This is the response by the writing team to the comments we received for the SOD Chapter 4 "Ecosystems, their properties, goods, and services" AR4 (Government and Expert review)

It should be noted that we have revised first all text, even if we planned to cut it to ensure no comments of the reviewers are not taken on board. Thus several comments may be annotated by 'A' agreed (done) despite the fact that the text was actually later removed (we had to considerably shorten the chapter). So you may find 'A' for text that is actually no longer present in the final version of the chapter.

Comment responsibilities (see also separate spreadsheet):

af/gm	
bg	
jt	
pd/gm	
av/af	
af/hb	
gm	
af	
jp/rw/af/gm	
mr/jdc/af	

Please use the following terminology while adding notes in the last column:
A – Agreed
R – Rejected (add rationale)
L – Left it under advisement (should be avoided for FGD)

NA – Not applicable

TR – Text Removed

White areas in rightmost column indicate a comment concerning a typically technical detail

Comments left white concern non-chapter 4 texts

LA responsibility includes that of the CAs for whom that LA is responsible

Following batches: EA

SPM and TS comments are not contained in this spreadsheet

Hint: To terminate a paragraph, i.e. to create a new one within a cell, press this key combination:
Control^Alt^Return (Windows) or Control^Option^Return (Mac)

bold - substantial comments.
red font - requires discussion in the writing team.

green font – CLA issue, possibly including CLAs from other chapters

G-4-xyzA: Is a cross reference to a government comment of chapter 4 with number xyz from batch A.

Note the letter A refers to the batch of comments (2nd column).

E-4-xyzA: Is a cross reference to an expert comment of chapter 4 with number xyz from batch A.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Notes of the writing team
E-4-8	A	0					Thank you

						Some refs: Wright, R.F.; Beier, C. and Cosby, B.J. (1998a) Effects of nitrogen deposition and climate change on nitrogen runoff at Norwegian boreal forest catchments: the MERLIN model applied to the RAIN and CLIMEX projects. Hydrology and Earth System Sciences, 2, 399-414.35. Jensen, K.; Beier, C.; Michelsen, A. and Emmett, B.A. (2003) Effects of experimental drought on microbial processes in two temperate heathlands at contrasting water conditions. Appl. Soil Ecology. 24, 165-176. Wright, R.F. (1998b) Effect of increased carbon dioxide and temperature on runoff chemistry at a forested catchment in southern Norway (CLIMEX project). Ecosystems, 1, 216-225 Peñuelas, J.; Gordon, C.; Llorens, L.; Nielsen, T.; Tietema, A.; Beier, C.; Bruna, P.; Emmett, B.A.; Estiarte, M. and Gorissen, A. (2004) Non-intrusive field experiments show different plant responses to warming and drought among sites, seasons and species in a North-South European gradient. Ecosystems, 7, 598-612. (Claus Beier, Risoe National Laboratory)	
E-4-9	A	0				The authors made considerable alterations to the previous version of the report and included all of the sections that were missing. There appears to be a much more even balance in the treatment of different biomes than was presented in the previous version. The major comments or criticisms I have on the latest report are in the following areas.	Thank you - we have made a major effort to improve the boreal and tundra sections, wetlands. Given our space constraints, the "big news" from DGVM and biocliamtic models tends to take precedence, unfortunately.

						1. I do not feel the present report does justice to the complex issues related to climate warming in arctic and boreal regions, in particular, the lack of a coherent and complete discussion of recent observations that permafrost is warming, the role of permafrost in a variety of important ecosystem processes (as noted in my previous review), a confusion between transitions between tundra and forest and forest and peatlands, lack of references to recent field-based studies that document the impacts of climate change and disturbance in this region, and the lack of any meaningful discussion on processes related to climate change and disturbance in boreal peatlands. 2. Furthermore, the lack of any in-depth discussion on inland wetlands in section 4.4.8 is a glaring deficiency of this report. Given the importance of wetlands as an ecosystem, their sensitivity to climate variations, and the fact that wetlands are being lost at an alarming rate due to anthropogenic activities, a more in-depth discussion of wetlands is critical for this report. 3. In terms of models that analyze effects of climate on the distribution of vegetation and biogeochemical cycling, there is a strong bias in this report towards dynamic global vegetation models, at the expense of ignoring the importance and utility of other modeling approaches, especially those that are based on plant physiology and biogeochemical considerations. I believe that the utilization and findings from these other modeling approaches are important to the subjects covered in this report, and a more even treatment of global modeling is needed. (Eric Kasischke, University of Maryland)	
E-4-10	A	0				Table and figures - the reproduction quality of some of the figures is not particuarly good. Many appear grainy and as a result look as if they have been scanned in. This reviewer acknowledges that this will be addressed before the chapter is finalised. (Paul J. Wood, Loughborough University)	A - done
E-4-11	A	0				Still a pretty terrestrial heavy chapter and the other chapters don't really get into the ecosystem aspects of marine and freshwater biodiversity and climate change-- much better than previous iterations but still needs more balance (Lara Hansen, WWF)	A - we have tried to do so.
E-4-12	A	0				section on past climates (4.2.1) lacks a clear message. In my opinion, there should be a clearer statement on the lessons learned from past climate changes, namely, that rapid climate changes do exist, and ecosystems are not able to adapt to those changes on a short time scale. (Oscar Abbink, TNO B&O)	Text revised substantiually and incorporated into a more comprehensive section on climate variability
E-4-13	A	0				References not always in ascending chronological order. There are still a number of typographical/spelling errors, words missing or poor English. I assume that these will be corrected. (Pam Berry, University of Oxford)	A

E-4-14	A	0				One of the most important results concerning desertification shown by the Millennium Ecosystem Assessment (MEA) is the estimate of the degraded global dryland area of 10-20%. This value is much smaller than that of 70% (3600 million ha) of drylands (suffering from soil or vegetation degradation) that was reported in the early 1990s (UNEP, 1992). I strongy suggest that this point should be mentioned in Section 4.4.2. My suggestion on the first verion was not considered in the second-order draft. (Masato Shinoda, Arid Land Research Center, Tottori University)	A - we have revised this in our figure 4.1. and text text in 4.4.2
E-4-15	A	0				In general, the report appears of high quality (Oscar Abbink, TNO B&O)	Thank you
E-4-16	A	0				I thought the second draft much improved over version one, and I did check to see that many of the suggestions I made in the first draft had been acted on. I have one suggestion regarding citations I am familiar with. (Jack Morgan, USDA ARS Rangeland Resources Research)	Thank you we followed your useful suggestions
E-4-17	A	0				General comment: Given the space constraints and the large scope of this chapter, the authors did an excellent and very rigorous assessment. (F. Stuart Chapin, III, University of Alaska Fairbanks)	Thank you
E-4-18	A	0				After reading the whole chapter I realized that there is a big contrast between the first and the second half. Whereas the second half is in general well-written and easy to follow, there are still important flaws in the first half (until page 34). In this first part, sentences are often too long and confusing and the ideas are not well linked. Moreover, global trends are often not highlighted enough. Therefore, I suggest the authors to carefully revise these sections. English should also be revised. I found the summaries of sections 4.4.5-4.4.7 relatively poor taking into account the amount of studies carried out on these subjects. (Laura Llorens Guasch, University of Girona)	A - we have attempted to rationalize the style.
E-4-19	A	2	18	2	21	A note from the authors of the chapter acknowledges that they are using a number of references that have yet to be published. IPCC rules prohibit the use of such references at this stage of the review procedure, since they cannot be evaluated by reviewers. The authors promise to remove any references that have not been published in time for inclusion in the final draft, but this circumvents the expert review procedure. All material dependent on references unpublished at the time of the release of this draft must be removed from this and subsequent drafts. (Lenny Bernstein, L.S. Bernstein & Associate, L.L.C.)	A - see IPCC rules
E-4-20	A	3	0			This summary is quite difficult to follow, since sentences are in general too long and there is too much information in brackets. (Laura Llorens Guasch, University of Girona)	A - we have cleaned up these problems as far as possible
E-4-21	A	3	1	56		Followiing are citations that were referred to, bu not provided, within the comments. The majority of these are available at http://members.cox.net/igoklany/ Goklany, IM. 1988. Climate Change Effects on Fish, Wildlife and Other DOI Programs. In: Proceedings: Second North American Conference on Preparing for Climate Change, Climate Institute, Washington, DC, December 6-8, 1988, pp. 273-281. Goklany, IM. 1995. Strategies to Enhance Adaptability: Technological Change, Economic Growth and Free Trade. Climatic Change 30: 427-449.	Thank you - we have cited those that are peer reviewed, recent, and relevant

						Goklany, IM. 1998. Saving Habitat and Conserving Biodiversity on a Crowded Planet. BioScience 48 (1998): 941-953 Goklany, IM. 2000. Potential Consequences of Increasing Atmospheric CO2 Concentration Compared to Other Environmental Problems. Technology 7S: 189-213. Goklany, IM. 2003. Relative Contributions of Global Warming to Various Climate Sensitive Risks, and Their Implications for Adaptation and Mitigation. Energy & Environment 14: 797-822. Goklany, IM. 2005a. A Climate Policy for the Short and Medium Term: Stabilization or Adaptation? Energy & Environment 16: 667-680. Goklany, IM. 2006a. Integrated Strategies to Reduce Vulnerability and Advance Adaptation, Mitigation, and Sustainable Development. Mitigation and Adaptation Response Strategies for Global Change, forthcoming. Goklany, IM, and Sprague, MW. Sustaining Development and Biodiversity: Productivity, Efficiency and Conservation, Policy Analysis No. 175, Cato Institute, Washington, DC, 1992. Goklany, IM., et al. 1992. America's Biodiversity Strategy: Actions to Conserve Species and Habitat. U. S. Department of Agriculture and Department of the Interior, Washington, DC. (Indur Goklany, US Department of the Interior)	
E-4-22	A	3	1			not much in ES on change in ecosystem services, just one general statement. Should be lots to highlight here. Rememebr this is the only bit many people will look at. I know there is pressure to keep ES short, but this should not be at the expense of excluding results of high policy relevance that people will be skimming through to look for. (Joanna House, QUEST, University of Bristol)	LA/R - We do not fully agree with this overall statement - the policy makers are likely to look only at the SPM and we made great efforts to revise the SPM.

#VALUE!	A	3	3	3	45	We are surprised that current effects on some key ecosystems that could be attributed to CO2 increases and accompanying climate change are not noted in the Executive Summary. Following are three candidates. First, recent data from Amazonia spanning 25 years (1976-2001) indicate that mortality and recruitment rates have both increased significantly in virtually every region and environmental zone, and that long-acting and widespread environmental changes are stimulating the growth and productivity of Amazon forests [O. L. Phillips, T. R. Baker, L. Arroyo, et al., Pattern and process in Amazon tree turnover, 1976-2001, Philosophical Transactions of the Royal Society of London Series B - Biological Sciences 359: 381 – 407 (2004); see also: Y. Malhi and O.L. Phillips, Tropical forests and global atmospheric change: a synthesis, Philosophical Transactions of the Royal Society of London Series B - Biological Sciences 359: 549-556 (2004).] Second, based on NDVI from 1982-2003, Herrman et al. (2005), note that contrary to assertions of wide spread desertification of the Sahel, large areas of the Sahel are greener now than they This seems to be contrary to the current statement on these lines [Reference: Herrman, S.F., et al., Recent trends in vegetation dynamics in the African Sahel and their relationship to climate," Global Environmental Change 15: 394-404 (2005)]. Third, global net primary productiviy has increased by 6% between 1981 and 1999, partly due to CO2 increases and climate change (Nemani et al. 2003). Ph11, Ma282, He91, Ne34 (Indur Goklany, US Department of the Interior)	R - Our selection of what is stated in the ES is based on the current literature (we used for our assessment over 3000 articles, including the ones mentioned by the reviewer) and found that the current early apparent effects of CO2 fertilization (although these may be also due to increased radiation e.g. Nemani et al 2003) and other impacts, such as nitrogen fertilization, are likely to be of a short-term and limited nature in terms of the overall effect (biospheric NPP). Numerous studies show that if climate continues to change, these beneficial effects start to saturate around mid century and are then swamped by negative impacts. Moreoer, since an emission pathway allowing for such effects does also imply a climate change committment (see WGI, AR4), we have to balance such effects against longer-term effects as well. Thus the overall balance, in particular also recognizing the uneven geographical distribution of such efffects around the globe (see also chapter 5) with many developing countries being most vulnerable already to the concomitant impacts of those "beneficial effects", doe according to our assessment not warrant to emphasize these short-term effects of being more than of a secondary order of importance. It would be irresponsible to highlight these clearly positive effects as purely "beneficial" as they are not of the same beneficial nature for all countries and as they are quite unavoidably precursors of more negative things to come. Finally, page limitations do not allow us to properly phrase secondary order effects, so that they are well understood in a balanced manner. Finally we also discuss this balance in the chapter, where we also show those beneficial effects clearly (4.4.1, 4.4.10, 4.4.11), e.g. by mapping them out (Figure 4.3) and we also discuss e.g. desert amelioriation in several places. Thus, in our overall assessment all these effects are considered.

E-4-24	A	3	3	3	7	This bullet conflates model projections with "evidence". The two are not the same. We have very little confidence in projections of the impacts of climate change on species and ecosystems (see above Comment), but even if we had plenty of confidence in such estimates that would not constitute evidence. In fact, we would need evidence at some time in the future to confirm that the projections made today were indeed right. Why our skepticism about model projections? Consider, for example, the projections made by Thomas et al. (2004) which is cited frequently within Table 4.2. This study did not take into consideration the role of CO2 in changing moisture requirements for plants or on plant productivity (and, therefore, other plant dependent species). Nor did it consider the effect of CO2 on the temperature tolerance on plants. In light of all these effects, how would these impacts of CO2 interact with changes in temperature and water availability to affect interspecies competition, and extinction potential of each species? Moreover, (Indur Goklany, US Department of the Interior)	R - while our confidence is not high, we do not believe that CO2 effects (for example) substantially affect projections for individual plant species in the main, due to the many other constraints on photosynthesis and growth. Evidence for CO2 effects on temperature tolerance are far from conclusive, the likely impacts of drought stress are likely to outweigh these, in particular in many tropical regions (cf. chapter 5 and our annotation to E-4-23A).
E-4-25	A	3	3	3	6	Could rather start with the result then relate it to the TAR after all the result is the most relevant bit, although it is good to know there is more evidence and greater confidence (Joanna House, QUEST, University of Bristol)	Text revised
E-4-26	A	3	3			Principal not principle (Pam Berry, University of Oxford)	Text revised
E-4-27	A	3	3			I would give the meaning of the abbreviation TAR at this point, since it is the first time it is mentioned in this chapter. (Laura Llorens Guasch, University of Girona)	A
E-4-28	A	3	4	3	4	Seems odd to give a level of confidence onw hat is a broad statement saying there is greater confidence (Joanna House, QUEST, University of Bristol)	A- text revised
E-4-29	A	3	6	3	6	"possible" vague term, not necessary as give confidence value, suggest delete or replace with something like "the risks of" (Joanna House, QUEST, University of Bristol)	A- text revised
E-4-30	A	3	9	3	14	This sentence is too long. (Laura Llorens Guasch, University of Girona)	A- text revised
E-4-31	A	3	9	3	11	it seems to me there should be lots of examples of impacts hapenning earlier that could be put here, not just the C source to sink which actaully acrries high model uncertainty (I would say too muich to say 2030 - see below). Are there not imapcts being felt already tahtw ere not predicted to occur this early in the TAR. this should be headline news. (Joanna House, QUEST, University of Bristol)	R - This topic is relevant, no doubt, but is the task of WGII, Chapter 1, not our chapter
E-4-32	A	3	9	3	13	Comment 3 also applies to this bullet. Not much confidence can be placed in these projections, and model projections do not constitute evidence. (Indur Goklany, US Department of the Interior)	R - We indicate our uncertainty, discuss relevance of the results, and do not imply that model results are empirical evidence - they are projections. However, we reject the argument that basically no confidence can be placed in these projections. One argument being the fact that these models are not applied for future projections unless they have demonstrated their ability to generate realistic projections under current conditions. Moreover, we discuss the skills of the various modeling approaches and consider those in our overall assessment.

E-4-33	A	3	9	3	9	"may" is a weak term, avoid generally "could' and "may": if its only "may" then it could as well be "not" so renders the result not wroth mentioning. Perhaps "are projected/expected to" as if it is not more crtain thatn th (Joanna House, QUEST, University of Bristol)	A- text revised
E-4-34	A	3	10	3	10	The date of 2030 doesn't belong in a general statement like this because it is scenario dependent. (Iain Colin Prentice, University of Bristol)	Text revised - we now refer to "this century"
E-4-35	A	3	10	3	10	203o (albeit with an approximately sign) seems a little to precise a date given the uncertainty in the experimental and model results re. temeprature effects on soil respiration, actual magnitude of Co2 fertilisation, not to mention the mulpiple drivers and where they will be at by 2030. In fact, this text as written seems to imply climate is the only driver: ecosystems were a source of CO2 during the 19th and early 20th century due to deforestation largely, then became a net sink sometime around the middle of the 20th century (high certainty - house et al in Millennium asssessment WGI ch.13) due to afforestation and reforestation in Europe, America and china with contribution from CO2 and N fertilsiation effects as well as climate effects (Joanna House, QUEST, University of Bristol)	Text revised - we now refer to "this century"
E-4-36	A	3	11	3	11	It may nto be clear to the reader why forests systems would turn the biosphere in to a C source, it is probably necessary to explain in an Exec summary (which is often allt hat is read0 that it is clamate change causing loss of forests due to drought that cause carbon loss. But even then, a lot of the C loss in teh cox et al result is not due to trpoical forest dieback (not boreal forest areas might increase) but is to do with temerature effects on soil respiration (Joanna House, QUEST, University of Bristol)	R - Due to the page limitations (ES is already at maxium of allocated space) we can not explain this here. However, those phenomena are explained in the chapter's text (e.g. 4.4.1, 4.4.10 and others)
E-4-37	A	3	12	3	14	the should be a separate sentence (Joanna House, QUEST, University of Bristol)	A- text revised
E-4-38	A	3	15	3	19	This sentence is too long. (Laura Llorens Guasch, University of Girona)	A- text revised
E-4-39	A	3	15	3	17	seems odd to have confidence on the thing that is changing (vegetation structure) as well as the ways it is changing major and rapid) (Joanna House, QUEST, University of Bristol)	A- text revised
E-4-40	A	3	17	3	17	"possible" weak, suggest to replace with "expected" especially since give confidence values (Joanna House, QUEST, University of Bristol)	A- text revised
E-4-41	A	3	18	3	20	start new sentence (Joanna House, QUEST, University of Bristol)	A- text revised
E-4-42	A	3	19			Eliminate "mainly detrimental" on line 19. Whether the changes are detrimental or not will depend on the amount and rate of climate change, and the specific location. (Indur Goklany, US Department of the Interior)	Text revised - we are now explicit about projected impacts
E-4-43	A	3	21	3	21	responses….TO CLIMATE CHANGE are…" (Joanna House, QUEST, University of Bristol)	A- text revised
E-4-44	A	3	21			Responses of geographic range size of endemic species are…	A- text revised

						(Stephen John Hawkins, The Marine Biological Association of the United Kingdom)	
E-4-45	A	3	22	3	22	"…with resulting NEGATIVE impacts…." (Joanna House, QUEST, University of Bristol)	A- text revised
E-4-46	A	3	22			“impacts on biodiversity and biodiversity hotspots” -> redundant. (Laura Llorens Guasch, University of Girona)	A- text revised
E-4-47	A	3	23	3	23	new sentence starting "Strongly sensitive systems INCLUDE coral reefs……" (Joanna House, QUEST, University of Bristol)	A- text revised
E-4-48	A	3	27			In many cases, persistence of endemic species requires… (Stephen John Hawkins, The Marine Biological Association of the United Kingdom)	A- text revised
E-4-49	A	3	29	3	31	As noted in Comment 3, it's not obvious that for low-to-moderate amounts of climate change, increased agricultural and forest productivity will not reduce the amount of land diverted to human uses which, in turn, would reduce habitat conversion and any resulting pressure on species and ecosytems. Thus, it is not neceessarily the case that climate change will increase the risk of extinction in the short to medium term. (Indur Goklany, US Department of the Interior)	N - however, all this would do is help improve the possibility of human adaptation and says nothing about the pressure of climate and carbon dioxide iteslf on the organisms.
E-4-50	A	3	29			I think “These effects” should be “This effect”. (Laura Llorens Guasch, University of Girona)	A- text revised
E-4-51	A	3	32			…many terrestrial species ( ), especially in open pelagic systems and in mobile fish. Responses of benthos including intertidal species have also been reported but will be species specific and aphasic. (Stephen John Hawkins, The Marine Biological Association of the United Kingdom)	A- text revised
E-4-52	A	3	33	3	34	The conclusion needs to be rewritten to indicate which are the major and secondary causes of species extinction. Also, the supporting material for this conclusion does not appear in section 4.4.1. The conclusion appears to be derived from section 4.2.3, which indicates the importance of factors other than climate change in determining biodiversity. (Lenny Bernstein, L.S. Bernstein & Associate, L.L.C.)	A- text revised
E-4-53	A	3	33	3	35	In addition to wildfires and invasive species I think that adding "pollution" is important because it is another very anthropogenic stress. Addtiionally these stresse are not only likely to exacerbate the effects of climate change but they will likley be exacerbated by climate change (invasive species become more competetive, fires gain more fuel, more pesticides are used...etc...) (Lara Hansen, WWF)	A- text revised
E-4-54	A	3	33	3	33	fire and invasice species are considered disturbances by many. Suggest "Changes in disturbance INCLUDING wildfire …"	A- text revised

						(Joanna House, QUEST, University of Bristol)	
E-4-55	A	3	33	3	35	Disturbance such as wildfires and "invasive" species might actually set the stage for colonization of areas with species that are more suitable to the new climate. Moreover, in the context of climate change, what's an "invasive" species? When the last ice age retreated, and species pushed polewards, weren't these species "invasive"? Would it have been better if invasive species had not colonized land as its climate changed? (Indur Goklany, US Department of the Interior)	This comment illustrates the difficulty of explicit and unambiguous human definitions of the natural world. Clearly, species advancing in response to natural climate change are not invasive in the sense used here. Species introduced by human interference far beyond the range they would have been able to get to naturally are alien, or non-
E-4-56	A	3	33	3	33	"… invasive AND NATIVE PEST species …" Can expect CC to cause disruption of current ecosystems (i.e., disruption of biotic controls on native pest species leading to amplified pest problems). This is a bigger problem than just invasives. I don't think this chapt gives enough weight to this likelihood. (Richard Fleming, Great Lakes Forest Research Centre)	A - we have cited far more literature on native pest species.
E-4-57	A	3	39	3	44	Too long sentence. (Laura Llorens Guasch, University of Girona)	A- text revised
E-4-58	A	3	39	3	42	Good point! (Richard Fleming, Great Lakes Forest Research Centre)	thank you
E-4-59	A	3	40	3	41	there is no result given to qualify with a confidence statement (Joanna House, QUEST, University of Bristol)	A- text revised
E-4-60	A	3	42	3	43	"Thus responses…4.6)" could be new sentence, but more importantly, this statement is policy prescriptive. IPCC gives results, it is up to policy makers to decide what responses are appropriate and whether to limit them to no regrets strategies. Also seems inappropriate to give a confidence statement on what is essentially a suggestion. (Joanna House, QUEST, University of Bristol)	A- text revised
E-4-61	A	3	45			Insert a new bullet that would read as follows: "Since non-climate-change-related factors (such as habitat loss) dominate threats to species, ecosystems and biodiversity at present and will likely do so for much of the remainder of this century, perhaps the most effective approach to reducing vulnerability to climate change in the short-to-medium term (i.e., the next few decades) would be to reduce these other on-going threats. In particular, since threats to terrestrial and freshwater biodiversity are dominated by diversion of land and water to competing human uses (e.g., cropland, harvesting of timber, and irrigation), sustainably increasing the productivity of land and water used to meet human demands for food, fiber, and timber would help stem, if not reverse, such habitat loss. Moreover that would help conserve carbon sinks and stocks, and reduce the socioeconomic costs of in situ conservation" For detailed rationale, see pages 52 and 53 of this chapter, and Comments 20 and 21 below. (Indur Goklany, US Department of the Interior)	R - We discuss carefully and at length based on the scientific literature the issue of dominance of LUC vs. CC. We do not agree with the reviewer's comment with respect of his assessment on what factors dominate throughout this century. Our text reviews all literature (we used over 3000 articles) and specialists fully aware of those issues and who have conducted detailed research on those effects are among the LAs of our chapter. Our assessment comes to another conclusion and therefore shifts our overall assessment and the relative relevance of the mentioned policies. We agree with the sentiment of protecting natural sinks, though not with the idea that other factors will trump climate change until the end of the century. We argue that protection of sinks alone will not be of use in the light of, for example, Fig 4.2. Furthermore, it is not the focus of our chapter to discuss relative mertis of various mitigation options and have to refer here to other chapters (notably chapter 18, WGII) or WGIII.

E-4-62	A	3	45			Add a second bullet on line 45 that would read as follows: "While in the long-term, any progress achieved in meeting sustainable development goals is unlikely to be sustained if ecosystem services continue to be degraded, in the short-to-medium term, advancing sustainable development would also simultaneously advance the capacity to adapt to climate change and reduce current vulnerabilities to climate-sensitive problems (e.g., hunger and disease) that might be exacerbated by climate change. In the short-to-medium term, such an approach might be the most cost-effective method of simultaneously addressing climate change and sustainable development." For rationale, see page 56, lines 21-27, and my comment on page 56 line 24 below. (Indur Goklany, US Department of the Interior)	R - Given the current literature those statements are not warranted. We have assessed all the mentioned effects and their relevance in detail and concluded that these effects have a more limited potential than the suggested wording implies. The text in the chapter has been improved to reflect that assessment better than this was previously the case. Moreover, the entire statement is geared towards a policy prescriptive intention and has to be refuted on that basis. Our work must be based solely on scientific findings.
E-4-63	A	3		58		General Comment on Chapter 4: For the most part this chapter uncritically reports the results of numerous studies that project -- not "predict", as is sometimes claimed in the text -- impacts. However, we believe the authors of this chapter have an obligation to go beyond merely reporting results from other studies. They should provide a critical evaluation as to why the results of any specific impacts study can or cannot be trusted to provide accurate results. For example, there is no information as to how well -- spatially and temporally -- the impact model used in a specific study reproduces recent changes in biota; the strength or weaknesses of the cascade of models that it uses to estimate impacts; what processes does the model incorporate or ignore; what are the cumulative uncertainties in its results (because of uncertainties in climate models, downscaling techniques, biophysical and socioeconomic models); and so forth. Without such a bona fide critical evaluation of the various studies and the methods used to project impacts, it's (Indur Goklany, US Department of the Interior)	A - This is a very valid comment. We have made substantial efforts to assess the credibility of results, and discuss now also in the text of the chapter in depth (as allowd by page limitations) the assumptions implicit in the various modelling approaches and how they have affected our various assessments. However, the focus of our chapter is on future impacts and again due to the page limitations we have not been able to discuss at any depth performance and skills of models to hindcast past and mimick present conditions.
E-4-64	A	4	1	12	31	This reviewer felt that the first few pages of the chapter were rather wordy and could have been much more succint. Background information and definitions are important but this reviewer felt that it took some time to get to the main (evidence based) part of the chapter. (Paul J. Wood, Loughborough University)	A - text improved and considerably shortened
E-4-65	A	4	1		9	Really nice intro (Lara Hansen, WWF)	Thanks, nevertheless, text was considerably shortened
E-4-66	A	4	5			I would mention the meaning of UNFCCC here. (Laura Llorens Guasch, University of Girona)	A
E-4-67	A	4	16	4	19	too many commas and "and"s (Joanna House, QUEST, University of Bristol)	A text improved
E-4-68	A	4	16	4	16	not sure what a vernal pool is (Joanna House, QUEST, University of Bristol)	A non permanent little pool forming in spring during a period of strong rainfall
E-4-69	A	4	16	4	19	“this chapter considers … impacts” -> rephrase. (Laura Llorens Guasch, University of Girona)	A text improved
E-4-70	A	4	21	4	21	suggest delete "from the global to local scales" as biomes are not at these scales (Joanna House, QUEST, University of Bristol)	R - the given range from global to local encompasses also the level of biomes
E-4-71	A	4	21			the focus of what? (Clair Hanson, IPCC TSU)	A text improved
E-4-72	A	4	23			insert 'WG2' before 'chapter' (Clair Hanson, IPCC TSU)	A text improved

E-4-73	A	4	23			“scenarios from WG I and chapter 2 (scenarios)” -> do you mean “scenarios from WG I and those reviewed in chapter 2”? Give the meaning of WG I. (Laura Llorens Guasch, University of Girona)	A text improved
E-4-74	A	4	28	4	38	suggest delete this paragraph, all spatial scales can respons at different time scales, this paragraph is not true and soes not really hold any useful info for the policy maker (Joanna House, QUEST, University of Bristol)	L - While it is true that it can't be excluded that all spatial scales may respond at different time scales, the correlation between the two has been demonstrated in many studies. Thus we reject the assertive notion that this is simply not true.
E-4-75	A	4	28	4	30	Good point! (Richard Fleming, Great Lakes Forest Research Centre)	Thanks
E-4-76	A	4	28	4	29	…understanding of temporal and spatial… (Stephen John Hawkins, The Marine Biological Association of the United Kingdom)	A
E-4-77	A	4	36			“at microscopic scales from a leaf ..” -> I would say “at smaller scales”, since there are ecophysiological changes at leaf level that are not microscopic. (Laura Llorens Guasch, University of Girona)	A
E-4-78	A	4	40	4	45	The text on "Biomes" is contradicted by the palaeorecord showing that biome shifts can (Iain Colin Prentice, University of Bristol)	TR, A partly, R partly - The statement that biome shifts would occur fast is generally unwarranted either. Thus the question remains which is the more common: Fast or slow development towards new equilibra? In particular with the qualifier of slow processes like soil formation given in the qualifying part of the sentence, we state only that a slow development is quite common in many areas of the globe, e.g. in the high latitudes, which are particularly subjected to impacts by global warming. The improved formulation is first not general, since we phrase it "may last up", which encompasses in our view fast as well as slow development towards new equilibra, and is formulated more cautiously "could" instead of "is expected to". This improvement should address the reviewers concerns, yet maintains a proper balance of the varied evidence.
E-4-79	A	4	47	4	49	Good point! (Richard Fleming, Great Lakes Forest Research Centre)	Thanks
E-4-80	A	4	48	4	49	It makes no sense to speak of disturbances (fire, insects etc) as if they were independent of climate. (Iain Colin Prentice, University of Bristol)	A partly - Reviewer should recognize that fire and insects have some independence of climate, they are not fully climate controlled. E.g. there are many human caused fires; insects were introduced into ecosystems by humans in several, important instances (e.g. gypsy moth).
E-4-81	A	4	48	4	48	"disturbance regimes such as fire or insects": I am not sure that one can class insect outbreaks or impacts as a regime, it might be better to phrase it as a disturbance event?	R - Disturbance regimes is a commonly used term. Insects can form part of a disturbance regime. The regime refers to the general situation, not an episodic event, and includes frequency and severity of an entire series of such events,

						(Gregory Masters, CABI)	thus the statistical properties of such events. Moreover, the term regime refers here only to fire and insects and not impacts.
E-4-82	A	4	51	4	52	Insert a comma after "Some" and delete the first "biomes" (Gregory Masters, CABI)	A
E-4-83	A	5	1			Inlcude at the end: Marine biomes are more open and responses have been shown on decadal scales (Beaugrand et al. SCIENCE 296 (5573): 1692-1694 MAY 31 2002) with more rapid regime shifts within decades. (Edwards M. et al. MARINE ECOLOGY-PROGRESS SERIES 239: 1-10 2002; Richardson AJ & Schoeman DS. SCIENCE 305 (5690): 1609-1612 SEP 10 2004; Edwards M. et al, LIMNOLOGY AND OCEANOGRAPHY 51 (2): 820-829 MAR 2006) (Stephen John Hawkins, The Marine Biological Association of the United Kingdom)	A
E-4-84	A	5	4	5	40	The column '%transformed' in Table 4.1 is not explained in the table legend. Add a sentence describing this column to the legend. (Heiko Balzter, Centre for Ecology and Hydrology)	Table converted to a figure
E-4-85	A	5	4			Table 4.1: In my opinion, “cultural and spiritual values” are services of all natural (Laura Llorens Guasch, University of Girona)	Table converted to a figure
E-4-86	A	5	4			Table 4.1: I suggest changing the legend of the table to something like “Global area extent, (Laura Llorens Guasch, University of Girona)	Table converted to a figure
E-4-87	A	5	4			Table 4.1: It is not clear that temperate grasslands also provide services such as livestock (Gregory Masters, CABI)	Table converted to a figure
E-4-88	A	5	4			Table 4.1 Define "% transformed" column (Richard Fleming, Great Lakes Forest Research Centre)	Table converted to a figure
E-4-89	A	5	4			please write NPP out in full (Clair Hanson, IPCC TSU)	Table converted to a figure
E-4-90	A	5	27			Boreal forests are also used for timber and non-timber products e.g. berries (Pam Berry, University of Oxford)	Table converted to a figure
E-4-91	A	5	28			Ecosystem services should be listed, including food and livestock production as a minimum (Pam Berry, University of Oxford)	Table converted to a figure
E-4-92	A	5	29	5	30	"Table 4.1: line 12 within the table starting with 'Tundra…' in column Biome/Ecosystem: (Harald Pauli, University of Vienna)	Table converted to a figure
E-4-93	A	5	38			Food, carbon sequestration, biodiversity, global and regional climate control… (Stephen John Hawkins, The Marine Biological Association of the United Kingdom)	Table converted to a figure
E-4-94	A	5	43	5	48	The definitions of communities and "population systems" make complete nonsense. It doesn't help that the literature is rather confused, nevertheless, confusion should not be perpetuated in an IPCC report. For logical consideration of these concepts and how they	A partly, R partly - That they make complete nonsense is not a view which is commonly held (see e.g. O'Neill et al., 1986, A hierarchical concept of ecosystems, for a thorough

						(Iain Colin Prentice, University of Bristol)	review on the subject). It is true that the literature is rather confused, and we agree it is preferable to refrain from getting into this debate in this IPCC report. TR, but principle of addressing various issues of cc impacts at different scales remains and we need to help readers to differentiate those phenomena accordingly. Giving readers some help was the purpose of using these concepts, without the ambition of getting into the depth of the arguments, let alone resolving the scientific debate on those issues.
E-4-95	A	5	43	5	44	The definition of communities is a little unclear. The way it reads suggests that communities are stable, but species turnover in communities can be high with the community still retaining its distinct character. Perhaps inserting "dominant" in between "species specific" and changing the end of the sentence to: "...thus a specific character from the diversity of dominant species" ; or something like that (my wording is not terribly good here but I am not keen on the use of the term "specific diversity". (Gregory Masters, CABI)	A text improved
E-4-96	A	5	43	5	44	…characterized by the assemblage of species in particular location that interact with each other and the environment to determine composition, structure and hence diversity. (Stephen John Hawkins, The Marine Biological Association of the United Kingdom)	A text improved
E-4-97	A	5	43			Communities occur at a level… (Stephen John Hawkins, The Marine Biological Association of the United Kingdom)	TR
E-4-98	A	5	46	5	46	insert "the dynamics of" after "by" (Gregory Masters, CABI)	A but TR
E-4-99	A	5	46			Populations are units of a single particular species… (Stephen John Hawkins, The Marine Biological Association of the United Kingdom)	A but we talk here about population systems, not populations
E-4-100	A	5	50			…continuously, at the individual organism level, and usually… (Stephen John Hawkins, The Marine Biological Association of the United Kingdom)	NA, since we followed other reviewers suggestions
E-4-101	A	5				Table 4: NPP needs to be defined in the figure legend. In the ecosystem services line there is a great deal of inconsistency, especially in regard to the use of "biodiversity." First, it would seem that biodiversity is a service of all of these biomes. Second, in some places it is quantified ("aquatic", "drought- and heat-adapted life forms") and in other places it is replaced by "diversity." I say either put it in all of them or remove it is as obvious, and pick consistent, comparable nomenclature. Finally, there are 11 rows for Terrestrail ecosystems, plus a sumnation of it, while freshwater and marine get three rows total, seems a bit skewed. Further confusion stems from the sumnation rows: 1) are the previous freshwater rows added into the terrestrial or the marine sumnations? and 2) if you add up all the terrestrial rows they are greater than the terrestrial row at the bottom. (Lara Hansen, WWF)	Table converted to a figure
E-4-102	A	5				Table 4.1: tropical grasslands cold include ecosystem services of medicines, subsitence livlihoods. Tropical forests could also include some kind of reference to supporting indigenous subsistence lifestyles. Tropcial rainforests play an essential role in regional rainwater recycling - not sure if this is what you mean by regional climate amelioration. (Joanna House, QUEST, University of Bristol)	

E-4-103	A	5				Table 4.1 How about montane ecosystems? Mountains are a separate category in the Millennium Ecosystem Assessment and are a separate section (4.4.7) in this Chapter. (Pam Berry, University of Oxford)	Montane ecosystems would be the wrong term, but rightly so, mountain ecosystem ought to be listed separately
E-4-104	A	5				T4.1: Mountain ecosystems aren't included in the table (Clair Hanson, IPCC TSU)	see E-4-103
E-4-105	A	6	1	6	6	What about genetic level via selection, gene expression etc. This is missing. (Stephen John Hawkins, The Marine Biological Association of the United Kingdom)	A
E-4-106	A	6	3	3	6	I don’t think that the existing sentence says anything meaningful. Of course it scales up, in some way, but how it scales up is the critical issue. Suggest replacing with something like, "However, many ecophysiological responses do not scale from the mirocoscale to the ecosystem scale in a linear or proportional way. A good example is the effect of changes on stomata on evapotranspiration which, at the canopy scale, is not equal to the effect at the scale of one leaf times the number of leaves. This and other examples are explained in Harvey (2000)" REFERENCE: Harvey, L.D.D. “Upscaling in Global Change Research”, Climatic Change 44, 225-263, 2000. (Danny Harvey, Dept of Geography, University of Toronto)	A text improved
E-4-107	A	6	9			I am a bit confused here in the way you separate out and refer to carbon sequestration as separate from cliamte regulation and sometimes talk about local and regional claimte regulation (see for example table 4.1, figure 4.1 and text in various places. Carbon sequestration is a process - the service surely is cliamte regulation as that is why you are doing it - to acheive climate mitigation (unless you include C sequestration for soil quality in this). Ecosystems play a role in global climate regulation through acting as a sink or source for verious greenhouse gases (not just CO2 but also including CH4, N2O and tropospheric O3). Ecosystems further influence cliamte through biphysical properties (e.g. albedo, evapotranspiration) and these effects occur regionally and locally. Please see chapter 13 of the Condition and trends volume of the Millennium Ecosstem Assessment "air qulaity and cliamte" for more info. (Joanna House, QUEST, University of Bristol)	A But we intend not to go into such detail, since we don't' have the space here to do that and rather prefer to refer interested readers to the MEA
E-4-108	A	6	14	6	15	carbon sequestration potential is barely "hardly recognised" being the subject of intense international negotiations as part of the Kyoto Protocol CDM and JI mechanisms and international trade in carbon credits. I would also hardly call c sequestration 'vital for human welfare" (despite being a carbon cycle scientist myself!) (Joanna House, QUEST, University of Bristol)	A
E-4-109	A	6	17	6	18	explain "local cliamte modfications" - please see my overall comment on this section (Joanna House, QUEST, University of Bristol)	R We simply cannot give textbook introductions. We refer here to the regulation of microclimate by dense vegetation, e.g. a forest.
E-4-110	A	6	17			…soil formation, global and local climate… (Stephen John Hawkins, The Marine Biological Association of the United Kingdom)	A
E-4-111	A	6	19			…and increasingly recognized as a valuable… (Stephen John Hawkins, The Marine Biological Association of the United Kingdom)	TR
E-4-112	A	6	39			Fig. 4.1: "Primary and other productions" needs to be defined (Gregory Masters, CABI)	R - We can really not afford to explain such basic terms as primary production. The glossary contains such explanations.

E-4-113	A	6	39			Fig 4.1: I find confusing to read “Ecosystem goods and services” in the legend when everything is labelled as “services” in the figure. (Laura Llorens Guasch, University of Girona)	A
E-4-114	A	6	46	6	51	I don't understand this paragraph. I think authors should clarify it. (Laura Llorens Guasch, University of Girona)	Text was improved, hopefully now clear enough. It is unfortunate that reviewer has not made it clear where the difficulties are.
E-4-115	A	6	47	6	47	you missed out "food".. Perhaps I noticed cos its snack time…. (Joanna House, QUEST, University of Bristol)	R That is not listed because there is chapter 5 this volume, which deals with food
E-4-116	A	6	48			nuts, spices etc not covered in chapter so remove	R While it is true that we do not discuss e.g. nuts per se, we do address impacts of climate change on services supportint the production of goods such as nuts. However, text was improved to convey better what we do and what we don't do in this chapter and crossreferences were added to other chapters dealing more with commercial goods and provisioning services
E-4-117	A	6	49			Games should be singular (game) (Pam Berry, University of Oxford)	A
E-4-118	A	6	50	6	51	carbon sequestration is listed separately to climate regulation, but why else is it of major interest as an ecosystem service. OK I know it is imprtant for soil quality, but is that really what you are getting at here? See comment on overall section (Joanna House, QUEST, University of Bristol)	Because it is not quite the same. For instance regulation of microclimate has little to do with carbon sequestration.
E-4-119	A	6	51	6	51	What do you mean by "disease, pest, and pathogen regulation"? These are technical terms with subtle differences but it's not clear that's what you're after. Many people lump diseases & pathogens. Others use "disease" to signify the symptoms of illness which can have biological causes (e.g., pathogens) or abiotic causes (e.g., radiation, chemical). We consider pathogens of forest trees as forest pests (along with some herbivorous insects and competingt vegetation [weeds]). (Richard Fleming, Great Lakes Forest Research Centre)	A - Wording simplified
E-4-120	A	8	1	8	1	spell out last glacial maximum (Joanna House, QUEST, University of Bristol)	TR - Wrong order because TSU or reviewer gave wrong first page number
E-4-121	A	7	2	4	30	The secion on key issues is not particularly clear. This reviewer was unsure how many key issues there were or if some or all were related in any way. It would be useful to the reader if each key issues was flagged either with a number or as a separate bullet point. This will ensure clarity. (Paul J. Wood, Loughborough University)	A - Numbering introduced
E-4-122	A	7	5			Insert space at end of the first sentence. (Paul J. Wood, Loughborough University)	A

E-4-132	A	7	10	7	11	The statement that "Climate change will exacerbate these human-induced pressures..." is too simplistic and not necessarily accurate. Perhaps the primary threat to ecosystems is conversion of habitat to human uses, but this threat will itself be modified by climate change and CO2 effects. In particular, if temperature changes are low to moderate, productivity of agriculture and forestry, for instance, will increase (see, e.g., Levy et al. 2004) (Le111, Le122), which – all else being equal -- should relieve some of these pressures because less land would then be needed to be cultivated or harvested for food, fiber and timber (Goklany 1998, 2000, 2003a, 2005a, 2006a). Of course, in the long term, excessive tempeartures would be detrimental. Accordingly, the sentence should be modified to read as follows: "To the extent increases in CO2 concentrations and climate change increases the productivity of land diverted to human uses, such an increase could reduce pressures on ecosystems by limiting the amount of habitat conversion (Goklany [illegible] (Indur Goklany, US Department of the Interior)	A partly R partly - text improved. However, we do not believe that the key issue is that climate change is in some instances, e.g. agricultural sector, showing intermediate/transitory impacts, which can be considered beneficial from a human perspective. The key issue we wish to address here is the long-term future, to which we are likely to be comitted, in particular should we have actually first move to a situation where we profit (as humankind) from a temporary phase of increased productivity. The first positive and the then predominantly negative are inextricably linked unless we talk about a much further distant future, 22nd and 23rd century, when a moderate climate change, say stabilisation at 550 ppmv, would result in a then benign climate change with predominantly positive effects. However, for such considerations the uncertainties are considerably greater (far distant future) and we doubt that the reviewer wants to address that point.
E-4-124	A	7	12	7	12	Redundant: isn't crossing a threshold a nonlinear response in itself? (Richard Fleming, Great Lakes Forest Research Centre)	R No. Crossing a threshold here refers to an input or parameter crossing a threshold value. The consequence of that is then the non-lilnear response, i.e. some state variable changes its values in a non-linear manner to the change in the input/parameter value.
E-4-125	A	7	12	7	13	A very important point, more research needs to focus on this, e.g. drivers and regulators of shifts in ecosystem states. (Gregory Masters, CABI)	Ok
E-4-126	A	7	13			…lead via positive feedback to novel… (Stephen John Hawkins, The Marine Biological Association of the United Kingdom)	A
E-4-127	A	7	17	7	22	Harrison and Prentice did not address the issue of rates of change and so should not be cited here. This paragraph is very superficial and entirely neglects the palaeoecology literature. Useful references include the paper by Bartlein et al. (1991, Ecology) which provides evidence contradicting the notion of millennium-scale lags.	R mostly, A partly - This paper is propably Prentice et al., 1991, Ecology 72: 2038-2056. As such it is too old to be cited in this IPCC report. This paper states "These results establish that the continental—scale vegetation patterns

						(Iain Colin Prentice, University of Bristol)	have responded to continuous changes in climate from the last glacial maximum to the present, with lags <= 1500 yr." We do not ignore the paleoecological findings. We only do believe that the "recent" past, i.e. e.g. the last 740'000 a (e.g. Augustin et al., 2004, Nature, 429: 623-628) or 650'000 a (e.g. Siegenthaler et al., 2005, Science, 310: 1313-1317), is not a perfect model for things to come. That record clearly shows repeated patterns, which mean that soil formation processes had plenty of time to "provide" the basis for biomes to shift rather easily on top of soils remaining similar during the repeated climatic changes of the past during that period. What we address in our chapter are future conditions, which are unprecedented by that record (ibido) and therefore may well require soils to form, Therefore, we agree with the reviewer, that one or one-and-half millenia have sufficed in the more recent past. However, we wish to emphasize that things to come (main focus of our chapter) are very likely (IPCC confidence level) unprecedented by that record and therefore the <=1500 a time lag from Prentice et al., 1991 may be well a too small lag in the future. Thus millennia can not be excluded. To partly take care of the reviewer's concerns we inserted word "possibly" before millennia. We reemphasize that this is a key issue, policy makers should be well aware and well informed. ???
E-4-128	A	7	19	7	22	Repeats p4 L43-5? (Richard Fleming, Great Lakes Forest Research Centre)	A it is similar, we pruned the text accordingly
E-4-129	A	7	21	7	22	be tolerable, should they happen non-coincidentally. (Stephen John Hawkins, The Marine Biological Association of the United Kingdom)	A
E-4-130	A	7	24	7	30	A very important point. (Gregory Masters, CABI)	Ok
E-4-131	A	7	24			…transformations include global as distinct from local species… (Stephen John Hawkins, The Marine Biological Association of the United Kingdom)	A
E-4-132	A	7	25	7	25	I guess the ? Is to what degree is this 'irreversible change' important? Are there species redundancies so that ecosystem structure & function & services are maintained? If so, how important is the loss of future resilience (fewer redundant sp)?	A - But which '?' is meant here by the reviewer? We used none. If the reviewer refers to "whether" in the first sentence, then our answer is: We have not the degree to

						(Richard Fleming, Great Lakes Forest Research Centre)	which this is important in mind (only), since the first big uncertainty comes with the question, how big is the fraction of global biodiversity that gets lost in a particular climate change scenario. Then, as the subsequent sentences explain, what role those species play ("redundant" species vs. "functional" species) for the functioning of ecosystems is the next big source of uncertainty. The question, how big are the risk by having only a minimum of complementary species providing key services and no back-up by "redundant" ones is another, additional (third) source of
E-4-133	A	7	26	7	26	references (Joanna House, QUEST, University of Bristol)	A - some key references added from terrestrial and marine ecosystems
E-4-134	A	7	29	7	29	In what context is the term "keystone" being used? Key predators and mutualists may or may not be keystone species, top predators are not automatically keystone predators. My understanding of keystone species, are those species that have a greater imapct on the community/ecosystem than would be predicted from their biomass alone. To test for keystone species, essentially removal experiments need to be done and then the community monitored. This is often very difficult or impossible to do, hence definign keystone species is very difficult (although an excellent concept). (Gregory Masters, CABI)	A We certainly wish not to imply that every top predator would be a keystone species. We agree with most of the argument and we made an effort to improve the text.
E-4-135	A	7	29			…keystone species and ecosystem engineers alter… (Stephen John Hawkins, The Marine Biological Association of the United Kingdom)	A partly - text improved
E-4-136	A	7	40	7	42	This is a non sequitur: as far as I know no one has challenged the notion that climate change would impact the physics of lakes and rivers, but the "previously held views" refer to ecosystems, not physics. It is also unclear what these views are, as they are not refernced. In any case the palaeorecord shows unequivocally that aquatic ecosystems respoind (and rapidly) to climate change. There is no mention of this here. (Iain Colin Prentice, University of Bristol)	TR
E-4-137	A	7	42	7	44	references (Joanna House, QUEST, University of Bristol)	R - The citation was given at the begin of the paragraph, i.e. the TAR (Gitaty et al., 2001), and according to IPCC rules
E-4-138	A	7	49	8	24	These lines can be deleted and the section can be started at 4.2.2. Do we really need to know about ecosystems of 8 million years ago? This section is on CURRENT sensitivities and vulnerabilities (Clair Hanson, IPCC TSU)	A - we have incorporated this section into a prargraph under climate variability, thank you
E-4-139	A	7	49			This section on "Insights from past climates is extremely sketchy and represents a missed opportunity. (Iain Colin Prentice, University of Bristol)	See comment E-4-138
E-4-140	A	7	49			Section 4.2.1: could say much more about past changes, going beyond biome shifts to really talk about effects on services, ecosystem health, biodiversity, extniction, c sequestration, resilinece. All the things that we are worried about in relation to change bioclimatic zones today, what does the past tell us about these fears and daptation options. This is of high importance to some policy makers e.g. the UK Depertment for Environment (DEFRA) was recently asking about what we can learn from paleo shifts to (Joanna House, QUEST, University of Bristol)	See comment E-4-138, due to lack of space we cannot go into such detail

E-4-141	A	7	50	7	51	Just a note that the "hockeystick" curve is under debate. However, it is good to leave the discussion out of the report. Present climate and CO2 change is relatively rapid and perhaps catastrophic, wether similar events occurred in the past or not. (Oscar Abbink, TNO B&O)	noted, although the hockey stick has survivied relatively intact (ie does not differe largely from Moberg et al for example.
E-4-142	A	7	51	7	51	WG1 cites the palaeo CO2 record as goingf back 650,000 years. Who is right? There needs to be consistency! (Iain Colin Prentice, University of Bristol)	A - corrected, we cite two records, on goes back 740 000 (temp proxies) and the other goes back 650 000 years (CO2)
E-4-143	A	7	51	7	52	Doesn't WGI say 650,000 yrs, I believe this is the oength of the latest ice record. (Joanna House, QUEST, University of Bristol)	A - corrected, we cite two records, on goes back 740 000 (temp proxies) and the other goes back 650 000 years
E-4-144	A	7	52	7	52	How de know the global warming was 6 degrees? No reference is given. (Iain Colin Prentice, University of Bristol)	TR
E-4-145	A	8	1	1		LGM needs to be defined (Dena MacMynowski, Stanford University)	TR
E-4-146	A	8	1	8	1	LGM is 21,000 years ago, not 18,000, after calibration of the 14C date. (Iain Colin Prentice, University of Bristol)	TR
E-4-147	A	8	1			please give meaning of LGM (Clair Hanson, IPCC TSU)	TR
E-4-148	A	8	1			Need to separate temperature changes immediately post-glaciation from more recent change and put into context. (Stephen John Hawkins, The Marine Biological Association of the United Kingdom)	TR
E-4-149	A	8	3	8	3	change into: Most ecosystems of the distant... . Some ecosystems are very much the same, although species composition is quite different. (Oscar Abbink, TNO B&O)	TR
E-4-150	A	8	3	8	3	"distant past" - how long ago, how does it relate to appearance of grass=lands 8 m yrs ago? (Joanna House, QUEST, University of Bristol)	TR
E-4-151	A	8	7	8	9	This is not true. The Pleistocene was predominantly cool (ice ages) and most modern biota evolved in the Pleistocene. But most evolutionary events during the WARM periods (interglacials) (see Alverson et al., 2001). (Al60???) Change the sentence in something like: "Evolutionary trends and, in particular, local and regional extinction events show that ecosystems can be very susceptible to climate change (Alverson et al., 2001)." (Oscar Abbink, TNO B&O)	Reference removed
E-4-152	A	8	7	8	7	De menocal (2004) is certainly not a primary reference for the origin of grasslands. Alverson et al. (2001) is not a primary reference for anything, and the statement attributed to that paper is al;most free of content. (Iain Colin Prentice, University of Bristol)	TR
E-4-153	A	8	13	8	13	say when the cretacous period was (Joanna House, QUEST, University of Bristol)	TR
E-4-154	A	8	15	8	15	say when the Pleistocene was (Joanna House, QUEST, University of Bristol)	done
E-4-155	A	8	16	8	17	the "the latter…" phrase in brackets is not a good summary of augustin et al conclusions - read just the abstract to see. Doesn't seem necessay anyway. (Chris Thomas, University of York)	A - we meant "the former", apologies, but TR anyway

E-4-156	A	8	20	8	24	This treatment is weak. "Idiosyncratic" should be deleted. :"Individualistic" is appropriate. There is a considerable literature on this topic, and very general agreement that climate impacts species in ways that are specific to the species -- thus falsifying the Clementsian notion of a co-evolved climax vegetation, (Iain Colin Prentice, University of Bristol)	TR
E-4-157	A	8	27			Section 4.2.2 contains mostly older ref's on climate variability (pre-2002). (Dena MacMynowski, Stanford University)	A LA - Pre 2002 is still after the TAR, which has in some instances not covered th literature published beyond 1999 (decided on a case by case basis, depending what was cited in the TAR). Nevertheless, our focus is certainly on recent literature only and we have improved the text.
E-4-158	A	8	41	8	42	Why aren't more current references included? For example Cochrane et al. (1999), Nepstad et al. (1999), and Siegert et al. (2001)? Cochrane, M.A., A. Alencar, M.D. Schulze, C.M. Souza, D.C. Nepstad, P. Lefebvre, and E.A. Davidson, Positive feedbacks in the fire dynamic of closed canopy tropical forests, Science, 284 (5421), 1832-1835, 1999. Nepstad, D.C., A. Verissimo, A. Alencar, C. Nobre, E. Lima, P. Lefebvre, P. Schlesinger, C. Potter, P. Moutinho, E. Mendoza, M. Cochrane, and V. Brooks, Large-scale impoverishment of Amazonian forests by logging and fire, Nature, 398 (6727), 505-508, 1999. Siegert, F., G. Ruecker, A. Hinrichs, and A.A. Hoffmann, Increased damage from fires in logged forests during droughts caused by El Nino, Nature, 414, 437-440, 2001. (Eric Kasischke, University of Maryland)	A - Cochrane, 1999, Positive feedbacks in the fire; Ne32; Si091 These references are excellent, however, also not the most recent. We improved the text based on even more recent work.
E-4-159	A	8	44	8	44	Large-scale climate oscillators affect the fire regime in parts of the boreal biome as well. The authors should consider referring to this paper on the Arctic Oscillation and Siberian forest fires: Balzter, H., Gerard, F.F., George, C.T., Rowland, C.S., Jupp, T.E., McCallum, I., Shvidenko, A., Nilsson, S., Sukhinin, A., Onuchin, A. and Schmullius, C. (2005): Impact of the Arctic Oscillation pattern on interannual forest fire variability in Central Siberia, Geophysical Research Letters 32, doi:10.1029/2005GL022526 (Heiko Balzter, Centre for Ecology and Hydrology)	A - Ba296
E-4-160	A	8	44			Some comment on NAO would be appropriate here: The NAO has been correlated with recruitment fluctuations and changes in phenology in marine ecosystems (Sims DW et al., PROCEEDINGS OF THE ROYAL SOCIETY OF LONDON SERIES B-BIOLOGICAL SCIENCES 268 (1485): 2607-2611 DEC 22 2001; Sims DW et al. JOURNAL OF ANIMAL ECOLOGY 73 (2): 333-341 MAR 2004) and NAO positive conditions have become more frequent leading to possible miss-matches (Edwards M & Richardson A. NATURE 430 (7002): 881-884 AUG 19 2004). (Stephen John Hawkins, The Marine Biological Association of the United Kingdom)	A - Si092; Si090; Ed09 Thanks for the references
E-4-161	A	9	17	9	50	The 2003 heatwave accentuated trends in population change in birds in France: two thirds of the 32 spp studied showed increases in population productivity, and most of these were species that previously had relatively stable or increasing populations. Species of bird that had previously been declining most showed the most negative responses. Ref: Julliard R, Jiguet F, Couvet D 2004	R - Thanks for the reference (Ju10), but we don't have the space to be really comprehensive. Though that work is interesting, we do not believe that the overall efffect for bird survival are clear and therefore decided against using that reference.

						Evidence for the impact of global warming on the long-term population dynamics of common birds PROCEEDINGS OF THE ROYAL SOCIETY OF LONDON SERIES B-BIOLOGICAL SCIENCES 271: S490-S492 Suppl. 6 (Chris Thomas, University of York)	
E-4-162	A	9	18	9	18	It should be "Ecological Impacts of the European heatwave" (Heiko Balzter, Centre for Ecology and Hydrology)	double entry, see Summerheatwave-7A
E-4-163	A	9	18			Box 4.1 ~ unneeded detail. Point was made earlier. (Richard Fleming, Great Lakes Forest Research Centre)	double entry, see Summerheatwave-5A
E-4-164	A	9	21	9	21	might be useful to put this risk in the context of say a 1 in 100 yr event becoming a 1 in 10 year event or whatever is appropriate. (Joanna House, QUEST, University of Bristol)	double entry, see Summerheatwave-.A
E-4-165	A	9	25	9	25	what is meant by "mean cliamte change conditions"? (Joanna House, QUEST, University of Bristol)	double entry, see Summerheatwave-.A
E-4-166	A	9	27			B4.1: what's GPP? Please write out in full before using the acronym (Clair Hanson, IPCC TSU)	double entry, see Summerheatwave-.A
E-4-167	A	9	34	9	35	Due to the heatwave or due to other climatic conditions that year, or over the previous years (e.g. high productivity allowing build up of fuel followed by drought over the whole season (not just the heatwave) (Joanna House, QUEST, University of Bristol)	double entry, see Summerheatwave-.A
E-4-168	A	9	44	9	45	May need more explanation to non-expert reader. This results is about loss of forest replacement with grasslands. I would not really refer to this as a "change in vegetations tructure" - it is a change in biome. (Joanna House, QUEST, University of Bristol)	double entry, see Summerheatwave-.A
E-4-169	A	9	44	9	49	Everything from "In addition" is global stuff, irrelevant to the topic of the Box. (Iain Colin Prentice, University of Bristol)	double entry, see Summerheatwave-.A
E-4-170	A	9	45	9	48	not to do with 2003 heatwave. Put in with general fire info. (Joanna House, QUEST, University of Bristol)	double entry, see Summerheatwave-.A
E-4-171	A	9				Somewhere around here you'll want to add Westerling, A.L., H.G. Hidalgo, D.R. Cayan, and T.W. Swetnam. 2006. Warming and Earlier Spring Increases Western U.S. Forest Wildfire Activity. Science DOI: 10.1126/science.1128834 (Lara Hansen, WWF)	double entry, see Summerheatwave-.A We127
E-4-172	A	10	1	11	12	This section requires some careful clarification in several respects. The term disturbance needs to be clearly and explicitly defined. What constitutes a disturbance? - this is currently not clear. Do the authors consider climate change a disturbance? again this in not clear. Clearly fire, most high magnitude droughts and floods constitute distubances - but this needs to be made clear. In addition, what are the 'other drivers'? - are they simply other disturbances. The section at present is very heavily skewed towards fire disturbances - others should be included. (Paul J. Wood, Loughborough University)	Title of section and text content changed (also explain disturbances in the glossary)

E-4-173	A	10	1			Section 4.2.3: Here & in other parts of chapt, tendency to over-emphasize fire & under-estimate insect impacts, especially in Canada. Impact stats (Fleming, R.A. 2000. Climate change and insect disturbance regimes in Canada's boreal forests. World Resources Review 12(3): 520-555) suggest insects cause 50% more damage than fire & that during outbreaks, spruce budworm alone causes about as much damage as fire. The mountain pine beetle outbreak now is dwarfing both fire & SBW impacts together. There is more literature on fire & CC in Canada for various reasons. (Richard Fleming, Great Lakes Forest Research Centre)	A - we cite these papers to represent better balance on disturbances.
E-4-174	A	10	3	10	5	Add CO2 and nitrogen to the list of drivers. (Indur Goklany, US Department of the Interior)	A
E-4-175	A	10	16			I would repeat "Land use change" instead of saying "This" at the beginning of the sentence. (Laura Llorens Guasch, University of Girona)	A
E-4-176	A	10	19	10	22	This sentence seems to be overly-broad, in that in many regions where climate change has been the most pronounced (e.g., the arctic and boreal regions), land use change is and will not be the primary driver of change, climate will. I suggest changing the sentence to read: "Several studies suggest that in temperate, tropical, and sub-tropical regions, landuse change….." (Eric Kasischke, University of Maryland)	A
E-4-177	A	10	21	10	23	not really saying much, delete (Joanna House, QUEST, University of Bristol)	A, Text removed, incorporated into another section
E-4-178	A	10	21	10	23	"However, … isolation" -> rephrase. (Laura Llorens Guasch, University of Girona)	A, Text removed, incorporated into another section
E-4-179	A	10	22			To the list of other factors that should be also considered, add CO2 and nitrogen. (Indur Goklany, US Department of the Interior)	A, Text removed, incorporated into another section
E-4-180	A	10	25	10	29	There is an additional way in which fire influences community structure, – alteration of site characteristics, such as the seedbed remaining after fire as well as soil temperature and moisture (see, e.g., Johnstone and Kasischke 2005; Kasischke and Johnstone 2005; Johnstone and Chapin 2006), which allow invasion of new species, including those that may not be as fire adapted as the species presently occupying the site. Johnstone, J.F., and E.S. Kasischke, Stand-level effects of burn severity on post-fire regeneration in a recently-burned black spruce forest,, Can J. For. Res., 35, 2151-2163, 2005. Johnstone, J.F., and F.S. Chapin, Effects of soil burn severity on post-fire tree recruitment in boreal forests, Ecosystems, 9, 14-31, 2006. Kasischke, E.S., and J.F. Johnstone, Variation in post-fire organic layer thickness in a black spruce forest complex in Interior Alaska and its effects on soil temperature and moisture, Can J. For. Res., 35, 2164-2177, 2005. (Eric Kasischke, University of Maryland)	R - I am concerned that this is too much detail, we can only provide the main messages.
E-4-181	A	10	28			"Thus … shifts" -> This sentence is not well linked with the previous one. (Laura Llorens Guasch, University of Girona)	A - done

E-4-182	A	10	29	10	35	This section is somewhat confusing. The first sentence suggests that most fire prone vegetation lies in tropical/sub-tropical regions, but the next sentence focuses entirely on the Canadian boreal forest region. However, the reader has no way of knowing this unless they are familiar with the literature. I do not agree with the conclusion of this sentence, e.g., that the changes in forest cover observed by Lavoie and Sirois (1998) are due to a combination of human-ignited fire and climate change, based on the observations of Wotton et al. (2003). The study of Wotton et al. (2003) focused on future human ignited fires, thus, cannot be used to support the argument presented in this sentence. Furthermore, a recent study by Kasischke and Turetsky (2006) showed that between the 1960s and 1990s, the area burned from human-ignited fires remained constant while the number of human-ignited fires increased. During this same time period, total burned area from fires increased by a factor of 2.5. Thus, while Wotton et al. (2003) conclude that the number of human-ignited fires will increase in warming climate, there is no evidence to suggest that th Heinselman, M.L., Fire intensity and frequency as factors in the distribution and structure of northern ecosystems, in Fire Regimes and Ecosystem Processes, General Technical Report WO-26, edited by H.A. Mooney, T.M. Bonnicksen, N.L. Christensen, J.E. Lottan, and W.A. Reiners, pp. 7-57, USDA Forest Service, Washington, DC., 1981. Kasischke, E.S., and M.R. Turetsky, Recent changes in the fire regime across the North American boreal region- spatial and temporal patterns of burning across Canada and Alaska, Geophys. Res. Lett., 33, L09703, doi:10.1029/2006GL025677, 2006. Wein, R.W., and D.A. MacLean, The Role of Fire in Northern Circumpolar Ecosystems, John Wiley and Sons, New York, 1983. (Eric Kasischke, University of Maryland)	A - text revised to improve clarity, better balance of fire discussion wrt regions. Wotton reference deleted, and Kasischke 2006 cited
E-4-183	A	10	30			Southern (Clair Hanson, IPCC TSU)	R
E-4-184	A	10	31	10	31	what does "the exception' refer to (Joanna House, QUEST, University of Bristol)	revised for clarity
E-4-185	A	10	31	10	32	I question the statement that boreal forest is NOT fire-prone. I don't believe the Kasischke et al article addresses this issue (although it emphasizes the importance of fire in determining carbon budgets of boreal forests), but considerable boreal research makes the point that in continental portions of the boreal forest (I.e., regions outside Europe and eastern Canada), fire is the dominant disturbance type and strongly governs community composition and carbon fluxes. Some useful references might be Johnson, E. A. 1992. Fire and Vegetation Dynamics. Studies from the North American Boreal Forest. Cambridge University Press, Cambridge. Rupp, T. S., F. S. Chapin, III, and A. M. Starfield. 2000. Response of subarctic vegetation to transient climatic change on the Seward Peninsula in northwest Alaska. Global Change Biology 6:451-455.	A text revised

						Wirth, C. 2005. Fire regime and tree diversity in boreal forests: Implications for the carbon cycle. Pages 309-344 in M. Scherer-Lorenzen, C. Körner, and E.-D. Schulze, editors. Forest Diversity and Function: Temperate and Boreal Systems. Springer-Verlag, Heidelberg. (F. Stuart Chapin, III, University of Alaska Fairbanks)	
E-4-186	A	10	32	10	35	The Lavoie and Sirois example should be qualified in terms of its applicability: the forest-tundra border of Eastern Canada (Pierre Bernier, Natural Resources Canada)	A
E-4-187	A	10	32	10	35	Surely human change dominated in this period. But cliamte change is increasingly imprtant in the future. (Joanna House, QUEST, University of Bristol)	R - see reference to Kasischke 2006
E-4-188	A	10	36	10	36	Additional references: Alencar, A.C., D.C. Nepstad and M.C.V. Diaz. 2006. Forest understory fire in the Brazilian Amazon in ENSO and non-ENSO years: Area burned and committed carbon emissions. Earth Interactions Vol. 10, paper 6, pp. 1-17. (http://earthinteractions.org). Barbosa, R.I. and P.M. Fearnside. 1999. Incêndios na Amazônia brasileira: Estimativa da emissão de gases do efeito estufa pela queima de diferentes ecossistemas de Roraima (Philip Fearnside, National Institute for Research in the Amazon - INPA)	thank you
E-4-189	A	10	38	10	39	Citations should also include van der Werf (2004) van der Werf, G.R., J.T. Randerson, G.J. Collatz, L. Giglio, P.S. Kasibhatla, A. Arellano, S.C. Olsen, and E.S. Kasischke, Continental-scale partitioning of fire emissions during the 97/98 El Nino, Science, 303, 73-76, 2004. (Eric Kasischke, University of Maryland)	A done
E-4-190	A	10	39	10	40	Additional reference: Barlow, J., C. Peres, R. O. Lagan, and T. Haugaasen. 2003. Large tree mortality and the decline of forest biomass following Amazonian wildfires. Ecology Letters 6:6-8. (Philip Fearnside, National Institute for Research in the Amazon - INPA)	thank you
E-4-191	A	10	40	10	40	alter rainfall patterns how? Increase or decrease? (Joanna House, QUEST, University of Bristol)	This is complex, uncertain, but may involve more intense events. Text revised

E-4-192	A	10	40			At the end of the sentence that ends on line 40, add the following: "Nevertheless, recent data from Amazonia spanning 25 years (1976-2001) indicate that mortality and recruitment rates have both increased significantly in virtually every region and environmental zone, and that long-acting and widespread environmental changes are stimulating the growth and productivity of Amazon forests [O. L. Phillips, T. R. Baker, L. Arroyo, et al., Pattern and process in Amazon tree turnover, 1976-2001, Philosophical Transactions of the Royal Society of London Series B - Biological Sciences 359: 381 – 407 (2004); see also: Y. Malhi and O.L. Phillips, Tropical forests and global atmospheric change: a synthesis, Philosophical Transactions of the Royal Society of London Series B - Biological Sciences 359: 549-556 (2004).] " (Indur Goklany, US Department of the Interior)	R - this section is about fire, not Amazon rainforests. This will appear in the forest section. We cross reference to the section
E-4-193	A	10	41	10	43	Work by Bergeron et al (2001, Can. J. For. Res 31(3): 384-391, and later publications) shows a drop in fire frrequency in the Eastern boreal forest of Canada. The trend towards increased fire frequency is not necessarily linear nor is it universal, at least in the short term. (Pierre Bernier, Natural Resources Canada)	A - reference to this woprk added
E-4-194	A	10	41	10	41	not just in DGVMs but in all models (Joanna House, QUEST, University of Bristol)	A - text revised
E-4-195	A	10	41			what are DGVMs? Write out in full the first time the acronym is used (Clair Hanson, IPCC TSU)	TR
E-4-196	A	10	41			Define DGCM at its first use (here), not on pg 13 line 2 (Danny Harvey, Dept of Geography, University of Toronto)	TR
E-4-197	A	10	42			Fosberg et al (1999) does not actually present any model results, a la Thonicke et al. (2001). A better reference would be van der Werf et al. (2003) van der Werf, G.R., J.T. Randerson, G.J. Collatz, and L. Giglio, Carbon emissions from fires in tropical and sub-tropical ecosystems, Global Change Biology, 9, 547-562, 2003. (Eric Kasischke, University of Maryland)	Reference removed
E-4-198	A	10	43			remove 'of the importance' and move 'globally' --> The global implications (Clair Hanson, IPCC TSU)	A
E-4-199	A	10	44	10	51	“Firstly, … climate change” -> I don’t see the relationship between what you explain here and the global implications of the importance of fire. This part should be rewritten. (Laura Llorens Guasch, University of Girona)	Added "regionally and globally" to the chapeau for this sentence
E-4-200	A	10	45	10	48	This section is supposed to be devoted to a description of current sensitivities, and not to policy recommendations. Accordingly, eliminate the sentence beginning with "Therefore management needs …" on line 45. (Indur Goklany, US Department of the Interior)	A
E-4-201	A	10	50	10	51	Just a reminder of previous emails with Andreas that there is evidence (Fleming, R.A., J-N. Candau, & R.S. McAlpine. 2002. Landscape-scale analysis of interactions between insect defoliation and forest fire in central Canada. Climatic Change 55(1): 251-272) that spruce budworm outbreaks also 'drive' fire potential and that CC influences this interaction between disturbances. (Richard Fleming, Great Lakes Forest Research Centre)	A - text now has a para on insects as a distrubance
E-4-202	A	10	51	10	51	Additional reference:	Thank you - we cite this now

						Nepstad, D.C., P Lefebvre, U.L Silva Jr., J. Tomasella, P. Schlesinger, L. Solorzano, P. Moutinho, D. Ray and J.G. Benito. 2004. Amazon drought and its implications for forest flammability and tree growth: A basin-wide analysis. Global Change Biology 10(5): 704-712. (Philip Fearnside, National Institute for Research in the Amazon - INPA)	
E-4-203	A	11	1	11	12	A very important point and I welcome the IPCC including the importance of IAS (Gregory Masters, CABI)	A
E-4-204	A	11	1		12	There are a wealth of marine and freshwater invasive species examples that could be added here. (Lara Hansen, WWF)	Added two important reviews as references
E-4-205	A	11	1			In the context of climate change, what's an "invasive" species? When the last ice age retreated, and species pushed polewards, weren't these species "invasive"? Would it have been better if invasive species had not colonized land as its climate changed? (Indur Goklany, US Department of the Interior)	This comment illustrates the difficulty of explicit and unambiguous human definitions of the natural world. Clearly, species advancing in response to natural climate change are not invasive in the sense used here. Species introduced by human interference far beyond the range they would have been able to get to naturally are alien, or non-native, and species advancing in response to anthropogenic
E-4-206	A	11	1			Greater storminess and higher return of extreme events will also alter disturbance regimes in coastal ecosystems leading to changes in diversity and hence ecosystem functioning. Saltmarshes, mangroves and coral reefs are likely to be particularly vulnerable (Bertness, M.D. and P. Ewanchuk. 2002. Latitudinal and Climate-Driven Variation in the Strength and Nature of Biological Interactions. Oecologia 132: 392-401; Bertness, M.D., P.Ewanchuk, and B.R. Silliman. 2002. Anthropogenic modification of New England salt marsh landscapes. Proceedings of the National Academy of Science 99 (3):1395-1398) (Stephen John Hawkins, The Marine Biological Association of the United Kingdom)	Thank you - we cite this now
E-4-207	A	11	5	11	6	I think authors should explain better this example. (Laura Llorens Guasch, University of Girona)	TR
E-4-208	A	11	12			Include at the end: Interactions between climate change and invasive non-native species have also been shown in marine systems (Stachowicz JJ et al. PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA 99 (24): 15497-15500 NOV 26 2002) with major functional consequences. (Stephen John Hawkins, The Marine Biological Association of the United Kingdom)	Due to page limitations suggestion was not followed, but work has been cited elsewhere, I.e. section 4.6.1 where role of invasive species for adaptation is discussed.

E-4-209	A	11	12			Add a new paragraph, which would read as follows: "Despite the additional disturbances that might have been caused or exacerbated by climate change (e.g., increasing fire frequency, and pest pressures), a comprehensive global analysis of the impact of global climatic changes on vegetation productivity for 18 years (1982 to 1999) based on both climatic data and satellite observations of vegetation activity indicates that recent climatic changes have enhanced plant growth in northern mid-latitudes and high latitudes (Nemani et al. 2003). Their results indicate that global changes in climate and CO2 have eased several critical climatic constraints to plant growth, such that net primary production increased 6% globally, with the largest increase in tropical ecosystems. Amazon rain forests accounted for 42% of the global increase in net primary production, owing mainly to decreased cloud cover and the resulting increase in solar radiation." (Indur Goklany, US Department of the Interior)	A - in fact we point this out in sections 4.4.1 and 4.4.10, that the carbon balance of the biosphere is biased towards greater sink strength with low levels of climate change (due warming in high latitiudes and decreased cloudiness in tropical forest), but this has little to do with disturbance which is focused in specific regions, and probably reflects a failure of remote sensing to quanitfy this at the scales at which the Nemani study was done. Recent papers with Dan Nepstad as co-authors refer.
E-4-210	A	11	13			Add - Paragraph on insect pests, mentioned in last sentence of report. Insect pests respond to changes in temperatures and precipitation, and to weather extremes and climate variability, Spruce bark beetles for instance, are flourishing from Arizona to Alaska, decimating forests, as warmer temperatures allow over-wintering range changes in altitude and latitude and extra generations per annum. Meanwhile, remnant droughts weaken tree defenses by drying the resin that drowns the beetles as they try to bore through the bark (Allan and Bershears, 2005 (need REF), Epstein and Mills, 2005, Burkett et al, 2005). The combination of further drought and dead stands are contributing to wildfires in the Western US and Canada (see Epstein and Mills, 2005) leading to carbon pulses, injury and property damage, harm to wildlife and impacts on watersheds. Elsewhere in the US tent caterpillars and the woolly adelgid are threatening Eastern forests and the emerald borer is killing ashes in the mid west. The synergies between warming induced range changes and pest abundance, extremes and pest abundance, extremes and their impacts on tree defenses, and extremes themselves could produce large-scale forest diebacks, with consequences for ecosystem functions, animal diversity, atmospheric carbon and even oxygen levels, if forests are so affected on multiple continents. These issues are addressed and further referenced on p27 and Box 5-10. Two (of many) refs on Tipping Points • Walker, G. The tipping point of the iceberg. Nature 441, 802-805 (2006). And Nature 2005 ref addressing on work of John Schellnhuber (Paul Epstein, Harvard Medical School)	Done, thank you for the advice
E-4-211	A	11	15			Section 4/3: not really sure what this section is trying to get over. Seems more about methods (Joanna House, QUEST, University of Bristol)	A - Title of section altered and section was substantially rewritten.
E-4-212	A	11	17	11	21	suggest delete paragraph as technical and not necessarily relevant for reader to know (Joanna House, QUEST, University of Bristol)	A partly - much of text deleted
E-4-213	A	11	17	11	18	“Climate models … models” -> rephrase.	R - There is no alternative, equally clear term for term

						(Laura Llorens Guasch, University of Girona)	'model' available (e.g. simulator is not really a synonym) and the statement talks about two categories of models, which both need be mentioned or the statement does not make sense any more.
E-4-214	A	11	18	11	21	“Simple global … variability” -> not sure what you mean. (Laura Llorens Guasch, University of Girona)	A TR
E-4-215	A	11	31	11	34	“However, … chapter” -> this sentence is too long and confusing (Laura Llorens Guasch, University of Girona)	A
E-4-216	A	11	35			There should be a para devoted to various types of biophysical models, how they are validated and what are the uncertainties associated with them. (Indur Goklany, US Department of the Interior)	R - It would be ceretainly beyond the scope of this chapter to discuss biophysical models in general. ???
E-4-217	A	11	38			Box 4.2: Confused mix of methodlogies (as impl;ied by box title), mechansisms and results. Where results are picked out they are for odd select examples e.g. Europe 2071. I'm not clear what the overall point is. (Joanna House, QUEST, University of Bristol)	TR
E-4-218	A	11	41			have enabled THE generatION of such scenarios (Clair Hanson, IPCC TSU)	A
E-4-219	A	11	42			For THE IPCC SRES A2 … (Clair Hanson, IPCC TSU)	A
E-4-220	A	12	2	12	2	What is "beta diversity"? (Joanna House, QUEST, University of Bristol)	A - glossary reference added
E-4-221	A	12	5	12	5	spell out RCM (regional cliamte models? (Joanna House, QUEST, University of Bristol)	A - see also glossary
E-4-222	A	12	5	12	5	simulations and simulate ins ame sentence (Joanna House, QUEST, University of Bristol)	A
E-4-223	A	12	5			give the meaning of RCM. (Laura Llorens Guasch, University of Girona)	A - see also glossary
E-4-224	A	12	5			“simulations simulate in a physically consistent manner” -> rephrase. (Laura Llorens Guasch, University of Girona)	A
E-4-225	A	12	8	12	13	too long sentences. (Laura Llorens Guasch, University of Girona)	A
E-4-226	A	12	11			insert 'the' after 'markedly if' (Clair Hanson, IPCC TSU)	A
E-4-227	A	12	17	12	28	This paragraph would fit better at start of 4.2.3. General point about indteracting drivers, no info about future (Joanna House, QUEST, University of Bristol)	Addressed
E-4-228	A	12	17	12	28	Condense & combine with p10 L14-23 (Richard Fleming, Great Lakes Forest Research Centre)	Addressed
E-4-229	A	12	17		28	Need to discuss other global change factors here, not just land use change. This would be a great opportunity to discuss those synergistic threats, like pollution and habitat degredation. (Lara Hansen, WWF)	Addressed, though could be expanded even more

E-4-230	A	12	27	12	28	Replace the sentence starting with "Consequently, many impact studies..." on line 27 with the following: "In particular, if temperature changes are low to moderate and CO2 continues to rise, productivity of agriculture and forestry, for instance, will increase (see, e.g., Levy et al. 2004), which – all else being equal -- should relieve some of these pressures because less land would then be needed to be cultivated or harvested for food, fiber and timber (Goklany 1998, 2000, 2003a, 2005a, 2006a). Of course, in the long term, excessive temperatures would be detrimental." (Indur Goklany, US Department of the Interior)	A - Text rewritten
E-4-231	A	12	33	12	43	this para seems more about modelling methods as per last section (Joanna House, QUEST, University of Bristol)	A - Modeling is key to project future impacts
E-4-232	A	12	33	12	43	Can't correlative and mechanistic approaches be used to back project or hindcast where the results are then compared with those from the responses from past climate changes and hence accuracy of these approaches be assessed (Gregory Masters, CABI)	A - Yes. However, the purpose of this comment is not very clear. We guess it actually targets at the second last statement. We have inserted some text to clarify our intentions with respect to the guessed intention of this comment.
E-4-233	A	12	33	12	34	“To project … approaches” -> rephrase. (Laura Llorens Guasch, University of Girona)	A text improved
E-4-234	A	12	34			raise --> rise (Clair Hanson, IPCC TSU)	A
E-4-235	A	12	34			Analog not anolog (Pam Berry, University of Oxford)	A
E-4-236	A	12	36			should be "present" (Danny Harvey, Dept of Geography, University of Toronto)	A
E-4-237	A	12	36			It is not clear whether this is talking about using the presence of species as the basis for modelling or whether it is referring to using the present as the basis for modelling the future. (Pam Berry, University of Oxford)	A - The 2nd is the case and wording was correct from "presence" to "present"
E-4-238	A	12	41			replace ; with . (Clair Hanson, IPCC TSU)	A
E-4-239	A	12	46			Section 4.4.1: Mostly focuses on CO2 fertilisation which is not a climate effect but is a separate driver that may to some extent ameliorate climate change imapcts. Could summarise info on CO2 more and focus on real cliamte drivers of change. For exapmple, one of the most important drivers of climate change in changing terrestrial carbon budgets is the temeprature effects on soil respiration. these are potentially huge and even larger than previosuly expected (see Knorr et al., 2005, nature). This section probably needs to say upfront somewhere that the link bewtween ecosystems and claimte here is greenhosue gases, may be obvious but not stated. Also greenhouse gases otehr thant CO2 largely ignored. natural processes in wetland ecosystems account for about 25-30% of current methane emissions and are expected to be dramatically changed by cliamte change with potentially large loses from drying peatlands and melting permafrost. A further 30% of methane emiissions are from agricultural ecosystems - not expected to be dramatically altered by cliamte change, more land use change. Ecosystems account for about 90% of cu (Joanna House, QUEST, University of Bristol)	The comment on R=f(T) does not reflect best knowledge. There is no evidence that a warmer climate (except for arctic systems with permafrost) will enhance soil R. This is a wide spread misconception derived from short term T-responses. A global comparison across thermal gradients (e.g. Raich and Nadelhoffer) shows that soil R is a function of site productivity (litter production). The definition of greenhouse gases is given elsewhere.CO2 fertilisation is (a) a climate effect in the sense that CO2 also drives climate, i.e. the two are coupled; (b) there is strong interaction between direct CO2 effects and climatic effects. A focus on CO2 here is therefore quite appropriate wl: R - CO2 fertilisation is (a) a climate effect in the sense that

E-4-240	A	12				General Comment on Section 4.4: This section for the most part uncritically reports the results of numerous studies that project -- not "predict", as is sometimes claimed in the text -- impacts. However, there is no information provided as to why the results of any specific impacts study can be trusted to provide accurate results. For example, there is no information as to how well the impact model reproduces recent changes in biota; the strength or weaknesses of the cascade of models that it uses to estimate impacts; what processes does the model incorporate or ignore; what are the uncertainties in its results; and so forth. Without such a bona fide critical evaluation of the various studies and the methods used to project impacts, it's hard to give credence to the results reported here. Providing such information should be one of IPCC's primary tasks, and so far this obligation has not been discharged well. (Indur Goklany, US Department of the Interior)	R - It would indeed be useful to include a longer section on studies that validate the models that project the impacts of climate change, but space limitations make this impossible. This would also lead even deeper into the realm of ecosystem modelling, which is not the core task of the IPCC, though clearly relevant. Successor studies to the Millenium Ecosystem Assessment will have to take up this point. A starting point is Prentice et al. (2006), which is being cited. gfm/ck: this is to be handeled by a modeller. I tend to agree wl:
E-4-241	A	13	1	13	9	I do not agree with the assertion in Line 1 – “The most advanced tools to achieve this scaling-up to global scale are Dynamic Global Vegetation Models…” especially in light of the sentence on Lines 4 and 5 that states “Reliability of results has improved in relation to previous generations of models but several aspects remain incompletely tested.” I believe this paragraph gives short shrift to several other types of models that deal with understanding the underlying linkages between physiologic processes, climate change, and biogeochemical cycling. Each type of modeling approach has its own strengths and weaknesses, and it is through the exercising, comparison, and continuous updating of models that use different approaches that a better understanding of ecosystem processes at multiple scalesemerges. This paragraph seems to me to be rather self-serving to those who have adopted the DGVM approach, and does not represent an objective review of the current state of the science. (Eric Kasischke, University of Maryland)	R - the sentence refers to scaling-up to the global scale; there are much better models than DGVMs that represent processes at the local or regional scale, but their scaling-up is not possible or is nt being done for a variety of reasons. So at the global scale, DGVMs remain, and even though they may lack detail that is present in regional-scale models, they are, as stated, currently the most advanced available tools. The expert reviewer refers to "several other types of models" but does not provide any examples or pointers. We are not aware of other global-scale approaches that rival the achievements of DGVMs. ck/gfm: this is for a modelling expert. I tend to agree
E-4-242	A	13	7			matches --> agreement (Clair Hanson, IPCC TSU)	A - done
E-4-243	A	13	11	13	26	This section should be updates taking into account the recebnt C4MIP work with COUPLED models of carbon cycli ng and climate, as described in the draft Chapter 7 of the WG1 report. (Iain Colin Prentice, University of Bristol)	
E-4-244	A	13	11	13	12	Suggest delete "based on methods ….. 1998) - too technical, anyway DGVMs were available long before the TAR and are used in the TAR (Joanna House, QUEST, University of Bristol)	A - the passage was deleted
E-4-245	A	13	11	13	26	if these are results from the Tar put in past tense and say how things have changed since the TAR (Joanna House, QUEST, University of Bristol)	A - we group TAR results and revisions in substections in the major impacts subsections (4.4.1 to 4.4.9)
E-4-246	A	13	11	13	26	From the subsection title it seems that this paragraph is meant to be a summary of the key vulnerabilities identified in the TAR. It is not clear at what point the chapter moves on to consider the developments since the TAR. The same applies in the other sections. (Pam Berry, University of Oxford)	A - we have written a chapeau paragraph to introduce the subsections, and revised the text substantially

E-4-247	A	13	11	13	11	"vulenrabilities" seems inapprorpiate e.g. "greening" does not seem to be a vulnerability. Perhaps "results" or "impacts" (Joanna House, QUEST, University of Bristol)	R - greening is a vulnerability in the sense that every change is a change to the underlying ecosystem, whether this change is more or less biomass. Whether the change is positive or negative depends on the question and the metric.
E-4-248	A	13	11			Sentence is unclear, helpful to state what is predated. (Pam Berry, University of Oxford)	A - passage has been deleted
E-4-249	A	13	12	13	12	Equilibrium biogeography models don't belong here. They have not been used for the purpose stated. (Iain Colin Prentice, University of Bristol)	A - yes, the passage was removed. Indeed, only DGVMs have addressed the temporal development of carbon source/sinks
E-4-250	A	13	15	13	18	“Substantial … today” -> too long sentence. (Laura Llorens Guasch, University of Girona)	A - sentence was split into two
E-4-251	A	13	18			Schaphaff et al. (2006) present their work as an update of and improvement on Cramer et al. (2001) (Cramer is one of the co-authors), and so should cited in place of Cramer et el. (2001). An enhanced vegetation model (which accounts for lagged changing species composition and climatic and direct CO2 effects) was driven with patterns of climatic change from 5 different AOGCMs, all with the IS92a GHG concentration scenario. The key results are: the terrestrial biophere shifts from a net sink at present (in all five models) to a net source in 3 models by 2050 or so, becomes roughly netural in one model, and remains a net (and rather strong) sink in one model. REFERENCE: Schaphoff et al. 2006. Terrestrial biosphere carbon storage under alternative climate projections. Climatic Change 74: 97-122. (Danny Harvey, Dept of Geography, University of Toronto)	Schaphaff was cited in various places and should also be used here wl: R - the section refers to TAR knowledge and Schaphoff et al. is recent; also the Schaphoff study is only partially an update: Cramer et al. use 1 scenario and 6 DGVMs, Schaphoff et al. 5 scenarios and 1 DGVM.
E-4-252	A	13	19	13	20	The mention that the TAR identified the dieback of Amazonian forest as a result with a “high degree of uncertainty” should be complemented somewhere with a statement that work since the TAR has, in general, decreased the degree of uncertainty associated with this general result. See: Stainforth, D.A., T. Aina, C. Christensen, M. Collins, N. Faull, D.J. Frame, J.A. Kettleborough, S. Knight, A. Martin, J.M. Murphy, C. Piani, D. Sexton, L.A. Smith, R.A. Spicer, A.J. Thorpe and M.R. Allen. 2005. Uncertainty in predictions of the climate response to rising levels of greenhouse gases. Nature 433: 403-406. Huntingford, C., P.O. Harris, N. Gedney, P.M. Cox, R.A. Betts, J.A. Marengo and J.H.C. Gash. 2004. Using a GCM analogue model to investigate the potential for Amazonian forest dieback. Theoretical and Applied Climatology 78: 177-185. (Philip Fearnside, National Institute for Research in the Amazon - INPA)	R - the section summarised the findings of TAR.
E-4-253	A	13	19	13	20	references (Joanna House, QUEST, University of Bristol)	???
E-4-254	A	13	21	13	21	over what period? By when? (Joanna House, QUEST, University of Bristol)	???
E-4-255	A	13	21			indicate the time period to which these fluxes pertain (Danny Harvey, Dept of Geography, University of Toronto)	???
E-4-256	A	13	23	13	26	Good point!	NA

						(Richard Fleming, Great Lakes Forest Research Centre)	
E-4-257	A	13	23	13	24	“Key … evolution” -> too long and confusing sentence. Rephrase. (Laura Llorens Guasch, University of Girona)	R - splitting setence is not helpful in this case, and it does not seem confusing
E-4-258	A	13	26	13	26	and were these needs met or are they still outstanding (Joanna House, QUEST, University of Bristol)	R - this is a summary of TAR only, not of subsequent developments
E-4-259	A	13	28	13	43	This paragraph presents a narrative along the lines "At first we believed that CO2 would have bigger effects but new evidence is contradictory to that". In fact, the stgory has always been that there are those who see CO2 effects in teh ecvidence and those who prefer to deny them as fasr as possible. But IPCC requires a more objective approach and so this section should be reworded in a more objective and less political way. (Iain Colin Prentice, University of Bristol)	needs rewording, but the message seems ok given the data from Duke, Oak Ridge and Basel for closed forests and the grassland data for undisturbed grassland (once moisture saving affects are acounted for: Morgan et al. review). Much of the confusion seems to rise from the terms used: All experiments show a large increas in GPP (irrelevant), a
E-4-260	A	13	28	13	28	not sure what is meant by having sub-title "impacts" here. Perhaps new results since the TAR. What are the TAR results "vulnerabilities" and these "impacts"? (Joanna House, QUEST, University of Bristol)	Now explained in a chapeau parapgraph
E-4-261	A	13	28	13	30	~Note the models have very different assumptions on CO2 fertilsiation effects and acclimation. The enhanced NPP over what period or comapred to what period. Is this (Joanna House, QUEST, University of Bristol)	I agree, this is all a matter of definition and terms. Acclimation is a bad term in this context. The issue is more likely related to long term element stoichiometry. To cover this in full would need far more printing space. wl: R - the general statement of the text remains true and does not imply all models are the same; it also holds for a large variety of future periods
E-4-262	A	13	28			Somewhere in here you need to add something on the effects of carbon dioxide on marine nutrient cycling and acidification issues. (Lara Hansen, WWF)	Thank you - we refer to this now
E-4-263	A	13	28		43	poorly written, difficult to follow (Clair Hanson, IPCC TSU)	R - do not agree
E-4-264	A	13	32	13	32	surely effects on water relations enhance CO2 direct fertilisation effects rather than constrain them. What are the effects of CO2 fertilisation on biodiversity exactly (leaving aside ocean acidification which is potentially very detrimental to biodviesity and possibly other marine ecosystem services such as coral reef amenity and fish stocks, but is not mentioned here - see recent synthesis reports to the royal society in the UK and WBGU in Germany). If it is the switch between C3 and C4 plants, say how this will effect (Joanna House, QUEST, University of Bristol)	Again, a deetailed covering of this issue would need far more space. The problem is the distinction of absolute vs. relative responses. Relative ones may increas, while absolute ones are certainly smaller. Water driven CO2-signals are extremely delicate as Morgan et al showed in their review (Oecologia). Gifford showed that the C3/C4 effect is soil moisture driven, likely an artifact of
E-4-265	A	13	36	13	37	suggest replacing text "…water savings DUE TO reduced stomatal conductance…" (Joanna House, QUEST, University of Bristol)	ok
E-4-266	A	13	38	13	38	what is meant by "atmospheric feedback' here, cliamte feedback? (Joanna House, QUEST, University of Bristol)	A - we have reworded this sentence to clarify.
E-4-267	A	13	38	13	40	Similar result with no CO2 fertilisation in mature boreal forest ecosystem demonstrated by Rasmussen et al., 2002 (Claus Beier, Risoe National Laboratory)	A - thank you for this useful reference

E-4-268	A	13	38	13	41	Should mention that the study by Shaw et al. is for grasslands. (Philip Fearnside, National Institute for Research in the Amazon - INPA)	A
E-4-269	A	13	45	14	11	With the amount of work looking at Aspen and CO2/O3 interactions at the Rhinelander FACE experiment, I was slightly surprised not to see any of it referenced here. An update of this work can be found at their website: http://aspenface.mtu.edu/ (Gregory Masters, CABI)	We now cite the Norby review in PNAS (No51)
E-4-270	A	13	45	14	11	this paragraph reads as though two people have written it (1) from ln 45-2 and (2) from 2-11 (better). Please try to ensure consistency (Clair Hanson, IPCC TSU)	A - text revised
E-4-271	A	13	45	14	11	The Korner et al results show a more mixed picture, with most species actually showing no basal area increment response to increased CO2. (Pierre Bernier, Natural Resources Canada)	All these results depend on the units used (see above for GPP, NPP vs. biomass/basal area).
E-4-272	A	13	49	13	50	The interpretation of forest FACE experiments given here simnply doesn't fit the facts. It is the unreplicated "prototype" plot at Duke that shows rapid falling-off of CO2-induced NPP increase; the three othera show not the slightest sign of diminution after six years of fumigation. The most important reference on the subject of forest FACE plots, the PNAS paper by Norby et al. (2005), is inexplicably ignored. That paper shows that there is a very consistent pattern of around 20 to 25 % NPP stimulation resulting from a 200 ppm enhahncement across all woody biomes. The Hungate et al. experiment is somehwat beside the point here because it is a rapdily evolving system, i.e. the degree of CO2 stimulation changes over the development of the ecosystem -- this is a different (Iain Colin Prentice, University of Bristol)	We accept this important comment and now cite the Norby paper - thank you - it is a critical one, and we also cite the B-factor that results. However, this comment to some extent reflects above units confusion. There is no biomass (c-stock) response in Oak Ridge and Basel, but there is one at Duke, but Schäfer et al made it clear that this resulted from a single (out of 3 pairs) FACE-ring with exceptional growth. NPP is nice to know, but does not necessarily reflect C-sequestration. At Oak Ridge NPP gains are restricted to annual fine root turnover. Hungate and the
E-4-273	A	13	50			simulation to increase with rapidly diminishes with time (Clair Hanson, IPCC TSU)	TR
E-4-274	A	14	2	14	5	The paragraph is also muddled with too many "Howevers". (Iain Colin Prentice, University of Bristol)	TR
E-4-275	A	14	7	14	11	This is almost incredible sophistry. The more the plants (especially lianas) respond to CO2, we are expected to believe, the less carbon they will store... There is no objective reason to believe that a "more dynamic" forest will store less carbon. Fater turnover of tissues means a greater rate of addition of carbon to the soil and thus a carbon sink. The magnitude of the resulting sink was calculated from Phillips et al.'s results in the TAR. This is very rough, obviously, but it shows that the effect is not negligible. And Phillips and his team have done a lot of work since the TAR, including several publications not cited here, consolidating their results and counrering criticisms of their methodology. So (Iain Colin Prentice, University of Bristol)	Have not seen the original text, but any faster tree turnover would reduce the hectare based mean C-stock (reduced residence time). Exactly this had been evidenced for Amazonia, the world's single biggest biomass C-pool. The highest stocks are found in the slowest growing forests (see Malhi et al. GCB 12:1107, 2006 coauthored by Phillips). The correlation between C-storage and rate of growth is negative in humid, steady state systems. I do not see the sophistry. These are well known facts from forest research
E-4-276	A	14	9	14	9	Additional reference: Laurance, W.F., A.A. Oliveira, S.G. Laurance, R. Condit, H.E.M. Nascimento, A.C. Sánchez-Thorin, T.E. Lovejoy, A. Andrade, S. D'Angelo, J.E. Ribeiro & C.W. Dick. 2004. Pervasive alteration of tree communities in undisturbed Amazonian forests. Nature 428: 171-175. (Philip Fearnside, National Institute for Research in the Amazon - INPA)	A - thank you for this useful reference
E-4-277	A	14	13	14	47	Excessive detail. Shorten (Richard Fleming, Great Lakes Forest Research Centre)	A - text revised
E-4-278	A	14	13		15	doesn't make sense (Clair Hanson, IPCC TSU)	A - text revised

E-4-279	A	14	16	14	17	DELETE "contrasting with earlier expectations" unless you can say who had thos exepctations, and why. (Iain Colin Prentice, University of Bristol)	A - text revised
E-4-280	A	14	18	14	21	I am not familiar with the Leuzinger paper, but in any case I can't understand what this sentence means. (Iain Colin Prentice, University of Bristol)	A - text revised
E-4-281	A	14	18			these? What may be reduced? (Clair Hanson, IPCC TSU)	TR
E-4-282	A	14	18			“these” -> do you mean “evapotranspiration rate”? (Laura Llorens Guasch, University of Girona)	TR
E-4-283	A	14	24	14	25	I can't understand this sentence either, nor the preceding sentence. There seems to be an implication that "gas exchange theory" whatever that may be is wrong. Is Gedney for or against "gas exchange theory"? And what on erath is "atmospheric feedback resulting from reduced evaporation" -- no reference is given. (Iain Colin Prentice, University of Bristol)	A - Text revised (We reinterpret this result more in line with Gedneys principle finding, that rising CO2 may have reduced evapotranspiration through its stomatal effects.)
E-4-284	A	14	25	14	25	what is meant by "atmospheric feedback' here, cliamte feedback? (Joanna House, QUEST, University of Bristol)	TR
E-4-285	A	14	28			remove 'the' (Clair Hanson, IPCC TSU)	A
E-4-286	A	14	32	14	32	The use of "would" here is a tell-tale sign that there is in fact no evidence for this effect. It's a pure model prediction, of the kind routinely derided in other places in the text. (Iain Colin Prentice, University of Bristol)	A - text revised
E-4-287	A	14	33	14	36	More gratuitous model-bashing already in the same sentence.... This is completely garbled. Acclimation hasn't been mentioned up to now. It is a real phenomenon that has not been fully explained, but it is interesting that after acclimation, there is always a positive CO2 effect remaining. In other words, acclimation deos not necessarily imply that the CO2 effect diminishes. Then we see an old favourite, ""a faster diminishing....THAN PREVIOUSLY ASSUMED" -- by whom and on what basis? By modellers, perhaps.... so it may be worth pointing out that the LPJ model used by Scholze et al. has always explicitly predicted the occurrence of acclimation in response to raised CO2. (Iain Colin Prentice, University of Bristol)	A - we have deleted the term "acclimation" from this sentence and reworded it to account for this useful comment
E-4-288	A	14	38	14	47	here finally is some text on the temperature response of soil respiration, but hidden in nutrient effects (Joanna House, QUEST, University of Bristol)	A - we have cited a recent review (Norby et al 2007, No53) to expand this point
E-4-289	A	14	38			should be "what fraction might be added to" (Danny Harvey, Dept of Geography, University of Toronto)	A - reworded
E-4-290	A	14	44	14	47	Not only Eliasson et al. but also the whole set of studies reviewed by Rustad et al., and a number of more rtecent studies, agree that the initial burst of increased respiration seen in warming experiments is transitory, typuically lasting only 2- 3 years. But as Knorr et al. (2005, Nature) showed, this is exactly what would be expected due to "burning off" of the most active soil carbon and it carries NO INFORMATION about the temperature response of the bulk of the soil carbon. Thus, the text as written here betrays lack of understanding of the current literature on the subject. (Iain Colin Prentice, University of Bristol)	A - Indeed an excellent point. We agree, none of these soil heating works should be used to infer global warming effects on R. Nadelhoffer and Raich have shown that soil R is driven by litter production, irrespective of T. Permafrost thawing being an exception. El30, Ru40, Kn13

E-4-291	A	14	45	14	47	this is not "by contrast' but would be expected fromt heproperties of soils and the way they decompose. Soils are made up of labile (rapidly decomposing) components as well as slower decomposing components. A warming experiment would burn of the labil perions as mentioned but is not long-term enough to see what happens to the slower pools. The ballamy and Schulze results are based on long-term real responses and probably capture this. both types of results are exactly as would be expected from soil respiration theory and can be predicted by the same multi-pool models. See Knoor et al 2005 nautre paper which explains exactly these kinds of apparent inconsistencies. (Joanna House, QUEST, University of Bristol)	A - we revise this piece, and cite Knorr et al 2005 (Kn13) Be162, Schu29
E-4-292	A	14	51	15	1	this part is rather confusing. I suggest authors to rewrite it. (Laura Llorens Guasch, University of Girona)	A - comprehensively rewritten section
E-4-293	A	14	51	15	1	the sentence is not easy to follow (Joanna House, QUEST, University of Bristol)	A - comprehensively rewritten section
E-4-294	A	14	51	15	1	The point made here about DGVMs applies quite generally to most DGVMs and all sources of mortality; it is not specific to fire disturbance and so it is not aproprikate to mention it here. (Iain Colin Prentice, University of Bristol)	OK - we revised the description of DGVM appropriately
E-4-295	A	14	52	15	1	I don't understand this sentence. Are there words or phrases missing? (F. Stuart Chapin, III, University of Alaska Fairbanks)	A - comprehensively rewritten section
E-4-296	A	15	1	15	3	suggest delete this sentence, states the obvious (Joanna House, QUEST, University of Bristol)	A - comprehensively rewritten section
E-4-297	A	15	3	15	6	you have to state that the assumed rates of migration might be too fast. Otherwise, it does not logically follow that the C sequestration is too optimistic, and hence, the word "thus" is not justified. Also: "Thus" must be preceeded by a semicolon and followed by a comma. (Danny Harvey, Dept of Geography, University of Toronto)	We do now
E-4-298	A	15	3	15	6	not to do with fire, the topic of this paragraph. (Joanna House, QUEST, University of Bristol)	text rvised
E-4-299	A	15	8	15	18	You should also incorporate the observations of Chapin et al. (2005) in this discussion. Chapin, F.S., III, M. Sturm, M.C. Serreze, J.P. McFadden, J.R. Key, A.H. Lloyd, A.D. McGuire, T.S. Rupp, A.H. Lynch, J.P. Schimel, J. Beringer, W.L. Chapman, H.E. Epstein, E.S. Euskirchen, L.D. Hinzman, G. Jia, C.L. Ping, K.D. Tape, C.D.C. Thompson, D.A. Walker, and J.M. Welker, Role of land-surface changes in Arctic summer warming, Science, 310, 657-660, 2005. (Eric Kasischke, University of Maryland)	A - Good point, but we use this reference elsewhere in the chapter , where we discuss these phenomena more in depth. We have therefore here only inserted a cross-reference
E-4-300	A	15	8	15	18	The work be Alan Betts for albedo-induced reforestation offset in teh boreal forest may be worth mentioning (Nature, 2000; 408(6809): 187-190) (Pierre Bernier, Natural Resources Canada)	A - Good point, but we use this reference elsewhere in the chapter , where we discuss these phenomena more in depth. We have therefore here only inserted a cross-reference

E-4-301	A	15	8	15	18	The authors state later that land use change is the main driver for C sink change (with which I strongly agree), yet there is only one paragraph here, compared with many on Co2 fertilisation. There needs to be reference int ehis paragraph to the IPCC Speclial report on LULUCF. The paragraph seems confused, There is not enough explanation of terms and mechanisms. Could start with imapcts of LUC on greenhouse gases as gloabl climate effects, then go in to regional biophysical effects. Biophysical effects in particular need more explanation as this is the only palce they are mentioned and readers might not know what albedo and laternt heat flux are (note I would suggest talk about evaptoranspiration effects and not mention latent heat fluxas less technical for non-specialist reader, and effefects precipitation as well as cooling). (Joanna House, QUEST, University of Bristol)	CO2 fertilization may be a significant sink, and also allow vegetation change such as "desedrt green up". It needs a specieal discussion. We do discuss land use, but this chapter does not warrant an extensive discussion of this issue which is dealt with so elswhere (WGIII,9).
E-4-302	A	15	14	15	18	But it can be shown (see the House et al. paper on tyhe subject) that the absolute global maximum reduction in atmospheric CO2 concentration due to reeforestation lies in the range of 40 to 70 ppm. This is also consistent with the SRLULC calculations and has not been challenged. (Iain Colin Prentice, University of Bristol)	A - Indeed a good point. We reference this paper (Ho02ct) and thanks for the useful reminder.
E-4-303	A	15	20	15	23	Good point! (Richard Fleming, Great Lakes Forest Research Centre)	A - thank you
E-4-304	A	15	20	15	23	Generic point not specific to biogeochemical cycles. Put up front somewhere or leave out. (Joanna House, QUEST, University of Bristol)	A - we have repositioned this text more appropriately
E-4-305	A	15	20	15	23	Delete this paragraph as it is hand-waving. (Iain Colin Prentice, University of Bristol)	R - Paragraph revised, but retained. It points at the often overlooked nonlinear effects, causing sudden and important changes in ecosystem structure. As also stressed in the cited articles, there is a need to recognize that non-linear responses to climate change are a likely response, because of the general predominance of the "gradual change" paradigm.
E-4-306	A	15	25	15	26	Put this sentence up front in this section since C is all that is talked about (Joanna House, QUEST, University of Bristol)	R - do not agree
E-4-307	A	15	26	15	27	not just DGVMs (Joanna House, QUEST, University of Bristol)	R - the positive feedback from the land biosphere into the atmosphere was studied with DGVMs
E-4-308	A	15	28	15	31	Schaphaff et al. (2006) present their work as an update of and improvement on Cramer et al. (2001) (Cramer is one of the co-authors), and so should cited in place of Cramer et el. (2001). An enhanced vegetation model (which accounts for lagged changing species composition and climatic and direct CO2 effects) was driven with patterns of climatic change from 5 different AOGCMs, all with the IS92a GHG concentration scenario. The key results are: the terrestrial biophere shifts from a net sink at present (in all five models) to a net source in 3 models by 2050 or so, becomes roughly netural in one model, and remains a net (and rather strong) sink in one model.REFERENCE: Schaphoff et al. 2006. Terrestrial biosphere carbon storage under alternative climate projections. Climatic Change 74: 97-122. (Danny Harvey, Dept of Geography, University of Toronto)	R - Thanks for all the arguments, but it is not quite clear what the reviewer suggests. We see also no big conflict between the two mentioned papers and see little reason to change the citations.
E-4-309	A	15	28			“HACM2-SUL Cramer et al.” -> a comma is missing.	A - corrected

						(Laura Llorens Guasch, University of Girona)	
E-4-310	A	15	30	15	31	NEP stands for Net Ecosystem (not Ecosphere) productivity. The TAR also distinguished NEP from NBP, net biome productivity, following Schulze and Heimann. If you like this distinction, be clear about which you mean. (Iain Colin Prentice, University of Bristol)	The term "Net ecosphere productivty" was on purpose used here, accounting for net biospheric productivity, since NBP does not per se imply global scale (see Gillard, 1969. Nature, 223: 500-501). Term revised to NBP, net Biome Productivity (following Schulze and Heimann inasmuch as all exchange processes are considered). But reviewer should also be aware of the arguments by Randerson et al., 2002. Ecol. Appl, 12(4): 937-947 on this topic and that whatever one chooses, the terms are likely to be misunderstood or sometimes even being misused. Thus "Net Ecosphere Productivity" is pretty clear, has no tradition of misuse, and is therefore somewhat attractive.
E-4-311	A	15	30	15	31	"climate change impacts on NEP" - ECOSYSTEM not ecosphere. Need to explain mechanisms of this earlier in section as mainly only talked about CO2 fertilisation effects (Joanna House, QUEST, University of Bristol)	A see also E-4-310
E-4-312	A	15	34	15	35	Which trends. Also this seems a ridiculous statement as cant stabilise climate even if cut concentrations to zero due to massive time lags involved. (Joanna House, QUEST, University of Bristol)	R - we are citing a model simulation that makes this "ridiculous" assumption, merely to make the point that net CO2 emissions form ecosystems are likely in the future. Nonetheless we have revised the text somewhat
E-4-313	A	15	36	15	36	increased it compared to what, over what period? (Joanna House, QUEST, University of Bristol)	TR
E-4-314	A	15	38	15	38	does CO2 fertilsitaionreall saturate post-2020, is this just one model result? Is there any evidence that CO2 fertilsiation will "saturate" at any point in the near future? (Joanna House, QUEST, University of Bristol)	TR and discussion improved
E-4-315	A	15	45			full stop and new sentence after 'feedback)' (Clair Hanson, IPCC TSU)	A- we reworded this sentence
E-4-316	A	15	46	15	46	over what period? (Joanna House, QUEST, University of Bristol)	We provide the time frame (by 2100)
E-4-317	A	15	48	15	49	if only half of GCM/scenario results show a net source by 2100, then how can you say in the executive summary that ecosystems will become a net source by 2030. Should state that these are the SRES emissions scnearios. (Joanna House, QUEST, University of Bristol)	A - We have revised our ES
E-4-318	A	15	48	15	48	"..is predicted BY 2100" (Joanna House, QUEST, University of Bristol)	A - revised
E-4-319	A	15	50			change to 'even for a warming of <2degC by 2100' (Clair Hanson, IPCC TSU)	A - revised
E-4-320	A	15	52			what is LPJ? (Clair Hanson, IPCC TSU)	We name the model now, and refer to the authors of the model
E-4-321	A	16	25			Fig. 4.2: How good is the fit between the CRU climatology and the other two models? (Gregory Masters, CABI)	We refer to the original paper

E-4-322	A	16	36	16	36	Fig 4/2: Why are the results from the CRU climatology so different to the claimtaologies from the models at two points in the past? What is an "effective CO2 fertilisation"? (Joanna House, QUEST, University of Bristol)	A - the first disagreement is at the beginning of the 20th century, where probably CRU data are not reliable due to a lack of observation stations around the globe; in the updated figure, CRU results are not given before 1950; the second disagreement is later but has been reduced in an
E-4-323	A	16	39	16	40	OAGCMs do not include vegeetation, it is the next stage of models first represented by Cox et al that do, typically called coupled-carbon cycle models, but anyway it is not necessary to confuse the reader with naming different types of models. It is enoguh to say "models that explicitly include feedbacks of the biopshere on climate (Joanna House, QUEST, University of Bristol)	Text revised
E-4-324	A	16	39			please delete "and modeling" (Tianxiang Luo, Institute of Tibetan Plateau Research, Chinese Academy of Sciences)	A - done
E-4-325	A	16	42	16	42	Instead of beginning the sentence with "Impacts...", a more concise formulation would be "Modeled impacts..." or "Impacts predicted by these types of models…" (Heiko Balzter, Centre for Ecology and Hydrology)	A - we reformulate this sentence more concisely
E-4-326	A	16	42	16	43	"POTENTIAL impacts include…." Note that not all mdoels in most recent intercomarisons (C4MIP - not sure of reference but see WGI) project amazon dieback. (Joanna House, QUEST, University of Bristol)	A- revised
E-4-327	A	16	45	16	45	higher concentration than what? Than without the feedback? (Joanna House, QUEST, University of Bristol)	A -revised
E-4-328	A	16	48	16	50	DGVMs also poor at dealing with boreal disturbances. E.g., I spent a week at PIC once seeing if we could get spruce budworm disturbances in a DGVM. The big immediate problem was that the DGVM had one functional type for boreal conifers. It didn't distinguish host (spruce & fir) from non-hosts (pine). In addition, stand replacing disturbances cause important shifts in age structure (references cited above) which you imply (p14 L51 - p15 L1) are ignored by DGVMs, (Richard Fleming, Great Lakes Forest Research Centre)	We now make this point very explicitly
E-4-329	A	16				F4.2: the caption is unclear. It states that ecosystems become a carbon source with a sink peak ~2030. This does not follow from the graph and the caption should be more clearly phrased. Something along the lines … ecosystems become less of a carbon sink from around 2030 – from the figure ecosystems only become a source when NCE becomes positive which isn't until ~2060 (Clair Hanson, IPCC TSU)	Rewrote the caption
E-4-330	A	17	1	17	13	this paragraph should be rewritten. It is confusing and the ideas are not well linked. The last sentence seems to be completely out of context. (Laura Llorens Guasch, University of Girona)	Re-arranged the text to make this more clear
E-4-331	A	17	1	17	12	this paragraph seems a cursory attempt to try and get some marine ecosystems in here. There is more that could be said in a more coherent manner (Joanna House, QUEST, University of Bristol)	Re-arranged the text to make this more clear

E-4-332	A	17	12	17	13	this sentence is about terrestrail fluxes wheras the rest of the paragraph is about ocean ecosystems so it does not belong here. Ia m not sure that this results can really be commented on at all here yet. It is not clear it will scale up at all, or what really impact wit will ahve on overall carbon balance,a fter all the plants are taking up carbon, even if they are releasing methane. if their biomass in icnreasing or staying stable there is no net carbon loss. I think this result, while fascinating in itself, is a red herring in this context. (Joanna House, QUEST, University of Bristol)	Re-arranged the text to make this more clear
E-4-333	A	17	14			As this section is rather long, a brief summary paragraph of the key points would be useful here.There is a summary at the end of Sections 4.4.2 to 4.4.9, and consistency is recommended. (Danny Harvey, Dept of Geography, University of Toronto)	Section shortened considerably
E-4-334	A	17	16	36	7	At appropriate points in Sections 4.4.2 to 4.4.8, an increase in the incidence of diseases should be mentioned, based on Harvell, C.D. et al. 2002. Climate warming and disease risks for terrestrial and marine biota. Science 296: 2158-2162 (Danny Harvey, Dept of Geography, University of Toronto)	Done
E-4-335	A	17	18			The latest assessment of global desertification by the Millenium Ecosystem Assessment (MEA) published in 2005 should be cited, which includes the estimates of global area affected by desertification/land degradation: 10-20% of world drylands. (Atsushi Tsunekawa, Arid Land Research Center, Tottori University)	Included
E-4-336	A	17	21			I guess you wanted to say “1 and 3 inhabitants per km2” (Laura Llorens Guasch, University of Girona)	Done
E-4-337	A	17	24		29	please restructure (Clair Hanson, IPCC TSU)	Done
E-4-338	A	17	25			“Sense of place” -> not clear what you mean. (Laura Llorens Guasch, University of Girona)	Done
E-4-339	A	17	35			two "and" (Pam Berry, University of Oxford)	Done
E-4-340	A	17	35			remove 'and' (Clair Hanson, IPCC TSU)	Done
E-4-341	A	17	35			please delete "and" (Tianxiang Luo, Institute of Tibetan Plateau Research, Chinese Academy of Sciences)	Done
E-4-342	A	17	35			delete “and”. (Laura Llorens Guasch, University of Girona)	Done
E-4-343	A	17	43		46	reads like a list (Clair Hanson, IPCC TSU)	CLAs to curb over-prunning of the 4.4.2 section such that in the end remaining text has no logic. CLAs: Page limitations should be observed by all authors and choices made according to priorities. Final text improved accordingly.
E-4-344	A	17	44	17	45	the statement that deserts might shrink by 60% seems to be at odds with everything else in this paragraph. Or do you mean that deserts (having some veg) are replaced with a landscape having no vegetation over 60% of their area? (Danny Harvey, Dept of Geography, University of Toronto)	Adjusted
E-4-345	A	17	47			“of about half the species” -> replace with “about half of the species”. (Laura Llorens Guasch, University of Girona)	Done

E-4-346	A	17	51			what does (mean 5.5 above ambient) mean? (Clair Hanson, IPCC TSU)	Adjusted
E-4-347	A	18	4	18	5	It is unclear whether you refer here to migratory birds breeding in the desert or migratory birds passing through desert areas on migration. I think the latter seems more likely, as rainfall is necessary for the production of food surces, such as the berries of Salvadora sp. bushes in the sahel, which provide very rich food tat migrant passerines use for fattening prior to crossing the Sahara in spring (Stoate, C. & Moreby, S.J. (1995) Pre-migratory diet of trans-Saharan migrant passerines in the western Sahel. Bird Study, 42, 101-106.) (Humphrey Crick, British Trust for Ornithology)	Done
E-4-348	A	18	4	18	6	“Desert … vulnerable” -> confusing sentence. Rephrase. (Laura Llorens Guasch, University of Girona)	rephrased
E-4-349	A	18	6	18	7	“a wide-ranging bird species of the Nama-Karoo desert species” -> redundant. (Laura Llorens Guasch, University of Girona)	removed
E-4-350	A	18	8			“A2 Simmons et al.” -> separate text from bibliographic reference. (Laura Llorens Guasch, University of Girona)	Done
E-4-351	A	18	10			“scenarios Currie 2001” -> separate text from bibliographic reference. (Laura Llorens Guasch, University of Girona)	Done
E-4-352	A	18	12	18	24	the subject of the paragraph, as indicated by the first sentence, is wet periods, but most of what the paragraph is talking about are the effects of greater dryness. Suggest restructuring the material so that one paragraph deals with one topic/change only. (Danny Harvey, Dept of Geography, University of Toronto)	Done
E-4-353	A	18	27	18	30	Is a repeat of Page 17 Lines 46 to 49. (Pam Berry, University of Oxford)	Done
E-4-354	A	18	29			Succulent (Clair Hanson, IPCC TSU)	R - Reviewer's comment is not understandable. In case the reviewer forgot a question mark, the term succulent is explained in the glossary
E-4-355	A	18	31			t? (Clair Hanson, IPCC TSU)	Done
E-4-356	A	18	51	18	52	potential evapotranspiration does not depend on how the rain falls (or even how much there is), so delete the 2nd part of the sentence (Danny Harvey, Dept of Geography, University of Toronto)	Adjusted
E-4-357	A	19	6			“most of which are transient” -> not sure what you mean. (Laura Llorens Guasch, University of Girona)	adjusted
E-4-358	A	19	6			“a large investment seed production” -> ”in” is missing. (Laura Llorens Guasch, University of Girona)	adjusted
E-4-359	A	19	7			high tillering ability' What is this? (Clair Hanson, IPCC TSU)	Removed
E-4-360	A	19	9			E.g --> example. E.g, means for example (Clair Hanson, IPCC TSU)	Done
E-4-361	A	19	14			“Atmospheric dust … years” -> it seems out of context. (Laura Llorens Guasch, University of Girona)	Adjusted
E-4-362	A	19	23			the severe droughts'. Which severe droughts? (Clair Hanson, IPCC TSU)	A - Text improved

E-4-363	A	19	25	19	26	The sentence about migrant birds and sahel drought would benefit from a little more detail: The survival of a number of long-distance migrant passerine birds has been shown to be lower under drought conditions in the Sahel (Peach, W., Baillie, S. & Underhill, L. (1991) Survival of British Sedge Warblers Acrocephalus schoenobaenus in relation to west African rainfall. Ibis, 133, 300-305; Baillie, S.R. & Peach, W.J. (1992) Population limitation in Palearctic-African migrant passerines. Ibis, 134, Suppl. 1,120-132; Marchant, J.H. (1992) Recent trends in breeding populations of some common trans-Saharan migrant birds in northern Europe. Ibis, 134, Suppl. 1, S113-S119; Szep, T. (1995) Survival rates of Hungarian sand martins and their relationship with Sahel rainfall. Journal of Applied Statistics, 22, 891-904; Robinson et al 2005 (already in refs)); leading to natural selection towards decreased body size in Sand Martins (Jones, G. (1987) Selection against large size in the Sand Martin Riparia riparia during a dramatic population crash. Ibis, 129, 274-280) (Humphrey Crick, British Trust for Ornithology)	removed to be in the box on migratory birds
E-4-364	A	19	31	19	33	The sentence is unclear: "…Taking advantage of …." (Tianxiang Luo, Institute of Tibetan Plateau Research, Chinese Academy of Sciences)	Done
E-4-365	A	19	31	19	33	Sentence lacks clarity. Suggested alternative - Advantage could be taken, for example, of the wildlife that will be favoured under climate change, such as increased reptile and amphibian richness, to promote eco-tourism, (Pam Berry, University of Oxford)	Done
E-4-366	A	19	31	19	45	Rewrite all this part. It is confusing and the ideas are not well linked. (Laura Llorens Guasch, University of Girona)	Done
E-4-367	A	19	31	19	33	improper sentence (Danny Harvey, Dept of Geography, University of Toronto)	Fixed
E-4-368	A	19	31			Statement on eco-tourism from increased reptiles and amphibians is unclear; amphibians are declining worldwide (Dena MacMynowski, Stanford University)	Fixed
E-4-369	A	19	31		33	doesn't make sense (Clair Hanson, IPCC TSU)	Fixed
E-4-370	A	19	33	19	36	I don't understand what these eco-tourism opportunites are - they sound a bit far-fetched given the problems posed in the second sentence - is the latter sentence really wortht including - of course the activities won't occur where conditions make them impractical! (Humphrey Crick, British Trust for Ornithology)	Adjusted
E-4-371	A	19	36	19	37	improper sentence (Danny Harvey, Dept of Geography, University of Toronto)	Fixed
E-4-372	A	19	39	19	39	With respect to th adaptation options for migratory birds that cross deserts, Robinson et al (2005) notes that it is important to maintain a coherent network of stop-over sites that such migrants can use to "refuel", as well as reducing other anthropogenic stresses on critical habitats. (Humphrey Crick, British Trust for Ornithology)	Removed - go to migratory Box by Jeff Price
E-4-373	A	19	39	19	40	state in plain, jargon-free langauge, what you are trying to say (Danny Harvey, Dept of Geography, University of Toronto)	Adjusted
E-4-374	A	19	40	19	40	What is "autonomous adaptation" - explian please! (Humphrey Crick, British Trust for Ornithology)	Adjusted
E-4-375	A	19	41			current --> currently	Fixed

						(Clair Hanson, IPCC TSU)	
E-4-376	A	19	42	19	43	I don't understand how " leaving deserts as they are" can be described as an adaptation measure? (Humphrey Crick, British Trust for Ornithology)	Fixed
E-4-377	A	19	42			what on earth does "cost-effective" mean in this context? (Danny Harvey, Dept of Geography, University of Toronto)	Adjusted
E-4-378	A	19	42			there --> they (Clair Hanson, IPCC TSU)	Done
E-4-379	A	20	3			E.g --> example. E.g, means for example (Clair Hanson, IPCC TSU)	Done
E-4-380	A	20	7		16	first 2 bullets don't refer to a T change. Please include (Clair Hanson, IPCC TSU)	TR - Was only prepared for internal use, i.e. integration into Table 4.1
E-4-381	A	20	8			change 19.2% to (20%) [greater precision is not justified] (Danny Harvey, Dept of Geography, University of Toronto)	TR - Was only prepared for internal use, i.e. integration into Table 4.1
E-4-382	A	20	11			change 51% to "about 50" (Danny Harvey, Dept of Geography, University of Toronto)	TR - Was only prepared for internal use, i.e. integration into Table 4.1
E-4-383	A	20	11			Bullet point on single bird species (Wheatear) is out of context with larger-scale summary (Dena MacMynowski, Stanford University)	TR - Was only prepared for internal use, i.e. integration into Table 4.1
E-4-384	A	20	12			insert "scenario" after "A2" (Danny Harvey, Dept of Geography, University of Toronto)	TR - Was only prepared for internal use, i.e. integration into Table 4.1
E-4-385	A	20	21		39	reads like a list (Clair Hanson, IPCC TSU)	agree - text revised
E-4-386	A	20	28			“(Hassan et al., 2005)” -> move this reference to the end of the sentence/paragraph. (Laura Llorens Guasch, University of Girona)	agree - text revised
E-4-387	A	20	30			there is a missing bracket after “wild foods”. (Laura Llorens Guasch, University of Girona)	agree - text revised
E-4-388	A	20	41	20	47	You must include a reference to Shaw et al 2002 on the Jasper Ridge experiment, where they actually did th emultifactor experiments with water, CO2, temperature and Nitrogen and, at least for the one year of data published in Science showed strong and unpredictable interactions on NPP. (Claus Beier, Risoe National Laboratory)	agree - reference added with linked text
E-4-389	A	20	45			ewaht are treatments? (Clair Hanson, IPCC TSU)	agree - text revised
E-4-390	A	20	49	21	22	I think authors should try to summarize this paragraph highlighting global trends. (Laura Llorens Guasch, University of Girona)	agree - text consolidated
E-4-391	A	20	51			5x --> five times (Clair Hanson, IPCC TSU)	agree - done
E-4-392	A	20	51			“5x as much” -> “5 times more”. (Laura Llorens Guasch, University of Girona)	agree - done
E-4-393	A	20	52	21	1	“A European … impacts” -> I would remove this information, since it only adds confusion (a direct effect of the rise in temperature might be mixed up with drier conditions). (Laura Llorens Guasch, University of Girona)	agree - text moved to more appropriate para on interactions of rivers
E-4-394	A	21	14			what is MAR? (Clair Hanson, IPCC TSU)	Mean annual Rainfall - glossar

E-4-395	A	21	24	21	24	This sems inconsistent with the notion (mentioned elsewhere in the text) that CO2 rise might be partly responsible for woody thickening, by increasing the competitive effectiveness of C3 plants. There is support for this from an analysis of palaeodata (two papers in GCB 2004). (Iain Colin Prentice, University of Bristol)	agree - we refer here to independent effetcs of warming and CO2 fertilization - this is now made more clear in a chapeau sentence indicating these effects are in opposition wrt to C3 and C4 plants
E-4-396	A	21	24	21	32	this paragraph should also be rewritten in order to organize and link the ideas better. (Laura Llorens Guasch, University of Girona)	agree - done
E-4-397	A	21	32	21	34	“Drying … (Thomas et al., 2005)” -> out of context. It could be moved to section 4.4.2. (Laura Llorens Guasch, University of Girona)	agree - done
E-4-398	A	21	36	21	38	this statement is too vague (give numbers!) and it cannot be related to the statements before and after (Danny Harvey, Dept of Geography, University of Toronto)	agree - text deleted
E-4-399	A	21	39	21	49	Reorganize. Ideas are not well linked. Main trends are not highlighted. The following reference may be useful: Leakey et al. (2006), Plant Physiology vol. 140, pp. 779-790. (Laura Llorens Guasch, University of Girona)	agree - done, and reference cited
E-4-400	A	21	39			remove [] (Clair Hanson, IPCC TSU)	agree- done
E-4-401	A	21	44	21	44	The text references an abstract of Feretti et al. 2001. I recommend that be replaced with a better article which fully describes the soil water responses of the shortgrass steppe to CO2. That citation is: Nelson, J.A., J.A. Morgan, D.R. LeCain, A.R. Mosier, D.G. Milchunas, and W.A. Parton. 2004. Elevated CO2 increases soil moisture and enhances plant water relations in a long-term field study in semi-arid shortgrass steppe of Colorado. Plant and Soil, 259, pp. 169-179. I was involved in both of the above projects, and the Nelson et al. one is a better paper for describing the water relations aspects of the CO2 responses of this grassland. Nevertheless, if there was another aspect of the Feretti work that the authors thought interesting (partitioning E and T from ET?), the full citation of the Ferretti paper is: Ferretti, D.F., E. Pendall, J.A. Morgan, J.A. Nelson, D. LeCAin, and A.R. Mosier. 2003. Partitioning evapotranspiration fluxes from a Colorado grassland using stable isotopes: Seasonal variations and ecosystem implications of elevated atmospheric CO2. Plant and Soil. 254, pp. 291-303. (Jack Morgan, USDA ARS Rangeland Resources Research)	agree - done, reference cited
E-4-402	A	22	3	22	16	You must include a reference to Shaw et al 2002 on the Jasper Ridge experiment, where they actually did the multifactor experiments with water, CO2, temperature and Nitrogen and, at least for the one year of data published in Science showed strong and unpredictable interactions on NPP. (Claus Beier, Risoe National Laboratory)	agree- done, reference cited
E-4-403	A	22	3	22	5	Not make complete sense. Suggested alternative - It is likely that temmperate grassland sequestraton……, and increases of 54% in net fixation are expected if CO2 doubles. (Pam Berry, University of Oxford)	agree - revised
E-4-404	A	22	3	22	5	garbled sentence (Danny Harvey, Dept of Geography, University of Toronto)	agree - revised
E-4-405	A	22	4	22	5	“but … CO2 doubles” -> rephrase. (Laura Llorens Guasch, University of Girona)	agree - revised
E-4-406	A	22	4			any need to mention glacial/interglacial levels?	agree - revised

						(Clair Hanson, IPCC TSU)	
E-4-407	A	22	13	22	16	is such fire exclusion at all realistic? (Danny Harvey, Dept of Geography, University of Toronto)	agree - revised by adding "albeit technically unfeasible"
E-4-408	A	22	27		28	what is canopy closure? (Clair Hanson, IPCC TSU)	agree- deleted
E-4-409	A	22	30	22	40	Reorganize. Ideas are not well linked. Main trends are not highlighted. (Laura Llorens Guasch, University of Girona)	agree- revised
E-4-410	A	22	30		31	what is CO2 fumigation? (Clair Hanson, IPCC TSU)	agree - changed to "enrichment"
E-4-411	A	22	31			"muted impacts" is too vague. Does it increase or decrease? (Danny Harvey, Dept of Geography, University of Toronto)	agree - now "limited impacts"
E-4-412	A	22	32			I suspect that the word "other" is needed after "of" (Danny Harvey, Dept of Geography, University of Toronto)	agree - revised
E-4-413	A	22	35	22	37	This statement is wrong, as shown by the analysis of Knorr et al. (Iain Colin Prentice, University of Bristol)	agree - revised and new literature cited
E-4-414	A	22	39			funding? (Clair Hanson, IPCC TSU)	agree - deleted
E-4-415	A	22	42	22	51	With respect to savanna fauna, I think it would be worth saying: As the migrations of large herbivores track seasonal changes in vegetation, climate change has the potential to alter migratory routes (and timings), which may increase conflicts with humans, particularly in areas where rainfall is low (Thirgood, S., et al. (2004) Can parks protect migratory ungulates? The case of the Serengeti wildebeest. Animal Conservation 7: 113-120). Land-use patterns in Africa can prevent animals adapting their migratory routes, for example, park boundary fences have been demonstrated to disrupt migratory journeys, leading to a population decline in Wildebeest (Whyte I.J. & Joubert S.C.J. (1988) Blue wildebeest population trends in the Kruger National Park and the effect of fencing. South African Journal of Wildlife Research 18: 78-87). Changed migratory routes may also have effects throughout the ecosystem (Fryxell, J.M. & Sinclair, A.R.E. (1988) Causes and consequences of migration by large herbivores. Trends in Ecology and Evolution 3, 237- (Humphrey Crick, British Trust for Ornithology)	agree - Thirgood now cited, some references somewhat out of date, but the idea is now reflected
E-4-416	A	22	42	22	51	Reorganize the ideas to highlight main trends. (Laura Llorens Guasch, University of Girona)	agree - done
E-4-417	A	22	42	22	51	It might be worth adding that an experimental warming combined with rainfall manipulations of a temperate grassland in the UK led to significant shifts in the invertebrate community, including species composition, dynamcis and phenology (Masters et al 1998; Masters & Brown 2001). References: Masters, G.J., Brown, V.K., Clarke, I.P., Whittaker, J.B. & Hollier, J.A. (1998) Direct and indirect effects of climate change on insect herbivores: Auchenorrhyncha (Homoptera). Ecological Entomology, 23, 45-52. Masters, G.J. & Brown, V.K. (2001) Effects of Experimental Manipulation of Climate on Calcareous Grassland Plants and Invertebrates. In: Impacts of Climate Change on Wildlife, eds. R.E. Green, M. Harley, M. Spalding & C. Zöckler, RSPB publication on behalf of EN, WWF-UK, UNEP WCMC & RSPB, pp. 57-59. (Gregory Masters, CABI)	Too detailed, old references
E-4-418	A	23	1			What does this statement mean?	agree - section removed to 4.6

						(Eric Kasischke, University of Maryland)	
E-4-419	A	23	1			is this all that can be written about adaptation in grasslands i.e., nothing? Please complete (Clair Hanson, IPCC TSU)	agree - section removed to 4.6
E-4-420	A	23	1			Adaptation costs and opportunities are to an (large) extent ecosystem specific. In this case there are issues to do with possible loss of large mammalian species, especially those important to tourism and the need for a better, more connected reserve network. (Pam Berry, University of Oxford)	agree - section removed to 4.6
E-4-421	A	23	18		24	state T change (Clair Hanson, IPCC TSU)	agree- in table 4.2
E-4-422	A	24	1	24	52	Care is required here since extinction occurs at a range of scales (local, regional - everywhere). Local extinctions may be reversible since there could be refugia from which recolonisation can take place. Organisms with limited distributions (particularly endemics) are most vlunerable to total extinction. (Paul J. Wood, Loughborough University)	agree
E-4-423	A	24	2			what is GMT? (Clair Hanson, IPCC TSU)	global mean temperature
E-4-424	A	24	4			insert "hypothetical" or "hypothetical and uncertain" before "CO2" (Danny Harvey, Dept of Geography, University of Toronto)	agree - done
E-4-425	A	24	6			here Mediterranean Basin has a B, other mentions have b. Please be consistent throughout section (Clair Hanson, IPCC TSU)	agree
E-4-426	A	24	7			“high rates of vegetation migration rates” -> Redundant. (Laura Llorens Guasch, University of Girona)	agree- corrected
E-4-427	A	24	9			specifiy whether the warming talked about is local or global mean, and the period to which it is relative (Danny Harvey, Dept of Geography, University of Toronto)	agree- corrected
E-4-428	A	24	13			what are fire escapes? (Clair Hanson, IPCC TSU)	see next comment
E-4-429	A	24	13			should not "escapes" be "episodes" or "events"? (Danny Harvey, Dept of Geography, University of Toronto)	agree - we refer to wildfire events
E-4-430	A	24	19		22	is growing season just determined by temperature? What about precip changes/requirements? Will the growing season split due to too litte precip and too high temperatures? (Clair Hanson, IPCC TSU)	text deleted

E-4-431	A	24	21	24	22	This is not precise. Researchers working at the Spanish site suggested a possible change in the species relative dominance of this community as a result of warmer conditions, but they did not demonstrate this shift. The main results suggesting this change were: a differential effect of warming on the growth of the two dominant species, a decrease in seedling diversity and a shift in the species composition of seedling recruitment. You can find this results in: * Llorens et al. (2004). Annals of Botany, 94 (6): 843-853 / * Lloret et al. (2004). Global Change Biology, 10: 248-258 / * Peñuelas et al. (2004). Ecosystems, 7: 598-612. Other results suggesting that species composition of this Mediterranean shrubland may change as a consequence of warming are published in: * Llorens L., J. Peñuelas (2005). International Journal of Plant Sciences, 166 (2): 235-245. (Laura Llorens Guasch, University of Girona)	text deleted
E-4-432	A	24	29	24	31	how can it be said that the Mediterranean vegetation experienced full recovery by 2004, when large areas burned in 2003? (Danny Harvey, Dept of Geography, University of Toronto)	agree - we now ad "from drought"
E-4-433	A	24	31	24	31	Add finding by Körner et al, 2005b, that Eastern Mediterranean forest showed dieback due to severe droughts in recent years. (Claus Beier, Risoe National Laboratory)	agree - now cited
E-4-434	A	24	33	24	36	too vague. Specify the precipitation/temperature change combinations that give rise to this favourable result, and whether they actually occur in any AOGCMs (the AOGCMs consistently simulate reduced summer rainfall in the Mediterranean region combined with warming - the Mediterranean is one of the few regions in the world where there is such consistency). I also suggest combining this paragraph with page 23, lines 50-51. (Danny Harvey, Dept of Geography, University of Toronto)	agree - text now more explicit
E-4-435	A	24	38			I would avoid use of the word "marginal", since it often means quite different things to economists and non-economists (and here, I think it is meant in the non-economist sense) (Danny Harvey, Dept of Geography, University of Toronto)	agree - changed to "limited"
E-4-436	A	24	43			move “(Borghetti et al., 1998)” to the end of the sentence. (Laura Llorens Guasch, University of Girona)	agree - done
E-4-437	A	24	44			change "which" to "and" (Danny Harvey, Dept of Geography, University of Toronto)	agree- done
E-4-438	A	24	48	24	50	it seems that authors state that the flowering phenology of these Mediterranean shrub species was reduced as a result of drier conditions. Taking into account that the word "phenology" refers to the seasonal timing of life-cycle events, it has no sense to say that flowering phenology was reduced. To be precise, authors of the quoted study found that drier conditions altered (mostly delayed, not reduced) the flowering phenology of these shrubs. They also found that functional flower production was reduced as a consequence of drier conditions. (Laura Llorens Guasch, University of Girona)	agree - corrected
E-4-439	A	24	49	24	50	Not clear what affected flowering phenology (certainly not experimental drying as implied by the sentence) or how it was affected, (Pam Berry, University of Oxford)	see previous comment
E-4-440	A	25	4	25	5	… persistence and species richness and led to range reductions (Pam Berry, University of Oxford)	disagree - sentence reworded

E-4-441	A	25	4	25	5	“reduced … range reductions” - > redundant. (Laura Llorens Guasch, University of Girona)	agree - corrected
E-4-442	A	25	19			“threaten substantial species range reductions” -> rephrase. (Laura Llorens Guasch, University of Girona)	agree - corrected
E-4-443	A	25	20			…adaptation which are unlikely to be realized. (Pam Berry, University of Oxford)	agree - corrected
E-4-444	A	25	27			“in excess of about 2ºC” -> I would remove “about”. (Laura Llorens Guasch, University of Girona)	text deleted, results summarized in table 4.2
E-4-445	A	25	29			change "reduced" to "decreased" (Danny Harvey, Dept of Geography, University of Toronto)	text deleted, results summarized in table 4.2
E-4-446	A	25	30	25	31	“high rates of vegetation migration rates” -> redundant. (Laura Llorens Guasch, University of Girona)	agree - corrected
E-4-447	A	25	30			remove 'n' and add dT (Clair Hanson, IPCC TSU)	TR
E-4-448	A	25	33		34	add T change (Clair Hanson, IPCC TSU)	TR
E-4-449	A	25	33			"escapes" should be "episodes" (Danny Harvey, Dept of Geography, University of Toronto)	agree -corrected to"events"
E-4-450	A	25	36			[for DGVM section ?? (Clair Hanson, IPCC TSU)	deleted
E-4-451	A	25	40	25	40	Some of the sections end with a short summary of the key findings in the section. This is a good idea but is not provided for 4.4.4 and should be included. (Claus Beier, Risoe National Laboratory)	agree - now done for all sections ("key vulnerabilities"
E-4-452	A	25	42	29	8	several key works or impacts are not cited in this section, in particular: Cox et al. (2000, 2004) on the Amazon rainforest being replaced with grassland in the HadCM3 model by the time global mean warming reaches 3 K if the mean climate becomes more El Nino-like; the greater susceptibility of disturbed tropical forests to climatic change (Laurance and Williamson, 2001); drought stress in Alaska (D'Arrigo et al. , 2004); and the current Western Pine Beetle outbreak (I have no references, but have seen it myself!). REFERENCES: Cox, P.M., Betts, R.A., Jones, C.D., Spall, S.A. and Totterdell, I.J.: 2000, ‘Acceleration of global warming due to carbon-cycle feedbacks in a coupled climate model’, Nature 408, 184-187. Cox, P.M., Betts, R.A., Collins, M., Harris, P.P., Huntingford, C. and Jones, C.D.: 2004, ‘Amazonian forest dieback under climate-carbon cycle projections for the 21st century’, Theor. Appl.Climat. 78, 137-156. D'Arrigo, R.D. et al. Glob Biogeochem. CYcles 18, GB3021; Laurance and Williamson, 2001. Conservation Biology 15: 1529-1535. (Danny Harvey, Dept of Geography, University of Toronto)	R - We cite these papers in several other sections of our chapter. To avoid redundancy this section does not repeat those arguments. We improved text by crossreferencing better those other sections.

E-4-453	A	25	42	32	18	Throughout Sections 4.4.5 and 4.4.6, Camill and Clark (2000) is continuously referred to when discussing processes in Tundra ecosystems. The research in this paper was carried out by Phil Camill as part of his dissertation research in boreal peatlands that were not in the tundra-taiga transition zone, but in the peatland-grassland-forest transition zone. I do not understand the use of this reference. Also, I found it odd that you did not discuss the findings of Sturm et al. (2001), who present convincing evidence of widespread shrub expansion in tundra over the past half century. (Eric Kasischke, University of Maryland)	A Thanks for the reference Stu14. Text improved accordingly
E-4-454	A	25	44			“densely treed” -> rephrase (Laura Llorens Guasch, University of Girona)	A
E-4-455	A	25	46	25	49	The description of forest climates is inappropriatly refered to as "benign". This is not appropriate for alpine and boreal forests where growth conditions are harsh. Forest grow where the water balance is appropriate. (Pierre Bernier, Natural Resources Canada)	A
E-4-456	A	25	46	25	47	As noted in my previous review, there are many regions containing boreal forest that receive less than 300 mm of precipitation. Also, should you use precipitation rather than rainfall here? (Eric Kasischke, University of Maryland)	A - That is all correct. Text was improved to better take situation in colder areas, where PET as well as AET are lower and thus less precip. Is needed, into account.
E-4-457	A	25	46			Forests require begining environmental conditions (summer T above 12 °C)? In many references can be find that mean long term temperature limit for forest is T above 10 °C in the warmest month of the year (9 °C in central Asia and 11 °C in the cloudy polar regions) (Milan Lapin, Faculty of Mathematics, Physics and Informatics, Comenius University)	A - Text improved to clarify that this rule is not applicable on the entire globe
E-4-458	A	25	47	25	51	“This … purposes” -> This sentence is too long. (Laura Llorens Guasch, University of Girona)	R partly - The actual sentence is not particularly long. Omitting the references would not sufficiently substantiate the argument. Thus sequence was switched to move the long paranthesis towards the end. Cf. E-4-459A
E-4-459	A	25	49			insert () around Hassan et al 2005 (Clair Hanson, IPCC TSU)	A
E-4-460	A	25	51	26	2	It is not obvious what the figure of 70.2 Pg in line 52 actually is - I assume it is the total carbon stored in boreal vegetation, but this should be explicitly stated. Particularly because it could be confused with the figure of 1640 PgC in line 1 of the following page. Also use the same units consistently (Pg or PgC). What does the 30% in line 52 indicate? If it is the percentage of the boreal vegetation carbon mass in relation to the total global vegetation carbonmass, this should be stated. (Heiko Balzter, Centre for Ecology and Hydrology)	A
E-4-461	A	25	52			Why is Smith et al. (2004) used here? Smith’s study addressed boreal peatlands, not forests. (Eric Kasischke, University of Maryland)	A - TR
E-4-462	A	25	52			the 30% is not clear (Pierre Bernier, Natural Resources Canada)	A
E-4-463	A	25	52			I would talk about northern circumpolar boreal forests in a different sentence, since it is difficult to interpret the information in brackets before having said that you are talking about biospheric carbon stocks.	A - TR

						(Laura Llorens Guasch, University of Girona)	
E-4-464	A	25		34		The ecosystem split among Tundra & arctic ecosystems; Mountains and grasslands appear slightly unfortunate because large shrubland and moorland areas in northern scandinavian, NW Europe and upland UK is not represented despite potential large effects predicted and already observed here - this also means that massive scientific research conducted at Abisko in Sweden, Zackenberg in Greenland, Wales and Scotland in UK are not represented at all. To me this appears a major flaw (Claus Beier, Risoe National Laboratory)	LA - First the IPCC plenary has given us "terms of reference" and we have followed those guidelines. Secondly, we would be happy to include other research, but the reviewer needs to be more specific than that and without specific references there is not much we can do. We already cite too much literature and have almost 3000 (2976 as of this writing) articles in our data base used for this chapter.
E-4-465	A	26	15	26	15	by 'were' do you mean to imply this is no longer the case? (Richard Fleming, Great Lakes Forest Research Centre)	A - changed tense
E-4-466	A	26	20	26	30	Literature cited here does not include Asian studies. I recommend to refer to Matsui et al. (2004) because this paper predicts the change of the suitable habitat for Fagus crenata forests under warming climate scenario and assesses the vulnerability by model analysis with high spatial resolution. F. crenata is the dominant tree species in the cool-temperate zone in Japan. The area of suitable habitat of F. crenata forests is projected to decline to 10 % of the current area. The pdf file of the paper can be downlowd from and http://cse.ffpri.affrc.go.jp/ntanaka/2004JVSMatsui_Vulnerability.pdf. (Nobuyuki Tanaka, Forestry and Forest Products Research Institute (FFPRI))	A partly - It does, e.g. Xu and Yan, 2001 and the reference list was made as comprehensively as possible, covering the entire globe. Moreover, several studies are global. Thanks for the reference.
E-4-467	A	26	21			what are VC 1-3? VC not mentioned in F4.4 (Clair Hanson, IPCC TSU)	A - text improved
E-4-468	A	26	21			remove 'refs at end of sentence' (Clair Hanson, IPCC TSU)	LA - Do not understand comment, since there is nowhere 'refs' at end of sentence ???
E-4-469	A	26	23	26	30	Shorten - I don't think all these refs are needed to make the point. (Richard Fleming, Great Lakes Forest Research Centre)	LA - Yes, but much progress has been made in this field since TAR
E-4-470	A	26	30	26	34	sentence is too long - break up into distinct ideas (Danny Harvey, Dept of Geography, University of Toronto)	A
E-4-471	A	26	34	26	39	Add also potential for leaching of nitrogen when climate change (warming) interact with high N status and plant uptake cannot accumulate the additional nitrogen as demonstarted by Wright et al., 1998a, b (Claus Beier, Risoe National Laboratory)	A text removed, albeit reference not cited, since pre-TAR
E-4-472	A	26	42			Similar results are stated also for Slovakia in: Balajka, J, Lapin, M., Mindas J., Princova, H., Stastny P., Szamesova, J., Thalmainerova D. (2005): The 4th Slovak National Communication on Climate Change, Slovak Ministry of the Environment, Bratislava 2005, 138 pp., http://unfccc.int/resource/docs/natc/slknc4.pdf (Milan Lapin, Faculty of Mathematics, Physics and Informatics, Comenius University)	R - Thanks for the reference, but the list needs not be that comprehensive. It only tried to cover major regions of the globe.
E-4-473	A	26	44			“in future climate change” -> I would change it to “in future” or “under future climate change”. (Laura Llorens Guasch, University of Girona)	A
E-4-474	A	26	49	26	52	Ideal conditions for many forest insects (Fleming 2000).	A - but text not changed to not make sentences even more complicated. Forest insects are discussed later.

						(Richard Fleming, Great Lakes Forest Research Centre)	
E-4-475	A	27	1	27	6	The above would also seem to constitute another example of a substantive biotic feedback but I think you already have more than enough refs to make this point. (Richard Fleming, Great Lakes Forest Research Centre)	A
E-4-476	A	27	1			forst --> forest (Clair Hanson, IPCC TSU)	A
E-4-477	A	27	6			Similar results are stated also in: Balajka, J, Lapin, M., Mindas J., Princova, H., Stastny P., Szamesova, J., Thalmainerova D. (2005): The 4th Slovak National Communication on Climate Change, Slovak Ministry of the Environment, Bratislava 2005, 138 pp., http://unfccc.int/resource/docs/natc/slknc4.pdf (Milan Lapin, Faculty of Mathematics, Physics and Informatics, Comenius University)	LA - Thanks for the reference
E-4-478	A	27	8	27	14	Work of Hogg et al (Can. J. For. Res.2005; 35(3): 610-622) shows the strong relationship of productivity to drought in boreal aspen forests in Canada. (Pierre Bernier, Natural Resources Canada)	A - Thanks for the reference
E-4-479	A	27	10	27	14	The sentence can be misunderstood in the sense that forests at high elevation sites had to recover from enhanced growth in 2003. It needs to be split in two parts - the recovery from the 2003 heatwave refers to an earlier sentence (line 9-10) stating increased mortality as an impact. (Heiko Balzter, Centre for Ecology and Hydrology)	A
E-4-480	A	27	12			contradicts page 24, line 30 (Danny Harvey, Dept of Geography, University of Toronto)	A - Text in Box 4.1 modified
E-4-481	A	27	16	27	32	May be interesting to add the owrk of Fleming et al (Climatic Change 2002; 55(1/2): 251-272) on the interaction between fire and insect infestation (Pierre Bernier, Natural Resources Canada)	A
E-4-482	A	27	16		32	pests - also increased risk of second generation swarming (bark beetle in Sweden - Schylter et al 2006: Assessment of the impacts of cliamte change and weather extremes on boreal forests in northern Europe, focusing on Norway spruce, Climate Research 31: 75-84) (Clair Hanson, IPCC TSU)	A
E-4-483	A	27	16			I think it would be better to mention first “insects” and second “fire”, since this is the order you follow later. (Laura Llorens Guasch, University of Girona)	R - There is some merit to this argument. However, fire is the more obvious one and insects are not everywhere on the globe that important a consequence from drought
E-4-484	A	27	18	27	18	Not sure this ref is correct here? (Richard Fleming, Great Lakes Forest Research Centre)	R - The reference is correctly cited and that statement (50 times larger) is from the cited article
E-4-485	A	27	36	27	37	This climate change induced stress on forests can be further specified* as either/both slow changes of mean conditions or/and more extreme events (preconditioning extremes) that do not cause a disturbance as such, but rather changes the tree's health status thus lowering the resistance to subsequent disturbances. * Schlyter, P., Stjernquist, I., Nilsson, C., Jönsson, A.M. & Bärring, L., 2006: Assessment of extreme weather impacts on boreal forests. Clim. Res., 31, 75-84. (Lars Bärring, Lund University /// SMHI)	A
E-4-486	A	27	36	27	36	CC may also exacerbate interactions between disturbances (Fleming et al.2002 ~ see above).	A

						(Richard Fleming, Great Lakes Forest Research Centre)	
E-4-487	A	27	36	27	40	“but climate … (Peltola et al. 1999)” -> I would remove this part from here, since it seems out of context and only adds confusion. (Laura Llorens Guasch, University of Girona)	LA - Comment is not clear, since there is no text "but climate … (Peltoal et al. 1999)". Text before citation Peltola et al., 1999 was improved.
E-4-488	A	27	46			remove 'in' after 'including' (Clair Hanson, IPCC TSU)	A
E-4-489	A	27	49	27	52	I am not sure what the theme of this sentence is, nor why is it included in this section. If this sentence deals with tundra, then why is it not in section 4.4.6? While fires do occur in tundra, they are not as widespread as in boreal forests, and very few studies have been done on this topic, none of which are referenced in this sentence. Note that Camill and Clark (2000) deal with permafrosted peatlands, not tundra. Harden et al. (2000) deal with burning of organic soils in forests, and does not deal with frozen soils. I think a more authoritative paper on the topic of increased emissions of CO2 and methane from frozen soils is Zimov et al. (2006). Zimov, S.A., E.A.G. Schuur, and F.S. Chapin III, Permafrost and the global carbon budget, Science, 312, 1612-1613, 2006. (Eric Kasischke, University of Maryland)	A - TR
E-4-490	A	28	2	28	22	This paragraph overlooks an important process that is likely to be important in transitions from tundra to boreal forest – disturbance from fire. One of the factors that regulates the invasion of tree species into areas dominated by tundra is the presences of deep organic layers. Field and modeling studies have shown that tundra sites that experienced fire were more likely to be invaded by trees than sites that were undisturbed (see, e.g., Landhausser and Wein 1993; Sirois et al. 1994). Landhaeusser, S.M., and R.W. Wein, Postfire vegetation recovery and tree establishment at the Arctic treeline: climactic - change - vegetation - response hypothesis, Journal of Ecology, 81, 665-672, 1993. Sirois, L., G.B. Bonan, and H.H. Shugart, Development of a simulation-model of the forest tundra transition zone of northeastern Canada, Can. J. For. Res., 24, 697-706, 1994. (Eric Kasischke, University of Maryland)	A - Fully agree with the sentiment and the reminder. However, references are old (La020, Sirois et al.) and are normally not used in our assessment. Moreover, we have tight page limitations. Sentence added, but may have to be removed during shortening process again.
E-4-491	A	28	2	28	22	This is a highly selective analysis of the literature on migration rates. The 2 km/yr maximum figure for spruce has long since been discredited -- this estimate was inflated by the use of uncalibrated 14C dates. On the other hand, the notion that "inferred estimates from pollen have over-estimated dispersal rates" is far from universally accepted and in any case cannot apply to colonization of deglaciated ground, where cryptic refugia certainly did not exist. A plethora of papers is cited here but key papers are missing. (Iain Colin Prentice, University of Bristol)	A - Text needed considerably improvement. Text improved
E-4-492	A	28	6	28	8	the information in brackets is quite difficult to understand. (Laura Llorens Guasch, University of Girona)	LA - There are no brackets used in those lines. We presume the reviewer means parantheses. Improved by inserting punctuations marks.
E-4-493	A	28	11			what does 150-250 yr mean nere? (Clair Hanson, IPCC TSU)	A
E-4-494	A	28	11			“150-250 yr” -> do you mean 150-250 m/yr?	A - no, lag length

						(Laura Llorens Guasch, University of Girona)	
E-4-495	A	28	19	28	22	unclear sentence. I think that you mean to say " … indicate a LAG,with DELAYED projections of major carbon losses …. to accelerate global climate change LATER" (Danny Harvey, Dept of Geography, University of Toronto)	A
E-4-496	A	28	19	28	21	I could not find the reference in Kurz and Apps (1999) to a measured, drought and fire-induced loss of forest land at teh southern boundary of the boreal forest in the Prairies. (Pierre Bernier, Natural Resources Canada)	A - was a mistake
E-4-497	A	28	24			insert (?) "due to land use change" after "cover" (Danny Harvey, Dept of Geography, University of Toronto)	A
E-4-498	A	28	28			non-sustainable --> unsustainable (Clair Hanson, IPCC TSU)	A
E-4-499	A	28	31	28	33	the information in brackets is too confusing. (Laura Llorens Guasch, University of Girona)	LA - There are no brackets used in those lines. We presume the reviewer means parantheses. Improved by inserting
E-4-500	A	28	36			In Canada and the US, agriculture abandonment is certainly the premier cause of forest land expansion. (Pierre Bernier, Natural Resources Canada)	A
E-4-501	A	28	39	28	40	the information in brackets is too confusing. (Laura Llorens Guasch, University of Girona)	LA - There are no brackets used in those lines. We presume the reviewer means parantheses. Improved by inserting
E-4-502	A	28	39		40	please find a clearer way of representing topics and references within brackets. This applies to the entire chapter (Clair Hanson, IPCC TSU)	LA - But we have to work with very constrained page limits. This forces us to be very succinct and abbreviated. We have inserted punctuations, which should make those
E-4-503	A	28	40			“including … (Pounds et al. 2006)” -> rephrase. It is not well linked with the first part of the sentence. (Laura Llorens Guasch, University of Girona)	A
E-4-504	A	29	6			rephrase as "… fraction of stands experience severe impacts due to climate change" (Danny Harvey, Dept of Geography, University of Toronto)	TR
E-4-505	A	29	8			add a bullet on Amazon forest possible being converted to grassland for >= 3C (Danny Harvey, Dept of Geography, University of Toronto)	TR - Besides, without knowing about the research on which this result is based, the suggestion can't be followed
E-4-506	A	29	11	32	18	Why is this restricted to the arctic and no mention made of the antarctic? (Humphrey Crick, British Trust for Ornithology)	Agreed, corrected
E-4-507	A	29	15	29	16	“This includes … tundra” -> I thought you were defining “tundra”. Clarify this point. (Laura Llorens Guasch, University of Girona)	Agreed, corrected
E-4-508	A	29	25	29	26	the statement that the arctic harbours unique species, seems rather meaningless, as all biomes harbour unique species - I guess the topical rainforest will harbour two to three orders of magnitude more uniques species than the arctic. (Humphrey Crick, British Trust for Ornithology)	Agreed, corrected
E-4-509	A	29	29			a --> an (Clair Hanson, IPCC TSU)	the text was changed, so now it is OK
E-4-510	A	29	35	29	35	What is meant by "subsistence" species? Is this word necessary here? (Humphrey Crick, British Trust for Ornithology)	Agreed, corrected
E-4-511	A	29	43			insert 'which' after 'regimes' (Clair Hanson, IPCC TSU)	Agreed, corrected

E-4-512	A	29		32		The loss of a chapter for the low arctic ecosystems, shrublands and moorlands make me add a comment for the arctic system. There is littel or no mentioning of the potential change in biodiversity in the wet/cold sgrublands as demonstrated by Penuelas et al., 2004. Also the rather important finding that drying in wet ecosystems may lead to increased decomposition rates and thereby to increased CO2 loss is not mentioned (e.g. Jensen et al., 2003) (Claus Beier, Risoe National Laboratory)	Agreed, a paragraf on the subject is added to the text.
E-4-513	A	30	5			“droughting” -> replace by “drying”. (Laura Llorens Guasch, University of Girona)	Agreed, corrected
E-4-514	A	30	7			replace 'several' with 'a few' (Clair Hanson, IPCC TSU)	Agreed, corrected
E-4-515	A	30	11	30	12	“shrub tundra displacing dwarf shrub tundra” -> clarify this sentence. (Laura Llorens Guasch, University of Girona)	Agreed, corrected
E-4-516	A	30	25	30	25	"paludification" is a seriously obscure piece of jargon - can it be replaced or explained please? (Humphrey Crick, British Trust for Ornithology)	Agreed, corrected
E-4-517	A	30	26			“as well” -> “as well as”. (Laura Llorens Guasch, University of Girona)	Agreed, corrected
E-4-518	A	30	32	30	44	I would have thought it would be worth mentioning: Seals that rely on ice for breeding are likely to suffer considerable habitat loss with a decrease in sea ice extent, particularly vulnerable may be species that are confined to inland seas and lakes, such as the Caspian Seal (Phoca caspica), the Baikal Seal (Phoca siberica, and subspecies of the Ringed Seal (Phoca hispida lagodensis and P. h. saimensis) which will be limited in their ability to track the receding ice cover (Harwood, J. (2001) Marine mammals and their environment in the twenty-first century. Journal of Mammalogy, 82, 630-640). For example, earlier spring break-up of ice together with lower snow depths suggest a continued low pup survival of Ringed Seals in western Hudson Bay (Ferguson, S.H., Stirling, I. & McLoughlin, P. (2005) Climate change and ringed seals (Phoca hispida) recruitment in western Hudson Bay. Marine Mammal Science, 21, 121-135). Such chanegs are likely to affect a significant proportion of pinniped species in bothe the artic and antarctic (Humphrey Crick, British Trust for Ornithology)	These data are very interesting. We could not consider all these aspects because of the very limited space.
E-4-519	A	30	34			a rise in icing events … (Clair Hanson, IPCC TSU)	Corrected
E-4-520	A	30	36	30	38	The sentence about population declines in arctic breeding shorebirds can be supported with reference to the review by Rehfisch, M.M. & Crick, H.Q.P. (2003) Predicting the impact of climate change on Arctic Breeding waders. Wader Study Group Bulletin, 100, 86-95. (Humphrey Crick, British Trust for Ornithology)	Yes, but unfortunately the volume of the text is very limited.
E-4-521	A	30	38			B4.6 is mentioned in the text before B4.5 (Clair Hanson, IPCC TSU)	L ???
E-4-522	A	30	40			character --> status (Clair Hanson, IPCC TSU)	Agreed, corrected
E-4-523	A	30	51			1st an --> a (Clair Hanson, IPCC TSU)	Corrected
E-4-524	A	30	51			“kilometres an year” -> “kilometres per year”.	Corrected

						(Laura Llorens Guasch, University of Girona)	
E-4-525	A	31	2			"Mother bears" is an odd phrase. Suggest "female" or simply "bears" (Dena MacMynowski, Stanford University)	Agreed, corrected
E-4-526	A	31	28			to the --> to the (Clair Hanson, IPCC TSU)	Corrected
E-4-527	A	31	32			are --> will be (Clair Hanson, IPCC TSU)	Corrected
E-4-528	A	31	48			“but also to increases” -> remove “to”. (Laura Llorens Guasch, University of Girona)	Agreed, corrected
E-4-529	A	31	49	31	50	you say "models" but give only one reference, which pertains only to Arctic regions, so it seems more appropriate to say " One model of methane flux predicts dramatic increases in the Arctic as soils warm ". However, what if soils become drier? Then, there would be limited methane emission increase. There must be more papers on potential changes in methane fluxes in the Arctic. (Danny Harvey, Dept of Geography, University of Toronto)	Agreed, a paragraf on the subject is added to the text.
E-4-530	A	32	11			MGT needs to be defined (Dena MacMynowski, Stanford University)	agreed, removed
E-4-531	A	32	12			“4ºC polar bears …” -> rephrase or add punctuation marks. (Laura Llorens Guasch, University of Girona)	agreed, removed
E-4-532	A	32	21	34	20	Recent observations of climatic warming and its effects on ecosystems in the Tibetan Plateau (TP) of China, the third pole of the world with an average elevation of more than 4000m above sea level should be included in the "Mountains" section. Liu & Chen (2000, International Journal of Climatology 20: 1729-1742) indicate that the main portion of the TP has experienced statistically significant warming since the mid-1950s (especially in winter) with a warming trend to increase with elevation. The linear rates of temperature increase over the TP during 1955-1996 are about 0.16 oC/decade for the annual mean and 0.32oC/decade for the winter mean, which exceed those for the Northern Hemisphere and the same latitudinal zone in the same period (Liu & Chen 2000). The glaciers in the TP have been retreating continuously with negative glacial mass balance in recent decades, which has an important impact on the water resources of the arid regions in Northwest China (Yao et al. 2004, Science in China (D) 47: 1065-1075). The large altitudinal observations across subtropical forest and alpine vegetation by Luo et al. (2004,Global Eco (Tianxiang Luo, Institute of Tibetan Plateau Research, Chinese Academy of Sciences)	added (in condensed form) in various places of section 4.4.7, as follows: (1) at beginning of "key vulnerabilities" paragraph; and (2) in the new paragraph on C storage.
E-4-533	A	32	25			what is beta diversity? (Clair Hanson, IPCC TSU)	re-phrased the sentence to add a very brief explanation.
E-4-534	A	32	25		26	and are in many regions the richest in terms of species diversity (Clair Hanson, IPCC TSU)	changed according to the comment.
E-4-535	A	32	26	32	26	"Please add the following citation: Väre et al. 2003 full reference: Väre, H., R. Lampinen, C. Humphries, P. Williams 2003: Taxonomic diversity of vascular plants in the European alpine areas. Alpine Biodiversity in Europe - A Europe-wide Assessment of Biological Richness and Change. Springer: 133-148." (Harald Pauli, University of Vienna)	done
E-4-536	A	32	30			inhabitability --> habitability	done

						(Clair Hanson, IPCC TSU)	
E-4-537	A	32	31			protec.tion --> protection (Clair Hanson, IPCC TSU)	done
E-4-538	A	32	40	32	40	"if possible in this paragraph related to the TAR, add the following citation at the end of line: 'e.g. Vetaas and Grytnes 2002; Pauli et al. 2003'; full references: Vetaas, O.R. and J.A. Grytnes 2002: Distribution of vascular plant species richness and endemic richness along the Himalayan elevation gradient in Nepal. Global Ecology and Biogeography, 11, 291-301. Pauli, H., M. Gottfried, T. Dirnböck, S. Dullinger, and G. Grabherr 2003: Assessing the long-term dynamics of endemic plants at summit habitats. In: Alpine Biodiversity in Europe - a Europe-wide Assessment of Biological Richness and Change, pp. 195-207. Springer, Berlin." (Harald Pauli, University of Vienna)	included only Pauli et al., because the paragraph is about vulnerability, whereas the Vetaas paper is primarily a descriptive study of biodiversity.
E-4-539	A	32	45	32	45	"please add the following citations in addition to MacArthur...; Beniston...: Grabherr et al. 1995; Gottfried et al. 1999; Theurillat and Guisan 2001; full references: Grabherr, G., M. Gottfried, A. Gruber, and H. Pauli 1995: Patterns and current changes in alpine plant diversity. In: Arctic and Alpine Biodiversity: Patterns, Causes and Ecosystem Consequences. Ecological Studies, Vol. 113 (eds Chapin, F.S. and C. Körner), pp. 167-181. Springer, Berlin. Gottfried, M., H. Pauli, K. Reiter K. and G. Grabherr 1999: A fine-scaled predictive model for changes in species distribution patterns of high mountain plants induced by climate warming. Diversity and Distributions, 5, 241-251. Theurillat J.-P. and A. Guisan 2001: Potential impact of climate change on vegetation in the European Alps: A review. Climatic Change, 50, 77-109." (Harald Pauli, University of Vienna)	added only Theurillat & Guisan, as the other references pre-date the TAR (the 1972 ref is fine, however, as it is sort of a "founding reference").
E-4-540	A	32	49	33	4	“However, … Mack et al. 2000)” -> this sentence is too long. (Laura Llorens Guasch, University of Girona)	I fully agree. Have tried to split the sentence into several shorter and clearer ones. I am not sure about the last part,
E-4-541	A	32	50	32	51	genetically fixed climatic tolerances. Do we know enough to say that there will be no in situ adaptive evolution? There is some very limited evidence of this occurring albeit not in mountain environments. Is it a case of like species dispersal it will occur too slowly to be (Pam Berry, University of Oxford)	I did not change the sentence; I think the available material on in situ adaptive evolution is too scanty to allow any clear statement (see e.g. the NATO ASI volume edited by Huntley et al. in 1996).
E-4-542	A	33	10	33	12	“but … plants” -> rephrase. (Laura Llorens Guasch, University of Girona)	done
E-4-543	A	33	11	33	11	I don't know why a temperature control of treeline is "surprising", as most models assume it to be true. Also note that the specific hypothesis advocated by Koerner is not universally accepted; the empirical evidence is equally consistent with GDD control. (Iain Colin Prentice, University of Bristol)	"surprisingly" was removed, and the entire sentence was re-phrased for clarity and accuracy.
E-4-544	A	33	15			Shouldn't it be that the treeline is above (higher than) its climatic limit due to grazing etc?	no, not at all. This must be a amisunderstanding. The

						(Pam Berry, University of Oxford)	sentence as it stands is clear, I think, and I do not perceive a
E-4-545	A	33	16			“in case … century-old” -> rephrase. (Laura Llorens Guasch, University of Girona)	Removed this from the sentence, and added an "for example" sentence right afterwards.
E-4-546	A	33	25			climata --> climate (Clair Hanson, IPCC TSU)	changed to "climates"
E-4-547	A	33	31	33	34	Dwarf-bamboos show a good exaple on impact of snow-cover. Decreased snow cover depth exposes calms and leaves of dwarf-bamboo species to winter cold, resulting in cold damages to the plants and eventually changes in their distributions. Boundaries of distributions of dwarf-bamboo species correspond to snow depth under current climate. This is explained by the paper (Tanaka et al. 2002) in which the growth of 4 dominant forest floor species of dwarf-bamboo is sensitive to snow-cover change. The pdf file of this paper can be downlowd from http://cse.ffpri.affrc.go.jp/ntanaka/2005GERSasa.pdf. (Nobuyuki Tanaka, Forestry and Forest Products Research Institute (FFPRI))	this is all fine and correct, but I find it not necessary to add another example here. Therefore I have decided to leave the text unchanged
E-4-548	A	33	36			caused by? (Danny Harvey, Dept of Geography, University of Toronto)	sentence was re-phrased to correct this awkward expression
E-4-549	A	33	36			“warming caused by increased precipitation” -> what do you mean? (Laura Llorens Guasch, University of Girona)	sentence was re-phrased to correct this awkward expression
E-4-550	A	33	37			insert 'can' before 'lead' (Clair Hanson, IPCC TSU)	the sentence has been re-phrased entirely, and the addition of "can" is not necessary any more.
E-4-551	A	33	40			climate --> environment (Clair Hanson, IPCC TSU)	done
E-4-552	A	33	41			from --> on (Clair Hanson, IPCC TSU)	done
E-4-553	A	33	41			“dependent from” -> change to “dependent on” (Laura Llorens Guasch, University of Girona)	done
E-4-554	A	33	49			Add reference Peñuelas and Boada 2003 (Josep Penuelas, CSIC-CREAF Barcelona)	done
E-4-555	A	34	5	34	6	"please skip the citations: 'Pauli et al. 2001 and 2003' that are not applicable at this point;" (Harald Pauli, University of Vienna)	done
E-4-556	A	34	8			Mountain regions are highly susceptible to changes in pests and diseases effecting forests and humans (Epstein PR, Diaz HF, Elias S, Grabherr G, Graham NE, Martens WJM, Mosley Thompson E, Susskind J. 1998: Biological and physical signs of climate change: focus on mosquito-borne disease. Bull American Meteorological Society, 78:409-417.), because of the disproportionate warming at high altitudes. Diseases and disease vectors are now circulating in highland regions, some populated, in Central Africa, Asia and the Americas. (Please check with Pim Martens, Tony McMichael and Jon Patz for updates. While there is controversy raised by a few, there is no real disagreement that conditions in mountainous areas are becoming more conducive to transmission of VBDs.) (Paul Epstein, Harvard Medical School)	added a sentence at the end of the preceding paragraph

E-4-557	A	34	9			The review of Jump and Peñuelas: JUMP A., PEÑUELAS J. 2005. Running to stand still: adaptation and the response of plants to rapid climate change. Ecology Letters R8: 1010–1020 could also be adequate here. (Josep Penuelas, CSIC-CREAF Barcelona)	R - However this work is cited under key issues, 4.1.2
E-4-558	A	34	9			Jump et al (2006b) used a genome scan to identify temperature-related adaptive differentiation of individuals of the tree species Fagus sylvatica. By combining molecular marker and dendrochronological data they assessed spatial and temporal variation in marker frequency at the locus identified as under selection. They show that marker frequency at this locus varies predictably with temperature. Probability of marker presence shows a declining trend over the latter half of the 20th Century in parallel with rising temperatures in the region. Our results show that beech populations may show some capacity for an in situ adaptive response to climate change. However as reported ongoing distributional changes demonstrate (Peñuelas and Boada 2003), this response is not enough to allow all populations of this species to persist in all of its current locations.ALISTAIR S. JUMP, JENNY M. HUNT, JOSE-ANTONIO MARTÍNEZ IZQUIERDO, JOSEP PEÑUELAS 206. Natural selection and climate change: temperature-linked spatial and temporal trends in gene frequency in Fagus sylvatica (Josep Penuelas, CSIC-CREAF Barcelona)	A
E-4-559	A	34	14			loose --> lose (Clair Hanson, IPCC TSU)	done
E-4-560	A	34	14			“wherever … warming” -> rephrase. (Laura Llorens Guasch, University of Girona)	done
E-4-561	A	34	23	34	23	There are also coastal wetlands. To avoid confusion could this section be titled 'Freshwater wetlands, lakes and rivers'? (Thomas Spencer, University of Cambridge)	Accepted. The section title will be changed
E-4-562	A	34	23	36	7	the drying up of prairie wetlands in North America should be discussed in this section (Danny Harvey, Dept of Geography, University of Toronto)	A reference is made to these wetlands now.
E-4-563	A	34	23			Section 4.4.8 - why is there no section on coastal wetlands - i.e. saline or brackish estuarine and salt marsh habitats. These are seriously threatened by sea level rise and are highly productive sites of great importance to the vast numbers of migratory birds that use them each year. Coastal wetlands also provide an important example of real pro-active adaptation in action - managed re-alignment of the coast - the flooding of low-lying farmland by breaching sea-walls that in the long-term are indefensible. See: Atkinson, P.W., Crooks, S., Drewitt, A., Grant, A., Rehfisch, M.M., Sharpe, J. & Tyas, C. (2004) Managed realignment in the UK - the first five years of colonization by birds. Ibis, (Suppl. 1), 101-110. (Humphrey Crick, British Trust for Ornithology)	Coastal systems are discussed in a separate chapter.
E-4-564	A	34	27			Replace 'A' with 'The' (Paul J. Wood, Loughborough University)	agreed
E-4-565	A	34	29			Himalaya --> Himalayas (Clair Hanson, IPCC TSU)	The plural form is INCORRECT.
E-4-566	A	34	30			Replace 'is' with 'are' (Paul J. Wood, Loughborough University)	agreed
E-4-567	A	34	31			Insert 'the' should read - Global estimate of the area under rivers, ……. (Paul J. Wood, Loughborough University)	agreed

E-4-568	A	34	38	34	39	I think it is important to say that a key service provided by aquatic ecossytems is food, inclduing aquaculture. (Humphrey Crick, British Trust for Ornithology)	accepted; approprate addition is made.
E-4-569	A	34	42			Replace 'hereby' with 'thereby' (Paul J. Wood, Loughborough University)	agreed
E-4-570	A	35	6			P? (Clair Hanson, IPCC TSU)	It is phosphorus; will be changed
E-4-571	A	35	10			This reviewer was a little concerned with the implication that invasive species will simply somehow shift nothwards along with other biota. I think that there is the potential for an asertion like this to be misinterpreted by readers if it is left in its current context. This reviewer would be inclined to remove 'invasive biota' from the sentence. (Paul J. Wood, Loughborough University)	Sentence is reworded. However, there is high certainty that the invasive species will extend their range.
E-4-572	A	35	16			change "by a 6 C" to "with a 6 C" or "for a 6 C" (Danny Harvey, Dept of Geography, University of Toronto)	agreed
E-4-573	A	35	16			by a' --> 'following a' (Clair Hanson, IPCC TSU)	agreed
E-4-574	A	35	17	35	18	“(e.g. due to … 2003)” -> rephrase. (Laura Llorens Guasch, University of Girona)	rephrased for clarity
E-4-575	A	35	17		18	bracketed statement - please rephrase. It currently reads as though there have been warming reduction in the lake not NPP and fish yield reductions (Clair Hanson, IPCC TSU)	rephrased for clarity
E-4-576	A	35	19			please give a reference or references supporting the statement that higher CO2 will generally cause higher NPP in lakes, as the papers cited after the next phrase do not seem to pertain to this point. This, if true, is a very important point, and should be highlighted with a full discussion in a separate paragraph, rather than just mentioned in passing (Danny Harvey, Dept of Geography, University of Toronto)	Sentence is suitably changed.
E-4-577	A	35	26			reduced up to' doesn't make sense (Clair Hanson, IPCC TSU)	corrected
E-4-578	A	35	29			Suggest line should read - Small increases in the variability of precipitation regimes will significantly impact…. Replace 'in' with 'of' and 'suffice to' with 'will'. (Paul J. Wood, Loughborough University)	agreed
E-4-579	A	35	30	35	33	Suggest the sentense should read - In monsoonal regions increased precipitation variability may diminish wetland biodiversity and prolong dry periods, promoting terrestrialization of wetlands e.g., Keoladeo National Park, India (Gopal and …… (Paul J. Wood, Loughborough University)	agreed
E-4-580	A	35	34			Delete 'the' (Paul J. Wood, Loughborough University)	agreed
E-4-581	A	35	35			Replace 'nutrients' with 'nutrient loadings'. (Paul J. Wood, Loughborough University)	agreed
E-4-582	A	35	38			Sentense shoudl begin - 'Climate change…… (Paul J. Wood, Loughborough University)	agreed
E-4-583	A	35	39	35	42	The final part of the sentense (on line 41) regarding policies and conventions is not clear and distracts the reader. This reviewer suggests revision to ensure clartity. (Paul J. Wood, Loughborough University)	sentence revised

E-4-584	A	35	39			Delete ',' comma (Paul J. Wood, Loughborough University)	agreed
E-4-585	A	35	44			Sentence should start with a capital letter (Paul J. Wood, Loughborough University)	agreed
E-4-586	A	35	45	35	47	The final sentece of the key vulnerabilities section is not clear and requires revision to ensure the point being made is clear. (Paul J. Wood, Loughborough University)	sentence revised
E-4-587	A	35	45			Delete 'the' (Paul J. Wood, Loughborough University)	agreed
E-4-588	A	35	46			to hard? (Clair Hanson, IPCC TSU)	word changed to '+H2367difficult'
E-4-589	A	35	49			Delete 'mostly' (Paul J. Wood, Loughborough University)	agreed
E-4-590	A	35	50			what is DOC? (Clair Hanson, IPCC TSU)	expanded to dull form
E-4-591	A	35	50			give the meaning of DOC. (Laura Llorens Guasch, University of Girona)	expanded to dull form
E-4-592	A	36	2			Should read '…..catchments complicates understanding of climate change impacts….' (Paul J. Wood, Loughborough University)	agreed
E-4-593	A	36	3			Replace 'demand' with 'demands' (Paul J. Wood, Loughborough University)	agreed
E-4-594	A	36	4			Should read '…….uncertainties of precipitation threaten….' (Paul J. Wood, Loughborough University)	agreed
E-4-595	A	36	5	36	7	Do the authors really mean this? Management of water resource is a highly political activity, which is fraught with problems at national and regional levels. To suggest that it should occur at a continental scale is very ambitous (even if desirable). It is important that goals are realistic and taken serioulsy by other scientists, practitioners and policy makers and those empowered to enforce them. (Paul J. Wood, Loughborough University)	There was an error. It was intended to be and has been changed to 'river basin scale'.
E-4-596	A	36	5			Delete 'the' (Paul J. Wood, Loughborough University)	agreed
E-4-597	A	36	10			In order to follow the format of the previous titles I would remove “and their ecosystems” of this one. Thus, I suggest the following title: “Oceans and shallow seas”. (Laura Llorens Guasch, University of Girona)	Agreed, done
E-4-598	A	36	24			…they harbour extensive biodiversity… (Stephen John Hawkins, The Marine Biological Association of the United Kingdom)	Done
E-4-599	A	37	8			replace "marginal" with "critical" (Danny Harvey, Dept of Geography, University of Toronto)	Done
E-4-600	A	37	10			give the meaning of SST. (Laura Llorens Guasch, University of Girona)	Done
E-4-601	A	37	22	37	23	This claim is not well supported by quantiative data. At the lease, the statement needs to be clarified in the use of the term 'corals' - does this mean coral species, or coral abundance? (Paul Marshall, Great Barrier Reef Marine Park Authority)	Statement clarified

E-4-602	A	37	24	37	24	Statement implies losses are due to climate change or coral bleaching. This is not the case, as stated in later chapter (Chapter 16, pg 9, lines 33-35). This statement needs to be clarified and qualified. (Paul Marshall, Great Barrier Reef Marine Park Authority)	Statement clarified
E-4-603	A	37	25	37	26	Lack of availability of suitable substrate is also an important factor limiting development of quantitatively similar reef development in higher latitudes, as stated in Chapter 6, pg 21, lines 2-5. (Paul Marshall, Great Barrier Reef Marine Park Authority)	Agreed,this has been added
E-4-604	A	37	30	37	48	Figure 4.3 should be modified to include (perhaps with a question mark), a 6th climate-related impact on corals: Disease. Goldberg and Wilkinson (reference given in comment to page 38, line 13) note an increase in coral diseases and suggest that this could be related to warmer conditions (diseases are spreading on land, so this is a reasonable speculation). There may be something in [Harvell, C.D. et al. 2002. Climate warming and disease risks for terrestrial and marine biota. Science 296: 2158-2162] on coral diseases. (Danny Harvey, Dept of Geography, University of Toronto)	Figure 4.3 removed from this chapter and amended
E-4-605	A	38	1			…over-fishing, non-native species, pollution… (Stephen John Hawkins, The Marine Biological Association of the United Kingdom)	Done - included and cited
E-4-606	A	38	7	39	17	this section on impacts should have paragraphs on two key groups: marine mammals and sea turtles. Can I suggest the following for marine turtles: The nesting biology of sea turtles is strongly affected by temperature, both in timing and in the determination of the sex-ratio of hatchlings (Hays, G.C., Broderick, A.C., Glen, F. & Godley, B.J. (2003) Climate change and sea turtles; a 150-year reconstruction of incubation temperature at a major turtle rookery. Global Change Biology 9, 642-646), but the impacts of this on overall population size are unknown at present, though population structure is likely to be impacted with an increase in the relative number of females. Sea turtles are also likely to be directly impacted by an increase in sea levels and the loss of egg laying beaches. Under a predicted sea-level rise of 0.5 metres this will amount to up to 32% of nesting beaches in the Caribbean (Fish, M.R., Cote, I.M., Gill, J.A., Jones , A.P., Resnshoff, S. & Watkinson, A.R. (2005) Predicting the impact of sea-level rise on Caribbean sea turtle nesting habitat. [illegible] (Humphrey Crick, British Trust for Ornithology)	Done – included and cited
E-4-607	A	38	7	39	17	this section on impacts should have paragraphs on two key groups: marine mammals and sea turtles. Can I suggest the following for marine mammals: Marine mammals, cetaceans and pinnipeds, feed mainly on plankton, fish and squid, and changes in their distribution, abundance and community composition in resposne to climatic factors, particularly sea temperature, are likely to pose a considerable threat ((Learmonth, J.A., MacLeod, C.D., Santos, M.B., Pierce, G.J., Crick, H.Q.P. & Robinson, R.A. (2006) Potential effects of climate change on marine mammals. Oceanography and Marine Biology: An Annual Review 44: 431-464). Changing water temperature also has an effect on the reproduction of cetaceans (see Sperm Whale case study) and pinnipeds, indirectly through prey abundance, either through extending the time between individual breeding attempts, or by reducing breeding condition of the mother (Whitehead, H. (1997) Sea surface temperature and the abundance of sperm whale calves off the Galapagos Islands: implications for the effects of global warming. Report of the International Whaling Commission. 47, 941-944). (Humphrey Crick, British Trust for Ornithology)	Done - included and cited

E-4-608	A	38	10			to this list, you can add "diseases", and cite: Harvell, C.D. et al. 2002. Climate warming and disease risks for terrestrial and marine biota. Science 296: 2158-2162 (Danny Harvey, Dept of Geography, University of Toronto)	Done - included and cited
E-4-609	A	38	10			…, altering disturbance regimes in coastal systems and mixing of the water column, loss (Stephen John Hawkins, The Marine Biological Association of the United Kingdom)	This is already implied with increases to wave height and frequency.
E-4-610	A	38	13			I recommend inserting a paragraph here providing an update on the extent to which coral reefs have and have not recovered from the 1998 bleaching event, which was the most severe event on record and, in some cases, killed corals that were 1000 years old. The source that can be cited is: Status of Coral Reefs of the World: 2004, Volume 1 (C Wilkinson, ed), published by the Australian Institute of Marine Science and available from www.aims.gov.au/pages/publications.html. This seems to be the most authoritative comprehensive source of information, and is updated every two years, so it would be very useful to have it referenced. The salient points from Chapter 1 (J. Goldberg and C. Wilkinson, "Global Threats to Coral Reefs: Coral Bleaching, Global Climate Change, Disease, Predator Plagues, and Invasive Species") are as follows: 16% of coral reefs worldwide were severely damage in 1998, 40% of which are recovering or have recovered (thus, 10% are still severely damaged). Mortality levels ranged from 1-80% for African corals, with patchy recovery. Devastating bleaching of virtually all shallow water corals oc (Danny Harvey, Dept of Geography, University of Toronto)	This has been cited within be dealt within the Coral Box
E-4-611	A	38	18	38	21	the reduction of productivity will have major impacts on the migratory species of fish, marine mammals and birds that rely on them (Learmonth, J.A., MacLeod, C.D., Santos, M.B., Pierce, G.J., Crick, H.Q.P. & Robinson, R.A. (2006) Potential effects of climate change on marine mammals. Oceanography and Marine Biology: An Annual Review 44: 431-464). (Humphrey Crick, British Trust for Ornithology)	Done - included and cited
E-4-612	A	38	31	38	31	Not only the expansion of subtropical gyres are predicted by models (Sarmiento et al, 2004b), if not as been detected using satellite time series data for the Atlantic and Pacific subtropical gyres (McClain et al, 2004). The expansion of the subtropical oligotrophic areas, low chlorophyll areas, of the northern hemisphere gyres of above mentioned oceans are very rapid, instead the subtropical gyres of the southern oceans, Atlantic, pacific and Indian, are not. I suggest to introduce in the line 31, after ..... stratified subtropical gyre biome, now observed in the North Pacific and Atlantic (McClain et al. 2004), were predicted by 4,0% (Northern) ..... Reference: McClain CR, Signorini SR, Christian JR (2004) Subtropical gyre variability observed by ocean-color satellites. Deep-Sea Research II 51:281-301 (Ricardo Anadon, Universidad de Oviedo)	Done - included and cited
E-4-613	A	38	39			Loose shifts in pelagic biodiversity (Beaugrand et al. SCIENCE 296 (5573): 1692-1694 MAY 31 2002) and in fish have been seen (Genner et al, PROCEEDINGS OF THE ROYAL SOCIETY OF LONDON SERIES B-BIOLOGICAL SCIENCES 271 (1539): 655 661 MAR 22 2004; Perry et al.,SCIENCE 308 (5730): 1912-1915 JUN 24 2005) (Stephen John Hawkins, The Marine Biological Association of the United Kingdom)	Done - included and cited

E-4-614	A	38	41	38	41	Changes in cod recruitment due to mismatch of phytoplankton bloom production were documented by Platt et al (2003). Changes in seasonality and recurrence of hydrographic events are documented in some areas (i.e. Llope et al, in press) with consequences in the composition of phytoplankton community (Llope et al, submitted). Probably this cascading effect in the lower trophic level can influence in a bottom-up mechanism all community, including the larval stages of many exploited species. This mechanism could be reinforced by changes in other species present in the ecosystem, like potential predators. The link between climate change and ecosystem response could be related to these driven mechanisms (Stenseth et al, 2002; Stenseth et al., 2003). I suggest introducing a small phrase related to these impacts. For instance: "(Beaugrand et al., 2003). Changes in seasonality or recurrence of hydrographic events or productive periods could affect by trophic links to many marine population, including exploited or cultured (Ricardo Anadon, Universidad de Oviedo)	Done - included and cited
E-4-615	A	38	42			…and larvae ( ) and lead to later spawning migrations (Sims DW et al. JOURNAL OF ANIMAL ECOLOGY 73 (2): 333-341 MAR 2004) (Stephen John Hawkins, The Marine Biological Association of the United Kingdom)	Done - included and cited
E-4-616	A	38	46			Include at the end: Phenology of pelagic systems (Edwards M & Richardson A. NATURE 430 (7002): 881-884 AUG 19 2004) has been observed and temperature related impacts on migration of squid (Sims DW et al, PROCEEDINGS OF THE ROYAL SOCIETY OF LONDON SERIES B-BIOLOGICAL SCIENCES 268 (1485): 2607-2611 DEC 22 2001) and flounder (Sims DW et al, JOURNAL OF ANIMAL ECOLOGY 73 (2): 333-341 MAR 2004) detected which are likely to come with climate change. (Stephen John Hawkins, The Marine Biological Association of the United Kingdom)	Done - included and cited
E-4-617	A	38	48			There is much missed here. Impacts on intertidal species (Svensson et al., OECOLOGIA 142 (1): 117-126 JAN 2005; Svensson et al., JOURNAL OF ANIMAL ECOLOGY 75 (3): 765-776 MAY 2006; Helmuth et al. SCIENCE 298 (5595): 1015-1017 NOV 1 2002; Helmuth et al. ANNU.REV.ECOL.EVOL.SYST. 37 (in press). Boreal intertidal species are becoming rarer in cold temperate areas (Mieszkowska et al, HYDROBIOLOGIA 555: 241-251 FEB 2006) and southern species are becoming more common. (Stephen John Hawkins, The Marine Biological Association of the United Kingdom)	Done - included and cited
E-4-618	A	39	18			Diseases also increase in coral reefs. Warming-induced bleaching can render them more susceptible to diseases (Harvell, C. D., Kim, K., Burkholder, J. M., Colwell, R. R., Epstein, P. R., Grimes, D. J., Hofmann, E. E., Lipp, E. K., Osterhaus, A. D. M. E., Overstreet, R. M., Porter, J. W., Smith, G. W., Vasta, G. R. Emerging Marine Diseases--Climate Links and Anthropogenic Factors. Science 1999 285: 1505-1510) as occurred dramatically in 2005 in the Caribbean, with warming-induced bleaching followed by white plague. Dust storms from Africa the size of the continental US along with climate change are contributing to Sahel droughts (I. M. Held*†, T. L. Delworth*, J. Lu‡, K. L. Findell*, and T. R. Knutson Simulation of Sahel drought in the 20th and 21st centuries PNAS _ December 13, 2005 _ vol. 102 _ no. 50 _ 17891–17896) and North Atlantic Ocean warming (Hoerling, Martin P., Hurrell, James W., Xu, Taiyi Tropical Origins for Recent North Atlantic Climate Change. Science 2001 292: 90-92). The dust contains soil fungi (e.g. aspergillosis), which is infecting fan coral in the Caribbean. Loss of coral affects liveli	Dealt with in Coral Box. Sentence added to 4.4.9 refer coral reef impacts to coral box (4.5)

						(Paul Epstein, Harvard Medical School)	
E-4-619	A	39	32	40	1	please add T change (Clair Hanson, IPCC TSU)	Some of the changes are directly due to CO2 and the ensueing impact on the carbonate chemistry including pH
E-4-620	A	39	48	39	49	Is this intended to mean extinction of species, or depletion of populations? This needs to be clarified. Further, these statistics would be more accurate and more usefully indicative of future problems if they were about degradation of ecosystems/depletion of populations/deterioration in values, rather than 'loss of species'. (Paul Marshall, Great Barrier Reef Marine Park Authority)	Coral box refered to for further clarification
E-4-621	A	39	49			Include: ~1C SST shifts in phenology of squid and fish (Sims DW et al., PROCEEDINGS OF THE ROYAL SOCIETY OF LONDON SERIES B-BIOLOGICAL SCIENCES 268 (1485): 2607-2611 DEC 22 2001; Sims DW et al. JOURNAL OF ANIMAL ECOLOGY 73 (2): 333-341 MAR 2004; Genner et al, PROCEEDINGS OF THE ROYAL SOCIETY OF LONDON SERIES B-BIOLOGICAL SCIENCES 271 (1539): 655-661 MAR 22 2004) (Stephen John Hawkins, The Marine Biological Association of the United Kingdom)	Done - included and cited
E-4-622	A	40	6	40	7	In relation with impacts on exploited resources, recently we have done a revision of the impacts on marine resources and ecosystems for the Spanish Secretary of Environment; some comment on policy was done, including adaptative responses related to changes of species objective for fishing industries, or carrying capacity of extensive mussel and other cultures. I suggest introducing a phrase about these problems. A possible reference was (Anadón et al, 2005) Reference: Anadón R, Duarte CM, Fariña C (2005) Impactos sobre los Ecosistemas Marinos y el Sector Pesquero. In: Moreno JM (ed) Evaluación Preliminar de los Impactos en España por efecto del Cambio Climático. Ministerio Medio Ambiente, Madrid, p 147-182 (Ricardo Anadon, Universidad de Oviedo)	Done – exploitable resourses mentioned and ref cited
E-4-623	A	40	15	44	7	Section "4.4.10 Cross-biome impacts" contains a lot of useful information, but its structure is too dense. It would benefit from being broken-up into shorter paragraphs with italicised sub-headings (as in section 4.4.9). For example, the second paragraph (from page 40, line 21 to page 41, line 5) might be subdivided according to biome, geographical area or latitudinal variation. (Mike Harley, English Nature)	A - identical to G-4-403
E-4-624	A	40	21	40	22	As a generalization, this statement is not true, because drought stress is already observed in boreal forests in Alaska - at the northern range limit. (OK, maybe models do project increased growth everywhere, but then you have to qualify the statement with reference to observations) (Danny Harvey, Dept of Geography, University of Toronto)	A - the word "mostly" was added to the sentence, indeed growth is not increased everywhere, not in models and not in the field
E-4-625	A	40	36	40	39	Greening of deserts is not mentioned in the desert section. It seems rather unlikely - how reliable are these DGVMs anyway? (Humphrey Crick, British Trust for Ornithology)	R - Greening here means an increase in vegetation cover by more than 20%. This may indeed happen due to increased stomatal closure under elevated CO2 concentration. DGVMs are the best available tool for projections on the
E-4-626	A	40	45	40	46	“Non-woody C3 … fertilisation” -> is this not contradictory with what you were saying in section 4.4.3, page 21, lines 39-43?	R - the word "projected" refers to model-based predictions, whereas in section 4.4.3 the word "not conclusively" shows that there is still important uncertainty in the findings; field

						(Laura Llorens Guasch, University of Girona)	and lab experiments cannot always be directly interpreted
E-4-627	A	40	52			loose --> lose (Clair Hanson, IPCC TSU)	A - done
E-4-628	A	41	5			F4.4 shows 2 different GCMs and 2 different scenarios so it doesn't really represent what's said in the text (Clair Hanson, IPCC TSU)	A - reference to the figure was misplaced here, it has been removed.
E-4-629	A	41	7			Fig 4.4: Greening of deserts is not mentioned in the desert section. It seems rather unlikely - how reliable are these DGVMs anyway? (Humphrey Crick, British Trust for Ornithology)	repeats E-4-625
E-4-630	A	41	41			Fig. 4.4: This mis an important figure and should be expanded (if possible) to fill a whole page (Gregory Masters, CABI)	LA
E-4-631	A	42	1	42	20	the synthesis results of Thomas et al. (2005) and Malcolm (2006) should be cited somewhere in this paragraph (Danny Harvey, Dept of Geography, University of Toronto)	A
E-4-632	A	42	28			Ro148? (Clair Hanson, IPCC TSU)	A
E-4-633	A	42	28			Ro 148 needs translating into a proper reference (Pam Berry, University of Oxford)	A
E-4-634	A	42	33	42	35	The following paper considers the question of the relative value of extensification (wildlife-friendly farming over a larger area), versus intensive use of some areas, allowing the remainder to be relatively untouched. They conclude that the latter is likely to be better for wildlife, the opposite of the sentiment expressed in this sentence. Title: Farming and the fate of wild nature Author(s): Green RE, Cornell SJ, Scharlemann JPW, Balmford A Source: SCIENCE 307 (5709): 550-555 JAN 28 2005 (Chris Thomas, University of York)	A
E-4-635	A	43	27			farther --> further (Clair Hanson, IPCC TSU)	farther is correct as it applied to direction
E-4-636	A	43	34	43	38	Robinson et al (2005 - in refs) reviewed the potential for the 300 migratory species of bird listed on the Appendices of the Convention on Migratory Species to be affected by climate change. They found that 84% face some threat from climatic change, almost half because of changes in water regime (lowered water tables and drought), and this was equal to the summed threats due to all other anthropogenic causes. (Humphrey Crick, British Trust for Ornithology)	A
E-4-637	A	44	16			Insert a paragraph break between "application. Bioclimatic". (Mike Harley, English Nature)	N
E-4-638	A	44	27	44	28	This rosy picture of DGVMs seems inconsistent with your earlier reports of problems dealing with age structure dynamics & my note above (p16) about representing disturbance. (Richard Fleming, Great Lakes Forest Research Centre)	N
E-4-639	A	44	27			Insert a paragraph break between "results. Limitations". (Mike Harley, English Nature)	N
E-4-640	A	44	33			give the meaning of PFT. (Laura Llorens Guasch, University of Girona)	N

E-4-641	A	44	43			Insert a paragraph break between "(e.g. soils, corals). Climate". (Mike Harley, English Nature)	N
E-4-642	A	44	52			remove “a”. (Laura Llorens Guasch, University of Girona)	N
E-4-643	A	45	0			Table 4.2: Thism si an excellent way to get the message across. Although it is obvious to many, it might be worth explaining the colour coding of this table and / or Fig. 4.5 (Gregory Masters, CABI)	A - colors removed
E-4-644	A	45	1	48		Table 4.2 - Some definitions are required for the column Assessment / GCM. This reviewer is unsure what M / 4, E, H2, H3, CS, M/ 5, CSM mean and could not find any definitions. (Paul J. Wood, Loughborough University)	A corrected
E-4-645	A	45	1	48	13	In "Table 4.2", add reference to the MONARCH project which projects impacts on species and habitats in Britain and Ireland. 'Harrison, P.A., Berry, P.M. and Dawson, T.P. (Eds.) (2001). Climate Change and Nature Conservation in Britain and Ireland: Modelling Natural Resource Responses to Climate Change (the MONARCH project). UKCIP Technical Report, Oxford'. (Mike Harley, English Nature)	A added
E-4-646	A	45	1			Table 4.2 Assessment/GCM column needs a key. (Pam Berry, University of Oxford)	A
E-4-647	A	45	1			Table 4.2 - The terms 'loss of reefs' and 'functionally extinct' need to be defined and related to each other in terms of scale of effect. 'Loss of reefs' could readily be interpreted as more serious than 'functionally extinct', for example, yet the table suggests the opposite. (Paul Marshall, Great Barrier Reef Marine Park Authority)	A terminology stadardized
E-4-648	A	45	9			table 4.2: No 4: “Antarctic … penguin populations” -> rephrase. No 17: “Total loss Arctic summer ice” -> “Total loss of Arctic summer ice”. (Laura Llorens Guasch, University of Girona)	A - page limits means the table has to be written in a more telegraphic style
E-4-649	A	45		48		Table 4.2: In order to reduce the length of the table, you are simplifying so much the description of the impacts that they are often difficult to understand. (Laura Llorens Guasch, University of Girona)	A
E-4-650	A	45				T4.2: this is a very good table but can you explain the shadings and why in the 1-1.7 range (light yellow) coral reefs are in red. Similarly, with Golden Bowerbirs @ 1.8deg; polar bears @ 2 deg etc… (Clair Hanson, IPCC TSU)	A colors removed
E-4-651	A	46	0			table 4.2: No 24: “1-2C” -> “1-2ºC” No 31: “New England maples at risk impacting tourism” -> what do you mean? No 31: “USA (fall colour)” -> Why do you put “fall colour” here? (Laura Llorens Guasch, University of Girona)	A entry removed
E-4-652	A	46				Table 4.2, No 31: Any risk to Canadian maples (tourism, maple syrup industry)? (Richard Fleming, Great Lakes Forest Research Centre)	A - Based on the literature we had at hand, we realize that there are probably many impacts missing
E-4-653	A	47	0			table 4.2, No 62: “2C” and “3C” -> “2ºC” and “3ºC” (Laura Llorens Guasch, University of Girona)	A

E-4-654	A	48	0			table 4.2, No 74 and 75: “loss tundra ecosystem”, “loss taiga ecosystem” -> “loss of tundra ecosystem”, “loss of taiga ecosystem”. No 83: a % symbol is missing after the numbers. (Laura Llorens Guasch, University of Girona)	A but see above
E-4-655	A	48	1	48	13	The source list for "Table 4.2" is incomplete; it contains only sources 1 to 44 (45 to 85 are missing). (Mike Harley, English Nature)	R - This was a common confusion and we need to clarify which numbers are in which column. 1-85 just matches the impact to the map and figure the references are in the last
E-4-656	A	48	3	48	13	Table 4.2. Well-done putting that together! Can you add results from Title: African plant diversity and climate change. Author(s): McClean CJ, Lovett JC, Kuper W, Hannah L, Sommer JH, Barthlott W, Termansen M, Smith GE, Tokamine S, Taplin JRD. ANNALS OF THE MISSOURI BOTANICAL GARDEN 92 (2): 139-152 2005..... ALSO results of Thomas et al 2004b give summaries of percentages of species projected to lose 100% and over 90% of range areas for warming scenarios (whereas Thomas et al 2004a dealt with the species-area analysis). If these percentage values are also useful, they can be found at: Thomas, C.D., S.E.Williams, A.Cameron, R.E.Green, M.Bakkenes, L.J.Beaumont, Y.C.Collingham, B.F.N.Erasmus, M.F. de Siqueira, A.Grainger, L.Hannah, L.Hughes, B.Huntley, A.S.van Jaarsveld, G.F.Midgley, L.Miles, M.A.Ortega-Huerta, A.T.Peterson & O.L.Phillips. Biodiversity conservation: Uncertainty in predictions of extinction risk/Effects of changes in climate and land use/Climate change and extinction risk. Nature (01 July); doi:10.1038/nature02719. (Chris Thomas, University of York)	A
E-4-657	A	49	0			Fig. 4.5: I like this figure, although authors should ensure that text in fig. 4.5b, especially the one over the red colour, will be readable. (Laura Llorens Guasch, University of Girona)	A
E-4-658	A	49	1			Fig 4.5a - In the Antarctic you have placed a whole list of numbers that are actually presumably global in scope and often not actually relevant to antarctica eg: 75 - "loss of taiga" - so this is confusing - they need ot be repositioned. The figure is a nice idea though, as is 4.5b (Humphrey Crick, British Trust for Ornithology)	A
E-4-659	A	49	46			Quality of figure 4.5 is poor. (Paul J. Wood, Loughborough University)	A
E-4-660	A	49	46			P49 Fig4.5: NB. This chart indicates changes that would occur over the next several decades, given projections for temperature rises. Also note that the surprises and sudden diebacks in forests would occur well before the timeline projected, due to the combined impacts of pest infestations, more frequent and more intense weather extremes and increasing climate volatility (e.g. changes in freeze-thaw cycles and the timing of seasons, decoupling of predator /prey, and pollinators). (Paul Epstein, Harvard Medical School)	A - however the map is to show the geographic range of items in the table, neither of which are all inclusive

E-4-661	A	49				Figure 4.5 should not be published in its present form, for two reasons. (1) The lower dashed curve implies that stabilization of atmospheric CO2 at 750 ppm leads to an eventual global mean warming of 3 K. Given the logarithmic dependence of forcing on CO2 concentration and 280 ppmv pre-industrial concentration, 750 ppmv corresponds to a forcing of 1.42 times that of a doubling, and thus an equilibrium warming of 3.55 K if the climate sensitivity is 2.5 K. However, this neglects forcing by non-CO2 greenhouse gases, so the warming for the 750 ppmv scenario and 2.5 K sensitivity is in the range of 4-5 K. (2) The climate sensivity could be much greater than 2.5 K, so stabilization at 3 K warming could arise from as little as 450 or even 400 ppmv CO2 (once the masking effect of aerosols is removed, as it will be sooner or later). I suggest replacing the one curve with two curves: 450/5.0 and 750/2.0, but make sure that non CO2 GHG are included in some way and allow for declining aerosol forcing (I can generate the curves if needbe) (Danny Harvey, Dept of Geography, University of Toronto)	N
E-4-662	A	50	5			16% is not nearly all. Any larger % for higher T change that can be cited? (Clair Hanson, IPCC TSU)	N - all entries changed
E-4-663	A	50	9			If the Amazon plant example is cross-refeernecing back to the species in Thomas et al 2004 (Miles analysis), the sample size of species for this group is too small, and it would be better to select another example to illustrate the point. (Chris Thomas, University of York)	N - the Miles entry has been deleted and the Amazon entry links back to Cox's work
E-4-664	A	50	22	50	24	With these figures for extinction/committed to extinction it is important to say whether this is with the assumption of no dispersal or perfect dispersal. (Pam Berry, University of Oxford)	A - that information is now available in the caption
E-4-665	A	50	44			At the end of this sentence, I would add something such as: "Ecological surprises also arise due to the complexity of interactions between climatic, abiotic, and biotic factors, which are often delicately balanced and most of which we do not fully understand. One example are declines in amphibian populations, which appear to be linked to changing climate but in ways that had not been anticipated (Kiesecker et al., 2001; Pounds et al., 2006)." REFERENCES: Kiesecker et al., 2001. Nature 410, 681-684. Pounds et al. 2006. Nature 439, 161-167. (Danny Harvey, Dept of Geography, University of Toronto)	A
E-4-666	A	50	50	51	16	The text in this paragraph requires editorial attention to ensure coherance. (Mike Harley, English Nature)	A
E-4-667	A	51	1	51	2	The sentence starting "In the B1 scenario…" isn't a sentence - competely obscure meaning. (Humphrey Crick, British Trust for Ornithology)	A
E-4-668	A	51	2	51	3	“In the … changes” -> rephrase. (Laura Llorens Guasch, University of Girona)	A
E-4-669	A	51	3	51	4	The greening up of deserts is not mentioned in the desert section and seems reallynunlikely anyway - one wonders how reliable these DGVMs are, as a result. (Humphrey Crick, British Trust for Ornithology)	R - Many DGVMs show greening of deserts around the world, much of the Sonoran and Chihuahuan Deserts, for example, are projected to convert to desert grasslands with increasing winter rains. The mechanism is not difficult.
E-4-670	A	51	3			Southern (Clair Hanson, IPCC TSU)	A

E-4-671	A	51	3			Not necessarily positive for biodiversity cf Karoo drylands plants would presumably not appreciate a long-term greenup (Chris Thomas, University of York)	A
E-4-672	A	51	6			“by (Thuiller et al., 2007b) -> change to “by Thuiller et al. (2007b)”. (Laura Llorens Guasch, University of Girona)	A
E-4-673	A	51	11			“In the A2 … changes” -> rephrase. (Laura Llorens Guasch, University of Girona)	A
E-4-674	A	51	18			table 4.3: the information in brackets is quite difficult to understand. I think authors should clarify it. They should also explain that numbers appearing in the vegetation change column correspond to those used in Fig. 4.4. (Laura Llorens Guasch, University of Girona)	A - table removed
E-4-675	A	51	25		33	poorly written, difficult to follow (Clair Hanson, IPCC TSU)	A
E-4-676	A	51	37	51	40	the key fundamental principal is that we have a moral, ethical responsibility to natrual systems not to destroy them. (Humphrey Crick, British Trust for Ornithology)	A
E-4-677	A	52	1	52	2	Specific comment. I disagree with the statement that natural ecosystem or natural reserves are not adaptable. They could adapt as any biological system adapt to different stresses, depend on how intense are the external pressure on it and it’s internal adaptation range. The IPC TR V (Gitay et al, 2002) recognizes that there is limited adaptation for some ecosystems (e.g. coral reefs and high-latitude and/ or altitude areas). For some of these systems, adaptation options may include limiting other pressures. (Avelino G. Suarez Rodriguez, Ecology and Systematic)	R - there is no comment on adaptation on page 52 lines 1 and 2
E-4-678	A	52	5	52	6	Good point! (Richard Fleming, Great Lakes Forest Research Centre)	A
E-4-679	A	52	7			loosing --> losing (Clair Hanson, IPCC TSU)	A
E-4-680	A	52	14			The impacts of warming, increasing weather variability and anomalies, and pests and diseases could hold enormous costs for forests and coastal marine systems, as well as managed agricultural systems (Epstein, PR, Mills, E. (eds.). Climate Change Futures: Health, Ecological and Economic Dimensions, Center for Health and the Global Environment, Harvard Medical School, Boston, MA., Nov 2005. http://www.climatechangefutures.org/pdf/CCF_Report_Final_10.27.pdf). Multiple industries are threatened by this combination of disturbances that reinforce one another, including timber, fisheries, travel, tourism, agriculture, as well as financial markets, insurance companies, and large multinational investors (Epstein and Mills 2005; Mills, E. Insurance in a Climate of Change. Science 2005 309: 1040-1044). (Paul Epstein, Harvard Medical School)	A comment to section 4.5. Included, together with a reference to the STERN review
E-4-681	A	52	27	52	44	This paragraph is far too weak, and is really partly in the realm of fantasy. It needs to begin with a preamble warning that adaptation will largely NOT BE POSSIBLE if the temperature change is too large. It should be clearly stated that a global mean warming of 4-5 K is nothing less than a global ecological catastrophe - this statement is clearly justified based on the evidence summarized earlier in this chapter. Even 2-3 K has serious ecological impacts, and in many cases, adaptation will simply not be possible.	Agree. Most of the literature is only for the earlier, small levels of climate change. This point is made explicit now, both in the introduction and the main text. Also links to Table 4.2 and figure 4.6 are included.

						(Danny Harvey, Dept of Geography, University of Toronto)	
E-4-682	A	52	27			Section 4.6.1: I welcome then IPCC stating this; it is a very important argument to get across to governments, practitioners ans scientists alike. (Gregory Masters, CABI)	Thanks
E-4-683	A	52	39	52	40	Replace the sentence starting with “Actions to reduce…” on line 39 with the following: “Since non-climate-change-related factors (such as habitat loss) dominate threats to species, ecosystems and biodiversity at present and will likely do so for much of the remainder of this century, it has been suggested -- first by Goklany (1988) and with greater elaboration subsequently (e.g., Goklany et al. 1992; Goklany and Sprague 1992; Goklany 1995, 1998, 2000, 2003, 2005a, 2006a; Opdam and Wascher 2004; Durraiappah et al. 2005) [NOTE: one of the functions of references is to give credit where it’s due] -- that perhaps the most effective approach to reducing vulnerability to climate change in the short-to-medium term (i.e., the next few decades) would be to reduce these other on-going threats. In particular, since threats to terrestrial and freshwater biodiversity are dominated by diversion of land and water to competing human uses (e.g., cropland, harvesting of timber, and irrigation), sustainably increasing the productivity of land and water used to meet human demands for food, fiber, and timber would help stem, if not reverse, such habit (Indur Goklany, US Department of the Interior)	I understand that adding the proper references is important. However, these list by only Goklany is too much. Full references are not given. I check them in the library and found that many of them were not directly relevant for this text. Most of the ideas presented (not directly research results but many conceptual papers) are also given by others papers, which were already cited as a result of concrete research.
E-4-684	A	52	41			Add new material after the period (full stop) on line 41 that would read as follows: “Moreover, Goklany (2000, 2003) notes that reduction in conversion of land to cropland due to enhanced food productivity would also reduce CO2 emissions, and limit habitat loss and fragmentation which would otherwise add to the substantial existing barriers to ‘natural’ adaptation (via migration and dispersion) of species if climate changes. Notably, Article II of the Framework Convention on Climate Change refers to allowing ecosystems to adapt naturally to climate change. Increased productivity from farm to palate would also lower the demand for cropland, thereby decreasing the socioeconomic costs of setting them aside for in situ conservation, an explicit goal of the Convention on Biological Diversity (Goklany 2003). Similar logic also argues for productivity-enhancement efforts in other spheres of human activity that rely on land and water, such as forestry, habitation, and irrigation Goklany 2003, 2005a).” (Indur Goklany, US Department of the Interior)	not relevant here in relation to adaptation of ecosystems.
E-4-685	A	52	47			add the very important caveat: "assuming that climatic change is small enough that meaningful adaptation is possible in the first place" (Danny Harvey, Dept of Geography, University of Toronto)	Done
E-4-686	A	53	1	53	2	Why are natural ecosystems and nature reserves "not adaptable"? Whilst it is unlikely that current species distributions and compositions will be maintained as climate changes, both may adapt naturally (eg species movements changing ecosystem composition and function) and/or through human interventions (eg altering reserve management practices to increase resilience and accommodate change). (Mike Harley, English Nature)	Sentence deleted. Adaptation explained in the introduction of the section.
E-4-687	A	53	1	53	2	to say that natural ecosystems "are not adaptable" is going too far (Danny Harvey, Dept of Geography, University of Toronto)	Sentence deleted. Adaptation explained in the introduction of the section.

E-4-688	A	53	1	53	10	Natural ecosystems are adaptable through dispersal and possibly slowly in situ evolutionary adaptation. Saying they are not adaptable is contradicting earlier references in the chapter to natural adaptation though range shifts. Reserves can also be part of planned human adaptation as they can be managed directly for climate change by increasing their area or through habitat restoration, such as is suggested in the following paragraph (Pam Berry, University of Oxford)	Sentence deleted. Adaptation explained in the introduction of the section.
E-4-689	A	53	2	53	2	By 'adaptable' you mean by human intervention? Many natural ecosysems are 'adaptable' by virtue of their resilience? Reword. (Richard Fleming, Great Lakes Forest Research Centre)	Sentence deleted. Adaptation explained in the introduction of the section.
E-4-690	A	53	7			you must add "and by the magnitude and nature of the change in climate" after "reserve". (Danny Harvey, Dept of Geography, University of Toronto)	Done
E-4-691	A	53	12	53	13	Robinson et al (2005 - in refs) could also be quoted with respect to the need to manage other stresses, along with Duraiappah et al 2005. They also pointed out that stress reduction may be the only practical adaptation policy available for the marine ecosystem. this would be worth mentioning. (Humphrey Crick, British Trust for Ornithology)	Good suggestion. Included.
E-4-692	A	53	12	53	14	I recommend dropping the two sentences on these lines since they are covered comprehensively under Comments 18 and 19. (Indur Goklany, US Department of the Interior)	Som redundancy is useful. Sentences not dropped
E-4-693	A	53	14	53	15	Robinsnon et al (2005 - in refs) also said that it was important to maintain "large" populations - I am not sure that "healthy" is specific enough. (Humphrey Crick, British Trust for Ornithology)	I have changed healthy to viable, which combines healthy and the size of the population
E-4-694	A	53	14	53	19	Probably good not to have very high connectivity - e.g., easier for contagious disturbances. (Richard Fleming, Great Lakes Forest Research Centre)	There are always trade-offs. Connectivity is important in fragmented habitats. Important to list.
E-4-695	A	53	19			Add to the end of this paragraph, the following new sentence: "Increrasing the productivity of human land use would also reduce habitat loss and fragmentation, and aid connectivity (Goklany 2000, 2003)." (Indur Goklany, US Department of the Interior)	True, but less relevant in discussing management of nature reserves. An additional sentence is included.
E-4-696	A	53	20			Figure 4.6. Comment. Adaptive measures of ecosystem management as reduce and manage of other stress on species and ecosystems and to protect them, could be included in the figure, at least for small temperature increment above the pre-industrial one. (Avelino G. Suarez Rodriguez, Ecology and Systematic)	Fig 4.6 is deleted. Figure was just an illustration and not based on the real scientific insights.
E-4-697	A	53	43	53	44	Species migration will be difficult to achieve BETWEEN protected areas in countries, like the UK, where protected areas are small and there is a lack of opportunity for movement/ presence of corridors. (Pam Berry, University of Oxford)	TRUE, between added. Specific example not, Next sentence rephrased to make point of limitation.
E-4-698	A	53	44			Replace "establishment of corridors" with "development of more permeable landscapes with greater ecological connectivity". (Mike Harley, English Nature)	Done

E-4-699	A	53				Figure 4.6 is completely indefensible - there is nothing in this chapter (Table 4.2 in particular) to justify the temperatures on the vertical scale. For example, there is no prospect of meaningful adaption to a 10 K warming, particularly in the space of 200 years! The evidence reviewed in the chapter supports the following temperature scale: replace 4 C with 1 C, replace 7 C with 2 C, and replace 10 C with 3 C (Danny Harvey, Dept of Geography, University of Toronto)	Agreed. Figure 4.6 deleted
E-4-700	A	54	5	54	6	Agree. Similarly, the use of provenance trials in forestry would seem to be of limited value, especially for long-lived species. (Richard Fleming, Great Lakes Forest Research Centre)	OK, additional example added.
E-4-701	A	54	5			Include reference: Stachowicz JJ et al. PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA 99 (24): 15497-15500 NOV 26 2002 (Stephen John Hawkins, The Marine Biological Association of the United Kingdom)	Done
E-4-702	A	54	13	54	18	May of these ideas need meshing with earlier points e.g. mashing new species with existing species is part of the issue with translocation and engineering habitats to facilitate species movements is part of the establishment of corridors. (Pam Berry, University of Oxford)	Indeed, sentence delete to focus point and minimize overlap.
E-4-703	A	54	18			Include at end: Engineering interactions to defend coastlines may change connectivity of coastal ecosystems including facilitation of spread of non-native species (Bulleri F., MARINE ECOLOGY-PROGRESS SERIES 287: 53-64 2005) as well as warm temperate species advancing polewards (Mieszkowska et al, HYDROBIOLOGIA 555: 241-251 FEB 2006; Helmuth et al. ANNU.REV.ECOL.EVOL.SYST. 37 (in press) (Stephen John Hawkins, The Marine Biological Association of the United Kingdom)	Done
E-4-704	A	54	44	54	44	Strange heading for a section when compared to the other headings in this part of the report. (Claus Beier, Risoe National Laboratory)	Heading changed.
E-4-705	A	54	47			Hannah and Lovejoy 2003 not in reference list. (Paul J. Wood, Loughborough University)	Added
E-4-706	A	55	9		10	EA? (Clair Hanson, IPCC TSU)	Ecosystem Approach. Acronym not used any more.
E-4-707	A	55	13			Add to the end of this paragraph, the following sentence: "For instance, reducing current threats to biodiversity through, for instance, reducing human demand for land and water, would increase the likelihood of in situ conservation, which is a principal goal of the CBD (Goklany 2003)" [See, also, preamble and Article 8 of the CBD.] (Indur Goklany, US Department of the Interior)	Redundant, already said earlier.
E-4-708	A	55	41	55	44	Good point! (Richard Fleming, Great Lakes Forest Research Centre)	Thanks
E-4-709	A	56	6	56	9	Poverty? Certainly in terms of dessertification, deforestation, etc. But isn't the increasing affluence of China also a problem - the prospect that soon each family will have a car? Maybe we need less affluence in the developed world, less development? (Richard Fleming, Great Lakes Forest Research Centre)	Poverty is one op the important vulnerability factors.

E-4-710	A	56	6			Add after the period (full stop) on line 6, the following: "In particular, producing more usable (and ingested) food per unit of land and water devoted to producing food, would not only help reduce hunger, it would also reduce human pressure on diverting land and water resources away from the rest of nature (Goklany 1998, 2000, 2006a). Specific measures to enable that include not only increasing crop yields, but also reducing losses and wastage in every link in the food chain from farm to palate the amount of land. That would , moreover, reduce losses of carbon sinks and stores, thereby advancing mitigation." (Indur Goklany, US Department of the Interior)	already said. Repetitive.
E-4-711	A	56	24	56	26	Modify the sentence commencing on line 24 with "Any progress…" and add a new sentence as follows: ""WHILE IN THE LONG-TERM, progress TOWARD SUSTAINABLE DEVELOPMENT GOALS is unlikely to to be sustained if ecosystem services continue to be degraded, IN THE SHORT-TO-MEDIUM TERM, ADVANCING SUSTAINABLE DEVELOPMENT WOULD SIMULTANEOUSLY ENHANCE THE CAPACITY TO ADAPT TO CLIMATE CHANGE AND REDUCE CURRENT VULNERABILITIES TO CLIMATE-SENSITIVE PROBLEMS (E.G., HUNGER AND DISEASE) THAT MIGHT BE EXACERBATED BY CLIMATE CHANGE (GOKLANY 2000, 2005a, 2006a). IN THE SHORT-TO-MEDIUM TERM, SUCH AN APPROACH MIGHT BE THE MOST COST-EFFECTIVE METHOD OF SIMULTANEOUSLY ADDRESSING CLIMATE CHANGE AND SUSTAINABLE DEVELOPMENT (GOKLANY 2005a, 2006a) " New language is in BOLD; deletions aren't shown.] (Indur Goklany, US Department of the Interior)	Message does not differ from current text and is taken from abroad recent assessment of all scientific literature, not only from one single author. Additonal reference added.
E-4-712	A	57	15	57	30	Section 4.8 a prime uncertainty implied in the first point but perhaps needing a separate point is the climatic uncertainty that comes from the use of scenarios from different GCMs. (Pam Berry, University of Oxford)	R - Scenarios are typically assumed as given, but indeed, are a major source of uncertainty. However, our task understood as deriving projections while taking climate scenarios as given, then that source of uncertainty is of
E-4-713	A	57	15	58	18	In "Key uncertainties and research priorities", we should note that to what extent soil N availability will constrain the predicted ecosystem carbon sequestration is still an open question (Shaw et al. 2002, Science 298: 1987-1990; Luo et al. 2004, BioScience 54: 731-739). Mack et al. (2004, Nature, 431: 440-443) indicate that two decades of fertilization have caused a shift in plant life form from tussock tundra to shrub tundra, resulting in a net ecosystem C loss. This is a major challenge for predicting alpine/boreal ecosystem behaviors in response to global warming-driven soil nutrient availability and/or increasing nutrient deposition to high latitude/altitude ecosystems (Grace et al. 2002, Annals of Botany 90: 537-544; Mack et al. 2004). There is a need to extrapolate experimental results over longer time scales and over larger landscapes and regions, and to further couple the biodiversity changes with biogeochemical cycles in global dynamic vegetation models. (Tianxiang Luo, Institute of Tibetan Plateau Research, Chinese Academy of Sciences)	A - Excellent points. But we believe this is already stated under point (iii) of key uncertainties and under bullet 2
E-4-714	A	57	17	57	19	Specific comment. ¨The projection for precipitations carry out a significantly higher uncertainty than temperature, which is also of great relevance for ecosystems in he southern hemisphere¨. Also, the precipitation uncertainty is very relevant to ecosystems in the northern hemisphere, particularly tropical and dry ones. (Avelino G. Suarez Rodriguez, Ecology and Systematic)	TR

E-4-715	A	57	21	57	22	Biodiversity projections, based on species envelope modelling approaches, are based on future fundamental rather than realized niches, unless they include factors such as land cover (habitat) changes and dispersal. The closest any study come to this is del Barrio et el, 2006, cited earlier in the chapter. (Pam Berry, University of Oxford)	R - No, these projections are not based on fundamental rather than realized niches. They assume that the basically unknown fundamental niche is well estimated by the realized one.
E-4-716	A	57	32			project --> protect (Clair Hanson, IPCC TSU)	R - That would be wrong
E-4-717	A	57	33	57	36	Presume you have seen recent Science perspective on permafrost carbon store: CLIMATE CHANGE: Permafrost and the Global Carbon Budget. Sergey A. Zimov, Edward A. G. Schuur, and F. Stuart Chapin III Science 16 June 2006 312: 1612-1613 (Chris Thomas, University of York)	A - Yes, thanks anyway and we have added the reference
E-4-718	A	57	33			Tipping points in general need identifying for all ecosystems, although the one picked out is of high potential impact (Pam Berry, University of Oxford)	A - We felt to make this a priority/selection for a research agenda is appropriate given uncertainties and risks
E-4-719	A	57	37	57	42	IPCC chapters should not be used to request "better funding" for anything! This really is special pleading! Evaluation is important, certainly. More fundamentally, there is a move towards the inclusion of more finely resolved and biologically explicit functional types in models. I don't actually see a lack of funding in this area and I do see a lot of exciting science which should lead to more robust abnd reliable models. (Iain Colin Prentice, University of Bristol)	A
E-4-720	A	57	38	57	40	The sentence beginning "To expand such research…" does not make sense. (Mike Harley, English Nature)	A
E-4-721	A	57	44			Northern Hemisphere (Clair Hanson, IPCC TSU)	A - Capitalization is not mandatory, according to e.g Merriam-Webster, but it is often done. But then the
E-4-722	A	57	47	57	50	Linked to point 6 above - Disturbance needs defining earlier in the chapter for this to make sence. What are insect calamities? Is this the most appropriate term? Please clarity. (Paul J. Wood, Loughborough University)	It is unclear what point 6, but assume it is E-4-172A. A - text improved
E-4-723	A	57	47	57	50	Agree but wonder if you also might want to mention CC influences on interactions between disturbances? (Richard Fleming, Great Lakes Forest Research Centre)	A
E-4-724	A	58	1			The role of extreme events, the sequences of extremes, concurrent extremes in multiple places, multiple types of extremes, and decreased return times and recovery capacity, all affect vulnerability and resilience to climate change in developed as well as underdeveloped nations. (Paul Epstein, Harvard Medical School)	A - well said, couldn't agree more
E-4-725	A	58	1			The number 1019 appears associated with some references. It is unclear what this relates to. (Paul J. Wood, Loughborough University)	A
E-4-726	A	58	18	58	18	There is no mentioning of a need for multifactor experiments despite the fact that this is mentioned as a lack at more places in the chapter and despite the fact that almost all studies related to climate change effects have been single factor studies while the few miultifactor studies conducted so far have demonstrated large and unpredictable interactions.	R - While this is certainly an area needing more emphasis, we belive that this is implicitly in many of the statements made. Moreover, we do not see strong evidence for the claimt hat there basically no multifactor studies conducted. This assessment may also depend strongly on what type of

						There is no mentioning of the need for more studies on precipitation effects and especially the change in precipitation seasonality. (Claus Beier, Risoe National Laboratory)	studies the reviewer has in mind. Most modeling studies look at multitude of factors.Finally we believe having made the last point, by having an entire bullet point dedicated to
E-4-727	A	59	0			REFERENCES: there are some incomplete references in the reference list (Clair Hanson, IPCC TSU)	A
E-4-728	A	59	1	102		A large proportion of the chapter is the reference list (43 pages). As a general observation this is a lot of reference material and unavoidable given the scope of the chapter. However, this reviewer would suggest that the authors check that all of the papers and books cited are really required and/or appropriate. (Paul J. Wood, Loughborough University)	LA
E-4-729	A	60	46	60	47	journal name, volume and pages are missing. (Laura Llorens Guasch, University of Girona)	A Ba305
E-4-730	A	61	20			it seems that commas are substituting certain characters. Which is the journal name? (Laura Llorens Guasch, University of Girona)	A Be182 EndNote record problem
E-4-731	A	70	3			the title is missing. (Laura Llorens Guasch, University of Girona)	A Fi104 EndNote style problem (Edited report)
E-4-732	A	72	3			give pages. (Laura Llorens Guasch, University of Girona)	A Gi066
E-4-733	A	73	14			the authors' names seem to be missing. (Laura Llorens Guasch, University of Girona)	A Ha240 EndNote style problem (Edited articles)
E-4-734	A	76	14			the title is missing. (Laura Llorens Guasch, University of Girona)	A Il03 EndNote style problem (Edited report)
		83	32			Journal, pages missing	Ma317
E-4-735	A	88	25			the title is missing again. (Laura Llorens Guasch, University of Girona)	A Pa109 EndNote style problem (Edited report)
		88	35			pages missing, af	Pa106
		89	28			pages missing, af	Pe160
E-4-736	A	91	7	91	9	the journal name is missing. (Laura Llorens Guasch, University of Girona)	A Re104
E-4-737	A	91	9			the name of the journal (Nature) is missing (Danny Harvey, Dept of Geography, University of Toronto)	A Re104
E-4-738	A	93	8	93	9	journal name, volume and pages are missing. (Laura Llorens Guasch, University of Girona)	A Scha22
E-4-739	A	93	10	93	11	volume and pages are missing. (Laura Llorens Guasch, University of Girona)	A Scha20
E-4-740	A	93	50			"in and and semi-arid" -> it should say "in arid and semi-arid". (Laura Llorens Guasch, University of Girona)	A Schw37
E-4-741	A	99	4			the last page is missing. (Laura Llorens Guasch, University of Girona)	A Vi23
E-4-742	A	99	47	99	49	incomplete information. (Laura Llorens Guasch, University of Girona)	A Wa118