoc.ac.uk) (Janice Lough, Australian Institute of Marine Science)	Reference added
19-380	A	20	12	20	14	The confidence level could be higher se eg Orr, J. C., V. J. Fabry, et al. (2005). "Anthropogenic ocean acidification over the twenty-first century and its impact on calcifying organisms." Nature 437(7059): 681-686. and see also Hoegh-Guldberg, O. (2005), Low coral cover in a high-CO2 world, J. Geophys. Res., 110, C09S06, doi:10.1029/2004JC002528. (William Hare, PIK)	Given the lack of site-specific studies to date, we feel "moderate" confidence is appropriate.
19-381	A	20	13	20	14	Could provide explanation of how changes in marine systems spurred by acidification would affect the global C cycle. (James S. Wang, Environmental Defense)	This level of detail is best reserved for WGI
19-382	A	20	14	20	14	Add "and marine ecosystems" after "cycle". (Janice Lough, Australian Institute of Marine Science)	Incorporated in new version.
19-383	A	20	16	20	26	This is speculative rhetoric. Algal blooms and surface water eutrophication are common during drought when river flow diminishes and stagnant surface water pools develop. Unless a more specific and substantiated comment can be made then the paragraph should be omitted. (William Kininmonth, Australasian Climate Research)	Accepted; section deleted.
19-384	A	20	16	20	16	where is "below"? (Rachel Warren, Tyndall Centre)	Section deleted
19-385	A	20	19		22	Point 6 applies here. The 'degree of belief among the authors in the validity of a conclusion' is a political test of confidence, and has meaning only if and inasmuch as we know the characteristics of those in agreement. There is a need to distinguish a method we might use to decide what action is prudent from that we might use to determine scientific validity. (Aynsley Kellow, University of Tasmania)	Comment is unclear.
19-386	A	20	28	20	35	Global rainfall is projected to increase under AGW and a shift in rainfall patterns is what will cause some regions to be drier and others wetter. To reference only the drying regions is an incomplete analysis.	Section deleted

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						(William Kininmonth, Australasian Climate Research)	
19-387	A	20	28	20	35	This effect must at this stage at least be below the threshold of examples to cite (Michael Manton, Bureau of Meteorology Research Centre)	Section deleted
19-388	A	20	37		48	Another positive climate feedback with regard to rapid land cover changes could result from increased climate variability, which could provide more frequent and intense triggers that would increase the probability for abrupt land cover transitions. (Günther Fischer, International Institute for Applied Systems Analysis)	Section deleted
19-389	A	20	37	20	48	Huge ecosystem transitions will occur by fire. This is already happening in Alaska where in excess of 5M acres of forest have burned each of the last two years--the ecosystem transition is already occurring--and this is an indication of what lies ahead for other areas. (Michael MacCracken, Climate Institute)	Fire discussion moved to emphasize regional consequences, 19.3.2, although the comment is somewhat speculative and lacks references. Whether or not there will be "huge" transitions is uncertain.
19-390	A	20	38	20	40	In this context on increasing fire frequency Gillet et al. (2004) could be cited for increasing fire frequency in Canada Gillete, N.P., A.J. Weaver, F.W. Zxiers, and M.D. Flannigan. 2004. Detecting the effect of climate change on Canadian forest fires. Geophysical Research Letters 31:L18211, doi:10.1029/2004GL020876. (Thomas Huntington, U.S. Geological Survey)	See above
19-391	A	20	40	20	40	omit comma afterCampbell, 2000) (David Major, Columbia University)	Section deleted
19-392	A	20	45	21	5	Make consistent with table 19.1, mention Gregory 2.7C local above preindustrial or 1.5C global matching Hansen 1C above present (Rachel Warren, Tyndall Centre)	Temperature baseline made consistent.
19-393	A	20	50			what is definition of positive? I think here should be negative. (page 19 line 30 where is same problem) (Lin Erda, Chinese Academy of Agricultural Sciences)	Terminology is correct as standard usage.
19-394	A	20	50			Comment on PLACEHOLDER FOR SOD: This should note that, however, the rapid build-up of methane concentrations since the 1700s has apparently slowed down, for now at least; concentrations have been stable for the past few years (see Blake, 2005, at http://cdiac.esd.ornl.gov/trends/otheratg/blake/methane/methane.html). (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Global methane trends may mask different trends from a variety of sources, including tundra. Basic science elements discussed in WGI, treated here by reference to that material.
19-395	A	20	50	20	50	Recent literature includes: Gedney, N., P. M. Cox, et al. (2004). "Climate feedback from wetland methane emissions." Geophysical Research Letters 31(20). Frey, K. E. and L. C. Smith (2005). "Amplified carbon release from vast West Siberian peatlands by 2100." Geophysical Research Letters 32(9). Cao M, Gregson K, et al.	Response of wetlands added to text, but we are relying on WGI for the bulk of the literature review.

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						(1998). "Global methane emission from wetlands and its sensitivity to climate change - effects of organic material amendment, soil properties and temperature." Atmospheric Environment 32(19): 3293-3299(7). Zhuang, Q., J. M. Melillo, et al. (2004). "Methane fluxes between terrestrial ecosystems and the atmosphere at northern high latitudes during the past century: A retrospective analysis with a process-based biogeochemistry model." Global Biogeochemical Cycles 18(3). (William Hare, PIK)	
19-396	A	20	50	21	1	Should also have a discussion of the northward advance of boreal forests during warming to complement the discussion of melting of permafrost peat soils. (William Kininmonth, Australasian Climate Research)	Chapter 19 is not about ecosystem changes but about Key Vulnerabilities. Northward boreal advance is not inconsistent with additional methane from permafrost.
19-397	A	21	3	23	11	The ice sheets need to be listed as one of the outstanding climate problems. (WCRP wrestled unsuccessfully with this community for at least 15 years, but some coordinated and focused work is clearly needed now.) (Michael Manton, Bureau of Meteorology Research Centre)	Implications for text unclear. Uncertainties discussed at length in WGI.
19-398	A	21	10	21	15	It should be noted that what is "rapid" in geologic terms, i.e., "a few centuries," is relatively slow in terms of human ability to respond. Thus, it should be noted that even if deglaciation is rapid, human systems have enough time to adapt. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Section rewritten to associate slow and rapid ice loss with particular rates (see tables).
19-399	A	21	12	21	12	Presumably "Atlantis, 2005" is a particularly aptly named reference--or is this a worst case scenario? (Michael MacCracken, Climate Institute)	Worst case scenario, but this level of detail is not relevant to the use of the reference.
19-400	A	21	19	21	20	Additional reference: Rignot, E., G. Casassa, P. Gogineni, W. Krabill, A. Rivera, and R. Thomas. 2004. Accelerated ice discharge from the Antarctic Peninsula following the collapse of Larsen B ice shelf. Geophysical Research Letters, 31(18): Art. No. L18401. (James S. Wang, Environmental Defense)	Detailed science left to WGI, by reference here to Ch 4,5, 10.
19-401	A	21	21	21	22	The statement is inconsistent. The Larsen ice shelf disintegrated (ie, fractured) and did not melt until it floated off to warmer waters. Need to be careful to distinguish between natural fracturing processes and possible melting. The ocean floor to 1000km from the Antarctic shore is covered with ice raft debris, not meltwater sediments. (William Kininmonth, Australasian Climate Research)	The statement is correct as written. Surface melting may lead to fracturing and disintegration. Bottom melting may also contribute.
19-402	A	21	21	21	21	Add "in 2002" after "very rapidly" (Janice Lough, Australian Institute of Marine Science)	Larsen ice shelf experienced 2 episodes of

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							rapid collapse; details of dates not relevant.
19-403	A	21	28	21	41	<p>These are speculative scenarios and take no account of recent Antarctic climate history nor of the factors that are unique to Antarctica. There is evidence that Antarctica (apart from the Antarctic Peninsula region) has been getting colder and that ice mass is accumulating. The Antarctic Circumpolar Current and the associated Ekman induced upwelling of near freezing water is a factor isolating Antarctica climatically. This discussion of the stability of the WAIS should be in the WG1 report. Suffice here to refer to a scenario of low probability because of the feedback of the upwelling.</p> <p>(William Kininmonth, Australasian Climate Research)</p>	This section has been rewritten to leave basic details of ice sheet dynamics and recent observations to WGI chapters. Scenarios here are based on WGI Chapter 10.
19-404	A	21	28	21	28	<p>Wording : alter to "impacts from rates and magnitudes of forcing different to today's, and also on different time scales" or similar.</p> <p>(Rachel Warren, Tyndall Centre)</p>	Passage eliminated; reference made to WGI material.
19-405	A	21	30	21	30	<p>The temperature threshold of 4oC is an upper bound for surface warming over the Ross Ice shelf reaching the threshold at which surface meltwater may form in summer. This range is from 1.5oC above the present, depending on how regional climate change develops if one looks at polar amplification ranges and the results of the Wild et al 2003 work cited by Oppenheimer. Further factors not considered here include basal melting of the ice shelves from below (see on the FRIS eg Grosfeld, K. and H. Sandhager (2004). "The evolution of a coupled ice shelf-ocean system under different climate states." Global and Planetary Change 42(1-4): 107-132. and on the Amery ice shelf Williams, M. J. M., K. Grosfeld, et al. (2001). "Ocean circulation and ice-ocean interaction beneath the Amery Ice Shelf, Antarctica." Journal of Geophysical Research-Oceans 106(C10): 22383-22399. Williams, M. J. M., R. C. Warner, et al. (1998). "The effects of ocean warming on melting and ocean circulation under the Amery Ice Shelf, East Antarctica." Annals of Glaciology 27: 75-80. Williams, M. J. M., R. C. Warner, et al. (2002). "Sensitivity of the Amery Ice Shelf, Antarctica, to changes in the climate of the Southern Ocean." Journal of Climate 15(19): 2740-2757.)</p> <p>(William Hare, PIK)</p>	Section has been completely rewritten to rely on relevant WGI chapters, particularly Ch. 10, where this material is discussed
19-406	A	21	35	21	36	<p>I would clarify this by adding "the response of grounded ice to ice shelf loss..."</p> <p>(Paul Baer, Stanford University)</p>	Section rewritten, with this material handled by reference to detailed WGI Ch. 10 discussion.
19-407	A	21	35	21	48	<p>This is a location where it needs to be made clear that the 10 C value is a local value and that the corresponding global average value is likely substantially less.</p>	Section rewritten, with this material handled

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						This needs to be made clear so proper comparisons can be made of when impacts would start (having a chart of this might be helpful). I might also add with respect to this number that the Eemian, at least globally, was not this much warmer, yet there are indications that roughly half of the Greenland and West Antarctic ice sheets melted (see paleo climate chapter of WG I). (Michael MacCracken, Climate Institute)	by reference to detailed WGI Ch. 10 discussion. 10C labeled here clearly as local.
19-408	A	21	40	21	41	The conclusion of Vieli and Payne go beyond this finding that the behaviour of the Huybrechts model is at least as much due to its numerics as its physics and they conclude that at present there exists no reliable model of these dynamics. Vieli, A. and A. J. Payne (2005). "Assessing the ability of numerical ice sheet models to simulate grounding line migration." J. Geophys. Res. 110(F1): 1-18. (William Hare, PIK)	Language modified; also, details such as this discussed in WGI chapters, particularly 10, noted by reference here
19-409	A	21	43	22	2	This paragraph on the probability functions for West Antarctic deglaciation over the next several centuries should say something about the amount of warming that was assumed to occur over this time period in deriving these probabilities. If the warming scenario was not specified, as stated for the Delphi exercise, then comment should be made on what the reader is to make of such results. Without a warming scenario made explicit, probabilities must implicitly include judgments about the likelihood of various degrees of warming combined with judgments of the likelihood of ice sheet response to any given level of warming. (Brian O'Neill, IIASA and Brown University)	Discussion eliminated; relevant material found in WGI.
19-410	A	21	45	21	45	, 2002). Both (David Major, Columbia University)	Section revised to eliminate typos
19-411	A	21	46			I would clarify which is which. (Paul Baer, Stanford University)	Discussion eliminated
19-412	A	21	46	21	46	Add "of Vaughan and Spouge (2002) after "Delphi exercise"; does latter need defining (maybe in a glossary?) (Janice Lough, Australian Institute of Marine Science)	Discussion eliminated
19-413	A	22	1	22	1	The reference to "a Bayesian approach" is puzzling. In what sense is "assuming a particular emissions scenario" Bayesian. It is merely a particular approach to conditionalizing. I suggest the mention of "a Bayesian approach" is deleted. (Jim Hall, University of Newcastle upon Tyne)	Discussion eliminated
19-414	A	22	1			Suggest dropping "follow a Bayesian approach". (Ha-Duong Minh, CNRS)	Discussion eliminated
19-415	A	22	4	22	5	Note that this is also confirmed by Greve, R. (2000). "On the Response of the Greenland Ice Sheet to Greenhouse Climate Change." Climatic Change 46(3): 289-303(15). Greve, R. (1997). "Application of a polythermal three-dimensional ice	Details of science, and appropriate references, found in WGI chapters.

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						sheet model to the Greenland Ice Sheet: Response to steady-state and transient climate scenarios." Journal of Climate 10(5): 901-918. (William Hare, PIK)	
19-416	A	22	4	22	22	This discussion also should be taken up in detail in WG1 report. However it is relevant to emphasise the higher probability given that GIS is currently melting at low elevations and is likely to continue even at current temperatures. The altitude-temperature feedback will not come into effect until melting actually commences on the high plateau, something that is not happening and will not happen until temperatures exceed 0C. (William Kininmonth, Australasian Climate Research)	Agreed; details in WGI.
19-417	A	22	4	22	7	While I think the numbers used here are likely more appropriate, the section in chapter 10 of WG I gives estimates of 8-10 C. Again, need to make clear if these are local or global numbers and give both values to help the reader. (Michael MacCracken, Climate Institute)	Numbers made consistent with WGI and mention local and global temperature increases
19-418	A	22	14	22	15	Not only lubrication is involved. Per what I have heard from Lonnie Thompson, if meltwater remains on the surface of the ice, then much of the downcoming IR and solar needs to be used for evaporation rather than melting of the ice. If there is no meltwater, then the energy goes to melting more ice, and given the ratio of the heat of vaporization to the heat of fusion, there will be several times as much melting if energy does not need to go to evaporation. (Michael MacCracken, Climate Institute)	Details left to WGI.
19-419	A	22	18	22	19	Note that Parizek and Alley have published estimates of the effect of this process Quaternary Science Reviews see their table 4. Parizek, B. R. and R. B. Alley (2004). "Implications of increased Greenland surface melt under global-warming scenarios: ice-sheet simulations." Quaternary Science Reviews 23(9-10): 1013-1027. (William Hare, PIK)	Reference is found in WGI discussion; we refer here to those particular WGI sections.
19-420	A	22	24	22	31	The evidence for a sea level high stand from stable coastal sites during the Eemian seems to be quite strong (see eg McCulloch, M. T. and T. Esat (2000). "The coral record of last interglacial sea levels and sea surface temperatures." Chemical Geology 169(1-2): 107-129. and other work): From the ice sheet point of view other work points to a reduction in mass of order 2-4 metres eg Tarasov, L. and W. R. Peltier (2003). "Greenland glacial history, borehole constraints, and Eemian extent." Journal of Geophysical Research-Solid Earth 108(B3): art. no.-2143. and as well modelling indicates this. The question of where the ice came from is	We have aligned our discussion with WGI chapters 6 and 10, where these details are discussed.

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						another issue (which ice sheet?). (William Hare, PIK)	
19-421	A	22	24	22	39	Given this is not WG1, this section should be omitted, apart perhaps for the last sentence. (Michael Manton, Bureau of Meteorology Research Centre)	Most of this discussion eliminated, now handled by reference to Ch 6 and 10, WGI.
19-422	A	22	31	22	31	Is this really "controversial"? During the Eemian, evidence is pretty clear that sea level was higher and there roughly half of Greenland had melted--and given the need for more SL equivalent, so must about half of WAIS--at least that is what I recall from WG I chapter 6. Okay, we do not have perfect understanding, but is it all really controversial in the larger sense, or just in the academic sense. I would think a less controversial word should be chosen. (Michael MacCracken, Climate Institute)	Discussion now made consistent with WGI chapters 6 and 10.
19-423	A	22	35	22	35	"and shifts in fisheries" is clearer than "as well as in fisheries" (Rachel Warren, Tyndall Centre)	Accepted
19-424	A	22	41	22	50	Based on the statements of the previous paragraph these quoted assessments are no more than speculation and add nothing to the discussion except confusion to those reliant on sound advice for policy direction. (William Kininmonth, Australasian Climate Research)	Most of discussion eliminated; remainder made consistent with WGI, Ch 6 and 10.
19-425	A	22	45	22	45	Under what emissions scenario is there moderate confidence that the MOC will slow down during the 21st century? At the end of the chapter there is much discussion of which stabilisation levels are required to prevent collapse. (Rachel Warren, Tyndall Centre)	Pagination wrong. Slow down is under range of SRES scenarios using IPCC AOGCMs, as is the case for entire report.
19-426	A	22	49	22	50	Again, it the evidence really "highly uncertain" in terms of what the significance of the result is for the scientific community at large--or is this mainly a huge tempest in a very specialized community. This is a chapter drawing general conclusions--keep a high-level view. That there were higher beaches is not highly uncertain, that there is no old ice in southern Greenland is not highly uncertain, etc. The main point is that these large ice sheets are not immutable--they have been quite different in different interglacials, and this has had a quite significant impact on sea level. (Michael MacCracken, Climate Institute)	Discussion tightened and shortened to leave details such as this to WGI Chapters 6 and 10.
19-427	A	23	7	23	11	This speculation is bordering on science fiction! (William Kininmonth, Australasian Climate Research)	Discussion eliminated
19-428	A	23	10	23	10	High Asian mountains are also experience deglaciation with massive losses projected Böhner, J. and F. Lehmkuhl (2005). "Environmental change modelling for Central and High Asia: Pleistocene, present and future scenarios." Boreas 34(2): 220-231. Lehmkuhl, F. and L. A. Owen (2005). "Late Quaternary glaciation of	Discussion eliminated

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						Tibet and the bordering mountains: a review." Boreas 34(2): 87-100. (William Hare, PIK)	
19-429	A	23	11			Wastage is a technical word, please clarify (Ha-Duong Minh, CNRS)	Discussion eliminated
19-430	A	23	13	23	13	Need a brief overview statement of what the MOC is, what sustains it, and why it may shut down. The deep ocean is stably stratified and work is required to cause overturning. Currently that work is partially done by buoyancy forces over polar regions and partially by wind stress. Need to emphasise that the discussion is about variations in the MOC as a complete shutdown is highly unlikely - there is no suggestions that the atmospheric winds will cease under anthropogenic global warming! (William Kininmonth, Australasian Climate Research)	These issues have been appropriately addressed by WGI. Recapitulating them here would be using valuable spaces that is needed for other content.
19-431	A	23	13	23	13	The north Atlantic accounts for less than half the total thermohaline circulation. The SH component should be mentioned. (Michael Manton, Bureau of Meteorology Research Centre)	Climate sensitivity is in North Atlantic as stated, but effects in southern hemisphere now noted.
19-432	A	23	13	24	6	19.3.1.3 Possible changes to the MOC are discussed without reference to the underlying mechanisms such as freshening of the North Atlantic by increased high latitude melt. Chance here to link hypothesised changes in MOC back to deglaciation of Greenland Ice Sheet in previous section. See immediate previous comment. MOC is later used interchangeably with THC. Best to be consistent and stick with MOC or THC throughout. (Glenn McGregor, King's College London)	Details left to WGI. Consistency now attempted.
19-433	A	23	22	23	24	No linkage between GMT increase and MOC shutdown is offered. The cold upwelling waters between the Antarctic Circumpolar Current and the continent are regulated by wind speed and Ekman pumping, not GMT. The Arctic Ocean is a region of net radiation deficit and the temperature will largely be affected by poleward heat transport by the oceans and atmosphere. The usual reason given for a slowdown of the Arctic thermohaline circulation is freshening of the Arctic Ocean waters. This has happened over recent years and the fresher waters are identified at the ocean floor, indicating that overturning is continuing although possibly at a reduced rate. (William Kininmonth, Australasian Climate Research)	Dynamic details found in WGI. GMT threshold used here is from Stocker and Schmittner.
19-434	A	23	23	23	24	I think again that "a few" is unhelpfully vague. (Paul Baer, Stanford University)	This section has been rewritten and made more precise.
19-435	A	23	24	23	24	"warming above a few oC" Is this within the bounds of the current projections?	

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						(Glenn McGregor, King's College London)	This section has been rewritten. The simulations and the discussion of WG1, chapter 10 address this question.
19-436	A	23	26	23	26	The way of writing here may mislead readers to think that stocker et al. has suggested 3 degrees centigrade within 100 years were threshold values for the THC to stop. However, this is not true. The threshold value by Stocker et al. seems to be around 4.5 degrees centigrade within 100 years (around 600 ppm at the climate sensitivity of 4 degrees centigrade. (Mitsutsune Yamaguchi, Teikyo University)	This section has been rewritten. Note that the threshold location depends on the very uncertain hydrological sensitivity that has been adopted in the model. "Faster than 3C in 100 years" is correct.
19-437	A	23	36	23	36	I am not sure that people will understand what is meant by "relative cooling"--why not say "reduced warming" to make clear (as is said in Ch 10 of WG I) that there will not be a cooling. (Michael MacCracken, Climate Institute)	Accepted
19-438	A	23	41	23	41	Link and Tol do not look at fisheries. Instead, they find that a MOC shutdown would bring economic benefits. (Richard S.J. Tol, Uni. Hamburg)	The citation in the draft used the wrong date. We have updated the citation (which refers to the working paper FNU-30) and have added one more citation)
19-439	A	24	3	24	4	This requires some set of assumptions about emissions, no? like "if emissions rise even at the rate of the lowest SRES scenario" (Paul Baer, Stanford University)	. The "design of risk management strategies does indeed require assumptions about future anthropogenic forcing.
19-440	A	24	3	24	3	Replace moderate by medium (Michael Manton, Bureau of Meteorology Research Centre)	The word-choice follows the Guidance notes for Lead Authors on Addressing Uncertainty. The use of "medium" would imply a rather strong probabilistic statement (cf. Table 3 in the aforementioned document) that seems unjustified given the large structural uncertainties of the current MOC predictions. Note that the current draft of WG1, chapter 10 does not provide such an assessment in the sense of Table 3.
19-441	A	24	7	24	7	In the non-climate change models what affected the water stress? (Rachel Warren, Tyndall Centre)	Section eliminated
19-442	A	24	8	24	8	We have seen substantial changes in the large-scale global modes, such as in the 1970s the relationships of ENSO and the large-scale circulation over much of the	The revised section contains two additional

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						tropics. People like Trenberth and Nicholls have written on it. What have been the impacts of such observed changes? Eg there have been studies of south-west Western Australia. (Michael Manton, Bureau of Meteorology Research Centre)	references discussing the potential or observed impacts of ENSO changes on agriculture and droughts.
19-443	A	24	8	25	22	No probability seems to be assigned (Michael Manton, Bureau of Meteorology Research Centre)	Probabilities have been inserted where appropriate.
19-444	A	24	10	24	21	An introductory comment about the impacts of ENSO, including the 1997-98 El Nino event would give context (see WMO 905 of 1999 - The 1997-98 El Nino Event: A scientific and technical retrospective). The extremes of ENSO are disastrous and essentially unpredictable. ENSO also impacts on water supplies, health and infrastructure in addition to fisheries and agriculture. (William Kininmonth, Australasian Climate Research)	The section has been rewritten and a reference to relevant section elsewhere in the FAR has been added. A more detailed discussion would be at odds with the severe space constraints.
19-445	A	24	10	24	10	Change "may" to the lexicon--so something like "it is possible that" or "it is likely", etc. (Michael MacCracken, Climate Institute)	Probabilities cannot be estimated yet, so we prefer to stay with the vaguer language.
19-446	A	24	11	24	11	Would "intensity and frequency of both El Nino and La Nina modes" be more descriptive than "e.g. mean, variance or the shape of the distribution"? (Janice Lough, Australian Institute of Marine Science)	Text eliminated.
19-447	A	24	13	24	17	Need to add "droughts" to this list (Janice Lough, Australian Institute of Marine Science)	Accepted
19-448	A	24	22	24	26	ENSO - climate impact link is moderated by the state of the PDO. This needs to be acknowledge. Also possibility that other major modes of atmospheric circulation may be moderated by low frequency modes of ocean thermal state. See: Sutton RT, Hodson DLR (2005) Atlantic ocean forcing of North American and European summer climate. Science 309:115-118 (Glenn McGregor, King's College London)	The section has been rewritten and a reference to other relevant sections on the FAR has been added. The sentence in question focuses on ENSO as a specific example. Of course, impacts of ENSO changes are modulated by other changes. This is a general feature that is already discussed, for example in WG1, chapter 10.
19-449	A	24	24	24	25	on global agriculture range between 100's of millions and over \$ 1 billion. It does mean a range of agricultural losses? (Lin Erda, Chinese Academy of Agricultural Sciences)	Yes and we think intent is clear
19-450	A	24	25	24	25	The "assumption" may be based on very sound physical theory, or it more dubious? (Rachel Warren, Tyndall Centre)	This section has been rewritten. The "assumption" referred to the adopted scenario in the analysis of Chen et al (2001) and was not exclusively based on sound physical

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							theory.
19-451	A	24	33	24	33	Should the PDO be mentioned as it modulates ENSO impacts? Any information from WGI about observed/projected changes in PDO? (Janice Lough, Australian Institute of Marine Science)	PDO discussion is in WGI; coupling to ENSO is a complex question beyond WGII interest in KVs.
19-452	A	24	33	24	33	Any information from WGI regarding possible recent changes in ENSO characteristics? (Janice Lough, Australian Institute of Marine Science)	Reference to WGI discussion of current changes added
19-453	A	24	34	24	39	The southern annular mode is a more consistent and appropriate name. Oscillation is a confusing term (Michael Manton, Bureau of Meteorology Research Centre)	The revised section adopts the wording of WG1, Ch10 (cf. sections 10.3.5.3.2 and 10.3.5.3.1)
19-454	A	24	37	24	37	AAO mentioned. This often referred to as the southern annual mode (SAM) in the literature. Likewise AO referred frequently to as the NAM. (Glenn McGregor, King's College London)	See above
19-455	A	24	41	24	45	This is speculation. What is clear is the major climate shift of the middle 1970s as Earth Atmospheric Angular Momentum (AAM) increased. Such an increase is linked to an equatorward shift of atmospheric mass associated with an increase in the zonal circulation, ie an increase in the low to high latitude temperature gradient over middle latitudes. This is consistent with the finding of Chen et al 2001 of an increase in the Hadley Cell circulation intensity. It is not clear that the middle 1970s shift is linked to increasing anthropogenic CO2. (William Kininmonth, Australasian Climate Research)	We disagree. The statements are general. Ozone depletion may have dominated early forcing, but EGH becomes more important later. Model simulations support this, and shifts were observed. So-called speculations are reasonable inferences. Relevant literature is cited, along with WGI discussion.
19-456	A	25	1			Temperature will be an important factor in determining key vulnerabilities for water resources, but not to say what is KV for water. (Lin Erda, Chinese Academy of Agricultural Sciences)	Pagination unclear
19-457	A	25	12	25	22	The two references to Cai's work do not appear to be consistent. (Michael Manton, Bureau of Meteorology Research Centre)	Not inconsistent. One statement refers to past behavior, the other to future behavior.
19-458	A	25	16			What does "zero-order assumption" mean? Please clarify. (Hideo Harasawa, National Institute for Environmental Studies)	Phrase eliminated
19-459	A	25	20			Insert 'a decline in production and' before 'increase..'. (Chris Hope, Judge Business School)	Pagination out of order
19-460	A	25	20	25	21	The NCEP/NCAR reanalyses show that over the past 15 years, if anything, SST have cooled over the Southern Ocean, not warmed as claimed in the text.	Text eliminated

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						(William Kininmonth, Australasian Climate Research)	
19-461	A	25	24	25	24	Delete continental from the title (Michael Manton, Bureau of Meteorology Research Centre)	Done
19-462	A	25	24	25	40	19.3.1.5 This section is weak in comparison to the others. In terms of impact on populations and their livelihoods this is a major KV and deserved more attention. (Glenn McGregor, King's College London)	Monsoon section is now comparable in length (or longer) than several other KVs in this section.
19-463	A	25	26	25	40	This section could be further developed eg On the Indian monsoon see May, W. (2004). "Potential future changes in the Indian summer monsoon due to greenhouse warming: analysis of mechanisms in a global time-slice experiment." <i>Climate Dynamics</i> 22(4): 389-414. Zickfeld, K., B. Knopf, et al. (2005). "Is the Indian summer monsoon stable against global change?" <i>Geophys. Res. Lett.</i> 32(15): 1-5. and Ramanathan, V., C. Chung, et al. (2005). "Atmospheric brown clouds: Impacts on South Asian climate and hydrological cycle." <i>PNAS</i> 102(15): 5326-5333. (William Hare, PIK)	We rely on WGI literature assessment for climate aspects of monsoon change.
19-464	A	25	26	25	40	On the East Asian Monsoon see Bueh, C. (2003). "Simulation of the future change of East Asian monsoon climate using the IPCC SRES A2 and B2 scenarios." <i>Chinese Science Bulletin</i> 48(10): 1024-1030. Bueh, C., U. Cubasch, et al. (2003). "Impacts of global warming on changes in the East Asian monsoon and the related river discharge in a global time-slice experiment." <i>Climate Research</i> 24(1): 47-57. (William Hare, PIK)	See previous comment
19-465	A	25	29			what does mean for GMT? (Lin Erda, Chinese Academy of Agricultural Sciences)	Acronym to be defined early in Chapter
19-466	A	25	30			outside the IPCC, "zero-order" is rarely used. I would call this a "first order assumption" (Paul Baer, Stanford University)	Phrase eliminated
19-467	A	25	31	25	32	The term "zero-order assumption" seems to be jargon. (Stephen De Canio, University of California, Santa Barbara)	Phrase eliminated
19-468	A	25	36	25	38	The parentheses here appear in odd places - I don't see any reason that the reference to Paleoclimatic evidence should be parenthetical, rather than just the citation. (Paul Baer, Stanford University)	Material eliminated
19-469	A	25	36	36	38	It is interesting that there is evidence that warming has intensified the Asian monsoon, because in WG I it gives the opposite sign--that is, warming will lead to weaker monsoons (at least in some regions). How this works thermodynamically is not clear to me, and I did comment on that to the WG I authors--but there does need	Yes – a problem of consistency. If warming is faster over land than summer monsoons should strengthen, although aerosol cooling

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						to be consistency across the IPCC report. (Michael MacCracken, Climate Institute)	could counter this. We will keep an eye on this consistency as drafts move along.
19-470	A	25	37	25	37	The claim that the northern hemisphere has warmed for the past four centuries contradicts almost everything written about climate change. Most would accept northern hemisphere warming for the past two centuries! (William Kininmonth, Australasian Climate Research)	Claim deleted. The pattern of inferred temperature discussed in the Anderson reference is complex.
19-471	A	25	38	25	39	The importance of aerosol and black carbon emissions to changes in the monsoon is worth citing a reference for. (Paul Baer, Stanford University)	We rely on WGI for such details.
19-472	A	25	43	34	1	As mentioned above, the presentation of sectoral impacts will have to change significantly to reflect the information in the FOD's of the sectoral chapters. (Günther Fischer, International Institute for Applied Systems Analysis)	Agree; had been shortened considerably
19-473	A	25	43	34	1	19.3.2 This section is very repetitive of the material that appears in Chaps 3 - 8 (Glenn McGregor, King's College London)	Have shortened
19-474	A	26	1	26	4	This is speculation based on a one-dimensional viewpoint. Many regions of North Africa and the Middle East that are now semi-arid or desert were savannah grasslands about 5,000 years ago when GMT were warmer than now. Intense precipitation events come about through organised weather systems and atmospheric overturning. Anthropogenic greenhouse gases do not generate energy, they only change the rate of transfer of existing solar radiation through the climate system. It is not obvious that an increase in anthropogenic CO2 will cause a more variable climate system with enhanced mass overturning. Certainly the CMIP2 computer model simulations do not project increased overturning of the Hadley Cells. (William Kininmonth, Australasian Climate Research)	Insufficient space to address this.
19-475	A	26	2			Here you could cite Huntington (In Press) for intensification of the Hydrologic Cycle: Huntington, T. G. In Press, Evidence for intensification of the global water cycle: review and synthesis, Journal of Hydrology (Thomas Huntington, U.S. Geological Survey)	Will leave to WGI
19-476	A	26	2	26	2	Replace will by are expected to, and delete hence (Michael Manton, Bureau of Meteorology Research Centre)	Disagree, but discussion eliminated
19-477	A	26	8	26	30	Nicholls has suggested that, independent of any change in rainfall, change in temperature is affecting water availability in Australia and hence the severity of droughts now. With no real trend in rainfall but a clear one in temperature, the main impacts on water are temperature driven (and real). (Michael Manton, Bureau of Meteorology Research Centre)	Insufficient space to address this

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19-478	A	26	10	26	12	It seems that temperature rise and presepitation change are linked. (Alexander Golub, Environmental Defense)	Agree
19-479	A	26	14			the Hayhoe et al 2004 cite isn't in the list of references. (Colin Polsky, Clark University)	No longer cited
19-480	A	26	15	26	15	These are key issues that should be the focus in the chapter. Factors enhancing / reducing vulnerability to climate stress – not a description of impacts! More of this ‘stuff’ needed!!!!!! (Coleen Vogel, University of the Witwatersrand)	We’ve enhanced discussion about development and adaptation
19-481	A	26	18	26	18	Replace will by is expected to (Michael Manton, Bureau of Meteorology Research Centre)	OK
19-482	A	26	21	26	21	It might be noted that this uncertainty about regional patters of precipitation change is mainly in regions of sharp orography (which is a reason that those relying on models almost solely to project changes in the Greenland and West Antarctic Ice Sheets should be showing a bit more humbleness in coming to the conclusion about a reduced estimate of SL rise compared to the TAR). (Michael MacCracken, Climate Institute)	Too detailed for chapter
19-483	A	26	28	26	30	"Often" is unhelpfully vague in this context - does it mean "sometimes" or "most of the time" or "usually" or "generally" or?? (Paul Baer, Stanford University)	“can” in particular cases
19-484	A	26	30	26	30	Delete 'often'. It is generally agreed that there is no confidence in individual simulations, only ensembles. (William Kininmonth, Australasian Climate Research)	Revised
19-485	A	26	32	26	36	I.e. increase of population density will increase damage. (Alexander Golub, Environmental Defense)	No need for change.
19-486	A	26	32	26	35	Again better. (Coleen Vogel, University of the Witwatersrand)	Laudatory.
19-487	A	26	36	26	39	Important that these lines be should be highlighted and the sense being Conveyed here used as a guide...clear vulnerability of the ‘system’ in the Face of climate risk...compare this a rather poorly articulated Section page 20...intent there but not coming across as ‘vulnerabilities’ Rather ‘impacts/responses.....of the system’ (Coleen Vogel, University of the Witwatersrand)	Unsure where this refers to.
19-488	A	26	39	26	42	In fact, Arnell (2004: Tables 10 and 14, for instance) shows that because of CC, in 2055 and 2085 more people would have a decrease in water stress than would have an increase under all scenarios. Also, Arnell’s Table 9 shows that there will should	Studies on water resources differ in their findings and revision states this.

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						be a net reduction in the population under water stress because of CC for both 2055 and 2085. Accordingly, on line 42, I would add the following: "However, under all scenarios, there will be a net reduction in the population at risk for water stress." I would also change "2050" to "2055" on line 39 (Indur Goklany, Office of Policy Analysis, Department of the Interior)	
19-489	A	27	1	27	17	There is a lack of parallelism in these bullet points - some are noun phrases, others are complete sentences with verbs. I'd pick one way or the other to do them all. (Paul Baer, Stanford University)	Bullets been eliminated
19-490	A	27	10	27	10	1 to 2C above preindustrial has been mentioned for corals, above 1990-2000 the threshold is lower (Rachel Warren, Tyndall Centre)	OK
19-491	A	27	19			Insert a new paragraph: " On the other hand, Goklany (2003, 2005a) points out that the results of Arnell et al. (2002) and Arnell (2004) indicate that CC would cause a net reduction in the populations at risk of water shortage." (Indur Goklany, Office of Policy Analysis, Department of the Interior)	This is not Arnell's conclusion. See # 488 above.
19-492	A	27	19	27	25	The Hitz and smith review only looked at global studies: a regional review finds a much more coherent picture. Arnell presented further work at the Exeter Conference on the relationship between global mean warming and water resources across a range of scenarios (the 2004 work cited does not provide the basis for concluding much at all as there is insufficient data in the paper published) (William Hare, PIK)	Discussion is consistent with water resources chapter. Reference to Hitz and Smith on water has been cut.
19-493	A	27	19	27	25	Note that the Döll and Siebert and Vörösmarty work are only to 2025 and one would not expect a big signal from warming on this time frame. Other work by Döll on longer time frames indicates substantial problems "Two-thirds of the global area equipped for irrigation in 1995 will possibly suffer from increased water requirements, and on up to half of the total area (depending on the measure of variability), the negative impact of climate change is more significant than that of climate variability" Döll, P. (2002). "Impact of climate change and variability on irrigation requirements: A global perspective." Climatic Change 54(3): 269-293. (William Hare, PIK)	Water discussion has been cut because of space constraints
19-494	A	27	19	27	23	'.....could not finds clear relationship (s)....' Would be very useful to unpack these or have a text box of examples (Coleen Vogel, University of the Witwatersrand)	No room
19-495	A	27	20	27	25	On the other hand recent studies from large basins like the Yellow River in China (Jiongxin, 2005) and the Lake Chad basin indicate that climate likely has been an	Insufficient space

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						important factor in reducing water supply and that further warming and decreases in precip will aggravate the situation. Jiongxin, X. 2005. The water fluxes of the Yellow River to the sea in the past 50 Years, in response to climate change and human activities. Environ. Manage. 35:620 - 631. (Thomas Huntington, U.S. Geological Survey)	
19-496	A	27	20			expand acronym GMT where used to improve readability (also p29 l 20 and elsewhere) (Ha-Duong Minh, CNRS)	Yes, everywhere. It is usually Greenwich Mean Time.
19-497	A	27	21			High inconsistency is a qualitative assessment of the state of knowledge, suggest using the controled vocabulary (Ha-Duong Minh, CNRS)	What is commenter referring to?
19-498	A	27	21	27	22	should it read "mismatch between life cycles of migratory species and their prey/predator species in wintering or breeding areas" (Rachel Warren, Tyndall Centre)	Yes, but discussion substantially shorter
19-499	A	27	22	27	22	But "net global impact" hardly is the right measure, given that water is not an international commodity. What matters is what is happening locally--not the net impact. (Michael MacCracken, Climate Institute)	No longer discussed (but literature addresses this topic so it could be a relevant topic to include)
19-500	A	27	23	27	25	I would modify this sentence as follows: "Hitz and Smith ARGUED (or POSTULATED) that GREATER climate change IS likely to increase stress for water resources, in part BECAUSE current water resource infrastructure is generally designed for today's climate." And add the following: "However, note that the Arnell studies, the ones that show high sensitivity to CC, do not include any adaptations that might be undertaken in the future despite the fact that adaptive capacity should be higher in the future (Goklany 2003, 2005a, 2005b). Goklany (2003) argues that there is considerable scope for adaptation particularly in the agricultural sector, noting that, since that sector is the major user of water worldwide, a small increase in the efficiency of agricultural water use would free up large amounts of water for use in other sectors." (Indur Goklany, Office of Policy Analysis, Department of the Interior)	adaptations have not been well studied and there is insufficient space to address this
19-501	A	27	23		25	Here is another example of the flaw referred to in 1: a statement is made about the vulnerability of existing water infrastructure to future climate change which assumes that water infrastructure will remain unaffected by the very socio-economic development driving the emissions scenarios, and in turn driving climate models.	chapter will discuss potential for adaptation but point out uncertainties about it being realized

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						(Aynsley Kellow, University of Tasmania)	
19-502	A	27	25	27	25	Current water resource infrastructure is geared to both demand and prevailing climate. (William Kininmonth, Australasian Climate Research)	Exactly, and will need to change with demand as well as climate in future.
19-503	A	27	27			See Point 5: 'Biodiversity' is added here - it is not in Art.2 Ecosystems are dynamic and their ability to adapt could include them becoming less biodiverse. (Aynsley Kellow, University of Tasmania)	True. In our opinion, that could be a key vulnerability
19-504	A	27	27			Section 19.3.2.2 is notably lacking in references, particularly in the bulleted list of possible impacts. It would seem especially important to have references here given that many statements are made attaching specific levels of warming to particular types of ecosystem or biodiversity impacts. (Brian O'Neill, IIASA and Brown University)	We are putting in more x-refs to chapters.
19-505	A	27	27	29	10	There may indeed be little research on the impacts of climate change on biodiversity hotspots globally. But there is some research on climate impacts on biodiversity and related issues. Se e.g. Velandre et al. (2005) Valuing the impacts of climate change on protected areas in Africa. Ecological Economics 53: 21-33. Also, biodiversity impacts are not limited to extinction: ecosystems transformed by human action or by anthropogenic climate change may provide more limited and less valuable services than relatively intact and resilient systems. See Turner, R. K., Paavola, J., Farber, S., Cooper, P., Jessamy, V., Rosendo, S. and Georgiou, S. (2003) Valuing Nature: Lessons Learnt and Future Research Directions. Ecological Economics 46: 493-510; Balmford, A., Bruner, A., Cooper, P., Costanza, R., Farber, S., Green, R. E., Jenkins, M., Jefferiss, P., Jessamy, V., Madden, J., Munro, K., Myers, N., Naeem, S., Paavola, J., Rayment, M., Rosendo, S., Roughgarden, J., Trumper, K., and Turner, R. K. (2002). Economic Reasons for Conserving Wild Nature. Science 297: 950-953. These indicative results are substantiated in a recent study by Bunker et al (2005) Species Loss and Aboveground Carbon Storage in a Tropical Forest Published online 20 October 2005 in Science Express Reports. Therefore, a wider range of impacts on biodiversity should be recognised and covered in the text. (Jouni Paavola, University of East Anglia)	Will rely on ecosystems chapter
19-506	A	27	29			I recommend writing this para with greater care and precision, as follows: "Ecosystems are highly SENSITIVE to climate change. BECAUSE OF THIS, THEY ARE VULNERABLE TO RAPID CLIMATE CHANGE AS IS PROJECTED BY MANY MODELS. That vulnerability is partly a function of the ..."	Discussion in SOD addresses impacts as a function of GMT

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						(Indur Goklany, Office of Policy Analysis, Department of the Interior)	
19-507	A	27	29	27	30	This does not seem to be a sentence--a minor flaw in a wonderfully edited draft. (Michael MacCracken, Climate Institute)	Looks like a sentence to me.
19-508	A	27	36	27	39	These passages are repetitious; why should this particular bullet point be given its own paragraph before the list of the bullet points? (Stephen De Canio, University of California, Santa Barbara)	Delete repetition.
19-509	A	27	36			Comment on para. How confident are we that in a warmer and wetter world, extinction will accelerate for amphibians? Any references? (Indur Goklany, Office of Policy Analysis, Department of the Interior)	No longer in chapter
19-510	A	27	36	27	36	This range is really from about 0.5oC above present if one includes coral reefs in the Indian ocean, tropical forest species in Australia etc and loss of some mountain systems (William Hare, PIK)	True.
19-511	A	27	36	27	37	Overall, global precipitation is expected to increase with the biggest impact from shifts in rainfall pattern. In some regions the rainfall amounts will be reduced but in others it will be increased. This latter will provide opportunities for amphibian species, including disease carriers! (William Kininmonth, Australasian Climate Research)	Ecosystems will change as mentioned. Wetter conditions may increase opportunities for some amphibians, but not increase species or biodiversity generally.
19-512	A	27	36	27	39	Remove as covered in following section (Janice Lough, Australian Institute of Marine Science)	Yes.
19-513	A	27	41	27	45	The structure of this paragraph suggests that the bullet points underneath are related to the questions of glacial melt and freshwater systems, but this isn't what the following list includes. The concerns about glacial melt and freshwater systems should be moved into the list, and a different summary paragraph put in front of it. (Paul Baer, Stanford University)	entire section has been revised
19-514	A	27	41	27	41	The statement: Extinctions are already being observed..." needs to be supported or deleted. While models project high rates of extinction, evidence that climate change is leading to extinctions has not been presented in earlier chapters of this FOD, nor is it available in the literature this reviewer is familiar with. For example, Thomas et al, 2004, cited later in this section, project that up to 37% of the species they studied could be committed to extinction by 2050, but provide evidence for only one species in which the climate change of the 20th century was a contributing, but not the only, factor. (Lenny Bernstein, IPIECA)	No longer discussed
19-515	A	27	46	28	41	Confidence levels are not consistently given in the assessments in this list of impacts. (Jim Hall, University of Newcastle upon Tyne)	Have tried to improve this

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19-516	A	27	48			Change "changes in temperature" to "changes in temperature, precipitation and net ecosystem productivity" (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Statements are defensible and consistent with Ecosystems chapter
19-517	A	27	48	27	52	Tree-grass ecosystems: if there is a sink to source transition in biogeochemical cycles a big shift from forests to grasslands is predicted at an uncertain threshold as explained in section 19.3.1.1 so there needs to be some cross referencing at this point to link the two sections (Rachel Warren, Tyndall Centre)	Too detailed
19-518	A	28	0			Polar Ecosystems. This para should be modified to note that some species of penguins are doing worse while other are doing better. [Refs: [1] Ainley, DG et al. and Croxall, JP et al. (2003), Adélie Penguins and Environmental Change. Science 300: 429-430. [2] Croxall, JP et al. 2002. Environmental Change and Antarctic Seabird Populations. Science 2002 297: 1510-1514. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	section has been revised and shortened.
19-519	A	28	1	28	37	It is here in particular that all the temperature changes need to be labeled as being local or global--or preferably give both. (Michael MacCracken, Climate Institute)	Yes.
19-520	A	28	2	28	3	A 1 to 2 increase in sea surface temperature is expected to result in widespread bleaching, this only happened in southern part of sub-tropic and tropic ocean in China (Lin Erda, Chinese Academy of Agricultural Sciences)	That is where most (warm water) corals are.
19-521	A	28	2			Coral Reefs. Para should note that "On the other hand, coral reefs have shown an ability to adapt to some degree of temperature change [References: [1] Gates, R.D. and Edmunds, P.J. 1999. The physiological mechanisms of acclimatization in tropical reef corals. American Zoologist 39: 30-43. [2] Adjeroud, M., Augustin, D., Galzin, R. and Salvat, B. 2002. Natural disturbances and interannual variability of coral reef communities on the outer slope of Tiahura (Moorea, French Polynesia): 1991 to 1997. Marine Ecology Progress Series 237: 121-131. [3] Rowan, R. 2004. Thermal adaptation in reef coral symbionts. Nature 430: 742. [4] Baker, A.C., Starger, C.J., McClanahan, T.R. and Glynn, P.W. 2004. Corals' adaptive response to climate change. Nature 430: 74.] (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Insufficient space, but conclusions on coral reefs consistent with ecosystems chapter
19-522	A	28	2	28	5	Replace 'is expected to' by 'may'. Change last sentence to '..... activities also increases the vulnerability of coral reefs to climate change.' (William Kininmonth, Australasian Climate Research)	First point stet, second change as suggested.
19-523	A	28	2	28	5	Also mention ocean acidification; Buddemeier, R.W., J.A. Kleypas & R.B. Aronson (2004) Coral reefs and global climate change, Pew Center Report and	Have done so

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						Wilkinson , C (2004) Status of Coral Reefs of the World 2004, GCRMN are probably key references as they discuss problems of the other stresses; I would also suggest that there is reasonably good evidence to raise the confidence level higher than "medium" - there has clearly been an increase in the frequency and extent of mass coral bleaching events affecting many of the world's coral reefs (eg 1998) which is clearly associated with warmer waters, i.e. impacts are already evident. (Janice Lough, Australian Institute of Marine Science)	
19-524	A	28	2	28	5	Finally, the chapter has gotten to the key issue of what will happen to coral reefs--this needs to be covered throughout, and especially up front. (Michael MacCracken, Climate Institute)	Insufficient space to say more
19-525	A	28	7	28	9	There is no evidence that penguin and polar bear numbers are being affected by climate change (William Kininmonth, Australasian Climate Research)	disagree: research has shown Adelie chin strap penguins being adversely affected and there is emerging evidence about decrease in ice cover adversely affecting polar bears.
19-526	A	28	7	28	14	Some at least of these temperature changes refer to preindustrial, for example Leemans & Eickhout. This means the 3C limit should come down if a 1990-2000 references point is to be used. The other figures could also be checked for this. (Rachel Warren, Tyndall Centre)	Will try to careful..
19-527	A	28	8			I'm not sure animals have "livelihoods" - I would say "threatens their existence" or "survival". (Paul Baer, Stanford University)	Agree. (but have you ever seen a dancing bear?)
19-528	A	28	8	28	8	I would suggest changing "livelihood" to "well-being" so as not to give indication that they are working for a salary. Also, I would change "penguins" to "seals" as the problem they face is much more obvious. (Michael MacCracken, Climate Institute)	OK and need to check re seals.
19-529	A	28	10			Migratory Species. This para should also note that according to the Royal Society for the Protection of Birds (RSPB) some bird species have become more abundant in the UK, perhaps because of CC. Similarly Finland's WWF notes that new species of butterflies have appeared in Finland, again possibly due to CC.[Refs: [1] RSPB. 2000, The State of the UK's Birds 2000; [2] RSPB. 2001. The State of the UK's Birds 2001; [3] WWF Finland 2002. Climate Change Has Altered Finland's Flora and Fauna, 17 May 2002, based on Finnish report, Suomen lajisto muuttuvassa ilmastossa," WWF Finland, Helsinki, ISBN 952-5254-07-2.] (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Discussion cut to save space
19-530	A	28	10			Migratory species. We know very little about the rate with which migratory species adapt to changes in the availability of their food sources. Clearly, since climate has changed over the past few centuries, there is some ability to adapt.	Again, changing form "impacts" to "shifts" covers most of this.

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						Moreover, we see that behavior and migratory patterns of birds, e.g., Canada Goose [<i>Branta canadensis</i>], are influenced by the availability of local food sources etc. Moreover it is also possible that the mismatches mentioned may lead to range shifts. This is what seems to have happened for British butterflies, damsel flies and dragonflies, for instance. Accordingly, I would change ".possibly leading to increased extinction rates" to "which may or may not affect extinction rates." {See, e.g., [1] Butterfly Conservation. 2001. Millennium Atlas of Butterflies in Britain and Ireland, Oxford University Press. [2] Hickling, R., Roy, D.B., Hill, J.K. and Thomas, C.D. 2005. A northward shift of range margins in British Odonata. <i>Global Change Biology</i> 11: 502-506. [3] Hampe, A. and Petit, R.J. 2005. Conserving biodiversity under climate change: the rear edge matters. <i>Ecology Letters</i> 8: 461-467.} (Indur Goklany, Office of Policy Analysis, Department of the Interior)	
19-531	A	28	10	28	14	This is speculation and there is no evidence of the impacts postulated. (William Kininmonth, Australasian Climate Research)	We respectfully disagree
19-532	A	28	10	28	10	Again be careful of lapsing into ‘impacts’ and ‘impact speak’... the language is clear...”Impacts are already evident.....” (Coleen Vogel, University of the Witwatersrand)	See above.
19-533	A	28	15	28	18	These passages are repetitious; why should this particular bullet point be given its own paragraph before the list of the bullet points? (Stephen De Canio, University of California, Santa Barbara)	Discussion cut
19-534	A	28	15	28	19	lines 15-19 are repeat with page 27 lines 36-39 and no reference (Lin Erda, Chinese Academy of Agricultural Sciences)	Ditto
19-535	A	28	15	28	19	See comment 36. Some habitats will come under stress but the changed rainfall distribution will also mean that there are new opportunities developing. (William Kininmonth, Australasian Climate Research)	Yes, but overall loss of diversity
19-536	A	28	20	28	24	The risk to arid and semi-arid and mountain top ecosystems must be read in the context of past climate change, especially the warmer and wetter conditions of 5,000 years ago. (William Kininmonth, Australasian Climate Research)	Why?
19-537	A	28	21	28	21	Some coral reef systems in the Indian ocean are projected to get this for about 0.5oC above present Sheppard, C. R. C. (2003). "Predicted recurrences of mass coral mortality in the Indian Ocean." <i>Nature</i> 425(6955): 294-297. (William Hare, PIK)	Changed.
19-538	A	28	24			Is it now IPCC practice to cite papers that have been submitted but not yet	Not clear what being referred to

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						accepted? Also, this paper is not listed in the references. (Stephen De Canio, University of California, Santa Barbara)	
19-539	A	28	28	28	41	no references for 1-2 (Lin Erda, Chinese Academy of Agricultural Sciences)	Chapter x-ref should suffice
19-540	A	28	28	28	32	Mobile pathogens are not only temperature dependent. Projections of future numbers must also take account of changing local rainfall patterns. Elimination of malaria from much of Europe, Russia (extending as far north as Archangel on the Arctic Circle up until the middle 20th century) and North America has been through public health and sanitation strategies, not climate change. (William Kininmonth, Australasian Climate Research)	Malaria comments irrelevant to ecosystem topics – we are talking about unmanaged systems.
19-541	A	28	33	28	36	This assertion only true in areas of higher rainfall. (William Kininmonth, Australasian Climate Research)	No longer stated
19-542	A	28	37	28	41	Such fires are already being seen in Alaska--this is not some impact way off in the future. (Michael MacCracken, Climate Institute)	Insufficient space
19-543	A	28	43	29	2	Reading this section I am left wondering what the habitats will evolve to under a 3C temperature increase. The impression is that the mass extinctions will leave the habitats barren, which is quite implausible. The claims deny species migration. (William Kininmonth, Australasian Climate Research)	Disagree with viewer's interpretation
19-544	A	28	43	28	46	This sentence is confusing--does the wild biosphere have an "original conservation objective"? (Michael MacCracken, Climate Institute)	Clarified in SOD
19-545	A	28	44	28	44	"of the terrestrial.." (David Major, Columbia University)	Yes.
19-546	A	28	45	28	45	Comment: the referent of the two uses of "their" is not clear. Do you mean the 50% of the terrestrial biosphere that is referred to? (David Major, Columbia University)	refers in both cases to nature reserves.
19-547	A	28	46	28	49	Thomas et al, 2004 did use the term "committed to extinction," but added the caveat that the extinctions could take several centuries to occur. As such the term is meaningless because it is impossible to verify whether a species will be come extinct centuries from now as a result of current climate change. IPCC authors have an obligation to assess the literature, not simply repeat it. Thomas et al demonstrate that a significant fraction of species are at increased risk of extinction because of projected climate change, but as is amply documented in Chapter 4, models of extinction are too crude to be used to determine which species, or which fraction of species, will become extinct. (Lenny Bernstein, IPIECA)	OK. SOD does not indicate how quickly or slowing this will hapen

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19-548	A	28	46	28	49	<p>It's'Its not clear how robust Thomas et al.'s's findings are, or what is their significance. First, it seems to me that there is evidence for poleward shifts but much less so for shrinkage at the equatorial limit. (See also comment 52). Second, the energy resources available to species will be different under a higher CO2 atmosphere, as will their demand for water. This was not included in their analysis. Third, we have had temperature fluctuations in the past of magnitudes similar to those considered by Thomas et al. Do they reveal any extinctions of the magnitude they estimate? Fourth, there seems to have been no consideration of "inertia" of species or the effect of competition. Fifth, since nature does abhor a vacuum, what would fill in the gaps left by departed species? It would no doubt be different, but that is intrinsically neither better nor worse.</p> <p>(Indur Goklany, Office of Policy Analysis, Department of the Interior)</p>	<p>Reviewer has an optimism about biodiversity that we think is not justified. Where is the scientific literature to back up these points?</p> <p>Point 1: drought and fire will largely determine change on low latitude side.</p> <p>Point 2: Re water demand higher temp means higher demand irrespective of CO2. Point 3: Yes e.g. K-T extinction. These were without habitat disruption brought on by humans.</p> <p>Point 4: inertia is why some extinctions are "committed" not immediate. Point5: results in very different species/ecosystems.</p>
19-549	A	28	46	28	49	<p>This seems to read as if one can have local extinctions. My understanding is that biologists want to call these "extirpations" and keep extinction for global loss.</p> <p>(Michael MacCracken, Climate Institute)</p>	Discussion tightened
19-550	A	28	48	28	48	<p>mid-range and not mid range....minor issues.....</p> <p>30 32 30 32 'diseases' or indeed extreme events – droughts and floods – or does Parry's work referred to in box take this into account.</p> <p>(Coleen Vogel, University of the Witwatersrand)</p>	Language clarified
19-551	A	28	50	29	1	<p>Hare 2003 has 2C as net threshold for reduction in agricultural production. What would this be without CO2 fertilisation, see latest Food Crops in a Changing Climate: Report of a Royal Society Discussion held in April 2005', Policy Document 10/05, June 2005. Mention here again losses in agriculture in Africa at low T rises.</p> <p>(Rachel Warren, Tyndall Centre)</p>	This section is about natural ecosystems
19-552	A	29	0	39		<p>Box 19.3: This box is based on one study only, and yet the concluding sentence in the box is, "[g]iven the uncertainties mentioned, medium confidence is suggested". That seems strong for a single study of such a complex subject.</p> <p>(Stephen De Canio, University of California, Santa Barbara)</p>	Box deleted.
19-553	A	29	8	29	8	<p>permanen't implies irreversible. The logical question to ask is whether the natural biosphere is similar now to what it was during the last interglacial. Or should we accept that the biosphere is continually changing?</p> <p>(William Kininmonth, Australasian Climate Research)</p>	Not sure why "permanent" is used apart from extinctions maybe. Extinctions do matter, and what it was like in the last interglacial is largely irrelevant, except to calibrate our understanding of how the system works.
19-554	A	29	12	30	36	<p>It is hard for studies on impacts over long periods to assess the increase in adaptability of developing countries. All such studies suggest that the gap between</p>	Not correct, A1 for example assumes rapid development in developing countries

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						developed and developing countries will increase, but all the basic scenarios for IPCC assume convergence. Assumptions about adaptability should be clarified in this section. (Michael Manton, Bureau of Meteorology Research Centre)	
19-555	A	29	13			Section 19.3.2.3: Could include a discussion of potential micronutrient limitation of crop yields. (James S. Wang, Environmental Defense)	Too detailed
19-556	A	29	14	29	37	Security of food production can hardly be analysed at the global level because surpluses in one region or area are not readily available in a deficit area. Seminal studies on famines such Amartya Sen, Poverty and Famines (Oxford: Clarendon Press, 1981); Amartya Sen and Jean Drèze, Hunger and Public Action (Oxford: Clarendon Press, 1989) have demonstrated that availability of food is seldom a reason for famines: the reason is lack of access to food. Access can be limited because of lack of access to markets - which characterises much of rural sub-Saharan Africa, or lack of ability to pay for food even when it would be available at the accessible markets. For this reason, spatially more disaggregated assessment is needed here, and one which makes use of conventional vulnerability reasoning. Farmers say in Canada and Tanzania are in completely different situations what comes to food security. Tanzanian farmers consume 70 percent of their production and sell the rest locally to obtain necessities such as clothing, school fees, medicines and so on: financial flexibility for food purchases is very limited and farming communities do not often enjoy any real access to markets. Canadian farmers are in turn fully integrated into the markets and spend a minuscule proportion of their income on food, and can effectively use external sources of food through markets. (Jouni Paavola, University of East Anglia)	The point is made in the SOD
19-557	A	29	15	29	15	This sentence is redundant if the objective is to feed all the people of the world. Presumably we start from the position that not all the people of the world are adequately fed today. (William Kininmonth, Australasian Climate Research)	True. If the problem today is not total food supply but accessibility, will it change for the better in the future? Trade and aid only works in a society ready to implement it.
19-558	A	29	18	30	36	Fischer et al. 2002 and Fischer et al. 2005 discuss the sensitivity and relevance of climate change impacts on crop yields for different levels of climate change and socioeconomic development paths (SRES scenarios). While level of climate change determines the magnitude of regional agronomic impacts (depending also on GCM) the assumptions on development path determine the role played by agriculture in the national/regional economies, the share and size of population directly dependent on agriculture, and the possibility to mitigate negative impacts for food security through increased food imports. [Fischer, G., Shah, M., and van Velthuisen, H.,	Good point. In limited space we have, we discuss importance of development paths

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						2002. Climate Change and Agricultural Vulnerability, Special Report as contribution to the World Summit on Sustainable Development, Johannesburg 2002. International Institute for Applied Systems Analysis, Laxenburg, Austria. pp 152.; Fischer, G., M. Shah, F. Tubiello and H. van Velthuizen, 2005. Socio-economic and climate change impacts on agriculture: an integrated assessment, 1990-2080. Phil. Trans. R. Soc. B doi:10.1098/rstb.2005.1744.] (Günther Fischer, International Institute for Applied Systems Analysis)	
19-559	A	29	18	29	27	You may want to note another feedback that could result in lower food production than some modeling suggests owing to a loss of available water holding capacity that is likely to accompany a decrease in soil organic carbon (Huntington, 2003). Huntington, T. G., Available Water Capacity and Soil Organic Matter. 2003, pages 1-5, Book Chapter In Lal, R. (ed.) Encyclopedia of Soil Science, DOI: 10.1081/E-ESS 120018496, Marcel Dekker, New York. (Thomas Huntington, U.S. Geological Survey)	Should go to Chapter 5.
19-560	A	29	18		37	There appears to be an unwarranted pessimism in much of the report, but here the pessimism appears to fly in the face of economic analyses by leading researcher (eg Robert Mendelsohn at Yale) suggesting that agricultural productivity could actually increase. (The authority for the tone of the report is the work of a Co-chair of WG II, and is thus hardly independent). The analysis rests almost entirely upon the benefits (supposedly short-lived) of carbon fertilization, and neglects other impacts such as temperature and rainfall which might be positive. (Aynsley Kellow, University of Tasmania)	Mendelsohn's work shows agriculture production declining above a few degrees.
19-561	A	29	19	29	22	The logic of a warmer wetter world not being more biologically productive needs to be substantiated. A significant proportion of the world's people live on food aid and subsistence where global food prices are irrelevant. (William Kininmonth, Australasian Climate Research)	Studies consistently show eventual declines in agricultural production.
19-562	A	29	19	29	29	The majority of models finds that a bit of warming would increase global food production, if carbon fertilisation is included. That's what both the SAR and TAR say (although not necessarily in the summaries). (Richard S.J. Tol, Uni. Hamburg)	We are saying the same thing. SOD will clarify
19-563	A	29	20		22	There is a non sequitur here: an increase in food prices can in no way mean that 'many people, particularly in poor regions would have increased difficulty . . . Growing food for themselves...' Subsistence farmers are not likely to be greatly affected by market prices, but if they were, price increases would in fact encourage investments and adaptation to increase productivity. (Aynsley Kellow, University of Tasmania)	No longer discussed because of lack of space

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19-564	A	29	25	29	25	Add that the HADCM3 has global temperatures of x to y by 2080 (take from WG1 - I have 2.3 to 4.3C relative to preindustrial) (Rachel Warren, Tyndall Centre)	No longer discussed because of lack of space
19-565	A	29	30	29	32	Some results suggest that CO2 fertilisation may have limited impact on yields. Heath et al, (2005), Rising Atmospheric CO2 Reduces Sequestration of Root-Derived Carbon, Science 309: 1711-1713; There are also results which indicate that warming per se will reduce yields of some important crops such as maize in the tropics where mean temperatures are above the ideal for the plant. See e.g. M. Bannayan et. al, (2004) Photothermal impact on maize performance: a simulation approach. Ecological Modelling 180: 277-290. (Jouni Paavola, University of East Anglia)	Defer to agriculture chapter.
19-566	A	29	36	29	37	from Box 19.3 we can not get this conclusion. (Lin Erda, Chinese Academy of Agricultural Sciences)	Completely rewritten.
19-567	A	29	37	28	41	This is a sweeping statement about fire-prone ecostyms that ranginvariety from the equatorial rainforests to sub-Arctic boreal forests. As an example, Australia had a history of wildfires before European settlement and regular burning did not deter growth of forest despite regular burning of lower understorey. (William Kininmonth, Australasian Climate Research)	p.28, lines 37-41. This is much abbreviated in rewrite in 19.3.4. Fact is that increased fire risk is widespread in studies. See Ch.5. We are not talking about fire-tolerant species such as some in Australia, but about fire intolerant species and increased frequencies stopping regrowth.
19-568	A	29	41	30	25	This section denies that the history of the past two centuries, when GMT rose by at least 0.6C, will be repeated if the climate continues to warm. Technological developments and species adaptation combined to ensure that agricultural production has steadily increased. The authors give the impression that human ingenuity has ceased and we must continue with only the tools we currently have, condemned to an inability to adapt and develop! (William Kininmonth, Australasian Climate Research)	We believe the chapter is balanced with regard to incorporating adaptation potential.
19-569	A	29	41	30	25	While global food production is indeed a key issue to be considering, one that also needs to be considered is the viability of farming as an occupation. In the US, where agricultural productivity (per acre) will likely increase, more production will lead to lower prices, which makes farming less viable. So, it would be helpful to distinguish between agriculture and farming--they can go in opposite directions. (Michael MacCracken, Climate Institute)	Point is too trivial for this chapter
19-570	A	29	50	29	50	I presume the above studies do consider the synergistic effects of changes in temperature and rainfall, but they cannot consider the synergies between climate impacts (Rachel Warren, Tyndall Centre)	Comment needs to be clarified

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19-571	A	30	1	30	4	Insert at line 4: "However, as Parry et al (2004, p. 57) itself acknowledges, these adaptive responses are based on currently available technologies, not on technologies that would be available in the future or any technologies developed to specifically cope with the negative impacts of climate change. The potential for future technologies to cope with climate change is large, especially if one considers bioengineered crops (Goklany, 2001b, 2003)." (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Box now deleted.
19-572	A	30	1	30	3	Latest Royal Society report also has info on ozone and CO2 fertilisation effect, I think these are new results (Royal Society 2005 and on www.royalsoc.ac.uk "Food Crops in a Changing Climate: Report of a Royal Society Discussion held in April 2005", Policy Document 10/05, June 2005" (Rachel Warren, Tyndall Centre)	Good point, but insufficient space to address
19-573	A	30	14			A1F1 should be A1FI. (Hideo Harasawa, National Institute for Environmental Studies)	Yes
19-574	A	30	16	30	17	This statement is overly simplistic and, accordingly, should be deleted. If it were generally true, all food-importing countries would be worse off than food-exporting countries, but that isn't the case. [Consider, e.g., China and Japan are among the biggest food importers.] Whether food imports are good or bad depends on what other economic activity the population engages in. There may well be some populations who are better off for importing food and devoting their energy, labor and capital on other economic pursuits (e.g., Singapore, Hong Kong, in addition to the two aforementioned countries.) In fact, some countries might also be environmentally better off by purchasing their food than trying to grow it under inhospitable conditions (Goklany 1995). (Indur Goklany, Office of Policy Analysis, Department of the Interior)	rewritten
19-575	A	30	19	30	25	I believe that underestimating the potential effects of increases in pests and pathogens on crops is dangerous. I believe that it is fair to say that as one moves from temperate to tropical agroecosystems one will find greater stresses from pests and pathogens in warmer climates. IF this is true it suggests that in general warming will bring more pests and pathogen stresses. (Thomas Huntington, U.S. Geological Survey)	True. Rewritten though.
19-576	A	30	26			Add the following new para to Box 19.3: "The Parry et al. analysis shows that whether or not climate changes, no matter which SRES scenario is used, through 2085 the future world will be better off with respect to hunger than it was in 1990 both in terms of absolute numbers and as a proportion of total population. Moreover, examining the total population at risk (PAR) for hunger in 2085 (defined as the PAR in the absence of CC plus the change in PAR due to only to CC), some	Box deleted. Relies now more directly on C.5 conclusions. The Parry et al results were in any case based in part on rainfall changes that were not well determined due to multi-decadal variability. This is one reason for dropping this box.

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						of the warmer scenarios actually result in lower levels of hunger, than some cooler scenarios. Third, the warmest scenario (A1F1) does not lead to the lowest level of well-being as measured by the total PAR, although it is the worst if one only considers the change in PAR due to CC alone . This is not just the consequence of wealth-related adaptive capacity, but also higher CO2 levels (and, at least in some areas, greater soil moisture). Equally important, the coolest scenario (B1) does not lead to the lowest level of hunger. Finally, for some scenarios (A2 and, possibly, B2), climate change might, in fact, reduce the PAR for hunger at least through 2085. [Ref: Goklany 2005a -- same as in comment no. 16]". (Indur Goklany, Office of Policy Analysis, Department of the Interior)	
19-577	A	30	32	30	32	'diseases' or indeed extreme events – droughts and floods – or does Parry's work referred to in box take this into account. (Coleen Vogel, University of the Witwatersrand)	Rewritten
19-578	A	30	33	30	36	It is important to elaborate since many studies interpret increasing crop yields as a result of CO2 concentration increases thus ignoring other factors that are mentioned in the chapter. (Alexander Golub, Environmental Defense)	Should be in Ch.5 and x-referenced
19-579	A	30	35	30	35	tropospheric ozone is largely an urban problem and is of less impact on rural agricultural production (ozone is a short-lived species). (William Kininmonth, Australasian Climate Research)	Applies over much of eastern US and western Europe, plus Asia.
19-580	A	30	35	30	35	Will not some areas become too dry to support cattle at all? Desertification etc. (Rachel Warren, Tyndall Centre)	Rewritten and shortened.
19-581	A	30	38	31	11	Chapter 5 discusses the high exposure and vulnerability of especially subsistence, smallholder, and pastoral agriculture in less developed countries. (Günther Fischer, International Institute for Applied Systems Analysis)	X-ref.
19-582	A	30	39	30	49	This is a very simplistic overview. It does not differentiate between subsistence and commercial cropping. A decrease in production over the higher rainfall low latitudes (where the majority of humans live) is a surprising outcome. The 20th century has seen remarkable increases in crop production as a consequence of improved fertilisers, pest control, species development and cropping methods. Warmer and humid climates may increase the problem of disease and pest control and this must be recognised as a challenge. (William Kininmonth, Australasian Climate Research)	Also temperature thresholds. Rewrite relies on Ch.5 x-ref.
19-583	A	30	40	30	40	Mention Malawi where dependent on fishery (Rachel Warren, Tyndall Centre)	To detailed. Have had to shorten.
19-584	A	30	46	30	47	Again this is better – not impact but areas vulnerable to a climate stress.	Praise.

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						<p>“At particular risk are dryland regions.....”....factors making this region or system vulnerable....much better and more of this needed!</p> <p>(Coleen Vogel, University of the Witwatersrand)</p>	
19-585	A	31	1	31	11	<p>When assessing the impacts of climate change, the starting point should be current vulnerabilities. Grazing is possibly not very viable in some countries, independent of climate change.</p> <p>(Michael Manton, Bureau of Meteorology Research Centre)</p>	Now much abbreviated. No objection to comment.
19-586	A	31	8	31	8	<p>Add to the sentence, '... could spread, requiring higher management costs for containment.'</p> <p>(William Kininmonth, Australasian Climate Research)</p>	Ditto
19-587	A	31	9	31	9	<p>Add to the beginning of the sentence 'Without additional management, livestock productivity,'.</p> <p>(William Kininmonth, Australasian Climate Research)</p>	rewritten (nothing on adaptation in this sector)
19-588	A	31	11			<p>Add at the very end of this line: "... unless adaptive measures limit losses in productivity (see, e.g., IPCC 1991. (First Assessment Report). Climate Change: IPCC Response Strategies, Island Press, 1991, p. 199).</p> <p>(Indur Goklany, Office of Policy Analysis, Department of the Interior)</p>	Ditto
19-589	A	31	13		20	<p>The treatment of fisheries is inadequate, especially when one considers El Nino takes its name form the impact of ocean current shifts on Eastern Pacific fisheries.</p> <p>(Aynsley Kellow, University of Tasmania)</p>	space demanded cuts – see Ch.5.
19-590	A	31	13	31	20	<p>I think that is should be mentioned that the sustainability of marine fisheries are already severely compromised by over exploitation (eg Worm et al (2005) Science 309: 1365-1369.)</p> <p>(Janice Lough, Australian Institute of Marine Science)</p>	Ditto
19-591	A	31	14	31	14	<p>See Xenopoulos, M. A., D. M. Lodge, et al. (2005). "Scenarios of freshwater fish extinctions from climate change and water withdrawal." Global Change Biology 11(10): 1557-1564.</p> <p>(William Hare, PIK)</p>	Ditto
19-592	A	31	15	31	15	<p>Add at the end of the sentence '.... Survive, as happens for many marine species with ENSO'.</p> <p>(William Kininmonth, Australasian Climate Research)</p>	implicit already, but cut in rewrite
19-593	A	31	17	31	17	<p>The CO2 increase and ocean acidification also has the potential of impacting marine productivity.</p> <p>(Michael MacCracken, Climate Institute)</p>	Insufficient space
19-594	A	31	19			Chapter 5 suggests that freshwater systems appear to be more vulnerable than	Good point, but insufficient space.

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						marine systems due to geographic discreteness (derived from recent studies of species extinctions, albeit with low confidence). (Günther Fischer, International Institute for Applied Systems Analysis)	
19-595	A	31	22		39	Chapter 5 highlights three key concerns to forestry: (i) altering species composition and productivity of commercial growing stock; (ii) shift in boundaries of insect species and consequently more frequent and severe events of insect damage; (iii) increased fire frequency and intensity. Nevertheless, it is concluded that due to the fact that the share of wood supply obtained from plantations is increasing and the opportunities for improved management and adaptation it is expected that global wood supply is not at risk due to climate change in 21st century. (Günther Fischer, International Institute for Applied Systems Analysis)	Section rewritten. As not a KV doubt if we need this detail, worthy as it is. See Ch.5.
19-596	A	31	22	31	39	See recent reviews showing problems in some areas eg Medit. region. tropics and sub tropics Maracchi, G., O. Sirotenko, et al. (2005). "Impacts of present and future climate variability on agriculture and forestry in the temperate regions: Europe." Climatic Change 70(1-2): 117-135. Sivakumar, M. V. K., H. P. Das, et al. (2005). "Impacts of present and future climate variability and change on agriculture and forestry in the arid and semi-arid tropics." Climatic Change 70(1-2): 31-72. Zhao, Y. X., C. Y. Wang, et al. (2005). "Impacts of present and future climate variability on agriculture and forestry in the humid and sub-humid tropics." Climatic Change 70(1-2): 73-116. (William Hare, PIK)	Ditto
19-597	A	31	22	31	39	19.3.2.4 Are windstorms worth mentioning here? (Glenn McGregor, King's College London)	Insufficient space. In Ch.5?
19-598	A	31	24	31	39	Another problem with the assumptions in this paragraph is that I do not think that it considers that land area suitable for forest growth may decrease where rainfall decreases and ET increases in excess of a threshold that will support trees i.e. we may experience a conversion to shrub or grassland if effective soil moisture is decreased near the current forest boundaries that exist because of current moisture limitations. (Thomas Huntington, U.S. Geological Survey)	Agree, but as above?
19-599	A	31	24	31	39	The studies on CO2 fertilisation referred to above are relevant also here. (Jouni Paavola, University of East Anglia)	Ditto
19-600	A	31	26	31	26	Does this finding apply to forests everywhere, or just in some regions? (Michael MacCracken, Climate Institute)	See Ch 4
19-601	A	31	35	31	35	Add into the sentence, '... ozone, a product of urban pollution, can ...'	To detailed.

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						(William Kininmonth, Australasian Climate Research)	
19-602	A	31	36	31	36	What rate of sea level rise can mangroves tolerate? Harasawa (2005) suggest magnitude of 45cm only can be tolerated but does not give timescale. Emphasize protective value of mangroves (and saltmarsh) to coasts, in protecting from storm surges and hurricanes. (Rachel Warren, Tyndall Centre)	Too detailed
19-603	A	31	41			Section 19.3.2.5 lacks references as well -- nearly the entire section is written without reference to any literature. (Brian O'Neill, IIASA and Brown University)	We are relying on reference to other chapters.
19-604	A	31	43	31	43	Replace 'increases in tropical cyclone intensity' by 'changes in tropical cyclone intensity and distribution, ...' (William Kininmonth, Australasian Climate Research)	Ditto
19-605	A	31	43	31	45	Include changes in ocean chemistry in list. (Janice Lough, Australian Institute of Marine Science)	Yes, ditto
19-606	A	31	43	31	47	This paragraph should also mention the potential impacts of changes in the CO2 concentration, affecting plants and ocean acidification. Maybe also mention storm damage to corals, etc. (Michael MacCracken, Climate Institute)	Yes, ditto
19-607	A	31	47	31	50	Knutson's is a prediction of changes in hurricanes due to climate change whilst Emanuel's is perhaps? an observed change not attributed? (Rachel Warren, Tyndall Centre)	p.32, lines 27---. Webster et al (2006) do attribute to SST increase.
19-608	A	31	49	32	2	Urban renewal will be another choice. According to the archeological excavation of Japanese cities, ground level has been constantly heightened since 400-800 years ago, by repetitive urban disasters (flood with sand, earthquake, urban fire, etc.) which append materials on ground, and the height reaches 2-6m on the original ground when the city was started. Even though frequency of the catastrophic disaster reduced today, the length of urban houses/buildings are relatively short (20-40 years) and frequently re-constructed (scrap and build). This is problematic for mitigation issue (emission), however implies possibility of gradual upraising of urban ground level. The situation seems to be common to many Asian cities. In mega-cities in Japan, large-scale reclamation, disposing urban garbages is creating new artificial islands, which has enough height against flooding. However, rather in inner area, that was previous water front that has recorded several meters of land subsidence (mainly caused by ground water usage for factories which is already regulated today), the land level is lower than the engineered water front area, and the houses are protected by polders and pumps today. (Hideyuki Kobayashi, Ministry of Land, Infrastructure and Transport)	This is a bit stretching things. Depends on the rate of SLR, but also does not apply to many large deltaic areas which are not all cities but well-populated. Must also consider other stresses adding to subsidence such as withdrawal of groundwater and oil and gas, loss of sediments due to upstream dams, etc. Margin al effect of SLR may be magnified by tipping the balance between flooding and no flooding. See Jeff Hecht in New Scientists, 18 Feb. 2006, p.8-9 for excellent summary and numbers at risk (based on Ericson, in press, Global and Planetary Change)..

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19-609	A	31	49	31	49	Is it possible to give a percentage of the world's population at risk (eg within xkm of the coast)? (Janice Lough, Australian Institute of Marine Science)	Yes – see previous comment reply.
19-610	A	31	50	31	50	After 'sea level rise' add 'and changing flood regimes.' (William Kininmonth, Australasian Climate Research)	Yes.
19-611	A	32	1			“that killed 27-40000 people” Are these numbers correct? If so what is a meaning of 27? (Hideo Harasawa, National Institute for Environmental Studies)	Now estimated at 50,000.
19-612	A	32	2	32	3	This also applies to Chesapeake Bay. (Michael MacCracken, Climate Institute)	Yes but too detailed
19-613	A	32	2	32	4	Examples of subsiding coastal areas could be more generic -- sediment-starved deltas and coastal cities where groundwater is being pumped. Interestingly in an old analysis of subsiding megacities (Nicholls, 1995, Geojournal) -- all cities were protected and there was no evidence of forced abandonment despite dramatic (up to 5 m subsidence!) -- although the risks are still there. (Robert Nicholls, University of Southampton)	Too detailed
19-614	A	32	5	32	5	Replace 'deglaciation' by 'polar ice melt' (William Kininmonth, Australasian Climate Research)	Good suggestion, if GIS is polar.
19-615	A	32	5	32	5	Need to change "may" (Michael MacCracken, Climate Institute)	2 nd “may” could be “would”
19-616	A	32	6			Add "over centuries" at the end of the sentence that terminates on line 6. [See previous comments on this matter.] (Indur Goklany, Office of Policy Analysis, Department of the Interior)	e.g. New Orleans?
19-617	A	32	7	32	7	Why should it be assumed that existing sea defences will be "overwhelmed"? As commented elsewhere in the report adaptation is certainly possible (though its implementation may be patchy). Simply stating that existing sea defences will be "overwhelmed" is potentially misleading. (Jim Hall, University of Newcastle upon Tyne)	ditto. Plus many non-urban cases, and poorer communities than New Orleans. Is not meant to mean everywhere, but in many places
19-618	A	32	11	32	11	Change to '... risk from rapid sea level rise'. (William Kininmonth, Australasian Climate Research)	Almost any SLR will adversely affect many atolls, which already suffer at king tides.
19-619	A	32	13	32	13	I would urge changing "human populations" to "human populations and their communities"--and this is already happening in the Arctic (Alaska in particular) (Michael MacCracken, Climate Institute)	Distinction not clear
19-620	A	32	16	32	21	The "high confidence" tags are used so sparsely that there is no consistent way of interpreting them as applying to either an entire paragraph or just the sentence immediately preceding. This needs to be clarified here, and elsewhere. (Paul Baer, Stanford University)	Agree

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19-621	A	32	16	32	17	Modify this sentence to read: "Mangroves, coastal wetlands, freshwater coastal wetlands, and coastal forests are all vulnerable IF THE RATE OF sea level rise, which causes erosion, submergence, and salt-water intrusion, IS SUFFICIENTLY RAPID." See comment No. 47. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	This is semantics. Almost any SLR will have some adverse effects. Would need to specify what is meant by rapid – say 0.1 m/century.
19-622	A	32	22			Insert "rapid" prior to "sea level rise" (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Ditto
19-623	A	32	22	32	31	Not sure whether this is the right place but I suggest that some reference be made to the health impacts of wildfires eg those that affected Indonesia in 1997-98 El Nino event. (Janice Lough, Australian Institute of Marine Science)	Insufficient space
19-624	A	32	24	32		What about those areas being made more vulnerable by migration Tourism etc – destruction of mangroves for development. These are Factors heightening potential vulnerabilities to climate risk and other risks e.g. tsunami????! (Coleen Vogel, University of the Witwatersrand)	Insufficient space
19-625	A	32	27			It should be noted that Knutson and Tuleya asumed that CO2 concentrations would increase at the rate of 1% per yr. The last time I checked, CO2 concentartions had increased at the rate of 0.44% /yr between 1959 and 2004 (using Mauna Loa data from CDIAC. The highest annual increas was 0.75% (for 1996). For 1989-2004, the growth rate was 0.45%/yr. Therefore, it seems that K & T may have overestimated the increase in wind speed. The reader is owed not only a reporting of their results but also a critical evaluation of the study's strenghts and weaknesses. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Reviewer is mistaken. K&T assumed a 1%/yr increase in radiative forcing. That is well established.
19-626	A	32	27	32	28	I think the main point from this work is the predicted large increase in the frequency of the more intense storms (cat 4 and 5) (William Hare, PIK)	Agree
19-627	A	32	27	32	27	Change to '...vulnerable to changes in the frequency and intensity of tropical cyclones.' (William Kininmonth, Australasian Climate Research)	Increase in intensity and possible changes in frequency and location of...
19-628	A	32	27	19	30	Is it possible to include some comments relating to the impacts of Hurricanes Katrina and Rita in 2005? (Janice Lough, Australian Institute of Marine Science)	Insufficient space to discuss these; although mention is made of some recent extreme evnts
19-629	A	32	27	32	30	I'd check with WG1 on the precise words on tropical cyclones. Indeed, it would be good if most of the science issues could simply be referenced back to WG1. (Michael Manton, Bureau of Meteorology Research Centre)	Yes, if WGI is up to date on this.

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19-630	A	32	29	32	30	My reading of Emanuel's paper is that it is the power of cyclones (power being a nonlinear function of wind speed, integrated over affected surface area and duration) that has increased over the last 30 years, but that the observed increase is considerably larger than would be predicted by the amount of warming that has been observed. This suggests that there are processes involved that we still do not understand and that nasty surprises are possibly in store. (Stephen De Canio, University of California, Santa Barbara)	Agree but insufficient space to address
19-631	A	32	29		30	Emanuel (2005) surely covers far too short a period to include as being relevant to long-term changes in cyclone patterns, especially when the same author is a co-author of a forthcoming paper in BAMS (Pielke, Landsea, Emanuel, Mayfield, Laver and Pasch, in press) that apparently states that 'claims of linkages between global warming and hurricanes are misguided...' (Aynsley Kellow, University of Tasmania)	The paper by Webster et al (2006), taken with the Emanuel study, is by far more convincing than either one alone—and they find similar effects in both Atlantic and Pacific—not likely to be a regional normal mode shift that coherent. We don't assign it high confidence, however, as it is early returns..
19-632	A	32	29	32	29	Emmanuel (2005). This paper has drawn a lot of attention and has been subject to considerable scrutiny ! (Glenn McGregor, King's College London)	Yes it has!
19-633	A	32	30			Add a sentence at the end as follows: "However, deaths and death rates due to hurricanes in the US from 1900-2004 have declined (Goklany, personal communication, 2005). This is consistent with Goklany's (2000) examination of trends from 1900-1997. Regarding U.S. property losses, once corrections are made to account for increases in the property at risk, there is no trend up or down in property losses [Goklany (2000); Roger A. Pielke, Jr., and Christopher W. Landsea, Normalized Hurricane Damages in the United States: 1925-95," Weather and Forecasting, American Meteorological Society 13: 621-631 (1998)]. These trends suggest that either the hurricanes have not gradually become more intense or other socio-economic factors have more than counteracted any such increase in intensity." NOTE: I'll fax the figures on hurricane deaths, death rates, and property losses to the phone number provided in the front. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Correct, although 1900 had the most deadly hurricane. Would be interesting to see analysis with 2005 included. Insufficient space to address in detail
19-634	A	32	32	34	1	The view of societies as static is at it worst here. There is an extensive literature (especially by Paul Reiter) on the importance of socio-economic factors in disease incidence, but it is ignored. The statement that 'economic growth does not lead necessarily to reduced vulnerability to the health damaging effects of climate change'(p33 lines 42-44) is disingenuous in the extreme. I would challenge the author of that statement to provide any evidence that multidecadal economic growth of the magnitude contained in any of the SRES scenarios has EVER not led	Discussion on development and potential for adaptation is being revised.

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						to improvements in the technical, financial and political capacity of any society to adapt better to health risks (or any other risks). Of course it is true, but banal, to state that distribution and education are important, but I know of no society where improvements in these have not followed significant prolonged economic growth. So it matters less that 'important prerequisites for adaptation' are currently not met in many locations than how quickly they will develop relative to rates of climate future change. The 'reference case' of the present is not meaningful to future risks. (Aynsley Kellow, University of Tasmania)	
19-635	A	32	32	32	32	Section would improve with a brief introductory statement about the relationship between health, education and available medical services. In some parts of the world certain diseases that were previously endemic are now controlled by public health measures and personal hygiene. This applies to malaria that was endemic through Europe, Russia and many parts of North America. (William Kininmonth, Australasian Climate Research)	Discussion has been shortened, but we do briefly discuss importance of development
19-636	A	32	32	34	1	Human health section addresses the appropriate issues and in a balanced fashion - and is consistent with conclusions of chapter 8. However, some specific examples of thresholds could be included that are relevant to health of certain populations - it is important to bring out the idea that some populations will have threshold exceeded sooner rather than later... . E.g. the example of malaria moving up highland areas to affect populations not previously affected, and the population displacement triggered by flooding or inundation. It should also be made clear that health effects in general get steadily worse as climate change increases- and at some point will be seen as unacceptable. Add ref. Kovats, Campbell-Lendrum, Matthies, RiskAnalysis, in press. (Sari Kovats, London School of Hygiene and Tropical Medicine)	Health is more briefly discussed in SOD. Details left to Ch. 8
19-637	A	32	34	32	35	Climate sensitivity relates to both the frequency and severity of attack and the difficulty to control. Climate variability or change do not necessarily imply more outbreaks but may be increased cost to control. (William Kininmonth, Australasian Climate Research)	Could be both
19-638	A	32	34	34	1	Studies on famines referred to in comment 19 are relevant also here. More generally speaking, issues of equity are equally important here as in the context of food production: health impacts are likely to be unequally distributed both globally and within nation states. On the global magnitude and incidence of direct and indirect health impacts due to climate change, see Bosello et al. (2005) Economy-wide estimates of the implications of climate change: human health. Ecological Economics, in press, available online. Impacts of heatwaves in Europe and in North America have also fallen more heavily on vulnerable groups of people. See e.g.	Will mainly leave to Chapter 8

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						Klinenberg, E. (2002) Heat Wave: A Social Autopsy of Disaster in Chicago. Chicago: University of Chicago Press; Schär, C., and Jendritzky, G. (2004) Climate change: hot news from summer 2003, Nature, 432, pp. 559-560. (Jouni Paavola, University of East Anglia)	
19-639	A	32	35	32	35	Many of these estimates assume stationarity between climate and health when in fact much of global society is becoming less climate sensitive (Glenn McGregor, King's College London)	Will briefly discuss under adaptation; leave details to Ch 8.
19-640	A	32	38	32	46	Recognizing that this chapter is based on the ZOD of earlier chapters, the discussion of malaria has to be brought in line with the discussion of the disease presented in Chapters 8 and 18. Chapter 8 points out that current estimates indicate that climate change will have less of an effect on malaria risk than indicated in the TAR. It also indicates that some of the increase in malaria reported recently appears to be more due to increased precipitation than to increased temperature. As such, areas in Africa that are projected to become drier will have a lower risk of malaria than they currently do. Chapter 18 makes the point that raising income provides the resources needed to control malaria. As has been pointed out many times, most developed countries, including the U.S., have climates conducive to malaria, but have brought the disease under control. All of the SRES scenarios project a significant increase in income for developing countries, including the poorest ones. (Lenny Bernstein, IPIECA)	Consider carefully with X-refs. This section is now drastically cut in any case.
19-641	A	32	38	32	39	Although malaria is being reported at higher altitudes there is some discussion about the role of climate change so this example could be misinterpreted. Could make general point that there is evidence of human and animal diseases responding to observed climate change and cross ref to chapter 8. (Sari Kovats, London School of Hygiene and Tropical Medicine)	Ditto
19-642	A	32	38	32	38	Malaria can not be treated simply as a function of climate. In many parts of the world malaria follows development. For example in the highlands of Papua New Guinea malaria followed new transport routes associated with coffee and forestry therefore the altitudinal expansion of malaria has had little to do with climate (Glenn McGregor, King's College London)	Insufficient space to address
19-643	A	32	38	32	39	Malaria may or may not be spreading to the highlands of Africa, and climate change may or may not contribute to this. Either omit or represent the literature. (Richard S.J. Tol, Uni. Hamburg)	SOD will be less specific on current malaria; will leave details to Ch 8.
19-644	A	32	44			Add a new sentence that reads: "However, based on Arnell et al. (2002), Goklany (2003) estimates that the contribution of CC to the total population at risk for malaria would be quite small (3.2%) at least through 2085. Notably, malaria is the most significant of the climate-sensitive parasitic diseases)."	The reviewer thinks 3% is small. If global population reaches 10 billion people (which is not certain), population at risk would be 300 million. Few would argue that is a small risk.

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						(Indur Goklany, Office of Policy Analysis, Department of the Interior)	
19-645	A	32	49	32	50	Qualify with 'mostly elderly people (William Kininmonth, Australasian Climate Research)	Insufficient space
19-646	A	33	0			2nd and 3rd paras. "New studies from a wide range of countries provides...." "For instance, concentrations of ground level ozone...." "The changing seasonal pattern of aero-allergens...." References are necessary to these sentences (Hideo Harasawa, National Institute for Environmental Studies)	Now greatly cut. Use X-refs to Chapters.
19-647	A	33	1	33	4	This statement is not substantiated as most of the elderly were at risk in poorly designed accommodation. Preparation through artificial cooling and care would likely offset the risk and minimise deaths. (William Kininmonth, Australasian Climate Research)	Adaptation in general terms will be discussed; details left to Ch 8.
19-648	A	33	2	33	4	Delete this sentence. It is incorrect, as it is almost certain that previous natural climate changes, such as the Little Ice Age, caused many deaths. See Fagan, B., (2000): The Little Ice Age: How Climate Made History 1300-1850. Basic Books, 246 pp. for a detailed history of climate impacts in Europe over the period. This history details many famines and similar fatal occurrences due to climate change. (Lenny Bernstein, IPIECA)	Point is not relevant
19-649	A	33	2	33	3	drop: "suggests that" The "may" in the sentence conveys the uncertainty. (David Major, Columbia University)	Discussion shortened
19-650	A	33	10	33	10	Insert '... malnutrition linked to changed rainfall patterns that exacerbate drought and flooding ...'. (William Kininmonth, Australasian Climate Research)	Insufficient space to address
19-651	A	33	10	34	1	This part of the section on health is similarly unreferenced, even though many statements of likelihood are made. If the strategy in this section (and the others in the above two comments) is to draw on material in other chapters, it should be noted explicitly and readers pointed to the specific locations. (Brian O'Neill, IIASA and Brown University)	Will reference Ch 8
19-652	A	33	15			Insert the following sentence at line 15: "Goklany (1995, 2000) notes that these decreases can be ameliorated in the future through trade, just as current food deficits are alleviated today" (Indur Goklany, Office of Policy Analysis, Department of the Interior)	We will briefly discuss importance of development; can't address all consequences in limited space
19-653	A	33	16	33	18	There are no references provided for the studies alluded to over here. Moreover there should be some acknowledgement that in the future, existing technologies such as refrigeration and better packaging should be more widespread if nations indeed get richer as is assumed in the SRES scenarios. Moreover one should expect that there would be new technologies to accurately and cheaply detect contaminated foodstuff. Accordingly, I would modify these lines as follows: "New studies from a	SOD briefly discusses importance of development

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						wider range of countries provide evidence that increases in daily temperature will, IF ALL ELSE IS EQUAL, increase the number of cases of some common forms of food poisoning in temperate regions. ON THE OTHER HAND, THIS WOULD BE COUNTERACTED BY GREATER DIFFUSION OF EXISTING TECHNOLOGIES (SUCH AS REFRIGERATION AND BETTER PACKAGING, AND NEW TECHNOLOGIES TO CHEAPLY AND ACCURATELY DETECT SPOILAGE, PARTICULARLY IF INCOME LEVELS IN DEVELOPING COUNTRIES RISE PER THE SRES' SCENARIOS." (Indur Goklany, Office of Policy Analysis, Department of the Interior)	
19-654	A	33	22	33	23	See comment 69. It can't be assumed that communities that lack infrastructure today will also lack it in the future. I won't belabor this any further, but suffice it to say that this oversight is systemic in this chapter. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	We do not assume that, but flooding is already increasing in many developed parts of the world.
19-655	A	33	22	33	23	Flooding can also be destructive where public infrastructure already exists. (William Kininmonth, Australasian Climate Research)	Good point.
19-656	A	33	23	33	26	Increased precipitation would tend to counteract, at least partly, increases in ozone and allergens. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Most precipitation increase are in heavy rain events, not spread over all pollution events.
19-657	A	33	30	33	31	There should be some acknowledgement here also that in the future adaptive capacities should be greater, particularly if the SRES' assumptions regarding economic growth and technological change hold up. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Adaptation is mentioned.
19-658	A	33	33	33	35	The impacts during ENSO extremes is a guide to health impacts that might be exacerbated by climate change. (William Kininmonth, Australasian Climate Research)	Insufficient space to address; will leave details to CH 8.
19-659	A	33	33	33	50	References! Please give attribution or cite sources. (Coleen Vogel, University of the Witwatersrand)	General X-refs.; section has been substantially cut
19-660	A	33	35	33	38	The MDGs will probably not be met by 2015, but they might be met by, say, 2050. I would argue that if health-related MDGs are not met, then the health impacts of CC will automatically look less important. See comment 23. In other words, if problems of the highest priority are solved, then lower priority problems would automatically rise higher. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	We disagree with the logic here. The reviewer states that development will make climate change a minor consideration. If development does not happen as reviewer has assumed, will not climate change have much larger impacts?
19-661	A	33	40	33	41	It is stated that "[o]ver the next 50 years approximately 3 billion people will be added to the global population" as if that were a fact, when actually it is just a forecast. Population forecasts have historically been characterized by large errors (Shlyakhter and Kammen 1992), so this statement should be qualified considerably	Yes; section has been cut

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						(Stephen De Canio, University of California, Santa Barbara)	
19-662	A	33	42	34	1	I would recommend the following rewrite: "But IF economic growth IS SKEWED OR IF SEGMENTS OF SOCIETY SEE LESS GROWTH THAN OTHERS, THEN THAT SOCIETY MAY NOT GET THE FULL BENEFIT OF THAT ECONOMIC GROWTH, AND SOME SEGMENTS MAY SEEN LOWER REDUCTION IN VULNERABILITY THAN OTHERS to the health damaging effects of climate change. A FACTOR AFFECTING THESE REDUCTIONS ARE the distribution of the benefits of growth, and trends in other factors such as education that have a strong, independent effect on health status. There are important prerequisites for adaptation that are currently not met in many parts of the world. For instance, access to primary health care and basic education are essential elements of strategies to cope with climate change, but are not available to millions of people. Public awareness, good use of local resources, effective governance arrangements and community participation are all required to mobilize and prepare for climate change. WHILE these present particular challenges in resource-poor communities TODAY, THESE CHALLENGES COULD BE AMELIORATED IN THE FUTURE IF THERE ARE BROAD ADVANCES IN ECONOMIC DEVELOPMENT, HUMAN CAPITAL AND THE PROPENSITY FOR TECHNOLOGICAL CHANGE." (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Existing text recognises possible increase in adaptive capacity. Some fine tuning would help, and has been done during rewrite. Insufficient space to address this in detail.
19-663	A	33	43	33	43	"necessarily lead to" is better (David Major, Columbia University)	Yes
19-664	A	33	49			how about "hundreds of millions"? (Paul Baer, Stanford University)	Yes
19-665	A	34	1	34	1	Resource-poor' is an ill-defined concept. Many poorer countries do have resources but they are undeveloped or the benefits do not flow through to the national population. (William Kininmonth, Australasian Climate Research)	Insufficient space to address
19-666	A	34	1	34	46	Add fisheries at risk in Rift Valley especially Malawi (Rachel Warren, Tyndall Centre)	Consider, but space limit
19-667	A	34	4	41	13	It's problematic to me that some sections (e.g., Africa) start with vulnerabilities of people, where others (e.g., Latin America) start with biodiversity. This implicitly suggests that people in Latin America are less important than biodiversity of the rainforest. I'd create a parallelism, focusing on human vulnerabilities first in all regions. (Paul Baer, Stanford University)	Addressed in rewrite and shortening
19-668	A	34	4			This section does not really address the problems that are likely to arise due to	cross-border issues are in Table 19.2, but

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						coupling among regions (economic and market interdependencies, shared resources like fisheries and migrating species, health threats, environmental refugees, etc.) (Michael MacCracken, Climate Institute)	space limits
19-669	A	34	4	41	13	19.3.3 Like 19.3.2 this section is very repetitive of previous chapters. Could this section be reduced to a table summarising the KVs by region? (Glenn McGregor, King's College London)	has been drastically reduced
19-670	A	34	4	44	42	The text indicates that key regional impacts will be discussed. However, currently the text does not offer robust enough reasoning WHY (and whether indeed) the discussed issues are the key regional impacts. This problem is mostly presentational but may also require amendments to the content. As it currently stands, the text moves from one impact to the other, without providing much in terms of scoping or justification for choosing to focus on the now discussed impacts. The "checklist" of impact categories underlying analysis could well be briefly (re)discussed in the beginning of the regional section, indicating that only those items of the list deemed most important for each region will be discussed. Judgement regarding key impacts could start discussion on each region. On its face, the regional impact assessment leaves a feeling of giving relatively large weight on impacts to non-humans. Or, the other way round, I see a clear need to focus more on impacts on humans and human systems in the impact assessment. (Jouni Paavola, University of East Anglia)	rewritten and cut, based on chapters and x-refs.
19-671	A	34	6	34	10	This has to be the right approach. Some of the previous sections could benefit from a similar focussed cutting back. (Chris Hope, Judge Business School)	Praise
19-672	A	34	6	34	10	Add at the end 'especially because of exposure, sensitivity and limited capacity to adapt.' (William Kininmonth, Australasian Climate Research)	Rewritten
19-673	A	34	9			A vulnerability is either unique or not unique; it cannot be 'particularly unique.' (Aynsley Kellow, University of Tasmania)	disagree, there are aspects that may be unique to regions
19-674	A	34	12	35	23	Africa's water resources would merit a paragraph in this subsection, in part because resources impacted by climate change in Africa are intimately interlined. Warming and changes in precipitation patterns change agricultural seasons, hydrological cycles and land cover. Increased seasonality of watercourses has implications for agriculture but also for human settlements and human health: low per capita consumption is directly associated with adverse health outcomes through the level of hygiene it makes possible. See particularly Thompson, John and Cairncross, Sandy (2002) Drawers of water: assessing domestic water use in Africa. Bulletin of World Health Organisation 80: no.1, p.61-62 and references in this short article.	Insufficient space; will leave to Ch 9.

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						(Jouni Paavola, University of East Anglia)	
19-675	A	34	12	35	23	Africa's vulnerability is largely due to its poverty. The climate change scenarios that would hurt Africa all assume that Africa will not be poor in 2050. (Richard S.J. Tol, Uni. Hamburg)	Disagree; A2 scenario may not raise incomes in Africa sufficiently to reduce risk. Even under high growth scenarios, distribution of income is not clear.
19-676	A	34	22			“African core climate change scenario” What is core? (Hideo Harasawa, National Institute for Environmental Studies)	line 30? Not in rewrite
19-677	A	34	22	34	22	Add after 'desertification', 'intermittent flooding' (William Kininmonth, Australasian Climate Research)	Rewritten
19-678	A	34	28			This para should note that the drop in per capita food production in Sub-Saharan Africa are due to a combination of factors including civil and cross-border strife, resurgence of malaria, AIDS, poor governance, lack of economic growth aggravated in some places by climatic variability. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Discussion substantially reduced; details left to Ch 9.
19-679	A	34	33	34	33	5% drop in rainfall would be associated with what kind of T change according to which GCM? (Rachel Warren, Tyndall Centre)	p.35, line 10. Not in rewrite.
19-680	A	34	35	34	35	I think Hannah 2002 has only 20% Karoo left hence extinction risk at 2.4C above preindustrial if link local T change to HadCM3 global pattern. Also ref point of 1990 is used here which is not mentioned on page 16 where ranges of years e.g. 1990-2000, or year 2000, are mentioned. (Rachel Warren, Tyndall Centre)	Not in rewrite
19-681	A	34	36	34	38	This is the only place where I've noticed that whether something can be considered a key vulnerability or not is given a confidence estimate. (Paul Baer, Stanford University)	Did give confidence
19-682	A	34	45	34	50	This para should be modified to correct the misimpression it conveys that Africa's current malaria problem had something to do with climate change. But as noted on p. 32, it isn't clear whether, or to what extent, that has to do with CC. It is more likely that the resurgence is due to a combination of factors including cessation of indoor spraying of DDT in some places (see, e.g., Goklany 2001: 15-18); AIDS, hunger and malnutrition which exacerbate the consequences of malaria; and poor governance which resulted in lack of resources for dealing with malaria, although it is one of the least costly diseases that a resource-poor country has to deal with. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	rewrite largely omits
19-683	A	34	45	45	50	Rather a gross exaggeration – not sure if this is strongly substantiated in the literature. E.g. Malaria incidence and response highly debated, in Kenya and elsewhere. Cholera etc.? Is there a direct	rewrite relieves problem

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						link climate – debated!! Also shown/ argued to be linked to management, development etc.!! We need to be careful here in over-attribution of certain vulnerabilities. If we are certain then substantiate with actual sources! (Coleen Vogel, University of the Witwatersrand)	
19-684	A	35	1	35	3	Malaria is not only a function of temperature. The mosquito habitats require still water bodies also. The claim should be substantiated in terms of projected temperature and rainfall patterns. (William Kininmonth, Australasian Climate Research)	Ditto
19-685	A	35	3	35	11	(Nyong, 2005) - Cite original source. (WWF 2000) This key reference not in the reference list. (Coleen Vogel, University of the Witwatersrand)	Not in rewrite
19-686	A	35	7			See above comments on Thomas et al. 2004. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Not in SOD
19-687	A	35	8	35	13	What does the "anticipated 5% drop in rainfall" refer to -- what scenario, model, how robust is the result, etc? Is the 1 C warming above 1990 for local or global temperatures? (Brian O'Neill, IIASA and Brown University)	not in rewrite
19-688	A	35	11	35	12	Are the quoted temperature increases (here and elsewhere in text referring to obviously regional impacts) regional or global? (Jim Hall, University of Newcastle upon Tyne)	Will try to be consistent in referring to GMT
19-689	A	35	21	35	22	Change sentence to '.. Climatic changes and an increasing amplitude of variability may, as well, trigger much larger and more frequent ...'. (William Kininmonth, Australasian Climate Research)	Rewritten
19-690	A	35	24	35	24	Is the disappearance of Kilimanjoro glacier worth mentioning? (Janice Lough, Australian Institute of Marine Science)	Insufficient space; will leave to Ch 9
19-691	A	35	25	36	31	The Asia section makes no mention whatsoever of Japan. (Jim Hall, University of Newcastle upon Tyne)	Insufficient space
19-692	A	35	28	35	28	'Asian societies have built up considerable experience..' – likewise in Africa, when referring to Africa, often the sense of victims given with No sense of 'agency' – we need to be consistent and fair. (Coleen Vogel, University of the Witwatersrand)	rewritten, but good point
19-693	A	35	30	35	30	Include China and Vietnam in the list of countries. (William Kininmonth, Australasian Climate Research)	Discussion has been substantially reduced
19-694	A	35	40	35	40	Is this a global or a local T increase and is ref point still 1990-2000	Will be consistent

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						(Rachel Warren, Tyndall Centre)	
19-695	A	35	43	35	43	Add at the end of the sentence', and pointing to the need for targetted interventions.' (William Kininmonth, Australasian Climate Research)	rewritten and cut
19-696	A	35	44	35	44	Cereal production predictions for S Asia are for what climate scenario? (Rachel Warren, Tyndall Centre)	Not in SOD
19-697	A	35	47	35	47	Add "tropical" before "cyclones" (Janice Lough, Australian Institute of Marine Science)	Agree
19-698	A	35	48	35	48	Add "tropical" before "cyclone" (Janice Lough, Australian Institute of Marine Science)	Ditto
19-699	A	36	1	36	3	Again rather impacts focused as opposed to vulnerabilities. (Coleen Vogel, University of the Witwatersrand)	Aren't such events indicative of vulnerability, e.g., the European heat wave?
19-700	A	36	5	36	6	This is better! (Coleen Vogel, University of the Witwatersrand)	Great
19-701	A	36	9	36	10	a temperature increase of 0.5°C and reduced precipitation could reduce grassland productivity by 6–32%, and by 40–90% if temperature increase by 2–3°C (Smith et al., 1996), the results mainly are due to the reduced precipitation rather than temperature increased, so if the scenarios for increase precipitation and result reducing grassland productivity may more persuasiveness (Lin Erda, Chinese Academy of Agricultural Sciences)	cut, but nothing needed anyway
19-702	A	36	12			Doesn't deforestation contribute to this? (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Yes
19-703	A	36	12	36	12	See the projections for Himalayan deglaciation in Bohner, J. and F. Lehmkuhl (2005). "Environmental change modelling for Central and High Asia: Pleistocene, present and future scenarios." Boreas 34(2): 220-231. and also a sample of observations Kulkarni, A. V., B. P. Rathore, et al. (2005). "Alarming retreat of Parbati glacier, beas basin, Himachal pradesh." Current Science 88(11): 1844-1850. A real bummer. See also deglaciation projections for China Yafeng, S. and L. Shiyin (2000). "Estimation on the response of glaciers in China to the global warming in the 21st century." Chinese Science Bulletin 45(7): 668-672. (William Hare, PIK)	Insufficient space; will leave to Ch 10
19-704	A	36	12	36	16	What is the evidence that deglaciation has resulted in flooding? There is also a lack of logic in the following statements. If global warming is increasing snowmelt then it is causing a draw-down on the ice pack reserve thus improving runoff. Ice in the reserve is not otherwise available for usage. Presumably if the ice pack is in balance the rivers are currently drawing on seasonal accumulation. (William Kininmonth, Australasian Climate Research)	Does not understand. Seasonal and inter-annual reserve/storage vital. Glacial outbreak floods well documented.

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19-705	A	36	12	36	16	Interaction of impacts with "deforestation"? (Janice Lough, Australian Institute of Marine Science)	Yes
19-706	A	36	18	36	25	See comment 69. Asia's adaptive capacity should be much improved in the future. Enhancing its adaptive capacity further is that Asia seems to be embracing GM technology, and thereby not foreclosing its technological options. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	This is a statement about biophysical sensitivity; where is literature that disproves it
19-707	A	36	18	36	31	The key vulnerability in this region would seem to be population increase rather than climate change. The latter is more of an exacerbation of an underlying problem. (William Kininmonth, Australasian Climate Research)	IPCC is about CC
19-708	A	36	19	36	19	please add "if no CO2 fertilization and any adaptation" (Lin Erda, Chinese Academy of Agricultural Sciences)	"could" covers the obvious
19-709	A	36	19	36	19	Re the Lin et al work (not in the references) but I think this refers to a scenario where CO2 fertilization does not work. Check this. Also note that this view is not universally shared eg Liu, H., X. B. Li, et al. (2004). "Study on the impacts of climate change on China's agriculture." Climatic Change 65(1-2): 125-148. which concludes "In summary, all of China would benefit from climate change in most scenarios." (William Hare, PIK)	Good point, but discussion on Asian agriculture been eliminated to save space
19-710	A	36	26	36	31	Are there any available studies on taiga to add? (Alexander Golub, Environmental Defense)	Insufficient space
19-711	A	36	27	36	27	Add "tropical" before "cyclones" (Janice Lough, Australian Institute of Marine Science)	Yes
19-712	A	36	27	36	27	Hare's 2C refers to pre-industrial I think, not 1990-2000, also make clear if global/local. The Barrier Reef, according to Hoegh Guldberg 1999 is at high risk for T increases less than 1C, since he looks at the next 20 to 30 years with IS92a which implies only small T increases (Rachel Warren, Tyndall Centre)	p.38, line 4? Yes.
19-713	A	36	29	36	31	These themes need expansion – these are some of the vulnerabilities that We need to profile and to highlight. (Coleen Vogel, University of the Witwatersrand)	Goes in cross-border issues in table 19.2
19-714	A	36	36	36	36	See also Cai, W. J., G. Shi, et al. (2005). "Multidecadal fluctuations of winter rainfall over southwest Western Australia simulated in the CSIRO Mark 3 coupled model." Geophysical Research Letters 32(12): -. (William Hare, PIK)	water supply vulnerability in Australia is a regional KV. Space?
19-715	A	36	37	36	37	...risk. Australian...	yes, if not cut

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						(David Major, Columbia University)	
19-716	A	36	38	36	41	Australia is not any different from anywhere else in having "economically and socially disadvantaged groups of people", except that it has less of them than most places. I'm not sure it makes sense to point that out specially here. (Paul Baer, Stanford University)	it is in the ANZ chapter and is significant.
19-717	A	36	41	36	43	'but Australia has a high capacity to adapt' – Expand, how in what areas, what capacities etc. (Coleen Vogel, University of the Witwatersrand)	space limited – see chapter
19-718	A	37	2	37	2	"alpine regions" rather than "glaciers" (Janice Lough, Australian Institute of Marine Science)	Yes
19-719	A	37	5	37	5	Differently to what? Add "across Europe" after current climate. (Rachel Warren, Tyndall Centre)	Where?
19-720	A	37	6	37	6	Add predicted losses in endemic species (Janice Lough, Australian Institute of Marine Science)	space?
19-721	A	37	10	37	11	What is the evidence for increased failure of hydrodams in New Zealand? (William Kininmonth, Australasian Climate Research)	now removed, but see chapter
19-722	A	37	11	37	13	Also impacts due to projected increases in tropical cyclone intensity and associated storm surges (Janice Lough, Australian Institute of Marine Science)	Insufficient space
19-723	A	37	14	37	14	Briefly explain why air pollution levels could increase (Rachel Warren, Tyndall Centre)	no room
19-724	A	37	15	37	16	'...such as fires and floods have....' Not coming across – needs bolstering. (Coleen Vogel, University of the Witwatersrand)	room?
19-725	A	37	15	37	15	Is the 60ppb the peak or the mean exposure? Currently means are increasing and peaks decreasing. (Rachel Warren, Tyndall Centre)	line 41. not in rewrite
19-726	A	37	16	37	16	Include "droughts" in recent events as there is evidence that the intensity of the 2002 drought was exacerbated by higher air temperatures (Janice Lough, Australian Institute of Marine Science)	Insufficient space
19-727	A	37	17	37	18	If these are the most vulnerable people in Australia and New Zealand, its worth explaining what their special "acute" vulnerabilities are. (Paul Baer, Stanford University)	remote, high exposure and poor resources. Insufficient space
19-728	A	37	17	37	18	Non-discriminatory government programs in Australia and New Zealand ensures that indigenous peoples are at no greater risk than other members of the populations. (William Kininmonth, Australasian Climate Research)	not true. Poor health, housing and water supplies, remote, exposed, poor education, poor services

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19-729	A	37	22	37	23	"Many climate models conclude..."? How many? Most of them? Do "many climate models" conclude the opposite? (Paul Baer, Stanford University)	Most
19-730	A	37	22	37	30	Should be better coordinated with Chapter 12. In Chapter 12 a lot is based on the discussion about North Atlantic Oscillation that determines climate in Europe and its vulnerability to climate change. (Alexander Golub, Environmental Defense)	Insufficient space
19-731	A	37	23		27	Especially given the uncertainties inherent in SRES scenarios and GCMs, let alone the absence of reliable regional models, the use of the expression 'will become' - particularly evident here - is inappropriate. (Aynsley Kellow, University of Tasmania)	Very strong consensus in GCM simulations for all SRES scenarios – see WGI consensus map.
19-732	A	37	24	37	24	Stott also calculated the probability that the event could be attributed to anthropogenic causes and obtained ratio 9:1 in favour of anthropogenic cause, though of course this is WGI so best to echo what is written there. (Rachel Warren, Tyndall Centre)	no change needed
19-733	A	37	32			"differently" usually means "differently from something else", rather than "variably within the single category" as it is used to mean here. I would say something like "Agriculture is expected to fare differently in different systems." (Paul Baer, Stanford University)	in different regions, if still included
19-734	A	37	35		49	Again, a curiously static, discombobulated view of society: increased use of air conditioning is to increase energy demand (lines 35-36) but seemingly do little to reduce the risk of heat-related death (lines 44-49). (Aynsley Kellow, University of Tasmania)	Addressed in SOD through discussion about development and vulnerability
19-735	A	37	36	37	36	How exactly would NW Europe be affected? (Rachel Warren, Tyndall Centre)	Insufficient space
19-736	A	37	43	37	43	Suggest numerical examples of bird, amphibian, plant, tree, insect diversity compared to a temperate forest. (Rachel Warren, Tyndall Centre)	Insufficient space
19-737	A	37	44	37	49	The 2003 heat wave event (confined to western Europe, central and eastern Europe were cooler than normal because of the blocking weather pattern) points to the need for application of available technologies to protect the vulnerable elderly. There is no reason to believe that the lessons of the 2003 event will not be learnt and future tragedies avoided. There is a need to be consistent with the statistics when referring to this event in different parts of the text. (William Kininmonth, Australasian Climate Research)	The heat wave points out that large extreme events can overwhelm even developed countries
19-738	A	37	44		47	This repeats pp 32 48 – p 33 2. Is about 35 000 the same as 27-40000 people ? (Ha-Duong Minh, CNRS)	revised

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19-739	A	37	44	37	46	Indeed well developed countries face significant risks from extreme events. (Coleen Vogel, University of the Witwatersrand)	Agree
19-740	A	37	46	37	46	' the heat wave killed..' Did this event expose vulnerabilities inherent in the system – this is key! Again shift the debate off impact to vulnerability (Coleen Vogel, University of the Witwatersrand)	good point. Not well adapted.
19-741	A	37	47	37	47	"35,000", cf 27-40,000 people referred to on Page 32, line 50 (Janice Lough, Australian Institute of Marine Science)	as above
19-742	A	37	47			Consider recently published numbers for Italy too. (Ha-Duong Minh, CNRS)	Insufficient space
19-743	A	38	2	38	2	Is 2C local or global and is this still above 1990-2000? (Rachel Warren, Tyndall Centre)	Clarified
19-744	A	38	4	38	4	How many tree species is this? (Rachel Warren, Tyndall Centre)	Insufficient space
19-745	A	38	8	38	9	This seems like a rather casual reference to a crucial vulnerability. Is there any more detail that could be given here? (Paul Baer, Stanford University)	Insufficient space to address; discussion been dropped
19-746	A	38	8	38	9	The potential effect on Europe of a shutdown or significant reduction in the MOC deserves more than two rather cryptic lines, given the space given to other effects on Europe (pp. 37-38). A similar comment applies to effects on Canada (p. 40, lines 1-2). (Stephen De Canio, University of California, Santa Barbara)	Mentioned in section 19.3.5
19-747	A	38	8	38	9	What will be the impact? (Janice Lough, Australian Institute of Marine Science)	Ditto
19-748	A	38	8			Expand MOC (Ha-Duong Minh, CNRS)	Ditto
19-749	A	38	9	38	9	"Impacted" is one word to use. Another might be "refrigerated". (Joke). (William Hare, PIK)	Ditto
19-750	A	38	13	38	13	Also explain that humans and forest ecosystems will increasingly compete for water especially under adaptation, presumably water stress will affect ecosystems and has this been taken into account in the ecosystem studies (Rachel Warren, Tyndall Centre)	where?
19-751	A	38	23	38	26	Need to make clear whether tree species that become extinct are replaced by expansion of existing species or whether the region becomes more open grasslands or semi-arid. (William Kininmonth, Australasian Climate Research)	too detailed. Been cut.

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19-752	A	38	23	38	23	Add at end of sentence, '... species, as is experienced in many regions during drought associated with El nino events.' (William Kininmonth, Australasian Climate Research)	Insufficient space. Fires yes, loss of species not so clearcut under occasional drought
19-753	A	38	24	38	24	the reference is mixed up. You mean "di Siqueira." (David Major, Columbia University)	Fix
19-754	A	38	25	38	25	Have to clean up the reference on ln. 24, and then say to which of the studies reference is made here. (David Major, Columbia University)	Yes
19-755	A	38	25	38	25	Do the studies in which agricultural yields increase rely on assumed CO2 fertilisation? (Rachel Warren, Tyndall Centre)	Yes, otherwise agriculture yields would mostl likely decrease. CO2 fertilization should be included just as changes in climate should be
19-756	A	38	29	38	33	The fact that different climate models and ecosystem models produce different results is not much different in this case than in any of the others discussed in this section. Why reference Risk Management here and not elsewhere? Also, TAR WGII Ch. 1 doesn't say anything useful about risk management frameworks that I could determine. (Paul Baer, Stanford University)	Should be Ch.2. It is a general point and no longer in shortened version.
19-757	A	38	35	38	37	Water supply in Andean regions depend often on glaciers and these are melting Mark, B. G. and G. O. Seltzer (2003). "Tropical glacier meltwater contribution to stream discharge: a case study in the Cordillera Blanca, Peru." Journal of Glaciology 49(165): 271-281. (William Hare, PIK)	Insufficient space
19-758	A	38	35	38	37	Need to explain whether the glacial melt causes a problem because increased runoff eventually extinguishes the glacial reserve and rivers are reduced to relying on only annual precipitation and/or the pattern of runoff is changed because precipitation no longer accumulates over winter as snowpack. Ambiguous and possibly misleading in its present description. (William Kininmonth, Australasian Climate Research)	Not discussed in SOD because of insufficient space
19-759	A	38	39	38	43	Are Sao Paulo and Mexico City threatened by sea level rise, coastal storms, floods and heat waves, or is it just poverty? (William Kininmonth, Australasian Climate Research)	No longer discussed in SOD
19-760	A	38	45	38	49	The example doesn't make sense in this context: the lead in sentence talks about different results in different climate models, but the example refers to some crops which are expected to have increased yields and others reduced yeilds. (Paul Baer, Stanford University)	Ditto
19-761	A	38	45	38	45	Add Katrina numbers	Extremes briefly mentioned in SOD;

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						(Rachel Warren, Tyndall Centre)	insufficient space for specifics.
19-762	A	39	1	39	1	adaptations ameliorate stresses in human systems but increase stresses in ecosystems (Rachel Warren, Tyndall Centre)	Agree, but insufficient space to address properly
19-763	A	39	2	39	2	Replace 'climate change' by 'rainfall change'. (William Kininmonth, Australasian Climate Research)	Yes
19-764	A	39	7	39	8	I know that there are good reasons to consider polar regions separately, but it encourages the general attitude of Americans that polar communities are "them" and not "us", even though they're US citizens (in Alaska). (Paul Baer, Stanford University)	no action needed
19-765	A	39	7	39	7	use either: ...as comprising" or "as composed of." (David Major, Columbia University)	?
19-766	A	39	14	39	22	The recent hurricane events in the Caribbean should be mentioned. This comment also refers to page 42, line 7. (Thomas Bruckner, Technical University of Berlin)	Agree; are mentioned in SOD
19-767	A	39	14			See comments 63 and 64. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Cannot locate other comments..
19-768	A	39	14	39	16	Actually, the main factor in deaths in many areas is inland flooding due to people living in river valleys and on hillsides--so intensified storms affect more than those along coastlines. (Michael MacCracken, Climate Institute)	Insufficient space
19-769	A	39	15	39	15	Is the 60ppb the peak or the mean exposure? Currently means are increasing and peaks decreasing. (Rachel Warren, Tyndall Centre)	Insufficient space; discussion dropped from SOD
19-770	A	39	19	39	22	Why do hurricanes get mentioned here and not in Latin America or Asia? (Paul Baer, Stanford University)	Discussion been reduced to save space
19-771	A	39	22	39	22	Add some reference to 2005 hurricane season? (Janice Lough, Australian Institute of Marine Science)	Yes.
19-772	A	39	22	39	22	What would MOC slowdown do exactly? (Rachel Warren, Tyndall Centre)	Discussion in Global section
19-773	A	39	29	39	29	This is the only place in the chapter which uses "would" - everywhere else uses "could". (Paul Baer, Stanford University)	Discussion on water has been cut to save space
19-774	A	39	33	39	33	"subsidized agriculture" is mentioned in connection with the USA but not in connection with other states where subsidies are a major distortion of agricultural markets (e.g. EU and Japan). Singling out agricultural subsidies in the context of the USA seems to be unbalanced.	Has been cut. But draft was fair comment – no need to mention all such cases – it was a case of adaptive potential, not a criticism.

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						(Jim Hall, University of Newcastle upon Tyne)	
19-775	A	39	33	39	33	What is the basis for the claim that 95-90 percent of water in the US southwest goes to subsidized agriculture? Is the issue that the agriculture is subsidized or that the projected climate change will require additional subsidies in the future? And is it an international problem or an economic problem relevant only to the US? (William Kininmonth, Australasian Climate Research)	85-90%; is a statement of fact (Brown , 2000). No longer in SOD
19-776	A	39	33	39	33	Add summer 2005 ice retreat data (Rachel Warren, Tyndall Centre)	Insufficient space
19-777	A	39	34	39	34	ADD: "Urban infrastructure on both coasts, especially water and sewer systems and transportation, is highly vulnerable to sea level rise." (David Major, Columbia University)	Good if space, but have to cut.
19-778	A	39	39	39	39	Do we mean 80% of the shorebirds nesting in the Arctic parts of Canada where climate change effects are observed? Is this 80% decline largely attributable to climate because it is in uninhabited areas? Or are pressures on migration also thought responsible? (Rachel Warren, Tyndall Centre)	had to cut.
19-779	A	39	41	39	42	5% from what? 20 to 21, 200 to 210, 2000 to 2100, or 20,000 to 21,000? It matters a lot. (Paul Baer, Stanford University)	detail has been cut.
19-780	A	39	49	39	50	In the 48 contiguous states, the issue of increased fires is mostly due to the accumulated fireload due to previously putting out major fires (recently, drought has been a major factor). However, in Alaska, there has been a significant increase in the amount of area burned, partly due to the weakening of the forests due to the stress of climate change, melting of permafrost, etc. (Michael MacCracken, Climate Institute)	details have been cut
19-781	A	39	50	39	50	Remove "on the other hand" since it is unclear why an increase in NPP in the Arctic would be considered a good thing, and is unlikely to help polar bears. If there is a reason why it offsets some of the negative impacts of the climate change then clarify why. (Rachel Warren, Tyndall Centre)	ditto.
19-782	A	40	1	40	2	Again, this is a pretty terse description of a major vulnerability - isn't there more that can be said here? (Paul Baer, Stanford University)	Wish there was
19-783	A	40	1	40	2	The potential effect on Europe of a shutdown or significant reduction in the MOC deserves more than two rather cryptic lines, given the space given to other effects on Europe. A similar comment applies to effects on Canada (p. 40, lines 1-2) (Stephen De Canio, University of California, Santa Barbara)	Ditto

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19-784	A	40	4	40	34	Polar regions include the Antarctic which is only mentioned on line 13. (Michael Manton, Bureau of Meteorology Research Centre)	We follow what is mentioned in the Polar Regions chapter; section cut
19-785	A	40	6			This para should be rewritten with greater precision. Certainly the Arctic has seen a warming since the the 1960s, but one cannot discuss CC only in the context of the past few decades. One need a longer term perspective. Such data as are available indicate that today's temperatures are no warmer than what they were during the 1930s. There was a rapid warming in the 1920s & 30s, followed by cooling through the 1960s, followed by the current warming. [See, for instance, GISTEMP data (for 64 deg N to 90 deg N) maintained by Jim Hansen et al. at: http://data.giss.nasa.gov/gistemp/tabledata/ZonAnn.Ts.txt]. Thus it's not clear that the current warming is out of the range of natural variability. See also the following referencess, for instance: [1] Polyakov, I.V., Alekseev, G.V., Bekryaev, R.V., Bhatt, U., Colony, R.L., Johnson, M.A., Karklin, V.P., Makshtas, A.P., Walsh, D. and Yulin A.V. 2002. Observationally based assessment of polar amplification of global warming. Geophysical Research Letters 29: 10.1029/2001GL011111. [2] Polyakov, I.V., Bekryaev, R.V., Alekseev, G.V., Bhatt, U.S., Colony, R.L., Johnson, M.A., Maskhtas, A.P. and Walsh, D. 2003. Variability and trends of air temperature and pressure in the maritime Arctic, 1875-2000. Journal of Climate 16: 2067-2077. [3] Przybylak, R. 2000. Temporal and spatial variation of surface air temperature over the period of instrumental observations in the Arctic. International Journal of Climatology 20: 587-614. [4] Przybylak, R. 2002. Changes in seasonal and annual high-frequency air temperature variability in the Arctic from 1951-1990. International Journal of Climatology 22: 1017-1032. [5] Taurisano, A., Boggild, C.E. and Karlsen, H.G. 2004. A century of climate variability and climate gradients from coast to ice sheet in West Greenland. Geografiska Annaler 86A: 217-224. [6] Chylek, P., Box, J.E. and Lesins, G. 2004. Global warming and the Greenland ice sheet. Climatic Change 63: 201-221. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	This is about what warming over the last few decades has caused. In addition we expect the rapid warming in the Arctic to continue; refer to polar chapter
19-786	A	40	6			There should be an equivalent piece (as per comment 80) on the ENTIRE Antarctic. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Discussion cut
19-787	A	40	6			Comment on section 19.3.3.7. Given that the current warming in the Arctic is apparently not unprecedented, readers will be well served if this section deals with the ecological changes and other CC impacts that occurred during the previous (1920s-1930s) warming, for instance, and reported on how nature and people responded.	Not relevant. Also the reviewer does not offer any citations

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						(Indur Goklany, Office of Policy Analysis, Department of the Interior)	
19-788	A	40	6	40	9	The ACIA, 2004 report is an inadequate reference alone. It only deals with temperature change since the late 1950s and gives a misleading picture of Arctic temperature changes over the 20th century. Longer temperature records from many parts of the Arctic point to temperatures being as warm during the 1930s as they have been recently. The 3 percent per decade decrease in Arctic sea ice is only representative of the recent warming decades and does not take account of the period of cooling temperatures from the early 1940s through to the middle 1970s. (William Kininmonth, Australasian Climate Research)	Discussion has been cut
19-789	A	40	10	40	10	The polar regions section is missing a main point about risks in Antarctica where ecosystem key species (molluscs, krill) at risk 1-2C above preindustrial (Peck et al 2004) and this would impact rest of food chain ie whole ecosystem (Rachel Warren, Tyndall Centre)	Insufficient space
19-790	A	40	11	40	16	There is no evidence of reducing sea ice around Antarctica and it is only on the Antarctic Peninsula that there is evidence of warming over recent years. Can the decline in migratory birds be attributed unequivocally to climate change or are there other contributing factors, such as destruction of transient habitats? (William Kininmonth, Australasian Climate Research)	These changes are mentioned in the Polar regions chapter and no causality is given.
19-791	A	40	18			On line 18, change "problems" to "change". Not all changes are problems. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	True, but the paragraph is about problems.
19-792	A	40	20			"hunting prey and feeding" is redundant. (Paul Baer, Stanford University)	Not necessarily, depending on the animal's habits. Discussion has been cut
19-793	A	40	22	40	23	Replace sentence with: 'Notwithstanding the ability to survive the major glacial-interglacial oscillations, the adaptive capacity of many polar species is judged to be low because they have long lifetimes and low fecundity.' (William Kininmonth, Australasian Climate Research)	The previous cycles were to warm eras like Holocene. Now we are going much warmer, so previous adaptation not relevant.
19-794	A	40	25	40	25	Is the reference point still 1990-2000? (Rachel Warren, Tyndall Centre)	1990
19-795	A	40	27			Modify to read as follows: "Indigenous human communities in Polar Regions are also highly SENSITIVE to climate change. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	These communities have limited adaptive capacity and are threatened with losing their way of life. That is vulnerable –.
19-796	A	40	27	40	27	Delete 'Indigenous' at the beginning of the sentence - all communities are vulnerable while the indigenous communities have shown themselves to be particularly adaptable over more than 12,000 years. (William Kininmonth, Australasian Climate Research)	Same point as above. We are not talking about previous glacial-interglacial cycles but unprecedented warming.
19-797	A	40	29			Modify the end of the sentence that currently ends there as follows: "...in response to climate change, although there are fewer indigenous people who are wholly	Discussion been cut

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						dependent on the traditional way of life. This is a trend independent of CC." (Indur Goklany, Office of Policy Analysis, Department of the Interior)	
19-798	A	40	33	40	34	I am not sure the parenthetical expression is worth mentioning for these high latitude regions--the counter problem is that permafrost melting and shorter cold seasons make travel on the tundra much more difficult. (Michael MacCracken, Climate Institute)	Good point, but has been drastically cut .
19-799	A	40	33	40	33	omit period: ..decrease (but..... (David Major, Columbia University)	OK
19-800	A	40	34			Strike "and access to region is increased". Not all would view this as a negative, as implied in this sentence. A lot of people bi\oth in and out of the Arctic would welcome this. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	The reviewer misunderstands. This is presented as beneficial outcomes.
19-801	A	40	41	40	42	Insert a clause to read '..... In a sector that puts enormous pressure on natural ecosystems and is highly ...'. (William Kininmonth, Australasian Climate Research)	Good point; although such a sweeping generalization may not be supported. Insufficient space
19-802	A	40	45	40	45	Change clause to read '... will squeeze coastal freshwater lenses and decreases ...' (William Kininmonth, Australasian Climate Research)	Good point, but cut to save space
19-803	A	40	45	40	46	These decrease in precipitation are typically only in some seasons--this point might be made. (Michael MacCracken, Climate Institute)	Our point is about annual decreases in precipitation
19-804	A	40	45	40	45	Reference point for corals 1-2C should be preindustrial. It is much less above 1990-2000. (Rachel Warren, Tyndall Centre)	ok.
19-805	A	41	1	57	50	Suggest highlight the new possible vulnerabilities that were not mentioned in the TAR, or where thresholds have changed (Rachel Warren, Tyndall Centre)	We feel it is better to present a comprehensive table as few readers will want to add what is presented in the 4Ar onto the TAR.
19-806	A	41	11	41	11	Insert a clause at the end of the sentence to read '.... Ocean circulation, as occurs dramatically during the extremes of ENSO variability. (William Kininmonth, Australasian Climate Research)	Insufficient space
19-807	A	41	12			See comment 51, regarding coral reefs. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Where?
19-808	A	41	13			"questionable" is an awfully vague adjective - isn't there something more specific that could be said? (Paul Baer, Stanford University)	Has been cut.
19-809	A	41	16			Comment 69 is particularly apropos for this section (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Where is comment?
19-810	A	41	16	42	44	The discussion of adaptation is informative and should appear earlier, where	Appreciate the compliment. We will give

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						vulnerabilities are considered. It should be a titled section, not hidden in a summary section. (Michael Manton, Bureau of Meteorology Research Centre)	adaptation appropriate prominence
19-811	A	41	16	55		The summary section 19.3.4 is not satisfactory. On one hand, there is redundancy in the text and on the other hand it does not make much contribution in terms of adding value to the preceeding discussion. Table 19.1 currently takes 12 manuscript pages and is far too long, particularly because it mostly repeats what has been said in the text already. If it says something which is not in the text, text should be amended accordingly. I recommend either deleting the table altogether or replacing it with a table or a pair of tables (one for impact categories and one for regional key impacts) which adds value to the text by crystallising the main findings. The new table(s) should be at most a third of the original in terms of size. The text and the table could be completely revised to replace the present section 19.3.4. Alternatively, the revised material from this section could be merged with 19.3.5 to form a stronger section that draws together the preceeding assessment and adds value to it. (Jouni Paavola, University of East Anglia)	Disagree, although we have cut back the section considerably in the SOD
19-812	A	41	19	41	19	Explain that adaptations for human systems, particularly for sea level rise or water stress, often or can have negative impacts on ecosystems (Rachel Warren, Tyndall Centre)	Insufficient space to get into detail on consequences of adaptation.
19-813	A	41	28	41	30	This claim that "in many cases probabilities don't allow for "firm risk estimates" and therefore "this leads to subjective assessment guided by expert judgments" is, in my opinion, somewhat misleading. Essentially all predictions of climate impacts subjective, since there is no set of repeated trials from which to extract frequentist data. (Paul Baer, Stanford University)	Has been reworded in earlier section.
19-814	A	41	30			This inevitably leads to subjective assessments guided by expert judgments. This sentence is very important, do not omitted in any time (e.g. SPM, TS and so on) (Lin Erda, Chinese Academy of Agricultural Sciences)	We will clarify
19-815	A	41	30	41	30	"leads to subjective assessments" Does subjective here also mean normative? (Glenn McGregor, King's College London)	In some cases, yes.
19-816	A	41	32	41	39	It is useful to eladorateon forest fires, pests and diseases. (Alexander Golub, Environmental Defense)	Insufficient space
19-817	A	41	33	41	33	"Authors' " (need to make this possessive) (David Major, Columbia University)	OK
19-818	A	41	33	41	34	"rarely if ever downstream impacts". But such 2nd or 3rd order impacts represent the human dimension and are therefore important	True, but difficult to do.

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						(Glenn McGregor, King's College London)	
19-819	A	41	35	41	35	Add Katrina numbers (Rachel Warren, Tyndall Centre)	We mention Katrina in the SOD.
19-820	A	42	3	42	9	What is the link between material in lines 3-5 and 6-9? Not clear (Glenn McGregor, King's College London)	Good point
19-821	A	42	6	42	7	The experience of the 1970 Bangladesh has not been repeated, although similar storms have hit the area. (Richard S.J. Tol, Uni. Hamburg)	Correct Not mentioned in SOD
19-822	A	42	8			"about 35,000 premature deaths" is different from "killed 27-40,000" in P32 last line. Please explain (Hideo Harasawa, National Institute for Environmental Studies)	Have corrected; is now cited as 50,000.
19-823	A	42	8	42	8	2004 should be 2003 (Glenn McGregor, King's College London)	Yes.
19-824	A	42	8	42	22	There is little room for optimistic or pessimistic views of the ability of ecosystems to adapt. The literature presents a clear picture of 1-2 above preindustrial having serious impacts. It is for the human systems where the optimistic/pessimistic gap in assessment of adaptation is so wide. The more humans adapt to climate change, the more pressure there will be on ecosystems, since these adaptations can for example, extract water from ecosystems or flood coastal wetlands, require wilderness areas to be converted to agricultural cultivation, etc. (Rachel Warren, Tyndall Centre)	Agree, but will need to leave to Ch 4.
19-825	A	42	9	42	9	And the 2005 Atlantic Hurricane season demonstrated the vulnerability of even the most developed country and, in particular, particular sectors of the population. (Janice Lough, Australian Institute of Marine Science)	We will mention Katrina
19-826	A	42	21	42	22	Given that you have to use "potential adaptation actors" in a parenthetical statement, is there any reason to use the personified "the system" at all? (Paul Baer, Stanford University)	Will clarify
19-827	A	42	36	42	36	Vulnerable ecosystems are not in the same class as coastal communities in this discussion: it is well established that the former have very few or no options. (William Hare, PIK)	Agree but because of space limitations will leave to CH 4
19-828	A	42	42	42	44	This should clarify that column 6 is the authors' view of what they consider to be "realistic." (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Tables are now changed, but of course evaluations of adaptations are made by the authors on the basis of the literature and their expertise.
19-829	A	43	0			Col. 6 Line 3 needs "slowdown" after "MOC" (Paul Baer, Stanford University)	Yes, but all these entries now changed.
19-830	A	43	0	55		Table 19.1: The sections 19.3.1, 19.3.2, and 19.3.3 provide a very good and	Has been changed.

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						comprehensive written summary of key global vulnerabilities, sectoral impacts, and regional impacts. When compared with these summaries, Table 19.1 (covering 13 pages) is largely repetitive and provides relatively little new information. I therefore suggest that Table 19.1 be deleted. And any specific information that might get lost by doing so (for instance, the column on adaptation assessments) could be incorporated in the respective written summaries (that is, sections 19.3.1, 19.3.2, and 19.3.3). (Thomas Bruckner, Technical University of Berlin)	
19-831	A	43	0	55		Table 19.1 is, no doubt, very useful. I think, however, there are some flaws in maintaining consistency throughout this table. While examples up to page 50 or 51 are systems or processes (which are clearly sensitive and vulnerable to climate change), I don't think the remaining examples in pages 52 to 55 can be classified in the same way. E.g., forests: as ecosystems are already covered by p. 48 (ecosystems), as source of wood supply or as basis for activities of forestry sector are insufficiently described. Climate change foremost affects hydrological cycles and consequently amount, quality and seasonal characteristics of water resources. Infrastructures are key components of national or sub-national economic systems; the vulnerable system is the economy. Health is a quality of human resources; the vulnerable systems are individual livelihoods, social or economic systems at various scales, or national economies. Also, the term 'cross-border issues' (p.55) is not very appropriate to denote a vulnerable system or process as the column heading suggests. In summary, I am not against presenting these examples but I urge you to rethink the logical consistency of the presentation. (Günther Fischer, International Institute for Applied Systems Analysis)	Have revised.
19-832	A	43	0	55		Table 19.1. Many of the above comments are pertinent to this table, so I won't repeat most of them. Please revise this table with them in mind. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Done.
19-833	A	43	0			Table 19.1 General Comment 1) Critical levels should be expressed at the top of the column box for each item and using a common scale /GMT vs 1990 or 1990-200 average or PI. (William Hare, PIK)	We will use GMT above 1990
19-834	A	43	1	43	1	In Comments make reference to the observed natural period of variability of the MOC of about 1,500 years that must be taken into account when attributing change to anthropogenic global warming. (William Kininmonth, Australasian Climate Research)	Disagree; model results are because of anthropogenic causes.
19-835	A	43	1	43	1	Table 9.1 needs an entry for acidification of the oceans. (Michael MacCracken, Climate Institute)	We will mention in SOD

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19-836	A	43	1			Table 19.1 is valuable. However, having physical causes (like the THC) listed in the same way as vulnerable systems (like enclosed water bodies and coastal cities) may lead to confusion. (Michael Manton, Bureau of Meteorology Research Centre)	We will try to clarify in SOD..
19-837	A	44	0			Second panel. See comments 5, 18, 17, 70 (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Cannot access these numbered internal x-refs.
19-838	A	44	0			WAIS and GIS Critical level: Greenland above 1.5oC GMT increase and WAIS 1.5-4oC GMT above 1990 (William Hare, PIK)	Have worked with WGI on being consistent
19-839	A	44	0			Table 19.1 GIS and WAIS collapse. Being devil's advocate, the Netherlands today shows that a developed country can defend against quite significant coastal hazards, although New Orleans reminds us of the downside. Developing countries cannot protect today, but if your socio-economic scenarios are optimistic, then things might be very different before this process kicks in. Atlantis project finds conflicting results at the case study and global scale http://www.uni-hamburg.de/Wiss/FB/15/Sustainability/Working_Papers.htm see FNU 75 to FNU 78 inclusive. (Robert Nicholls, University of Southampton)	We will cite reviewers work on this in the SOD
19-840	A	44	1	44	1	The high confidence of rapid and irreversible sea level rise is at odds with the low probability of disintegration of the WAIS. Because of the very different probabilities of occurring (the GIS is actually melting at the low altitude periphery while Antarctica is getting colder) suggests that the GIS and WAIS should be tabulated separately. (William Kininmonth, Australasian Climate Research)	They have been made separate entries. Confusion over what is "rapid" clarified, and WAIS less optimistic than comment suggests.
19-841	A	45	0			Col 4 Lines 13-20 - is carbon cycle feedback now considered to contribute to climate sensitivity? I assumed that since it increases measurable atmospheric concentrations, it is on the "concentrations" side of the system. Is there guidance from WGI on this? (Paul Baer, Stanford University)	Tricky question. Our view is that climate sensitivity refers to warming for a given initial doubling of CO2, with feedback amplifying this to give greater resulting warming at equilibrium, but debateable. Certainly accelerates warming as in new version.
19-842	A	45	0			Col 4 Lines 1-10: "middle of this century" under what emissions/temperature scenarios? (Paul Baer, Stanford University)	not much difference in warming by 2050 for various SRES scenarios
19-843	A	45	0			This entry in Table 19.1 indicates to me that the risks associated with "positive feedbacks of climate change on carbon dynamics" are much more severe than the text discussion of pp. 19-20. I suggest that the text be brought more into conformity with the table. The statement in the table that "Gas hydrates in tundra	Revised text puts this in reasons for concern #5

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						and oceans may destabilise episodically with uncertain timing” seems quite a serious danger indeed (Stephen De Canio, University of California, Santa Barbara)	
19-844	A	45	0			Carbon dynamics Critical level around 2-3oC GMT above 1990 as by then most models show some level of +ve FB... (William Hare, PIK)	observations suggest could be earlier. Captured in revision.
19-845	A	45	0			"Vulnerable system or process col." Should methane be included here? (Glenn McGregor, King's College London)	methane now has separate entry
19-846	A	45	1	45	1	Comments: gas hydrates in oceans unlikely to destabilise unless through geological action. Need to define what is a critical and/or unexpected threshold. Need to be aware that sequestration leading to the major coal fields occurred during high atmospheric CO2 periods. (William Kininmonth, Australasian Climate Research)	Wrong re hydrates. Not sure of answer re coal fields.
19-847	A	45	1	57	50	Suggest add rate of change info wherever possible as well as magnitudes (Rachel Warren, Tyndall Centre)	Have tried to.
19-848	A	45	1	57	50	I presume there is an intention to add references to most of the statements in the table especially specific ones (Rachel Warren, Tyndall Centre)	No. Text and general X-refs to chapters only.
19-849	A	45	1	45	50	How does 3C/100 yr compare with current rate of change, will other assessments e.g. Schlesinger, Rahmsdorf will be included about magnitudes as well as rates or is rate considered more critical than magnitude for threshold? (Rachel Warren, Tyndall Centre)	Where? Don't know what this refers to.
19-850	A	46	0			There should be some indication here that would identify what portion of the problem is due to CC, and what portion due to human demand, poor planning and subsidies (maladaptation), etc. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Varies greatly from case to case.
19-851	A	46	0			Water bodies Critical level - some bodies appear to be introuble for 0.5oC (Amersee, Lake Tanganyika) above 2000. (William Hare, PIK)	See new table 19.2 entry
19-852	A	46	0			Vulnerable system or process col: Water bodies have not been mentioned previously in Chap 19 as a KV (Glenn McGregor, King's College London)	Not essential
19-853	A	46	1	46	1	Comment: Many inland seas fluctuate - the Caspian Sea water level fell about 3 metres between 1920 and 1980 and has recovered 2 metres since, despite significant water harvesting from inflowing rivers since 1940. (William Kininmonth, Australasian Climate Research)	Does not need this detail.
19-854	A	46	1	46	50	Is 3C local or global and is above 1990-2000? Local 2.7C above preindustrial	See new entry in Table 19.1

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						implies 1.5C above preindustrial globally which matches Hansen 1C above current. What are rates of sea level rise expected between x and y cm/year? (Rachel Warren, Tyndall Centre)	
19-855	A	47	0			Col 4 line 4: 2°C increase globally or regionally? (Paul Baer, Stanford University)	Rewritten
19-856	A	47	0			See previous comments on water supply (e.g., comment nos. 5, 35,44, 46) (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Which comment?
19-857	A	47	0			Glaciers Critical level: I would say 1-2oC above present levels would lead to the loss of large glaciers in the low latitudes and high Asia sufficient to cause major water supply problems. (William Hare, PIK)	See revised entry
19-858	A	47	1	47	1	Comment: Glacial meltwater regulated by winter accumulation and spring-summer thaw. A changed hydrological regime will require new management technologies to manage and harvest wintertime rainfall regime. (William Kininmonth, Australasian Climate Research)	See new entry in Table 19.2 re high mountain communities
19-859	A	47	1	57	50	Ocean acidification needs to be included, and also about chemistry of sea also affecting corals. (Rachel Warren, Tyndall Centre)	New entry in Table 19.1
19-860	A	47	1	47	50	Does recent news on C loss from UK soil affect picture? Is the climate sensitivity range referred to based on a calculation that includes the potential for these feedback processes or not? If they are not included in these calculations then there is the potential to go beyond the ranges of climate sensitivity referred to. (Rachel Warren, Tyndall Centre)	Biospheric feedback. Good question. Depends on defn of cl. sens. but does mean more warming likely. See entry in new 19.1
19-861	A	48	0			Strike " large impacts on food and tourism". These impacts, would at best be local. Trhese ecosystems do not produce a large amount of food supples globally. With rehgard to tourism, that's an activity that would shift from an "inhospitable" toi a "more hospitable" place. Regarding affordability of responses, note that what may be currently unaffordable may be much more affordable in the future if SRES scenarios are borne out. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	It is large locally/regionally, e.g., nature tourism, small islands dependent on reef fisheries. Will likely be local vulnerabilities.
19-862	A	48	0			4th column: The refernces for the claim of extinction should be provided, as well as na evalutaion of that claim. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Entries changed see table 19.2
19-863	A	48	0			Table 19.1 Ecosystem loss -- for coastal ecosystems the issue of coastal squeeze between riisng sea levels and defences is a real issue wirthy of highlighting. If we get large rises in sea level and we defend, this is bad news for these systems, including in developed country settings (e.g., Nicholls and Klein, 2005) see	New entry in table 19.2 covers this but lacks detail (see X-ref to chapter)

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						NICHOLLS, R.J. and KLEIN, R.J.T., 2005. Climate change and coastal management on Europe's coast. In: Vermaat, J.E.; Ledoux, L.; Turner, K., and Salomons, W. (eds). Managing European coasts: past, present and future. Berlin: Springer (Environmental Science Monograph Series), 199-225. and sister chapter ROCHELL-NEWALL et al in same book. (Robert Nicholls, University of Southampton)	
19-864	A	48	1	48	1	Comment: The early Holocene was probably warmer than now by about 2C and the existing species survived. Because of the poleward bias in global warming, tropical SST would have been less for GMT rise of 2C. Must recognise that potential for adaptation by ecostems is hindered but not excluded by human developments. (William Kininmonth, Australasian Climate Research)	Early Holocene probably not that warm globally. "Bounded ecosystems" partly covers human development point. Also did not have human development, further limiting species adaptation.
19-865	A	48	1			Column 4 also needs to mention the CO2 increase and its effects (on land and in the ocean) (Michael MacCracken, Climate Institute)	Covered for oceans in new entry.
19-866	A	48	1	48	50	Add that some developing countries communities completely rely on this fishing. (Rachel Warren, Tyndall Centre)	Insufficient space
19-867	A	49	0			The impacts and criteria listed in columns 2 and 3 seem not to be in agreement with the relatively sanguine prospects for adaptation described in column 6. In particular, compare the wording of column 3 with that of column 6. (Stephen De Canio, University of California, Santa Barbara)	revised entry in table 19.2 covers this. (Some reviewers think we're too pessimistic on adaptation)
19-868	A	49	0			This, for the most part, seems to, duplicate p. 44. Recommend merging the two pages. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Kept separate the issues of ice sheets melting and coastal vulnerabilities under different headings..
19-869	A	49	0			Column 6: see comment 98. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	We do not have numbered comments
19-870	A	49	0			Column 5: See comment 91. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Ditto
19-871	A	49	0			Column 4: The population at risk depends, among other things, on the level of economic development and, of course, population [Ref: Nicholls, R.J. (2004). "Coastal flooding and wetland loss in the 21st century: changes under the SRES climate and socio-economic scenarios," Global Environmental Change 14 (1): 69-86.]. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	True. Taken into account.
19-872	A	49	0			Column 3: "Adaptation is costly," compared to what? See Goklany (2003, 2005) which indicate that it would be cheaper and more effective in the short to medium term to focus on adaptation -- reducing vulnerability to current climate sensitive problems that might be exacerbated by CC or through efforts to more broadly	This is central argument between those who are optimistic about adaptation but pessimistic about mitigation and those with the opposite views. Both actions are necessary and have

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						enhance adaptive capacity through sustainable development -- rather than on mitigation that would go beyond "no regrets". In the interim, efforts should be made to make mitigation more cost-effective in the long term, while implementing "no regret" measures". (Indur Goklany, Office of Policy Analysis, Department of the Interior)	costs, benefits and limits. We have taken this into account and tried to present a balanced view.
19-873	A	49	0			Column 2: I would modify this to say that if or when tropical storms and cyclones intensify significantly, then damages would be greater than they would otherwise be. I would leave the confidence rating to the science work group. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	revision omits this
19-874	A	49	0			In column 3, "Criteria for inclusion..." add: "urban infrastructure, especially water and sewer systems and transportation, is highly vulnerable." (David Major, Columbia University)	detail in referenced chapters
19-875	A	49	0			Table 19.1 Coastal cities, low-lying islands and densely populated deltas. The integrated assessments from FUND and others suggest that protection will be widespread, and looking empirically for sea levels up to 1 m, I think mosy coastal cities will be protected. It is as much about socio-economics and development as about sea-level rise. I do not deny the risks, but I think it is likely that we can cope in many places. However, small islands do have particular problems and I think that their vulnerability stands out compared to other coastal areas. (Robert Nicholls, University of Southampton)	Good point. Will need to leave details to Chapter 6
19-876	A	49	1	49	1	Comment: "intensification of tropical cyclones already observed" cannot be substantiated. Atlantic hurricanes were probably as frequent and as intense in the early 1960s before satellite surveillance (two category 5s in 1960 and again in 1961) and the frequency and intensity does not only depend on SST (record low numbers of Atlantic storms in 1997 leading to major El nino event). (William Kininmonth, Australasian Climate Research)	Disagree; see Emanuel and , and Webster et al. papers.
19-877	A	49	1			Column 2 seems to me rather weak--need to change "may" to "very likely" as there is little chance of anything else happening. (Michael MacCracken, Climate Institute)	Language change in revision
19-878	A	49	1	49	50	Is threshold above 1990-2000 still? (Rachel Warren, Tyndall Centre)	1990
19-879	A	50	0			Should note that chnages in traditional lifestyles are occurring against a background of on-going and rapid change. CC may, at best, only accelerate these changes. Some of these changes may be voluntary on the part of the some members of the indigenous community. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	We are talking about CC effects. SLR and removal of populations is undeniable.
19-880	A	50	1	50	1	Comment: Indigenous communities have survived there hunting and gathering	Current CC is to unprecedented temperatures

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						lifestyles for thousands of years through major climate shifts. It is the hybrid semi-settled lifestyles that are contributing to major difficulties. (William Kininmonth, Australasian Climate Research)	and sea level not adapted to before, especially with high populations and rigid national boundaries.
19-881	A	50	1	50	50	It is possible to demonstrate 1-2C above preindustrial as well as 1990 (and by implication 1990-2000). The statement gets progressively weaker as the reference point is moved - e.g. from Corfee-Morlot's 1990 to this chapter's 1990-2000. Warren 2005 concluded the 1-2C problems with a preindustrial reference point. Coral 1-2C threshold should be with respect to preindustrial. Suggest add information about rates of change. Should include areas of biomes transformed at 1-2C or 3C and comment on how rate of change effects means in transformed areas there are likely to be many extinctions because of lack of time for natural adaptation processes. The whole problem is that (1) some species/ecosystems have nowhere to go and (2) those that do cannot keep up with the rate of change and (3) increases in pests/diseases/fire/lack of synergy in response of different ecosystem components to changing temperatures, are likely to disrupt existing ecosystems. (Rachel Warren, Tyndall Centre)	reference point has been fixed. Not sure what this comments on, but guess it is ecosystems on p.48. Entries have been rewritten and covers most or all comments.
19-882	A	51	0			Columns 4 & 6: Modify the second last sentence to note that current constraints on adaptive capacity would/could be surmounted in the future, especially if the SRES scenario assumptions regarding economic growth and technological prowess, hold up. See Goklany(2005a, 2005b). (Indur Goklany, Office of Policy Analysis, Department of the Interior)	High adaptive capacity was and is recognised, but uneven distribution, limits and lack of implementation must be recognised also.
19-883	A	51	0			Columns 2 & 3: Should note that (a) the decline in developing countries would be compensated for much of this century, at least, by increased production in developed countries, (b) current modeling, eg., Parry et al (2004) do not fully consider the potential for technological change [Goklany 2005a; comment 16], (c) should note that the contribution of CC to the population at risk for hunger could very well be smaller than the contribution of other non-CC related factors [Goklany (2005, 2005a)] (Indur Goklany, Office of Policy Analysis, Department of the Interior)	See chapter X-refs for details. We are talking about marginal effects of CC. Question whether aid and trade can redistribute food adequately in next 50 years, as it has failed to do in Africa in last 50 years.
19-884	A	51	0			Column 5: Should note that all else being equal, plants do better under nutrient stress, ozone and SO2 pollution, water stress, if CO2 levels are high. See comment 40. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	But all else is not equal; climate is changing too. Also FACE data shows O3 erodes carbon fertilization effect
19-885	A	51	0			4th column "Above several oC" is ambiguous, and if this sentence is translated into other languages, it will be misinterpreted. (Hideo Harasawa, National Institute for Environmental Studies)	It is deliberately imprecise, and should remain so in other languages.
19-886	A	51	1	51	1	Comment: It is misleading to equate low latitude with developing and high latitude	Temperature limits of crops apply in tropical

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						with developed countries. In general biosphere response is positive to warmer temperatures, higher rainfall and increased CO2 concentrations. Of concern is that some regions will become drier because of shifts in rainfall patterns as is observed with ENSO. Response of agriculture complicated by response of pests and disease making the overall outcome uncertain. (William Kininmonth, Australasian Climate Research)	countries and when exceeded will be very difficult to adapt to. Literature shows latitude response
19-887	A	51	1			Column 1 also needs to discuss what happens to farmers--greater production leads to prices falling, which makes it much more difficult to make a living farming. This is clearly the problem now in the US and elsewhere, which is why there are crop subsidies in many countries--so more production can really worsen things for farmers even though consumer prices (if not tax supports) seem likely to drop. (Michael MacCracken, Climate Institute)	Relevance to climate change is not clear. Is this a key vulnerability?
19-888	A	51	1	51	50	Take WGI estimates of min/max sea level rises and rates with/without GIS/WAIS melt and include. With large sea level rises coastal developed areas will end up on reclaimed land or islands, since obviously unless you barricade the whole coastline the sea will come around the back if you only project sections of the coast, except where developed areas are in coastal lowlands surrounded by highland. Thus it is not feasible even in developed countries, for large sea level rises, as placing sea defences in front of towns. This is implied here but could perhaps be emphasised. (Rachel Warren, Tyndall Centre)	Adaptation discussed in Global Section by reference to Atlantis project.
19-889	A	52	0			See comments for page 51. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	see reply above
19-890	A	52	1	52	1	Comment: The proposition of negative impacts dominating after 2-3C GMT rise is difficult to rationalise with the laying down of coal beds in earlier times when global temperatures were warmer (prior to polar glaciation) and CO2 levels were higher. The statement that adaptation generally of forests has greater potential in plantations than in natural forests because of the higher level of management is counter-intuitive. Needs detailed explanation in the text. (William Kininmonth, Australasian Climate Research)	Issue here is rate of change; reviewer is referring to as large a change in temperature but over a much longer time period.
19-891	A	53	0			The Comments section reports that loss of glaciers leads to problems for water supply. This is expected in the future, but to my knowledge I do not know of anywhere where water shortages have already occurred as a result of melting glaciers. Perhaps an example or citing papers where this is shown would clarify this. (Mark Carey, University of California, Berkeley)	Insufficient space to address this.
19-892	A	53	0			Top panel. Should note that CC may reduce net population at risk, at least through the rest of this century [Arnell (2004)], and this result was obtained despite not	This misinterprets Arnell's findings. see p.50 of that paper. "... this gives a misleading

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						having included any adaptation in the analysis [Goklany (2005a).] (Indur Goklany, Office of Policy Analysis, Department of the Interior)	impression... increases in runoff generally occur during high flow seasons, and may not alleviate dry season problems.. etc.”
19-893	A	53	0			Column 6: Include, as an option for adaptation, developing property rights for water, ending subsidies for overuse of water by certain favored groups. Structural adaptations are more likely to damage aquatic ecosystems. Water rights, pricing, etc., could in fact help free up water for ecosystem and freshwater species. It's not clear to me that such adaptations are necessarily costly, in fact they may pay for themselves, although currently "favored groups" would probably pay a price. See Goklany 2005b, and references therein. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	reforms of water pricing was mentioned and is in new version. See X-ref to chapter 3.
19-894	A	53	0			Bottom panel, column 6: Modify " ...more opportunity.." to read: "...more opportunity and greater ability ion the future..." (Indur Goklany, Office of Policy Analysis, Department of the Interior)	revised and shortened version. Cannot include everything. See X-ref. to Ch.7.
19-895	A	53	0			Bottom panel, Column 4: Start this with "Extreme WEATHER events DUE TO NATURAL VARIABILITY (e.g., floods...) are already damaging ..." (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Could accept, but has been changes and shortened.
19-896	A	53	0			In column 6, top, "Adaptation potential," add after the first sentence: "and increased integration and regionalization of water supply systems." (David Major, Columbia University)	See X-ref to Ch.3.
19-897	A	53	0			In column 2, top, add: "and the potential for increase in extreme events can negatively affect water quality" (David Major, Columbia University)	Good point, but cannot include all. See X-ref to Ch.3
19-898	A	53	0			In column 2, bottom, first sentence, add: "and sea level rise..." (David Major, Columbia University)	Could add SLR and melting permafrost etc., but space limits so see X-ref to Ch.7.
19-899	A	53	1	53	1	Comment: The arid and semi-arid regions of north Africa and the Middle East, at least, were wetter during the warmer early Holocene and have dried over the past few thousand years. This is at odds with the claim of increased aridity with higher GMT. (William Kininmonth, Australasian Climate Research)	Holocene analogue not necessarily applicable. Models and theory clearly show drying in Mediterranean
19-900	A	53	1	53	1	Comment (Infrastructure): It is as much the changed patterns of frequency and intensity of tropical cyclones that are a concern. The evidence for even stronger storms than category 5 is not compelling, especially as hurricane intensity is dependent on a range of other factors in addition to SST. (William Kininmonth, Australasian Climate Research)	Changed locations and frequency is a concern, and likely if changes in ENSO etc., but changes not well-established. Models, theory and observations support increase in intensities.
19-901	A	53	1	53	50	How many degrees is several. Are refs to preindustrial of 1990-2000. (Rachel Warren, Tyndall Centre)	Yes relevant to 1990; several was term selected by IPCC plenary

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19-902	A	53	2			Under infrastructure, the issue of storm surge needs to be mentioned--and also the higher levels of intense precipitation, that can cause flooding. Another critical condition is land subsidence. (Michael MacCracken, Climate Institute)	Largely implied in old wording. Revised wording in table 19.2 relegates details to X-ref. Ch.7. we report vulnerability, not detail why in Ch.19.
19-903	A	54	0			Why are increased deaths from killer heat waves not included in the health impacts listed in column 2? (Stephen De Canio, University of California, Santa Barbara)	Is in new Table 19.2 entry.
19-904	A	54	0			Column 6: Modify the last sentence to read: "Such development, while uncertain, is likely, according to the SRES scenarios. Moreover, based on recent human experience at least, there ought to be advances in technologies [Goklany (2000b).]" (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Completely reworded in revised version.
19-905	A	54	0			Column 1: Should note that the contribution of CC to the population at risk for malaria could very well be much smaller than the contribution of other non-CC related factors [Arnell et al. (2002); Goklany (2005, 2005a)] (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Our concern is with marginal effects of CC. Context is discussed in main text.
19-906	A	54	0			Impacts confidence col.: mention heat related mortality and morbidity (Glenn McGregor, King's College London)	In revised version.
19-907	A	54	0			Adaptation Potential Col: mention short (acute)- versus long-term adaptation as these are very different. The rest of the text in this column is very tortuous (Glenn McGregor, King's College London)	Completely rewritten.
19-908	A	54	1			The issue of heat stress from hotter days with greater humidity, so much higher heat index, needs to be mentioned. (Michael MacCracken, Climate Institute)	In revision.
19-909	A	55	0			Columns 4 and 6: Should allude to trade as an important factor in determining criticality and adaptation potential . See Goklany (1995, 2000). (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Too detailed; should be addressed in CH 5.
19-910	A	55	0			Column 6: Given the history and success of aid, I would emphasize "strong development" policies, including freer, unsubsidized trade in goods, services, ideas, and people. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Do add aid, but be wary of being policy-prescriptive.
19-911	A	55	0			Column 5: Strike the editorial between dashes. This is a much more complex issue that would need a much more detailed exposition than is furnished here. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	It is now removed.
19-912	A	55	1			It is important to be mentioning these cross-border issues. The US National Assessment grouped them as relating to (a) economic investments, trade, business, etc.; (b) shared resources like water, fisheries, migrating species, etc.; (c) health concerns relating to travelers--both business and pleasure, and in both directions;	Insufficient space

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						(d) environmental refugees and caring for others in other countries, national security interests, etc. Some delineation of the types of effects being considered ought to be mentioned. (Michael MacCracken, Climate Institute)	
19-913	A	55	30	55	50	Include infrastructure problems already in Arctic (see ACIA 2004) (Rachel Warren, Tyndall Centre)	Insufficient space
19-914	A	56	0			Figure 19.2: although figure 19.2 is very important, I do not consider it necessary to show a figure already displayed in the Third Assessment Report once again. In order to show that considerable progress has been made towards a more specific determination of possible systemic and normative thresholds, I would like to propose that an extended version of Figure 19.2 be developed. For each of the five categories displayed in figure 19.2, step-plots should be shown that, for instance, exhibit the onset of possible instabilities (for systemic thresholds) or selected values of possible normative thresholds (for instance, 10, 20, or 50% loss of protected area) as a function of global mean temperature change. An illustrative figure with indicative numbers is attached as a Microsoft PowerPoint file (Ch19 Bruckner step-plot.ppt). In some cases, the onset might be characterized by sharp numbers; most often, however, an uncertainty range would have to be shown according to the uncertain onset numbers contained in the Table 19.1. (Thomas Bruckner, Technical University of Berlin)	Interesting point. We are limited by space and thus would find it difficult to extend the figure. Whether it stays depends on whether we need to save the space.
19-915	A	56	1	58	26	I find this whole section to be a bit strange - it presents the "burning embers", then discusses reasons why various subcategories might be changed, but it doesn't actually change them. Whose job is it to redo the figure? It would be tragic if AR4 says that the "reasons for concern" have been revised, but doesn't actually produce a revised figure. (Paul Baer, Stanford University)	The text now does what he wants. Question remains re a Figure.
19-916	A	56	1	58	26	Fig. 19.2 has a large shortcoming that is without time scale. No evidences to give for these conclusions in 2050 or 2100. So the update also need explanation of time scale. (Lin Erda, Chinese Academy of Agricultural Sciences)	We can make clear the warming in the figure is increase in GMT by 2100 relative to 1990.
19-917	A	56	1	58	26	Including this 'update' could be seen as rewriting the earlier parts of the chapter. The new structure should incorporate this information, or you should stay with the old. (Michael Manton, Bureau of Meteorology Research Centre)	Substantially revised.
19-918	A	56	1	58	26	The order of key concerns could be reconsidered in line of the arguments presented above. Social vulnerability reasoning is not employed to a sufficient degree in the assessment.	SOD has societal vulnerability as a category.

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						(Jouni Paavola, University of East Anglia)	
19-919	A	56	1	58	26	<p>Sub-section 19.3.5 does not appear to get adequate attention nor does it feel like being on the right slot. The section starts with a poor transition and does not tie well to what has been covered above in 19.3. My suggestion would be to transform this section of text to a full section of the chapter (e.g. 19.4), to emphasise its function as a summary / synthesis of preceding assessment presented in 19.3. The extent of assessment and analysis in the section should also be increased from the present, so as to prolong the section by 50 - 100 %. This would be necessary even if the text would be retained as subsection 19.3.5. This would not present a problem for the overall length of the chapter as cutting down the table 19.1 more than compensates for this additional material.</p> <p>(Jouni Paavola, University of East Anglia)</p>	We need to cut the entire chapter down, not add length. We think the section is appropriate and in the right place.
19-920	A	56	5	56	5	<p>The four reasons for concern and the five embers are due to Smith et al. Watson wasn't even near.</p> <p>(Richard S.J. Tol, Uni. Hamburg)</p>	Both are cited.
19-921	A	56	16			<p>Comment on Item 1. There seems to be a tendency to equate an impact to an "adverse" effect. Accordingly, there should be statement to the effect that impacts can be good, bad or indifferent, depending on the viewer's subjective criteria. Also, one needs more than two references to be able to justify a sweeping statement that there is now "high confidence" that increases above 1-2 degrees would lead to adverse consequences. Moreover, whether there are two or twenty references, there ought to be a critical evaluation of the referenced studies before one can accept (or not) their conclusions. In addition, the issue of "adverse impacts" also begs the question, important to policy-makers, as to how significant are these impacts, and how do the CC impacts compare with those due to non-CC related factors. It makes a difference if impacts are adverse-and-significant or adverse-but-not-significant. Similarly, it makes a difference if the impacts of CC are secondary to the impacts of other factors (on say biodiversity [see Goklany (2005, 2005a, 2005b)].</p> <p>(Indur Goklany, Office of Policy Analysis, Department of the Interior)</p>	Reviewer misses the point of the RFC. They reflect different perceptions about what may be considered to be dangerous. Many consider the vulnerabilities discussed in the unique and threatened systems to be sufficient identification of Article 2 vulnerabilities. Whether the reviewer agrees is not relevant, unless he can demonstrate that this RFC does not reflect concerns that have been raised in policy discussions or the literature. Most of the impacts are negative for obvious reason of long-term adjustment to present/rece
19-922	A	56	16	57		<p>It is not clear whether the conclusion on "unique and threatened systems" represents only a change in confidence or also a change in temperature threshold relative to TAR. The conclusion is stated as high confidence (rather than medium confidence) that warming of 1-2 C (rather than up to 2 C) would have adverse impacts on these systems. Does the "1-2 C" figure represent a different judgment than the 2 C figure used in TAR? Also, it would be better to make clearer (and clearer than was made in TAR) what this threshold means. TAR says in the conclusion to Ch 19 that there is "harm" to such systems at 2 C or less, although earlier in that chapter it focuses</p>	Reviewer has a good point. Adverse ecological impacts are emerging and will likely be more evident with warming just up to 1oC. Statement has been revised to say up to 2oC.

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						on "threats to existence or functioning", a much more serious level of impact. Here, the conclusion also seems to use the "harm" standard, rather than existence/functioning. But if that is the case, then why distinguish 1-2 C from 0-1 C, since there is also said to be much stronger evidence of impacts already occurring? The levels of concern should be more clearly distinguished, otherwise the impact of the conclusion becomes diluted. (Brian O'Neill, IIASA and Brown University)	
19-923	A	56	20	56	21	"observed impacts of climate change" There is very little evidence for this. I think change is being confused with variability here (Glenn McGregor, King's College London)	See literature such as Root et al. (2003) and Parmesan and Yohe (2003).
19-924	A	56	22	56	23	As previously mentioned the ACIA,2004 report needs to be read in the context of temperature trends since the late 1950s. There is substantial evidence that polar temperatures were as warm in the 1930s as they have recently been. (William Kininmonth, Australasian Climate Research)	We feel we have read the report appropriately. Does the reviewer claim the warming in Arctic regions has nothing to do with anthropogenic climate change?
19-925	A	57	6			Comment on Item 2. (a) For the same reasons as articulated in the previous comment, I recommend caution in claiming "high confidence" in the state of knowledge regarding extreme events. (b) Both the European heat wave and the US's more recent experience on hurricanes indicate that regardless of whether CC contributed to these phenomena, adaptation would be superior to mitigation, especially in the short to medium term, to reduce damages from such extreme events. They also indicate the importance of human and social capital in executing an effective response. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	don't know what is referred to here. Obviously adaptation has a role. especially in the near term when CC is small. Mitigation acts to reduce CC so as to avoid changes which it is difficult or impossible to adapt to.
19-926	A	57	6	57	18	Is it correct that this text concludes that more recent literature is consistent with the TAR conclusion on extreme events? That seems to be the case but it is not stated explicitly. (Brian O'Neill, IIASA and Brown University)	Clarified.
19-927	A	57	6	57	18	Coverage on extreme events should incorporate newest results. See e.g. Webster et al, (2005) Changes in tropical cyclone number, duration and intensity in a warming environment. Science 309: 1844-46. On the role of social vulnerability in the consequences of extreme weather events, see Adger et al (2005) Socio-ecological resilience to coastal disasters. Science 309: 1036-39. (Jouni Paavola, University of East Anglia)	Done.
19-928	A	57	7	57	7	heat wave' is a rather ambiguous term and generally has local definition. (William Kininmonth, Australasian Climate Research)	-General meaning is clear enough.
19-929	A	57	7	57	8	Remove "intensities" after "tropical cyclone", as frequency and magnitude already mentioned.	Revised.

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						(Janice Lough, Australian Institute of Marine Science)	
19-930	A	57	13	57	13	Delete 'Recent'. (William Kininmonth, Australasian Climate Research)	Disagree; these events make the point.
19-931	A	57	15		18	There is a dangerous reliance for the attribution of extreme events to single sources that are both very recent, and the use of Emanuel in relation to cyclones appears inappropriate. Given the high proportion of scientific findings which are not subsequently validated (see, for example Ioannidis in JAMA (2005)), this is extremely unwise. (Aynsley Kellow, University of Tasmania)	Revised.
19-932	A	57	17	57	18	Change "tropical cyclone intensity increases" to "more intense tropical cyclones" (Janice Lough, Australian Institute of Marine Science)	Revised
19-933	A	57	17	57	18	There may not be enough evidence yet to warrant the statement that human influence has already significantly increased the risk of intense tropical cyclones. (James S. Wang, Environmental Defense)	Language has been softened.
19-934	A	57	18			is "(more than 90%; very likely)" a confidence level? (Hideo Harasawa, National Institute for Environmental Studies)	Has been changed in SOD.
19-935	A	57	18	57	26	The thermal isolation of Antarctica by the Antarctic Circumpolar Current and associated upwelling of near freezing subsurface water by Ekman pumping, recent apparent cooling over the Southern Ocean (NCEP/NCAR SST Reanalyses) and apparent cooling over Antarctica except for the Antarctic Peninsula suggest that deglaciation of WAIS is less likely than previously thought. (William Kininmonth, Australasian Climate Research)	S. Pacific and S. Atlantic gyres have strengthened, pushed further south, and upwelling water has warmed, especially near Antarctic Pen. Lots of observational evidence this warming has triggered major changes and that this may continue with further global warming.
19-936	A	57	20	57	34	I've always found this "reason for concern" to be incoherent. It's called "distribution of impacts" But in fact it's not a measure of equity or inequity at all. It's "white" when only developing countries are harmed, and turns "red" when all countries are harmed. Thus in fact it is really just a proxy for aggregate impacts, not for the equitable distribution of impacts. Whose job is it to fix this? (Paul Baer, Stanford University)	Reviewer misreads the figure. It is yellow at less than a degree indicating that it could be "dangerous." This RFC becomes yellow at a much lower temperature than aggregate RFC.
19-937	A	57	20	57	34	The conclusions for distribution of impacts are also unclear in what exactly is different from the TAR conclusions. The statement that recent work shows vulnerability to climate change is variable within developed countries could be entirely consistent with the TAR conclusion (net positive market impacts in developed countries up to 2 C, turning negative at higher levels), or it could indicate information that was not included in the TAR deliberation. Which is it? (Brian O'Neill, IIASA and Brown University)	The latter. This is an elaboration, but recognizes distribution as an issue within developing countries
19-938	A	57	20	57	34	The observation that distribution of impacts within countries has to be	Insufficient space to get into this.

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						acknowledged is important point made in here. There would be need to reflect on the consequences of this acknowledgement for adaptation and mitigation policies as well: it would appear that the acknowledgement indicates a need for more nuanced treatment of questions of adaptation and what is the appropriate mix of response measures. (Jouni Paavola, University of East Anglia)	
19-939	A	57	28	57	34	Does this warrant modifying the TAR conclusion? It would seem so. (William Hare, PIK)	Is still uneven distribution of impacts.
19-940	A	57	32			Change "are also" to "may also be" (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Disagree
19-941	A	57	33			Not all impacts on indigenous populations at high latitudes would be adverse, e.g., warming ought to reduce mortality and morbidity due to extreme cold. Accordingly, I would change ""sinficant adverse impacts..." to "significant impacts, both positive and negative, ..." (Indur Goklany, Office of Policy Analysis, Department of the Interior)	The SOD mentions benefits from Arctic warming elsewhere. These populations are facing increased risks (ACIA, 2005)
19-942	A	57	34	58	8	It is very surprising that this is the only presentation of aggregate impacts. Isn't one of the key vulnerabilities that the aggregate impacts could overwhelm the current global production and trade system. (Chris Hope, Judge Business School)	Will also be mentioned in Tables 19.1 and 19.2 of SOD
19-943	A	57	34			Might be worth emphasising the rapid growth in the number of coastal dwellers -- at a rate twice the global increase in population (Robert Nicholls, University of Southampton)	"...and the increasing numbers of coastal dwellers..."
19-944	A	57	35			Item 3. Add a para here to say: " Recent work also suggests that, notwithstanding greater climate change, based on estimates of global populations at risk for hunger, water shortage and coastal flooding made under the "Fast Track Assessment", human well-being may be higher in richer-but-warmer world than in poorer-but-colder worlds, at least through much of the remainder of this century [Goklany (2005b)]. With respect to environmental well-being the results are more equivocal." (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Literature such as Nicholls and Tol (2006) and Parry et al (2004) shows higher risks with higher levels of climate change. Yes, ceterus paribus, higher level of development is expected to reduce vulnerability. We state that elsewhere.
19-945	A	57	36	58	8	As already suggested above, the treatment of aggregate impacts needs a more robust frame or template. While monetary losses definitely belong here, they hardly exhaust aggregate impacts as distinct from the other four reasons for concerns. In the minimum, predicted loss of life should be covered under this title. (Jouni Paavola, University of East Anglia)	Agree and added paragraph on non-monetary aggregate impacts.
19-946	A	57	50			Their should be an evaluation of the CRML study	Our determination is that it is worth citing. .

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						(Indur Goklany, Office of Policy Analysis, Department of the Interior)	
19-947	A	57	50			What is the reliability of a document authored and published by a private consultancy? Should such sources be used in IPCC documents? (Aynsley Kellow, University of Tasmania)	Grey literature can be used.
19-948	A	57	50	57	50	Add "tropical" before "cyclone" (Janice Lough, Australian Institute of Marine Science)	Yes
19-949	A	58	3	59		Figure 19.3 indicates that there are "ancillary benefits" of mitigation such a "human health and other benefits from limiting local/regional air pollution". This is incomplete because there could be other ancillary benefits, including those stemming from no-regrets investments in energy efficiency and re-orientation of tax codes to restrain greenhouse gas emissions rather than taxing work and savings (see Krause et al., 2002). (Stephen De Canio, University of California, Santa Barbara)	This figure has been dropped.
19-950	A	58	6	58	8	See comment 16, on precisely this point. (Indur Goklany, Office of Policy Analysis, Department of the Interior)	Not clear what this refers to.
19-951	A	58	10	58	10	This category also included large scale changes in atmospheric regimes eg drought Wang, G. (2005). "Agricultural drought in a future climate: results from 15 global climate models participating in the IPCC 4th assessment." Climate Dynamics: 1-15. (William Hare, PIK)	Agree and added in mention of changes in climate variability. Drought was not part of the TAR discussion on singular events
19-952	A	58	18		26	p. 58, lines 18-26: These lines should be indented to line up with the text in lines 10-16. (Stephen De Canio, University of California, Santa Barbara)	See revision.
19-953	A	58	18	58	19	The lowering of the threshold does not seem to be what is presented in the WG I report (chapter 10), though I would think that this lowering of the threshold is correct. (Michael MacCracken, Climate Institute)	Has been checked with WGI
19-954	A	58	22	58	24	This faster melting of Greenland is not what is in the WG I report--they seem to lean to slower melting than in the TAR. (Michael MacCracken, Climate Institute)	Made consistent w/ WGI
19-955	A	58	25	58	26	The statement "is not reporting high confidence conclusions" is unhelpful. If is reporting "low confidence" or some other level (or range) of confidence then say so specifically. (Jim Hall, University of Newcastle upon Tyne)	Made consistent w/ WGI
19-956	A	58	29	59	25	Discussing response strategies in the context of DAI seems inappropriate, except for mitigation. Adaptation strategies are about coping with whatever interference occurs. Indeed a 'simple' cost-benefit analysis can be used to decide on whether to	The outline approved by the IPCC plenary specifically asks for a section on adaptation and mitigation response strategies. The second

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						adopt a strategy, independent of whether it is deemed dangerous. (Michael Manton, Bureau of Meteorology Research Centre)	part of the comment is not clear.
19-957	A	58	29			Overall, Section 19.4 is not well integrated with the rest of the chapter, nor with the rest of the report. I have the sense, after reading through it, that it repeats some material in previous sections, and that it covers ground already covered either in Ch. 2, or in WG3. I understand there is a good argument for including this topic in the chapter to provide at least one place where the mitigation side and impacts side of avoiding DAI can be addressed in an integrated way. However I think future drafts should strive to better link to WG3 and to Ch 2 to make sure material is covered in depth in the appropriate chapter, is effectively summarized elsewhere where it is needed (with appropriate pointers), and that the treatments are consistent. (Brian O'Neill, IIASA and Brown University)	The outline approved by the IPCC plenary specifically asks for a section on response strategies. There is very little overlap with Chapter 2, which does not explicitly address mitigation assessments. The revised section adds many cross-references to WG III chapters and focuses more strongly on the avoidance of potentially “dangerous” climate change so as to minimize the overlap with WG III.
19-958	A	58	29	67	50	The role of this section of text in the chapter is not clear. The section is also long and does not offer clear value added in terms of well-summarised lessons or arguments (unlike the five reasons for concerns, for example). This is not to say that the material does not have a role in the chapter. Quite the contrary. But the specific contribution of this area of assessment has to be thought through better and the text revised so that it delivers that contribution in an accessible and poignant way. My suggestion would be to split and reallocate the material in the chapter so that condensed methodological discussion would form a part of an expanded 19.2, together with a treatment of social vulnerability which is now largely missing from 19.2, and so that the substantive results that are now presented in the section would be placed in their appropriate context in the present section 19.3. As this would cut down the number of main sections in the chapter, it might be an idea to consider splitting the section 19.3 to form new main sections of the chapter. Alternatively, if the section is to be retained as a whole, it should be considered whether the material should be presented before the "reasons for concern" synthesis. Also, the key findings of the section should be presented in a table or a figure or other such device which clearly distil them from the text. (Jouni Paavola, University of East Anglia)	The revised section has been condensed and focussed. We have not followed the suggestion to restructure Chapter 19 since the present structure reflects both the outline agreed by the IPCC Plenary as well as long discussions within the author team. We present tables 1 and 2 as summary tables in the beginning of 19.3, and find the presentation of the “reasons for concern” synthesis to be useful as a concluding synthesis after the more detailed information in the section.
19-959	A	58	31	59	25	This text would appear to belong to the conclusions of the chapter, rather than here. (Jouni Paavola, University of East Anglia)	We disagree. This text has been revised in the SOD and is an introduction to the section.
19-960	A	58	35	58	47	Are there global ancillary benefits of mitigation and adaptation, such as induced technological progress, for example? (Alexander Golub, Environmental Defense)	We have added cross-references to other AR4 chapters where this question is discussed.
19-961	A	58	35	58	41	rewrite--lines 35 and 36 duplicate lines 40 and 41. (David Major, Columbia University)	Done.

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19-962	A	58	40		41	Sentence can be dropped. Says nearly the same as sentence starting in line 35 above. (Günther Fischer, International Institute for Applied Systems Analysis)	Done.
19-963	A	58	42			I agree and don't find Figure 19.3 very convincing. It is easy to find counter examples of regional (e.g. to adapt water supply systems), national (e.g. change in trade policies) or global (e.g. biotechnology research to overcome resource limitations in cropping) adaptations. (Günther Fischer, International Institute for Applied Systems Analysis)	This figure has been dropped.
19-964	A	59	5			Given the ambivalence of the text, Figure 19.3 may not be appropriate (Michael Manton, Bureau of Meteorology Research Centre)	This figure has been dropped.
19-965	A	59	9	59	17	This paragraph does not seem relevant to the chapter (Michael Manton, Bureau of Meteorology Research Centre)	The first part of the paragraph has been dropped; the second part is necessary to provide some context for the studies reviewed in this section.
19-966	A	59	23	59	24	Are the positive impacts in developed countries only in the agricultural sector? And if so is the positive direction seen only if carbon fertilisation effects are taken into account? Have any agricultural benefits actually been detected so far? (Rachel Warren, Tyndall Centre)	This comment does not relate to the text on the specified page.
19-967	A	59	28	60	23	Bayesian techniques are a useful approach to decision-making under uncertainty, as subjective estimates of probabilities can be progressively and reiteratively revised in the light of subsequent knowledge. They can assist choice, but they do not determine the veracity of knowledge, and are not likely to be of much assistance in expert surveys unless we are sure that we satisfy the usual requirements for representativeness, reliability and so on, of any survey research. (Aynsley Kellow, University of Tasmania)	We have added cross-references to other AR4 chapters where this question is discussed.
19-968	A	59	29			Section 19.4 seems to have substantial overlap with material earlier in the chapter (in the introduction to this section), to Ch. 2.2.3 on uncertainties (in section 19.4.1), to Ch 2.3.4 on methods of evaluating impacts associated with mitigation scenarios (in section 19.4.2). It may be worth focusing less on methodological aspects in the literature (which seems more appropriate to Ch 2) and more on drawing conclusions from the literature relevant to key vulnerabilities (which is not the focus of Ch 2). (Brian O'Neill, IIASA and Brown University)	We have added these cross-references and streamlined the discussion of these issues in our chapter.
19-969	A	59	31			The reference in this line to Ch 2.2.2 should be to Ch. 2.2.3. (Brian O'Neill, IIASA and Brown University)	Done.
19-970	A	59	38	60	23	I have a number of reservations about this paragraph. I recognise that it is very difficult to summarise the theory and practice of uncertainty representation into a	Text changed as suggested.

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						<p>single paragraph, but I think in an attempt to be concise and accessible some well known mistakes have been made. The first is in supposing that the "natural randomness in the climate system can be characterised by frequentist (or objective) probabilities". We know that the "natural" climate system is non-stationary at a range of scales. We also know that it is immensely complex. Any statistics we present about the "natural" climate will be profoundly influenced by the choice of variables and the methodology used to estimate the statistics. Supposing that we can make truly "objective" statements about natural variability is in my opinion misleading. Next, it is asserted that epistemic uncertainty "can only be represented by Bayesian (or subjective) probabilities". This ignores the whole field of work on imprecise probabilities and non-probabilistic representation of epistemic uncertainty. A good review of methods is available in the special issue of Reliability Engineering and System Safety: 85(1-3) (2004). See also Hall, J.W. Handling uncertainty in the hydroinformatic process. Hydroinformatics, 5(4) (2003) 215-232. The following paper discusses these matters in the context of climate change and has been resubmitted following a first round of favourable reviews so may be published in time for AR4: Hall, J.W., Fu, G. and Lawry, J. Imprecise probabilities of climate change: aggregation of fuzzy scenarios and model uncertainties, Climatic Change, in review (can be made available on request). Of particular concern is the assumption that uncertainty can only be mathematized with probability rather than by specifying sets of possible outcomes or using hybrids of probability and set-based methods. The last line of page 60 refers to "a selected number of possible values" which is obviously a set-based method (not deterministic) and guardrail methods can also be interpreted as being set-based approaches. Finally it is asserted that "value diversity (such as different attitudes to risk or equity) cannot be meaningfully described probabilistically". The problem is not that value diversity "cannot be meaningfully described" - one could of course conduct surveys of preferences and obtain statistics for the variation across a population. The problem is in taking account of multiple and potentially conflicting values/preferences is situations of social choice. (Jim Hall, University of Newcastle upon Tyne)</p>	
19-971	A	60	4	60	5	<p>adjust spacing in "refer" (David Major, Columbia University)</p>	Done.
19-972	A	60	8	60	11	<p>Can you say something more here about this debate than just "it's controversial"? In particular, can you get away with saying that "of course you can talk about the probabilities of future social choice" as long as you acknowledge that such probabilities are subjective - just like estimates of the climate sensitivity and other</p>	We have added cross-references to other AR4 chapters where this question is discussed.

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						parameters (as you point out in the next paragraph). (Paul Baer, Stanford University)	
19-973	A	60	11			Attitudes to risk and equity can be the subject of Bayesian investigations in just the same way as other scientific and economic parameters. (Chris Hope, Judge Business School)	Addressed in connection with Comment 19-970.
19-974	A	60	22			add "subjective" before likelihood. (Ha-Duong Minh, CNRS)	Done.
19-975	A	60	26	67	50	The probabilistic approach is very useful for understanding DAI. Since it is relatively new in the literature, it could be presented in a more comprehensive way. I would expect that authors would extend this section. (Alexander Golub, Environmental Defense)	We have added cross-references to other AR4 chapters where this approach is discussed in more detail.
19-976	A	60	26			Section 19.4.2 on methodological approaches to response strategies characterizes approaches by several dimensions that have substantial but not complete overlap with dimensions used in Ch. 2 to characterize mitigation scenarios (see section 2.3.4.1) and their application to impact and adaptation assessment (section 2.3.4.2), sections of the chapter I was responsible for putting together. There are areas of obvious similarity, others that discuss common literature but characterize it differently, and others that are unique to one chapter or the other. We should reserve time at the Merida meeting to discuss how to improve the consistency between these chapters. (Brian O'Neill, IIASA and Brown University)	We have added a cross-reference to this chapter.
19-977	A	60	34	60	34	Replace the word "prevent" with "determine the start of" (Mohamed El-Shahawy, Faculty of Science- Cairo University - Giza -Egypt)	Not clear.
19-978	A	61	1	61	2	The term "hybrid" analysis is not well defined. The text refers to using a selected number of point-values of uncertain variables. This is an example of set-based method. (Jim Hall, University of Newcastle upon Tyne)	Text changed as suggested.
19-979	A	61	14			Table 19.2: "Integrated assessment of key vulnerability and DAI" should be replaced by "Cost-benefit analysis". (Thomas Bruckner, Technical University of Berlin)	Text changed as suggested.
19-980	A	61	14			Integrated assessment should not be equated with cost-benefit analysis. Also, suggest switching the last two rows, i.e. put cost-effectiveness penultimate. (Ha-Duong Minh, CNRS)	Text changed as suggested.
19-981	A	61	14			It is not clear that the categorization of methods in Table 19.2 is the most useful one. Several categories overlap so much that the utility of the distinction breaks down. E.g., IA studies are often scenario analyses, carried out by analyzing	We changed the wording of the categories table (following comments 19-979 and 19-980), thereby also addressing this problem.

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						individual scenarios within an IA framework. There are many IA studies that are not cost-optimizing. Cost effectiveness studies are very often scenario analyses, often of stabilization pathways. (Brian O'Neill, IIASA and Brown University)	
19-982	A	61	24	61	25	Here "a discrete range of scenarios" is described as a "hybrid method". See comments above. A discrete range of scenarios is a set, and is a perfectly legitimate uncertainty representation. (Jim Hall, University of Newcastle upon Tyne)	But it is not a probabilistic representation. However, the label has been removed.
19-983	A	62	1			. Sentence starting 'therefore...' does not follow from previous sentence. (Chris Hope, Judge Business School)	This section has been rewritten.
19-984	A	62	7	62	22	NOTE: LONG COMMENT - SEE FORMULA BAR FOR FULL COMMENT-..... I propose to slightly re-shuffle the paragraph with the purpose of distinguishing more systematically between (a) the methods to design those scenarios, (b) the multi-gas/CO2 nature and (most importantly) (c) to allow the clearer distinction between monotonically increasing and non-monotonically increasing concentrations trajectories. Furthermore, the proposed text is believed to add clarity as it mentions the lower-level stabilization pathways, which necessarily involve a peaking concentration profile (and do not belong to the "recently developed" overshoot profiles - given that they are around quite some time since 1994) . This "necessity" aspect of "overshooting trajectories" for the lower stabilization levels warrants mentioning, I believe (as it does not seem to be mentioned in other parts of the text). Finally, some key references in regard to energy-model derived stabilization scenarios, like Morita et al. 2000 and EMF-21, are proposed to be added. One could as well introduce the distinction between scenarios and pathways, given that the former are accompanied by socio-economic and technological scenarios, while the latter aren't. THE PROPOSED NEW TEXT TO SUBSTITUTE THE CURRENT PARAGRAPH: Concentration stabilization and peaking scenarios have proven useful in examining the constraints on emissions that would follow from consideration of key vulnerabilities. The applied methods for designing such scenarios generally differ across the studies, with some prescribing a smooth trajectory of concentrations (Enting et al., 1994; Schimel et al., 1996; Wigley et al., 1996), setting additional constraints on the path of emissions (Izrael and Semenov 2005; Meinshausen et al., 2005), employing sophisticated technology and energy system models (Morita et al., 2000; EMF-21**, van Vuuren et al., 2003, Nakicenovic and Riahi, 2003... etc.)	Text added as suggested, with some editing.

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						<p>or extending existing scenarios (Swart et al., 2002). Furthermore, the scenarios differ in regard to their scope in emissions, as some studies focus on the key radiative forcing agent CO₂, while others include additional gases and aerosols in their analysis (Swart et al.2002; O’Neill and Oppenheimer, 2004; Wigley, 2004; EMF-21**; Meinshausen et al. 2005). Another key characteristic of the scenarios with particular relevance to the avoidance of key vulnerabilities is their shape, which influences their transient temperature implication (see e.g. Schneider and Mastrandrea, 2005 ...). Two main categories can be distinguished in regard to the shape: (a) stabilization scenarios, which imply monotonically increasing concentrations from current levels up to a final asymptotic stabilization concentration. (b) scenarios, which imply a peaking concentration with subsequent lowering of concentrations. While such a peaking is a necessity for the exploration of stabilization levels close to or below current concentration levels (see e.g. Enting et al. 1994 and Wigley et al. 1996; ...), a number of studies designed as well scenarios with a temporary exceedance of higher stabilization levels on multi decadal timescales with so-called “overshoot trajectories” (Kheshgi., 2004; O’Neill and Oppenheimer, 2004; Izrael and Semenov, 2005; Kheshgi et al., 2005; Meinshausen et al., 2005; Wigley et al. 2004).</p> <p>THE ADDIOTIONALLY CITED REFERENCES IN FULL (TO BE CHECKED)</p> <p>*Wigley, T.M.L., Richels, R. and Edmonds, J.: submitted, 'Overshoot Pathways to CO₂ stabilization in a multi-gas context', in Schlesinger, M.E. and Weyant, J.P. (eds.), Human Induced Climate Change: An Interdisciplinary Perspective, Cambridge University Press, Cambridge, UK.</p> <p>*van Vuuren, D.P., Eickhout, B., Lucas, P.L. and den Elzen, M.G.J.: 2004, 'Long-term multi-gas scenarios to stabilise radiative forcing - exploring costs and benefits within an integrated assessment framework', Energy Policy (accepted). Can't find</p> <p>*Morita, T., Nakicenovic, N. and Robinson, J.: 2000, 'Overview of mitigation scenarios for global climate stabilization based on new IPCC emission scenarios (SRES)', Environmental Economics and Policy Studies 3, 65-88.</p> <p>*Nakicenovic, N. and Riahi, K.: 2003, 'Model runs with MESSAGE in the Context of the Further Development of the Kyoto-Protocol'. Berlin, WBGU - German Advisory Council on Global Change: 54. Report-No.: WBGU II/2003 available at http://www.wbgu.de/wbgu_sn2003_ex03.pdf</p> <p>*EMF-21**, Note: Please ask those who run EMF-21 for the latest references to be used. For example, F.C de la Chesnaye, Delachesnaye.Francisco@epamail.epa.gov</p> <p>PS: In terms of transient temperature implications and multi-gas scenarios, one could as well cite (Note this is shameless self-promotion :-): Meinshausen, M.:</p>	

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						2005 (forthcoming), 'What does a 2°C target mean for greenhouse gas concentrations? - A brief analysis based on multi-gas emission pathways and several climate sensitivity uncertainty estimates. ' in Schellnhuber, J.S., Cramer, W., Nakicenovic, N., Wigley, T.M.L. and Yohe, G. (eds.), Avoiding Dangerous Climate Change, Cambridge University Press, Cambridge. (Malte Meinshausen, NCAR, National Center for Atmospheric Research)	
19-985	A	62	11	62	15	The text on overshoot scenarios is missing reference to Wigley's work on this topic. (Brian O'Neill, IIASA and Brown University)	Reference added.
19-986	A	62	24	62	34	The outcomes of these studies are dependent on the sensitivity of the model used to CO2 increase. For less sensitive models the stabilisation concentration for the same climatic thresholds would be higher. This point should be made in the text. (William Kininmonth, Australasian Climate Research)	The temperature ranges associated with these stabilization levels are taken from the IPCC TAR, which has been clarified. The dependence of the relationship between stabilization concentration and temperature increase on climate sensitivity is now explicitly stated in the next paragraph.
19-987	A	62	29	62	31	The statement that "only the 450 ppm CO2 stabilization scenario is 'likely' to avoid MOC collapse (assumed to occur for 3oC increase in global mean temperatures in 100 years) and may also avert deglaciation of West Antarctica" should be given much more prominence. It is quite an important statement and should not be buried in the text as it now is. (Stephen De Canio, University of California, Santa Barbara)	This point has now been changed to link 450ppm and a temperature increase of 2C. We find it is more appropriate to link this temperature increase to specific key vulnerabilities in 19.3.
19-988	A	62	38	62	38	Substitute "including overshoot scenarios" with "including overshoot and peaking scenarios" - The peaking refers to the class of scenarios that peak and subsequently decline in concentrations without focussing on the what the ultimate stabilization level might be. (Malte Meinshausen, NCAR, National Center for Atmospheric Research)	Change made
19-989	A	62	41	62	41	Substitute "depicts the risk of exceeding a temperature" with "depicts the probability of exceeding an equilibrium temperature" - Two reasons: (a) Add "equilibrium" as figure 19.4 does not depict probabilities for transient temperatures. (b) the "probability" term seems to be more acceptable by a wider scientific audience although "risk" is not incorrect, if the consequence is assumed to be sketched by a step function around the temperature threshold (here 2°C), given that risk=probability x impact. (Malte Meinshausen, NCAR, National Center for Atmospheric Research)	Change made
19-990	A	62	43	62	50	It is of course fine to choose a particular example. This is not just an example, however, but among the more aggressive of the examples in the literature. You	We make it explicitly clear that this is an example, and two examples making the same

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						should balance this by devoting equal length to an example that is on the more conservative side. (Richard S.J. Tol, Uni. Hamburg)	point would be redundant. This example is a reflection of the literature, not of a policy prescriptive choice, and no “balancing” should be necessary.
19-991	A	62	43	62	46	The sentence starts with “we present --- “. This is not IPCC style of writings. Lead authors should not express their opinion, but should introduce ideas or opinions described by literatures. Please change the sentence accordingly. (Mitsutsune Yamaguchi, Teikyo University)	This section has been rewritten to remove the text in question.
19-992	A	62	46	62	49	This is a SERIOUS misinterpretation of the information in the graph. In fact, stabilization at 470 ppm CO2e reduces the probability of exceeding 2° to 33% not for ALL of the PDFs but for ONLY ONE, the Forest Expert, one of the two most optimistic. A correct interpretation is that to reduce the risk to 33%, stabilization has to be between 355 ppm CO2e and 470 ppm CO2e, depending on the PDF; if you leave off the two outliers, you still get about 390 to 450. To reduce the risk to below 10%, you have to look at information about the PDFs that is not shown on the chart because for at least three PDFs the numbers are below the 350 ppm level that is the lowest shown, The numbers are actually from 327 to 420, with a mean and median of about 375, depending on exactly which PDFs you include in the calculation. Mike Mastrandrea should know this - he and Malte and I created a spreadsheet which does exactly this calculation! (Paul Baer, Stanford University)	Corrected as suggested by the author of the research (see next comment).
19-993	A	62	46	62	49	Substitute the sentence "To render eventual exceedence of this exemplary threshold "unlikely" (<33% chance) for all climate sensitivity distributions considered, the CO2-equivalent stabilization level must be less then 470ppm. To make exceedence "very unlikely" (<10% chance), the level must be below 420ppm" with the new text "To render eventual exceedence of this exemplary threshold "unlikely" (<33% chance), the CO2-equivalent stabilization level must be below 400ppm for the majority of considered climate sensitivity uncertainty distributions (range 350 and 470ppm). To make exceedence "very unlikely" in equilibrium (<10% chance), the level must be even lower given the current knowledge on the uncertainty of climate sensitivity." REASONING: This slight change of the text is proposed as the originally cited numbers 470 and 420ppm cite the most 'optimistic' case. The current version of the text however claims that 470 and 420 are the bounds when taking into account ALL considered climate sensitivities, which is unfortunately not the case.... For example, for the Murphy et al curve, the probability of exceeding 2°C in equilibrium for 470ppm stabilization is around 85%, not lower than 33%.	Changed as requested

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						(Malte Meinshausen, NCAR, National Center for Atmospheric Research)	
19-994	A	63	3	63	5	It might be worth pointing out that the lognormal PDF used in this study has only a 5% chance of exceeding 4.5°C, which is relatively optimistic compared to either recent published PDFs or most expert opinion as expressed in Morgan and Keith 1995. (Paul Baer, Stanford University)	We now state that the Wigley CDF is pictured in Figure 19.4, so that readers can compare it to other published distributions, and have reminded readers that different assumptions would change the results.
19-995	A	63	7	63	9	The time to reach CO2 stabilisation, even if emission levels were to be held constant, is dependent on assumptions and may be long or short. For example, because of the large natural exchange between the atmosphere and the oceans and terrestrial biosphere compared with the atmospheric loading, the mean residence time of CO2 in the atmosphere is only a few years. However, as the human emissions are an additional input to the atmosphere they will bias the natural loading until a new equilibrium is reached. The natural exchanges also respond to the increasing atmospheric loading to reduce the actual increase in atmospheric loading. The predicted response of the natural exchanges is based on a range of essentially unvalidated assumptions and may be overly pessimistic. This point is underscored by the discussion on whether or not the stabilisation trajectories lead to overshoot. (William Kininmonth, Australasian Climate Research)	Comment noted, though no change is suggested.
19-996	A	63	9			There should be a closing parenthesis at the end of this line. (Stephen De Canio, University of California, Santa Barbara)	Changed as suggested
19-997	A	63	9	63	14	This figure illustrates the relevance of set-based methods. The figure illustrates a set of probability distributions. There is a well developed mathematics for dealing with this type of hybrid information (see references above). (Jim Hall, University of Newcastle upon Tyne)	Noted, no change needed
19-998	A	63	9	63	9	...realized). (David Major, Columbia University)	Changed as suggested
19-999	A	63	10			FIGURE 19.4. Please update the figure with the finally accepted version of the Hare and Meinshausen paper, available in EPS (Illustrator CS2) format at www.up.umnw.ethz.ch/~mmalte/simcap/plots/Hare_2005_FIGURE_19_4.eps . Thanks. The slight revisions are: (1) The climate sensitivity PDF by Schneider von Deimling et al. is not included any more (since not yet available in final form), (2) the radiative forcing is depicted on the top axis, and (3) the terminology is corrected to "probability of overshooting" instead of "risk to overshoot". Please contact the author of the figure, if there are any requests/questions in regard to the EPS file (mmalte@ucar.edu). (Malte Meinshausen, NCAR, National Center for Atmospheric Research)	Changed as suggested

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19-1000	A	63	10			Change figure caption to new text: "Probability of exceeding an equilibrium global warming of 2°C above preindustrial (corresponding to 1.4°C above 2000 levels). Source: Hare and Meinshausen (2005)". If a longer figure caption were desired, one could add: "Many estimates of the uncertainty in climate sensitivity suggest that only by stabilizing anthropogenic radiative forcing at levels below 400ppm CO2 equivalent concentrations (range 350 to 470ppm), the probability of exceeding 2°C equilibrium warming can be termed "unlikely" (<33% chance - see vertical axes)". (Malte Meinshausen, NCAR, National Center for Atmospheric Research)	Changed as suggested.
19-1001	A	63	21	63	25	A more thorough description of the probabilistic approach could be useful here. Importance of probabilistic approach and consideration of overshoot scenario is new and therefore may be not very well understood by policy makers. At the same time it is a very powerful tool to present DAI without losses of important information (Alexander Golub, Environmental Defense)	Unfortunately, space does not allow.
19-1002	A	64	1	64	20	In the table, try to explain which are static/dynamic and which are deterministic/probabilistic (or explain that you can have both) without adding extra columns/rows to the table. (Rachel Warren, Tyndall Centre)	This comment is not consistent with the text it references. This information is provided in the text following the table.
19-1003	A	64	5	64	8	"Equilibrium" means at the end of the period. (Alexander Golub, Environmental Defense)	Comment unclear
19-1004	A	64	6	64	8	This is really a strong conclusion but the dynamic approach, be effective and to provide an accurate guide to probabilities of exceeding thresholds, has to also include a characterisation of uncertainty in key system properties or drivers (beyond climate sensitivity) eg ocean heat uptake rate, carbon cycle feedbacks, uncertainties in radiative forcing. Sensitivity calculations indicate that ignoring these can lead to misleading conclusions. (William Hare, PIK)	This is true, and the qualifier "dynamic approaches that properly incorporate sources of uncertainty in the climate system" has been added.
19-1005	A	64	8	64	8	"that a dynamic" (David Major, Columbia University)	No, there are multiple dynamic approaches possible.
19-1006	A	64	30	72	50	I suggest that ALL of these modelling approaches are kinds of integrated assessment modelling. Hence in the table 19.2 the third method should say "cost-benefit analysis" and not integrated assessment. All of the methods to identify climate policies to avoid DAI require doing integrated assessment in a quantitative or possibly qualitative, fashion. (Rachel Warren, Tyndall Centre)	This has been changed as suggested.
19-1007	A	65	8	65	11	Please modify: "It has been applied to several normative [add: and systemic] thresholds for climate impacts, which are" (Thomas Bruckner, Technical University of Berlin)	Text changed as suggested.

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19-1008	A	65	9	65	16	Introduction of socio economic characteristics would complicate analysis since it brings more uncertainties like application of WTP, which is subjective and the results are biased. (Alexander Golub, Environmental Defense)	This comment does not seem to be relevant since we are reporting about past assessments that have been published in the scientific literature.
19-1009	A	65	25	65	25	then should be than (Glenn McGregor, King's College London)	Addressed.
19-1010	A	65	26			Please add the following sentence: "In order to achieve that goal, the tolerable windows approach has been extended to support extensive sensitivity analyses (Kriegler and Bruckner, 2004) and the inclusion of probability density functions for less certain parameters (Rahmstorf and Zickfeld, 2005). [The cited reference is: E. Kriegler, T. Bruckner: Sensitivity Analysis of Emissions Corridors for the 21st Century, Climatic Change 66, 345-387 (2004).] (Thomas Bruckner, Technical University of Berlin)	Reference added.
19-1011	A	65	29			Please replace: "Rahmstorf and Zickfeld (2005) ..." by "Using a dynamic reduced-form model of the thermohaline circulation (Zickfeld and Bruckner, 2003), Rahmstorf and Zickfeld (2005)" [The cited reference is (note also that this cite is contained in the literature list of chapter 19, but not mentioned in the main text): K. Zickfeld, T. Bruckner: Reducing the Risk of Abrupt Climate Change: Emissions Corridors Preserving the Atlantic Thermohaline Circulation, Integrated Assessment 4, 106-115 (2003). In the context of the tolerable windows approach, probability constraints for the stability of the THC have been already investigated earlier in: K. Zickfeld, T. Bruckner, T. Kuhlbrodt: Safeguarding the Atlantic Thermohaline Circulation: A Sensitivity Analysis of Emission Corridors, Poster Presentation, International Conference on "Earth System Modeling", September, 15-19, 2003, Hamburg, Germany (2003). http://www.iet.tu-berlin.de/~bruckner/Publications/hamburg03_poster.pdf .] (Thomas Bruckner, Technical University of Berlin)	Reference added.
19-1012	A	65	30	65	30	"leaves the range of" Meaning ?? (Glenn McGregor, King's College London)	Addressed.
19-1013	A	65	30	65	31	"5% and 10% risk.....2035 and 2065 respectively" Are these risks or probabilities. Further what temperature increases are these % levels associated with and above which level (pre-industrial ?) (Glenn McGregor, King's College London)	First part addressed. Second part is discussed in the cited references.
19-1014	A	65	33			Please add: "A recent integrated assessment modeling study (Bruckner and Zickfeld, 2005) coupled a dynamic model of the Atlantic MOC with a reduced-	Reference added but proposed text is too long to be added as well.

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						<p>form climate model and a global economy model, the latter used to calculate the monetary cost of climate protection. If a conservative (worst-case) MOC calibration and a low worldwide future mitigation capability is assumed, the study indicates that even a relatively moderate business-as-usual emissions path would leave the emission corridor within the next two decades. This would not result in an immediate breakdown of the MOC, but a MOC collapse might well be inescapable due to the combination of climate system inertia and inadequate future emissions mitigation options."</p> <p>[The cited reference is: T. Bruckner, K. Zickfeld: Low Risk Emissions Corridors for Safeguarding the Atlantic Thermohaline Circulation, Mitigation and Adaptation Strategies for Global Change (accepted, 2005). This reference should substitute for the reference "Bruckner, T., and K. Zickfeld. 2004. Low Risk Emissions Corridors for safeguarding the Atlantic Thermohaline Circulation. Paper read at Greenhouse Gas Emissions and Abrupt Climate Change: Positive Options and Robust policies, at Paris" (which is already contained in the literature list of chapter 19, but not cited in the text.).]</p> <p>(Thomas Bruckner, Technical University of Berlin)</p>	
19-1015	A	65	38	65	42	<p>These are very strong conclusions, and although they are the result of only one study, they should be given more prominence. The general conclusion about the importance of the risk of a large-scale singularity or other instabilities can also be found in Hall and Behl (forthcoming) (Stephen De Canio, University of California, Santa Barbara)</p>	Discussion of this reference added.
19-1016	A	65	42			<p>Needs a comment about the treatment of uncertainty in these studies similar to the one in the paragraph above for the tolerable windows. (Chris Hope, Judge Business School)</p>	There is not enough room for an in-depth discussion of these uncertainties in this chapter.
19-1017	A	65	45	66	24	<p>Section 19.4.5: Most of the models used to conduct cost-effectiveness and tolerable windows approach analyses classify as comprehensive integrated assessment models covering both the climatic and economic systems. The title of section 19.4.5 is therefore misleading. It seems that the models discussed in this section utilize a cost-benefit framework. I suggest that one should use "cost-benefit analysis" in the title and several times in the text of this section (for instance, page 66, line 7). Currently, cost-benefit analysis is only explicitly mentioned within the section on cost-effectiveness analysis. This does not reflect the influence that cost-benefit analysis has had on climate change policy formulation to date.</p>	This point is noted, and the section title has been deleted in the SOD 19.4

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						(Thomas Bruckner, Technical University of Berlin)	
19-1018	A	65	45			Section 19.4.5 on IA assessments does not correspond well to the definition of this approach in Table 19.2. Many of the studies discussed here are not optimizing analyses. It raises the question of what is actually meant by "integrated assessment" in this part of the chapter -- it should be defined, since there are several definitions floating around in the literature and they sometimes differ from common usage. (Brian O'Neill, IIASA and Brown University)	This point is noted, and the section title has been deleted in the SOD 19.4
19-1019	A	65	47	65	47	after CO2 concentrations add" to avoid DAI" is this is what is meant (Rachel Warren, Tyndall Centre)	This comment is not consistent with the text indicated.
19-1020	A	65	50	65	50	536ppm CO2 matches what CO2 equivalent as used in previous pgph? (Rachel Warren, Tyndall Centre)	This comment is not consistent with the text indicated.
19-1021	A	66	6	66	15	The title of the Link and Tol (2004b) paper (and presumably also its economic estimates) refers to a "slowdown" of the thermohaline circulation, yet the paragraph purports to give estimates of the damages from a "shutdown" of the MOC (line 7). These discrepancy needs to be corrected. Also, if Europe accounts for roughly a third of gross world output, lines 12 and 13 would imply that a "shutdown" of the MOC would cause approximately a 3% decline in European output. Yet the paragraph also states that "current analyses might be best interpreted as order-of-magnitude estimates" (lines 9-10). In light of these considerations, is presenting the damage estimate of "1% of gross world product" helpful or potentially misleading? (Stephen De Canio, University of California, Santa Barbara)	The text has been clarified to refer to both slowing and shutdown of MOC. As we wish to accurately reflect the literature, the point being made is that significant abatement can be economically efficient EVEN for damages less than 1% GWP. This is now clarified.
19-1022	A	66	6	66	15	The focus on MOC collapse is quite extraordinary given the low likelihood of its occurrence. The Arctic Ocean is in a region of net radiation deficit and warming of the Arctic Ocean surface can only occur if the import of energy by the ocean currents increases (as has been observed in recent years), but this requires a strengthening of the MOC. A more likely scenario is a fluctuating MOC as surface currents respond to wind stress to trigger inertial oscillations of the natural frequency of the MOC. (William Kininmonth, Australasian Climate Research)	When other examples enter the literature, they can be incorporated. This is a commentary on the literature, not the chapter.
19-1023	A	66	10	66	13	Here, several preceding studies, such as Cline 1992, Nordhaus 1994, 2000 are omitted. These should be added as showing the different views. (Mitsutsune Yamaguchi, Teikyo University)	The point being made here is integration of damages from MOC into a CB integrated assessment framework, not estimates of climate damages or even damages from abrupt climate changes. These studies do not cover

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							this topic.
19-1024	A	66	17	66	24	A similar analysis is done in Hope, 2005, with a full probabilistic treatment of uncertainty. (Hope C, "The marginal impact of CO2 from PAGE2002: An Integrated Assessment Model Incorporating the IPCC's five reasons for concern", Integrated Assessment Journal, October 2005). (Chris Hope, Judge Business School)	The focus of this paragraph is on the probabilistic analysis of crossing thresholds for DAI, which Hope, 2005 does not address. However, we have added a reference to it to highlight that other researchers are treating uncertainty probabilistically in IAMs
19-1025	A	66	27	67	4	This subchapter probably should be renamed to Cost-effectiveness versus Cost-benefit analysis. Also, it should be significantly extended to better reflect the most recent literature. For example, I would suggest including results from Mastrandrea, Schneider, 2004 and related works. It will give a different view on cost-effectiveness and how it may be under scrutiny. (Alexander Golub, Environmental Defense)	We have condensed these subsections into one section on mitigation response strategies. Unfortunately, space limits our ability to add additional information.
19-1026	A	66	30	66	32	It should be noted that studies like WRE 96 which show that "cost-effective" pathways delay emissions reductions depend on assumptions about both discounting and technological development, and are essentially expert opinion rather than objective fact. (Paul Baer, Stanford University)	We have added a statement reminding readers that the cost-effective balance is dependent on assumptions such as those suggested by the reviewer.
19-1027	A	66	32	66	32	Add the related reference by "Azar, 1998" to "Wigley et al. 1996". Azar revisited the debate that was triggered by the original Wigley et al. paper. FULL CITATION OF AZAR: Azar, C.: 1998, 'The timing of CO2 emissions reductions: the debate revisited', International Journal of Environment and Pollution 10, 508-521. (Malte Meinshausen, NCAR, National Center for Atmospheric Research)	We have added the reference
19-1028	A	66	35	66	39	It is not correct to say that a cost-effectiveness analysis would suggest a larger reduction of CO2 emissions than cost-benefit analysis. In the case of cost-effectiveness analysis, emissions reduction is predetermined. The problem with cost-benefit analysis is its out of date presentation of economic damage. The probabilistic approach, if applied to the damage calculation, would suggest a much greater reduction of carbon emissions than conventional integrated models that treat economic damage as a determined and continuous function. (Alexander Golub, Environmental Defense)	The statement referred to in the chapter makes the point that cost-effectiveness analyses that incorporate constraints linked to abrupt climate change or other climate impacts neglected in classical cost-benefit analyses suggest larger reductions, which we believe is in keeping with the reviewer's comment. We have edited the statement to clarify.
19-1029	A	66	35	66	39	This sentence compares the reduction volume of GHG emissions between the level determined by cost-effective analysis and the one determined by cost-benefit analysis. Unless target level (either concentration or temperature) are set, this kind of comparison will be meaningless. Suggest deletion. (Mitsutsune Yamaguchi, Teikyo University)	This sentence has been modified such that the comparison is parallel, the main point being that cost-benefit approaches that do not set such constraints will arrive at less stringent reductions. We believe this statement is valid.

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19-1030	A	66	37	66	39	I would cite the sources (Azar's work and some of Tol's) that generates different results to CBA studies, either here or above. (Paul Baer, Stanford University)	Some of these sources are indeed cited here and above.
19-1031	A	66	47			There is a typo in "confide4nce". (Stephen De Canio, University of California, Santa Barbara)	Corrected
19-1032	A	67	3	67	4	The statement that "these authors argue that the scientific uncertainty cannot by itself [be] used as a justification for doing nothing today to mitigate potential climate damages" should be more prominent. Note also the typo (omission of "be"). (Stephen De Canio, University of California, Santa Barbara)	The grammar has been corrected. Statement 5 in the synthesis now addresses aspects of this point.
19-1033	A	67	5			Add a new para, as follows: "Based on analyses of the global impacts of climate change under various mitigation scenarios (ranging from uncontrolled emissions to CO2 stabilization at 550 and 750 ppm) and relative costs associated with different schemes to either mitigate climate change or reduce vulnerability to various climate-sensitive hazards (namely, malaria, hunger, water shortage, coastal flooding, and losses of habitat), Goklany (2005) indicates that, at least for the next few decades, risks and/or threats associated with these hazards would be lowered much more effectively, rapidly and economically by reducing current and future vulnerability to those hazards now rather than through stabilization at some date in the future. This can be achieved by targeting measures to reduce vulnerabilities to the various urgent climate-sensitive problems that might be exacerbated by future climate change. Alternatively, vulnerability can also be reduced by broadly advancing sustainable development, through, for instance, measures designed to meet the MDGs. Either approach would advance adaptive and mitigative capacities in tandem with sustainable development (Goklany 2005b). On the other hand, mitigation may be unavoidable in the longer term. Accordingly, over the next few decades, Goklany argues, the focus of climate policy should be to: (a) broadly advance sustainable development (particularly in developing countries since that would generally enhance their adaptive capacity to cope with numerous problems that currently beset them, including climate-sensitive problems), (b) reduce vulnerabilities to climate-sensitive problems, (c) implement "no-regret" emission reduction measures while (d) striving to expand the universe of such measures through research and development of cleaner and more affordable technologies. Such a policy would integrate climate and sustainable development policies, helping solve current urgent problems facing humanity while preparing it to face future problems that might be caused by climate change." (Indur Goklany, Office of Policy Analysis, Department of the Interior)	This paragraph is not appropriate here. Note that a section specifically on adaptation has been added to 19.4 in the SOD.

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19-1034	A	67	5	67	5	Add cost-benefit analysis. (Richard S.J. Tol, Uni. Hamburg)	We now re-label the integrated assessment section more accurately as cost-benefit analysis, as it treats these assessments.
19-1035	A	67	7			Section 19.4.7 This needs to be expanded in the SOD! (William Hare, PIK)	There is a conflict with the page limit of our chapter.
19-1036	A	67	9	68	8	A pressing question that is not adequately addressed in this section is how ambiguous scientific information is to be used by decision-makers. This is quite distinct from using probabilistic information, which, as the text suggests, leads directly to risk-based decision making. In the presence of ambiguous information (including severe uncertainty about which of a range of probability distributions are correct) decision-makers may (or may not) wish to seek options that are robust to epistemic uncertainties. There is some linkage between robustness and precautionarity, as discussed in a nice chapter by Kriegler, E., Held, H. and Bruckner, T.: 2005, 'Climate Protection Strategies under Ambiguity About Catastrophic Consequences', in (eds.), Decision Making and Risk Management in Sustainability Science, Nova Science Publ. Inc., New York, pp.in press. (Jim Hall, University of Newcastle upon Tyne)	We have added a cross-reference to the WG III AR4 where this question is discussed.
19-1037	A	67	16			Hope, 2005, contains a simple representation of adaptation as a policy option. (Chris Hope, Judge Business School)	Reference not known.
19-1038	A	67	22	67	30	This paragraph seems to suggest that a risk-management approach based on probabilities will take account of uncertainties. This is quite incorrect because, as already explained above, there is severe uncertainty about what those probabilities are. As JM Keynes and many others since (Levi, Walley and Ben-Haim give some of the most trenchant arguments) have argued, probability is not an appropriate framework for representation of complete ignorance and severe uncertainty. (Jim Hall, University of Newcastle upon Tyne)	Text added.
19-1039	A	67	22	67	22	I would urge rewording this without making such a big deal of uncertainties. I would replace "Uncertainty" with "Complexity" and this is the real reason. (Michael MacCracken, Climate Institute)	We disagree.
19-1040	A	67	22	67	30	The conclusion that "uncertainty prevails" is not suitably specific. It implies that nothing that can be said about our current knowledge of appropriate responses to avoid DAI. I don't think that is the conclusion to be drawn from the literature. Second, this text goes on to say that since uncertainty prevails, deterministic scenarios are not a good approach because they can't cover the full range of plausible outcomes. This conclusion is unsupported and counter to the logic of using scenarios in the first place (including the development of SRES, etc.). A typical motivation for scenarios is precisely to explore a full range of outcomes	Text edited to address the main concerns.

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						when uncertainty is high. Further, the text then concludes that because uncertainty prevails, probabilistic approaches are more useful than deterministic ones (actually, the text uses the non-committal language "may be more useful" which actually says nothing at all, but I assume the authors really mean that these approaches probably ARE more useful). This conclusion does not automatically follow and therefore must be justified on other grounds. Scenarios have a long history of being applied when uncertainties are so large as to preclude assignment of meaningful probabilities. As this chapter (and others) document, there are components of the problem in which the literature offers more support to quantifying probabilities for (e.g., climate sensitivity) and components where there is little or no support (socio-economic development paths, regional impacts, etc.). Conclusions should reflect this situation rather than offering blanket statements. (Brian O'Neill, IIASA and Brown University)	
19-1041	A	67	23			I would say "cannot" rather than "may not" (Paul Baer, Stanford University)	Done.
19-1042	A	67	28			It is not "despite" the large uncertainties that they reveal, but BECAUSE they reveal these uncertainties, that it is necessary to use these types of approaches! (Paul Baer, Stanford University)	Addressed.
19-1043	A	67	31	67	32	This statement should be given greater emphasis. (Stephen De Canio, University of California, Santa Barbara)	This is the most prominent place available in our chapter.
19-1044	A	67	31	67	35	It means that some adaptation is inevitable. (Alexander Golub, Environmental Defense)	We disagree. Societies may choose not to proactively adapt, for instance because they consider the risk too small.
19-1045	A	67	31	67	35	This is an unsubstantiated statement. The only large-scale singularity of the climate record of the past million years is the sudden Arctic temperature reversal between the last glacial maximum and leading to the Holocene brought on by the irregular flow of meltwater into the North Atlantic. Scenarios for 'irreversible change' are dependent on untested assumptions. Given the historical record and the inertia of the climate system then the emphasis should be on the high probability of such events not occurring. (William Kininmonth, Australasian Climate Research)	We believe that our statement is substantiated.
19-1046	A	67	31	67	35	This description is based on only one literature (Rahmstorf and Zickfeld, 2005). Though Wigley, 2004 is cited as well, the latter literature seems not to discuss particularly about large-scale singularities. Under this situation it is dubious to declare positively that this is "more robust" as stated in line 21 in page 67. Deletion is recommended. (Same argument applies to sentences in page 4, lines 41-44). (Mitsutsune Yamaguchi, Teikyo University)	These statements have been reworded such that the statements can be seen as more robust, as the reviewer recommends.

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19-1047	A	67	38	67	42	The conclusions on costs (including the learning rate for low emitting technologies) may be true but I do not think there is a basis in this chapter for them (I may have missed it). This seems like WG3 Ch 3 territory. (Brian O'Neill, IIASA and Brown University)	Statement deleted.
19-1048	A	67	39	67	42	Delete the following sentences as those should be discussed in WG3. "--- depending on the rate of learning that brings down costs of low-GHG emitting technologies, makes achievement of the lower range of stabilization targets (e.g., less than 500 ppm CO ₂ -equivalent) increasingly expensive or infeasible (except via overshoot scenarios)". (Mitsutsune Yamaguchi, Teikyo University)	Statement deleted.
19-1049	A	67	43	67	45	Consistency of language suggests re-phrasing the sentence as; ' Computer modelling using different analytical methods and emission scenarios indicate a high confidence' (William Kininmonth, Australasian Climate Research)	Text changed.
19-1050	A	67	43	67	50	The focus on the 450 CO ₂ level in this text seems unbalanced given its relative lack of attention in the preceding material. If this is a synthesis section, my expectation is that it should reflect preceding discussions. The only study referred to in the context of a 450 target is Corfee-Morlot and Hoehne. Also, not all the studies cited in this text make an explicit link between 450 CO ₂ and its warming implications (e.g., the O'Neill and Oppenheimer 2004 study used equivalent CO ₂ levels and did not associate any true CO ₂ levels with these outcomes). Thus, overall, the text gives the impression that a level of 450 CO ₂ is given special significance without a substantial discussion presented to support it. (Brian O'Neill, IIASA and Brown University)	There is more evidence for this stabilization level in Section 19.3.
19-1051	A	67	45	67	45	What does "warming in excess of 1C-2C" mean? Simply "in excess of 2C" presumably. (Jim Hall, University of Newcastle upon Tyne)	Addressed.
19-1052	A	67	47	67	50	Mentioning just two impacts here understates the many and potentially severe impacts of a warming in excess of 2C. (Jim Hall, University of Newcastle upon Tyne)	These illustrative examples have been removed.
19-1053	A	67	48	67	50	There is a following description; "--- it could also induce significant shrinkage of the major ice sheets ---". In this sentence, major ice sheets seems to include WAIS. However, some studies indicate that a 2 to 4 degree centigrade warming above current levels could begin WAIS deglaciation (low to medium confidence) p. 5 lines 43-45 in this chapter. Also, Oppenheimer and Alley 2004, 2005 projected that a global warming of 4 degree centigrade above today's level would result in disintegration of WAIS within several centuries (p. 21, lines 29-31). In addition,	This illustrative example has been removed.

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						there is a description that, depending on the models, WAIS shows little shrinkage until local temperature warm by about 10 degree centigrade (p. 21, lines 37-38). Whereas the above description in page 67 focuses on the effect of increase of 1 to 2 degree centigrade. In view of the above, the sentence begins with "it could also ---" seems not to be robust and should be deleted. (Mitsutsune Yamaguchi, Teikyo University)	
19-1054	A	67	50			Add a new para as follows: "In the short to medium term risks and/or threats from climate-sensitive hazards can be reduced more effectively and rapidly through measures designed to reduce the vulnerability to climate-sensitive hazards by either broadly advancing sustainable development (through, e.g., meeting the MDGs) or by reducing vulnerabilities to urgent climate-sensitive problems that might be exacerbated by future climate change. At the same time, "no-regret" emission reduction measures ought to be implemented along with programs to expand the universe of such measures through research and development of cleaner and more affordable technologies." (Indur Goklany, Office of Policy Analysis, Department of the Interior)	This statement is not substantiated by the literature reviewed in our chapter.
19-1055	A	67				Additional conclusion on overshoot concentration will be very useful. (Alexander Golub, Environmental Defense)	This topic is discussed extensively earlier in our section.
19-1056	A	68	3	68	4	Re research priorities: It is clear that we know (1) very little about the consequence of rates of temperature increase on the key vulnerabilities, and (2) even less about the consequence of maximum exceedence amplitude and degree years in overshoot scenarios. These are going to become increasingly important as we go from arguing about stabilization targets to arguing about emissions pathways to reach those targets. Similarly, it will be important to develop probabilistic models that actually provide risk estimates for transient temperature increases based on emissions scenarios, given carbon cycle uncertainty and uncertainty in the rate of ocean heat uptake. (Paul Baer, Stanford University)	These useful points have been noted, and we have integrated some of the ideas into 19.5.
19-1057	A	68	3			Add the following to the priorities for research: *Research into the probabilistic transient climate change associated with different peaking concentration scenarios; This research is more challenging than the probabilistic temperature implications of stabilization scenarios, because not only climate sensitivity, but as well the climate system properties that influence inertia have to be taken into account. However, the climate response of scenarios that aim at reducing concentrations after peaking (e.g. with capped cumulative emissions) can be better constrained in terms of their maximal global mean temperature implications (CITE E.G. Allen, M. et al. "Observational constraints on climate	Very useful comment, will be considered further in the TOD.

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						sensitivity", in in Schellnhuber, J.S., Cramer, W., Nakicenovic, N., Wigley, T.M.L. and Yohe, G. (eds.), <i>Avoiding Dangerous Climate Change</i> , Cambridge University Press, Cambridge.) (Malte Meinshausen, NCAR, National Center for Atmospheric Research)	
19-1058	A	68	30	68	30	In this ppgph make sure the MOC statements are included in the table 19.1 (Rachel Warren, Tyndall Centre)	Comment not consistent with text indicated.
19-1059	A	68	48	69	25	Suggest that this section is changed to be about cost benefit analysis, since integrated assessment is also the other 3 methods, so change title of section 19.4.5. Suggest that this may mean moving some of the text to the scenario section so these studies can be classified as probabalistic scenario analyses instead? (Rachel Warren, Tyndall Centre)	Comment not consistent with text indicated. (but similar comments have been addressed)
19-1060	A	69	0	90		There are numerous references which are not of a high quality here: that do not appear to be peer-reviewed literature; that are incomplete; are referred to in the text but not listed; that are in press and thus cannot be verified, etc. One assumes that some of these will be remedied in subsequent drafts, but both the high level of citation of sources which are very recent and thus not subject to verification, or authored by CLAs, LAs or CAs detracts from the authoritativeness of the chapter — especially when it is considered some key references (often pointing to different conclusions) are not included. One would prefer to see these sources (referred to above) included and discussed. (Aynsley Kellow, University of Tasmania)	Effort has been made to expand the references cited, as well as a heavy reliance on the findings of other chapters in AR4. We believe this is the best method to ensure broad coverage of sources.
19-1061	A	69	1			This is a bibliography, rather than a list of references. There are many listings which are not referred to, though one assumes they have been consulted (Aynsley Kellow, University of Tasmania)	This will be fully addressed in the TOD.
19-1062	A	70	4	70	4	A stronger statement could be made here that authors have argued that scientific uncertainty is a reason for earlier action rather than postponed action. (Rachel Warren, Tyndall Centre)	Comment not consistent with text indicated.
19-1063	A	70	42	70	42	change to "except via overshoot scenarios which are, as explained above, less likely to prevent DAI". (Rachel Warren, Tyndall Centre)	Comment not consistent with text indicated.
19-1064	A	86	5			Amartya Sen's book "Development as Freedom" is undoubtedly important work about what the economical development is, and actually it is cited in the references section of this chapter. But, very curiously, no description on his work is seen in the main text. (Kiminori Itoh, Yokohama National University)	Sen is now cited in 19.4.1
19-1065	A	90				The authors' charge is to assess "key vulnerabilities" and so they do. The result is a rather biased review of the literature, surpressing everything that is good about	We follow the IPCC Plenary outline—and have added text at the outset to make that

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						climate change and cheap energy. I would throw out the entire chapter. If that advice is not followed, the chapter should start with the caveat "We were looking for bad things, and this is what we found. We ignored all the good things." (Richard S.J. Tol, Uni. Hamburg)	clearer. Reviewer should take up his concern with Plenary delegates. In any case, Chapter 20 deals with cost/benefit issues and concludes that there is little more than low confidence in most conclusions.